UNIVERSITY OF TURKU

ABSTRACT

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Abstract

The research and development activities are vital for economic development, although those are not at a socially optimal level. The issue is more severe in novel green high-technology small and medium-sized enterprises, which are resource-constrained and might find investing in their research and development unappealing since it is challenging for green companies to reap the full benefits of their products due to externalities and spillovers. Therefore, the economic environment for these companies could be mitigated by public subsidization. However, subsidization might be controversial as it might not attract or incentivize green SMEs to allocate and invest their own funds in innovation activities and could also lead to deadweight or crowding effects.

As pecking order theory addresses the green high-technology SMEs might encounter financial barriers because of insufficient turnover and uncertainty related to their technologies. Moreover, being less-established actors, the green SMEs face legitimacy challenges that can be difficult to overcome. The EU has approached these obstacles and alleviated the underinvestment with its Horizon 2020 framework program that offers funding for innovative projects. As the H2020 funding is granted by a respectable body, the certification could be leveraged by the companies to attract resources and network with consortium or industry partners.

The objective of this thesis is to examine Finnish unlisted green high-technology SMEs and the EU's H2020 framework program. The study pursues to answer for the objectives by addressing the SMEs' motives to apply for the H2020 subsidies, how the SMEs have utilized the instruments and what type of impacts have been realized. Also, reporting and cooperation in the H2020 program are studied. The empirical part of the thesis was conducted by interviewing 10 case companies in the green sector.

The study finds that funds and networking by the H2020 are the primary factors to apply for the subsidies whereas, surprisingly, the EU certification was not important and occasionally recognised as disadvantageous. Moreover, although the H2020 subsidy was leveraged when obtaining external capital, the resource constraints prevented investing additional internal funds. However, the H2020 projects can be quite large in relation to the size of the SMEs and thus, tie up companies' resources, creating a forced crowding-in effect.

Key words	H2020, subsidies, SMEs, R&D, green innovation, leverage, certification, crowding effect

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Tiivistelmä

Tutkimus- ja kehitystoiminta ovat talouden kehityksen kannalta elintärkeitä, mutta eivät ole tällä hetkellä sosiaalisesti optimaalisella tasolla. Erityisesti vihreät korkean teknologian pk-yritykset ovat resursseiltaan rajoittuneempia sekä saattavat nähdä investoimisen vähemmän houkuttelevampana, koska niiden on haastavaa saada tuotteistaan täysimääräinen hyöty ulkoisvaikutusten vuoksi. Tästä johtuen, kyseisten yritysten taloudellista toimintaympäristöä voidaan parantaa julkisten tukien avulla. Kuitenkin, tukeminen saattaa olla ristiriitaista, sillä se ei välttämättä houkuttele tai kannusta vihreitä yrityksiä allokoimaan ja investoimaan varojaan innovaatiotoimintoihin ja voi johtaa myös rahoituksen syrjäytymisvaikutuksiin.

Kuten rahoituksen nokkimisjärjestyksen teoria esittää, vihreät korkean teknologian pk-yritykset saattavat kohdata rahoituksellisia rajoitteita riittämättömän liikevaihdon tai teknologiaan kohdistuvan epävarmuuden takia. Lisäksi vähemmän vakiintuneina toimijoina vihreät pk-yritykset kohtaavat legitimiteettihaasteita, joita voi olla vaikea ylittää. EU on lähestynyt aihetta ja tukenut ali-investointeja Horisontti 2020 -puiteohjelmalla, joka tarjoaa rahoitusta lupaaville innovatiivisille projekteille. Koska H2020-tukirahoituksen myöntää huomionarvoinen taho antaa sertifiointi yrityksille erinomaisen mahdollisuuden houkutella yritykseen muita resursseja ja verkostoitua konsortioiden sekä toimialan kumppaneiden kanssa.

Tämän työn tavoitteena on tutkia suomalaisia listaamattomia vihreitä korkean teknologian pk-yrityksiä ja EU:n H2020 -puiteohjelmaa. Tutkimus pyrkii vastaamaan työn tavoitteisiin käsittelemällä pk-yritysten motiiveja hakea H2020-tukia, kuinka pk-yritykset ovat hyödyntäneet tuki-instrumentteja ja millaisia vaikutuksia tuilla on ollut. Lisäksi tarkastellaan raportointia ja yhteistyötä H2020-puiteohjelmassa. Tutkimuksen empiirinen osa suoritetaan haastattelemalla 10 vihreällä sektorilla operoivaa pk-yritystä.

Tutkimuksessa havaitaan, että H2020-ohjelman tarjoamat varat ja verkostoituminen ovat ensisijaisia syitä tukien hakemiseen, kun taas yllättäen EU-sertifikaattia ei koettu arvokkaaksi ja todettiin toisinaan jopa epäsuotuisaksi. Lisäksi, vaikka H2020-tukea hyödynnettiin ulkoisen pääoman hankkimisessa, resurssirajoitukset estivät pääosin yritysten sisäisten lisävarojen vivutuksen. Kuitenkin, H2020-hankkeet voivat olla niin suuria verrattuna pk-yritysten kokoon, että ne sitovat yritysten resursseja hankkeeseen luoden välttämättömän vipuvaikutuksen.

Avainsanat	H2020, yritystuet, pk-yritykset, T&K, vihreä innovaatio, vipuvaikutus, sertifiointi, rahoituksen syrjäytymisvaikutus

UNIVERSITY OF TURKU
Turku School of Economics

EU HORIZON 2020 SUBSIDY INSTRUMENTS IN FINNISH UNLISTED GREEN HIGH-TECHNOLOGY SMES

Utilization, impacts and experiences of grants from the case companies' perspectives

Master's Thesis
in Accounting and Finance

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LIST OF ABBREVIATIONS

BF	Business Finland
COSME	Competitiveness of Enterprises and SMEs
CORDIS	Community Research and Development Information Service
DPF	Direct Projet Funding program in Germany
EU	European Union
FET	Future Emerging Technologies
H2020	Horizon 2020
IA	Innovation Action
IPR	Intellectual property rights
KMO	Flemish innovation program
MCC	The marginal cost of capital
MRR	The marginal rate of return
R&D	Research and Development
RIA	Research and Innovation Action
SBIR	Small Business Innovation Research
SC	Societal Challenges
SME	Small and medium-sized enterprises
TRL	Technological Readiness Level
VC	Venture Capital

1 INTRODUCTION

1.1 Background

The definitive element of economic and productivity growth is technological progress. According to the models in endogenous theory, technological development, in turn, is perceived in the context of economic decision making. Therefore, technological development is considered to be dependent on the surrounding economy and public policies. (Howitt 2004; van Elk et al. 2019.) In traditional neoclassical models of Solow (1956) and Swan (1956), the importance of the technological process is presented as a mean to encourage and sustain long-term economic growth. The endogenous growth theory states that innovation and knowledge investments are crucial for economic contribution creating opportunities for new R&D activities. These activities are performed by public institutions and the private sector, contributing 30% and 70% of the R&D investments in the OECD area, respectively (van Elk et al. 2019).

Public aid and contribution have a pivotal role regarding financing novel technologies as well as dispersing the benefits enhancing the welfare of the society. These new technological innovations provide solutions for current and emerging societal and environmental issues such as demographic concerns, climate change and energy efficiencies. (Čučković &Vučković 2018, 107.) The threats of global warming and the consequence of greenhouse gas emissions stress green alternatives and innovations that alleviates the pressure on climate as well as improve economic development (Yang et al. 2019, 156).

The massive aggregate energy subsidies of 4.7 trillion dollars are primarily concentrated on large enterprises, and at the global level, represents approximately 6% of world GDP (Coady et al. 2019). These resources have been traditionally concentrated on fossil fuels rather than on green innovation, impeding the adoption of clean technologies. However, according to the Schumpeterian perspective, small and medium-sized enterprises (SME) are the primary engine for technological change due to their ability to produce innovations in emerging industries, for example, in sustainable energy. These innovations can displace prevailing old technologies and create new economic opportunities that can increase competitiveness globally (Galope 2016, 371). The importance of SMEs for the economy is massive since they are the drivers of new technological and green innovations and the backbone of the economy as well representing 99 % of the companies and over 50 % of the value-added inside the EU (European Commission, 2020A). A company can

be classified as an SME if it meets certain criteria regarding the ownership stake, size of staff headcount, turnover or balance sheet. Although the definitions of SMEs vary between national economies to some extent, Finland has a similar classification as the EU. An SME is a non-subsidiary, independent firm with less than 250 employees, whose annual turnover will not exceed over 50 million euros or has a total balance sheet maximum of 43 million euros. (European Commission 2020A; Tilastokeskus 2020.)

Despite the importance of novel technologies for economic and sustainable development, underinvestment occurs in clean R&D among green high-technology SMEs as they face severe barriers or might lack proper incentives to invest in new innovations. Green high-technology SMEs are generally capital-constrained due to insufficient internal funds or turnover to sustain their growth and current development activities (Čučković & Vučković 2018). Acquiring additional external capital from financial markets is problematic since banks are cautious of admitting loans for green high-technology SMEs as they may not have proven track record or reliable collateral due to the nature of their valuables, that is, intangible assets. Moreover, financiers could perceive the green high-technology SMEs' investment risk as too high due to asymmetric information, great possibility of default and long horizon on returns (Meuleman & De Maeseneire 2012; Yang et al. 2019). Thus, the investors might demand a huge return on their investment, which would discourage SMEs from innovating or accepting financial terms (Lerner 1999).

In addition to SMEs' capital constraints, underinvestment in R&D for novel green technologies is more remarkable than common innovations. R&D does not only include much uncertainty, but the scientific knowledge remains tacit to some extent as well. That is, the knowledge and expertise could be challenging to extract and is partly embodied in employees such as key researchers who might depart the company. Therefore, companies obtain intellectual property rights to secure their costly R&D efforts and innovations to capitalize and compensate their initial investments in risky activities. (Nelson 1959.) However, the outcomes of environmental innovations, such as clean air, can be enjoyed by all actors in the economy without directly paying for it, indicating a positive externality. The dual externality, from both knowledge created by private R&D investments and decrease in harmful pollution in the economy, puts novel green high-technology SMEs in a position where it is challenging to compete against innovative firms in other high-technology industries. That is because the green SMEs not only bear the full cost of their R&D investments but also find it difficult to fully appropriate and internalize the fruits of

their outputs' and innovations' results (Bi et al. 2016.), leading to less innovation activities that would be optimal from the perspective of societal welfare.

Concurrently, novel green high-technology SMEs face the liability of newness compared to more established firms in the industry. As these SMEs might not have proven track records or completely functional technologies, they are yet to be proved as valid actors in the economy. An approach to overcome the liability of newness is to attain social acceptance, that is, legitimacy, which signals the appropriateness of the SME in spite of the prevalent uncertainty. (Zimmerman & Zeitz 2002.) Nevertheless, new radical innovations could create legitimacy issues as it is perceived as challenging to apprehend these technologies in the eyes of stakeholders.

To address these challenges concerning R&D and innovation activities, governments in both developed and developing economies have preemptively initiated several government-financed R&D programs (Li et al. 2019). Besides, considering environmental issues, the EU has established a new plan, Green Deal, to improve resource utilization and movement to a circular economy that aims to carbon neutrality by 2050. One of the plan's purpose is to invest in climate-friendly technologies and provide financial aid for companies thriving for these solutions. (European Commission, 2020B.) However, to target the high technology-based SMEs and improve their R&D activities, the EU has continued its multiyear framework programs. In 2014 it introduced Horizon 2020 (abbreviated H2020), the most significant research and innovation program ever established in the EU before Horizon Europe is initiated in 2021 (Euroopan Komissio 2014). With a budget of 80 billion euros, the program emphasizes SME participation by specifically designed financial instruments.

The effectiveness of the subsidy programs for high-tech SMEs have been studied in the previous literature, the most notable being the U.S.-based Small Business Innovation Research Program (SBIR). Although the effectiveness of different R&D subsidy programs has yielded mixed results over multiple decades (Zúñiga-Vicente et al. 2014), recent empirical research indicates positive impacts on resource acquisition, particularly for high-technology SMEs (Meuleman & De Maeseneire 2012; Guerini & Quas 2016; Hottenrott et al. 2018; Bellucci et al. 2019; Li et al. 2019) and novel early-stage green technologies (Howell 2017; Islam et al. 2018). The certifying nature of a respectable body mitigates the information asymmetry between high-technology SMEs and private investors, helping to improve the level of legitimacy.

However, the certification effect of government R&D subsidies on resource acquisition and level of legitimacy might vary among stakeholders, such as public bodies or private investors, due to differing objectives. Therefore, the certification effect of governments' R&D subsidies might have a diverse impact on the high-technology SMEs, as governments seek to support firms with large spillovers for the whole society compared to private investors who pursue to maximize their rate of returns (Wei & Zuo 2018). In turn, the subsidized SMEs might utilize the certification in various ways, and the phenomenon can affect their decision and motives to apply for these subsidies, such as H2020.

The government programs are under scrutiny because of the limited resources that have to be collected via taxes indicating the necessity to show the impacts of these programs. (Wallsten 2000; Becker 2014; Radas et al. 2015 Dimos & Pugh 2016.) Because the H2020 program is running from 2014 to 2020, the effectiveness of the program is still ongoing and is relatively little studied compared to previous EU framework programs. To maximize the effectiveness of the EU's funds, particularly in green innovations, it is essential to examine how have the green high-technology SMEs utilized the H2020 subsidies and what have been the impacts on the SMEs.

1.2 Research objectives and limitations

The objective of this study is to address and gain a thorough understanding between innovative high-tech green SMEs and the H2020 framework program. An H2020 subsidy is extremely competitive and difficult to obtain, and the success rates in the program are low as eventually only 5–15 % of the applicants receive the subsidy. Moreover, the application and the decision process itself may tie and require additional resources. (Business Finland 2020C; European Commission 2020I.) Also, obtaining the H2020 subsidies can put excessive stress on the high-tech SMEs, which are usually already in shortage of internal resources. Thereby, it is essential to understand the primary motives to apply for H2020 subsidies.

Besides that the company might try to acquire additional resources, the receipt of the H2020 subsidy could also be a strategic decision to leverage recognition via public certification. By utilizing in part legitimacy theory and certification effect, this study aims to explain and seek answers for the leveraging and effectiveness of the H2020 subsidy.

In light of understanding more comprehensively the subsidy process and the choice of applying for the H2020 program, as the application procedures and reporting can be

quite strenuous, this study also examines the experiences concerning reporting obligations and cooperation between SMEs and H2020 program.

To answer for the objectives of this study, the following research questions are applied:

- What kind of motives and factors has affected the applying for H2020 subsidies?
- How has the SMEs experienced the reporting and cooperation during the H2020 support period?
- How have the H2020 subsidies been leveraged in and impacted the SMEs?

Due to the inherent nature of financially constrained innovative green high-technology SMEs in the economy, the role of the government is addressed as a means to explain why there is a need for intervention and targeted subsidies in the economy. Thus, the partial purpose is to clarify and elaborate more closely for the reader the general view why, particularly R&D subsidies for green high-tech SMEs, are essential to support their activities and economy in its entirety as well.

The literature presented primarily addresses direct R&D subsidies for SMEs, excluding a more profound examination of any other form of subsidies such as wage or employee subsidies. Although the influence of the H2020 subsidies for green high-tech SMEs' is one of the subjects of the research, this study does not examine or measure output such as products or patents. Thereby, the effectiveness and evaluations in reducing greenhouse gas emissions are beyond the scope of this study. In turn, the study emphasizes impacts on internal factors, such as resource acquisition and SME’s perceptions of how H2020 certification has been realized among stakeholders.

Additionally, the concentration of public R&D subsidies should be on the most distant technologies from the market where the impact could be the highest possible (Popp 2019). Thus, this study excludes green SMEs, such as traditional wind or solar energy that does not operate in the emerging technology field, and focus on SMEs in less established and mature technologies. These developing state-of-the-art green technologies (Howell 2017) include, for instance, wave power, biomaterials, energy storage, fuel cells and hydrogen.

1.3 Research methodology and methods

In Finland, accounting's methodological examination has primarily embraced Neilimo and Näsi’s (1980) classification model as a fundamental for analysis. Their classification

model comprises four different categories: conceptual, nomothetical, decision-oriented and action-oriented approaches. These approaches can be separated into descriptive and normative as well as theoretical and empirical aspects. A decade later, Kasanen et al. (1993) supplemented this model by introducing a fifth classification, the constructive approach.

The aim of this thesis is aligned with the action-oriented approach to accomplish an encompassing and comprehensive understanding of the actions and behaviour of firms in real-world business settings by using empirical means (Pihlanto 1994, 370). Generally, the approach aspires to examine the real world through one or a few objects. Following Neilimo and Näsi (1980), the action-oriented approach exists as a counterpart to the nomothetic research approach. Moreover, the action-oriented approach is suitable and appropriate to management studies focused on practical orientation, mainly as the objective is to understand management actions profoundly. (Pihlanto 1994, 370.)

According to Pihlanto (1994, 369, 373), the action-oriented approach specifically utilizes case study as an inherent method of choice because the hermeneutic and extensive nature of action orientation requires intense interaction between the researcher and the human actor. Such action is solely feasible by harnessing the case study or equivalent intimate method, and thereby, a case study could be unavoidable.

Conversely, Lukka (1991, 176–177) states that the action-oriented study's objectivity has limitations because the approach does not pursue finding specific results that could be generalized. Also, the statistical generalizability of case studies is hampered because the study often includes only one or a few cases. Despite the lack of objectivity and the low number of cases, reliable and high-class case studies are generalizable among the research community. That is, the case studies can be generalized to a certain level by looking for structural similarities based on the results of the case study and existing research (Lukka & Kasanen 1995). Therefore, contextual generalization could be adapted in the action-oriented approach and in a case study that enables a more comprehensive understanding of reality. This conception requires a profound comprehension of the factors, such as history, market and the institutional environment surrounding the objected phenomenon. (Lukka & Kasanen 1995, 76–79, 83–86.) Besides, case study research does not have to meet with quantitative studies' ideals, especially so as the researcher underlines thick description, interpretation and understanding the case (Geerzt 1973; Lukka 1999).

The theoretical part of the study is conducted in its entirety as a literature review. The theory chapters' objective is to acquaint the reader with the research topic through several relevant studies and provide tools for analyzing the empirical part of the research so the phenomenon under study can be addressed comprehensively and critically. In addition, this study utilizes qualitative research methods, and 10 case study companies' executive-level employees are interviewed in person. One explanation for the case studies popularity is the capability to demonstrate complicated business problems in a clear, approachable and down-to-earth way (Eriksson & Kovalainen, 2008, 116). Although case studies are subjective, the risk of excessive subjectivism exists, resulting from the researcher's arbitrariness and unfoundedness of interpretations and generalizations. The argumentation and analysis should always reflect even-handedly the findings of the researcher and not be based solely on selectively chosen information. (Salmi & Järvenpää 2000.) In qualitative business research, it is usual to form a closer connection with the companies in question. The close working relationship is established around collective trust and views of common objectives for both parties involved. (Eriksson & Kovalainen 2008, 66.) This close relationship could enable a possible research bias where the researcher might influence the results to present a particular outcome and violate business research ethics.

However, there are multiple benefits when utilizing interview methods in research, such as flexibility in questions and open dialogue with interviewees (Tuomi & Saarijärvi 2018), although context and situation can influence interviews in different ways. A thorough examination of results requires careful analysis, and developing statements based on interviews should be addressed cautiously (Hirsjärvi & Hurme 2011, 11–12). There are three distinct categories for which interviews can be separated regarding their structure: structured, semi-structured and non-structured interviews. The structured interview utilizes questionnaires while unstructured interviews, on the contrary, reminds of ordinary discussion. (Hirsjärvi & Hurme 2011, 44–47.)

In this study, semi-structured interviews were applied to gather information from interviewees. Multiple qualitative interviews within business studies fall under this category that can be utilized to examine both what and how research questions. This method enables open questions, and the questions are concentrated around specific topics, which could be called a thematic interview. The subject and theme are uniforms for every interviewee. However, the precise choice of words or phrasing may vary in thematic interviews, and the tone of the interview is somewhat conversational and informal. From this

perspective, semi-structured and thematic interviews may not be considered equal. (Eriksson & Kovalainen 2008; Hirsjärvi & Hurme 2011.)

The most challenging issue in semi-structured interviews is that the researcher must ensure that every topic on the outline is addressed and simultaneously be prepared to process in-depth responses and formulate follow-up questions. On the other hand, following too strictly to the premeditated questions could leave the interviewee's essential topics uncovered. Although semi-structured interviews are partly systematic, it might be challenging to compare empirical data as the interviewees respond and understand the same questions according to their own interpretations. (Eriksson & Kovalainen 2008, 82.)

The case companies in this study are all Finnish innovative high-tech unlisted green SMEs. The rationale for this choice is to understand the motives behind applying for H2020 subsidies as well as how and why the subsidies have influenced these SMEs where the externalities and market failure are exceptionally high. All the case companies are located in Finland to consider equal factors such as institutions and capital markets, primarily significant venture capital (VC) environment for high-technology SMEs. The data collection method and case companies are introduced in chapter 4.1 and 4.2 in more detail.

1.4 The structure of the study

The thesis consists of five chapters. The first chapter is the introduction which includes research objectives and presents the methodology and methods. The first chapter is followed by the theoretical part of the study that is presented primarily as a literature review consisting of previous studies and existing theories. The purpose of the theoretical chapters is to create an understanding of the research topic on the basis of previous literature. Moreover, the theory chapters help to enlighten the reader to understand multiple approaches to why there is a need for subsidization for green innovative high-tech SMEs and why these SMEs might utilize subsidies. Therefore, triangulation of theories (Eriksson & Kovalainen 2008, 293) is applied; several theories are utilized in addressing and interpreting the case.

Chapter two addresses subsidization from the perspective of public authorities providing reasons why green high-tech SMEs' R&D activities should be subsidized and address what kind of subsidy instruments and programs exist. Subsection 2.1 begins by presenting a wide overview of how R&D investment subsidies have been previously uti-

lized in the economy and introduces what kind of direct or indirect R&D subsidy instruments exist for SMEs. As the direct grant is found more suitable for high-tech SMEs, its effect on capitally-constrained SME's level of R&D investments is examined more thoroughly. Thereafter two market failures, spillovers and externalities, are addressed based on Nelson (1959) and Arrow's (1962) research that is complemented and reinforced by multiple empirical evidence. These two market imperfections lead to insufficient levels of R&D investments primarily due to the low level of appropriability of green innovations that have the potential for huge economy-wide benefits. Subsection 2.2 expresses subsidy impacts on project implementation and R&D investments by introducing deadweight and crowding effects. The primary focus of the two concepts is to illustrate how subsidies might be used and allocated inside the SME. The H2020 framework program is addressed in subsection 2.3, where the differences and similarities of three subsidy instruments, Research and Innovation (RIA), Innovation Action (IA) and Small and Medium-sized Enterprises (SME), are explored in more detail.

The third chapter emphasizes the perspectives of an individual SME and its reasons and motives to acquire public subsidies. As high-tech SMEs encounter heavy financial constraints, Donaldson's (1961) pecking order theory is applied in subsection 3.1 to demonstrate the lack of viable financing options, both for internal and external capital, and justify the rationale for public funding. Subsection 3.2 concentrates on legitimacy theory and certification effect. The purpose of this subsection in this study is to explain what kind of roles legitimacy and public certification through subsidization have in novel small ventures or less established industries such as green-tech. The research of Zimmerman and Zeitz (2002) and Fisher et al. (2016) contributes to this subsection extensively by illustrating legitimacy thresholds with multiple stakeholders and explaining how public certification might improve novel small venture's level of legitimacy, thus enhancing its recognition and competitiveness. In addition to legitimacy benefits, the SME could leverage public subsidies through the certification effect while pursuing more resources and growth. The subsection ends by examining a table of previous studies and addressing the effects of public certifications on SMEs. In subsection 3.3, SMEs and EU subsidies are addressed. The subsection particularly presents reasons why high-tech SMEs might or might not apply for EU instead of national subsidies.

The fourth chapter of the thesis is the empirical part, which is divided into four subsections. Subsection 4.1 describes data collection and case companies, in which EU funding and tenders portal and Community Research and Development Information Service

(CORDIS) were primarily used to gather information and select the case companies. As the definition of green in business context might include various companies and industries, it is also addressed how the case companies were categorized and selected for the empirical part from the EU funding and tenders portal. Moreover, this subsection explains why these particular case companies and interviewees were chosen for this study. The last three subsections depict the themes of the interviews. Subsection 4.2 emphasizes factors and motives to apply for the H2020 subsidies, primarily addressing three distinct matters: funding, certifications and legitimacy, and networking and visibility. In turn, subsection 4.3 presents what kind of reporting and collaboration experiences the case companies have had in the H2020 program. The subsection examines in more detail the issues in flexibility and collaboration between one case company and the H2020 program as it provided a quite different view of the experiences compared with other case companies. The last subsection, 4.4, addresses the utilization and impacts of the three subsidy instruments on SMEs. First, the subsection presents how the case companies have leveraged the H2020 subsidy instruments, and second, what kind of effects the subsidies truly had in the case companies.

Chapter five presents the discussion based on the empirical part of the study, and the research results are evaluated. In addition, the case companies and most essential findings are compiled into one table to mitigate the cross-case examination of the research results. Lastly, chapter six concludes by summarizing the study and provides four suggestions for future research.

2 PUBLIC PERSPECTIVE FOR SUBSIDIES

2.1 Public intervention

In the economy, microeconomic and macroeconomic reasons exist for the public to intervene in R&D. Macroeconomic argumentation stresses the impact of public intervention on innovation and economic development. One reason for such government intervention is maximizing social welfare by breaking monopolies or addressing negative externalities like pollution. In contrast, the microeconomic approach addresses the market failure theory. This theory argues that several market failures occur in innovation, leading to unsatisfactory levels in R&D investments. Although most economists concur that the lack of public aid would result in insufficiency in innovation, several authors agree that market failures are not the most notable reason for such intervention. Correcting market failure can be troublesome as there are cases when intervention has caused other failures or distortions to market competition. (Pisár et al. 2020.)

2.1.1 Subsidizing R&D investments

One reason to allocate public R&D subsidies for firms is justified by the market failures, which reduces the impacts of long-term economic growth. However, despite the public encouragement and support, the R&D expenditures in OECD countries have remained relatively stable. On average, during the period 2000–2019, the gross domestic spending on R&D has increased from 2.1 % of GDP to 2.4 %. (OECD 2019.) Although the payoffs of R&D and the number of expenditures are heterogeneous among economies, from the perspective of the entire global economy, assessment by the IMF (2016, 29) proposes that R&D investments are not at a socially optimal level, even at boom periods (Hud & Hussinger, 2015). Improvement in public subsidies to a socially optimal level would result in a 40 % higher private R&D expenditure providing a 5–8 % increase in GDP globally over time as a consequence of international technological spillovers and productivity growth provided by human capital (IMF 2016, 29).

Despite the potential positive effects on GDP, subsidizing firms incur costs and create a strain on the government's budget, leading to cost-benefit analysis questions. For example, Decramer and Vanormelingen (2016) found out that an investment subsidy's impact on growth for productive SMEs was not significant. However, the authors esti-

mated that the subsidy cost per created job was half a million euros. Furthermore, according to Takalo et al. (2013), measuring the R&D subsidies' impact on net welfare is problematic and should also include time and effort in the application process.

Even though R&D subsidies are identified to be beneficial and encourage the level of innovation, there exists debate in economies whether the government's funds should be allocated to subsidize other cost-effective alternatives than R&D. In addition to a considerable financial leverage effect on government funds, public R&D subsidies were observed to be more effective than subsidies for private consumption, particularly during the recession (Brautzsch et al. 2015). As Hall (2002) expresses that a high proportion of R&D spending is realized as researcher's wages, Brautzsch et al. (2015) found evidence that 86 % of the initial R&D subsidy expenditures were used to acquire intermediate inputs from other sectors, demonstrating a macroeconomic multiplier effect. Evidence in the literature (Romp & De Haan 2007) indicates that public investments, including the R&D programs, results in the largest multipliers. Brautzsch et al.'s (2015) support this statement as their input-out model suggests that the multipliers on output, employment and income relative to the initial R&D impulse are above two. Put differently, the public funds invested in consumption in contrast to R&D leads to lower multipliers and net economic welfare.

Although R&D subsidies and public funding have their role in supporting innovation activities and long-term economic growth, not all firms receive a similar degree of assistance. According to Čučković and Vučković's (2018) calculations on EU data, albeit EU funding forms a significant source of capital for creative SMEs, they are less likely to obtain public financial support in comparison to large innovative enterprises. This finding is irrespective of different EU funding sources. However, even though in 2014 large firms accounted for approximately 80 % of patent technology compared to SMEs' share of 17 %, it is observed that nascent and rapidly expanding SMEs generate in relative terms more groundbreaking and revolutionary innovations. (Čučković and Vučković, 2018.)

As SMEs are the engine of the economy and contribute relatively more radical innovations than large firms, how should governments support these financially disadvantaged innovative SMEs? According to Radas et al. (2015), the R&D subsidization policy should not be the same for large firms and SMEs since they do not innovate in similar ways. Vas (2017) identifies two non-refundable subsidy instruments for policymakers to encourage innovation and R&D efforts in creative SMEs: cash transfers, such as R&D

grants, and tax benefits. Both subsidy instruments' objective is to reduce expenses for R&D activities, yet the effects may not be similar.

The primary differences between the utilization of direct R&D grants and tax subsidy are the applicability for SMEs and the government's control to achieve its objectives. Direct R&D grants are accorded to SMEs for particular projects. In contrast, tax benefits serve to promote and support a large group of firms to undertake R&D. Tax benefits are also technology-neutral and irrespective of the industry and the firm's nature. (Bérubé & Mohnen 2009; Czarnitzki et al. 2011.) In their study, Busom et al. (2014) investigated whether knowledge-based SMEs utilize R&D grants or tax incentives while facing market failures such as appropriability and financial barriers. Their results indicated that financially constrained SMEs mostly prefer R&D grants over tax incentives.

The applicability in the utilization of R&D instruments between SMEs and large firms can be outlined by three factors: timing, eligibility and magnitude. First, as tax incentives are obtained ex-post, grants are often fully available before initiation of the project. Second, tax benefits are more straightforward to obtain since all firms file taxes at the end of the year. Also, every R&D project is qualified as eligible per se, whereas in grant proposals, the projects ought to meet strict requirements. Lastly, the number of tax benefits is determined based on the tax position of the firm, which might be challenging to prefigure for SMEs.

Moreover, many young, highly innovative SMEs make no profit and thus, do not have a positive tax liability to benefit from. In turn, with grants, an SME can recognize the precise amount of financial aid for its forthcoming project. (Busom et al. 2014, 576–577.) Le and Jaffe (2017) add that more novel innovation demands additional capital; thus, R&D grant is likely to have a greater influence on SMEs innovation efforts. Their findings support the evidence that large project grants have a higher value in improving innovation than tax benefits or R&D capability building grants, and R&D projects grants have three times higher probability of increasing product innovation.

From the government's perspective, direct grants enable control over R&D type. Therefore, direct grants are used to achieve specific objectives and target projects that provide high value for society. (Bérubé & Mohnen, 2009.) On the other hand, tax benefits are unable to retain control over the utilization of the subsidy. Hence, private enterprises will finance the projects which generate the largest private rate of return. (Hall & Van Reenen, 2000.)

What kind of an effect should be expected from a direct government R&D grant on R&D investments for capital-constrained high-tech SMEs? According to Dimos and Pugh (2016), in literature do not exist either conclusive theoretical or empirical guidance on the fruitfulness of government's R&D grants for improving private R&D. However, as economic theory suggests, R&D grants ought to reduce the marginal cost of capital (MCC) for R&D, thus activating more investments (Takalo et al. 2013). This is verified by Hyytinen and Toivanen (2005) whose research indicates that capital-constrained high-tech SMEs in Finland experience upward-sloping MCC. In the presence of government grant, these SMEs were found to invest more in R&D in relative terms. The increase in private R&D as a result of a reduction in MCC can be based on two reasons: The grant per se lowers the rate for external finance as the need for funding from the markets is reduced, or the grant includes a quality signal and thereby affects favourably for the cost of external capital (Takalo & Tanayama 2010, 37). The impact of R&D grant on MCC and subsequently for a firm's R&D investments is presented in figure 1.

The vertical axis in figure 1 measures the cost of funds, which is MCC, and concurrently the private marginal rate of return (MRR) for firms' projects. In turn, the horizontal axis determines the level of R&D investment and sales growth. The improvement in sales growth is based on an approach where stimulation in a firm's R&D investments increases its assets which, in turn, are utilized to generate sales. This proportional 'percentage of sales' method posits a constant ratio between R&D investments and sales. (Hyytinen & Toivanen 2005, 1387.) The MRR is presented in the form of a downward-sloping curve as a firm faces multiple prospective R&D projects with different expected values. Hence, the investments could be ranked in descending order utilizing their rate of return.

On the other hand, MCC is illustrated by an upward-sloping curve reflecting the opportunity cost of a firm's investments. The MCC is initially flat as internal funds, like retained earnings or owners' investments, are at the firm's disposal with a constant capital cost. After the depletion, the firm needs to acquire external finance to fund its R&D investments. Due to the presence of capital market imperfections, that is, asymmetric information and moral hazard, the cost of external capital is rising as the amount of required capital is increasing. (David et al. 2000; Hall 2002; Hyytinen & Toivanen 2005)

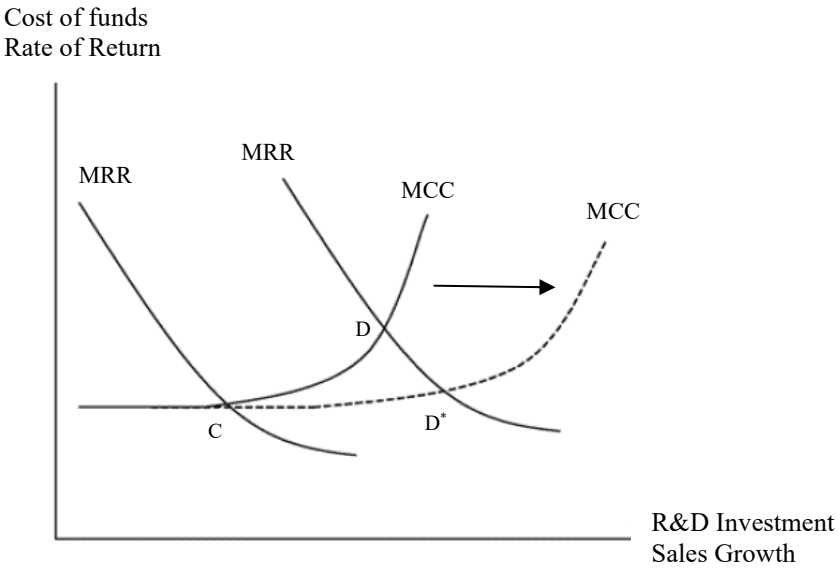

Figure 1 The effect of direct government subsidy on R&D for capital-constrained SMEs (Adapted from Hyytinen & Toivanen 2005)

Figure 1 demonstrates how in the presence of sufficient internal capital, a positive shock, such as grants, has no impact on the level of R&D investments. If the firm had excessive internal funds or the capital markets would be perfect, the MCC curve would be horizontal and completely flat instead of upward-sloping. A government grant is ineffective in this case, as the firm would not invest in below point C projects. However, the impact of government grant on R&D investments is contingent on the elasticity of supply of MCC (Wallsten 2000), as demonstrated in the shift from intersection point D to D*.

While maintaining the MRR curve constant, the government grant has two effects on capital-constrained firms. According to Hyytinen and Toivainen (2005), direct effect shifts the MCC curve to the right by enabling the execution of additional projects that were not viable with the existing capital cost. The indirect effect lowers the external cost of capital by affecting information asymmetries, thereby decreasing the dotted MCC curve slope, as Takalo and Tanayama (2010) proposed. Nevertheless, government R&D grant might move MRR and MCC curves concurrently, making it challenging to observe whether the government grant plays a role in mitigating deficiencies in capital markets or enables expansion and additional R&D investments (David et al. 2000). Nevertheless, it has to be borne in mind that a government R&D grant might increase the level of R&D investment, but no possibly employment even if the grant would not increase researchers' salaries. Labour and capital could be either complementary or substitutes (Decramer &

Vanormelingen, 2016, 1009), and thus, an investment decision may depend on the firm's technology and capital costs.

Conclusively, Hyytinen and Toivanen (2005) suggest that government grants should disproportionately assist firms in industries where external finance dependence is more robust, and capital market imperfections are stringent, for instance, in high-tech green SMEs (Bi et al. 2016). These firms are more likely to encounter an inelastic MCC curve, and hence the government grants could be adjusted accordingly with the elasticity of MCC. However, a firm and its projects could have various cost profiles and uncertainty in different evolution stages, leading to underinvestment in R&D efforts. This issue is addressed in chapter 2.1.2 in more detail.

Radas et al. (2015) imply that an R&D grant could increase the level of R&D inputs and thus outputs temporarily and affect the firm more thoroughly, enhancing the absorptive capacity. They propose that SMEs which receive the R&D grant might be able to increase their innovation level permanently. Therefore, the government grant could decrease the cost of R&D activities and also alter the whole organization.

2.1.2 Spillovers and externalities in R&D

According to Nelson (1959), there are three fundamental reasons why firms are not prepared to spend enough on research activities: it is a public good, uncertain nature of research and financial limitations. Thus, public aid can be justified due to the inherent quasi-public nature of R&D. Arrow (1962) supports Nelson (1959) by explaining that firms lack the incentive to invest in R&D at a socially optimal level due to appropriability concerns. As the results and returns from research projects are more doubtful and intangible than in development, particularly in the early-stage innovations, the issue with underinvestment is more intense in the latter, creating unequal market failure. Nicolaides (2013, 104) argues that the amount of subsidy corresponding to market failure size is not a sufficient approach for intervention. The best policy would be to eliminate the failure by internalizing externalities. In this situation, the firm would have the ability to appropriate all returns from the innovations and adjust its research effort in accordance with private benefits.

However, it is rather challenging to appropriate all the benefits from basic research, and due to the positive nature of R&D for other economic actors, spillovers occur. In addition to spillovers, another reason regarding investments concern imitation costs. If

the imitation costs are low, competition fierce and patent protection weak, the firm may not reap sufficient profits from its R&D activities. (Mansfield et al. 1981, 909.)

To correct the level of underinvestments in privately funded R&D, the majority of the economies have decided to utilize direct grants or tax incentives (Bérubé & Mohnen, 2009). Governments can adjust the support for firms considering the amount of spillover effect in separate innovation stages. For instance, in Croatia, companies are permitted to deduct their profit tax base for eligible costs of basic research and development by 150 % and 100 %, respectively. In SMEs, the size of this profit tax base deduction for eligible costs of R&D could be increased by 20 percentage points (Radas et al. 2015, 16). A comparable policy could be found in the Belgian R&D programme for innovative firms where the subsidy rate of direct grants is 40 % for research and 15 % for development activities. Furthermore, the subsidy rates for research and development are increased for SMEs by 20 % and 10 %, respectively. (Czarnitzki & Lopes-Bento 2013, 77.)

Figure 2 demonstrates the shift in funding in different phases of innovation for technology investments. The difference between social and private funding could also be interpreted as the magnitude of spillovers, which diminishes as the product approaches commercialization. In multiple instances, (positive) spillovers indicate the unintentional leakage of technologically valuable and beneficial information trickling to other parties (De Bondt 1996) without full compensation for the firm. In turn, the social rate of return includes the full benefits and costs of the investments to society, whereas the private rate of return considers only the benefits and costs borne by the individual firm (OECD 2003). Thus, the social rate of return includes a social or environmental value that is not reflected in the traditional financial accounts of which ordinary private investment returns are calculated. Therefore, the magnitude of positive spillovers and externalities in figure 2 can be realized as too high private costs or much higher social benefits.

At every stage where the private rate of return falls below social return, underinvestment occurs unless the government does not intervene via subsidies (Nemet et al. 2018). Supporting Nelson (1959), Nemet et al. (2018) state that the difference between the social and private rate of return is highest in both basic research and the demonstration stage. In basic research, tacit knowledge is embodied in employees who may transfer the amassed intangible asset with them as they leave the firm. Consequently, the gap between private and social return remains large.

Unlike basic research, applied research might have generated marketable value (Chu & Furukawa 2013). As the accumulated knowledge can be utilized to create early innovation, which is easier to get patents than basic research, the spillovers are smaller since the patent is based on basic invention instead of pure knowledge. This reduction of uncertainty is illustrated as a diminishing gap in figure 2.

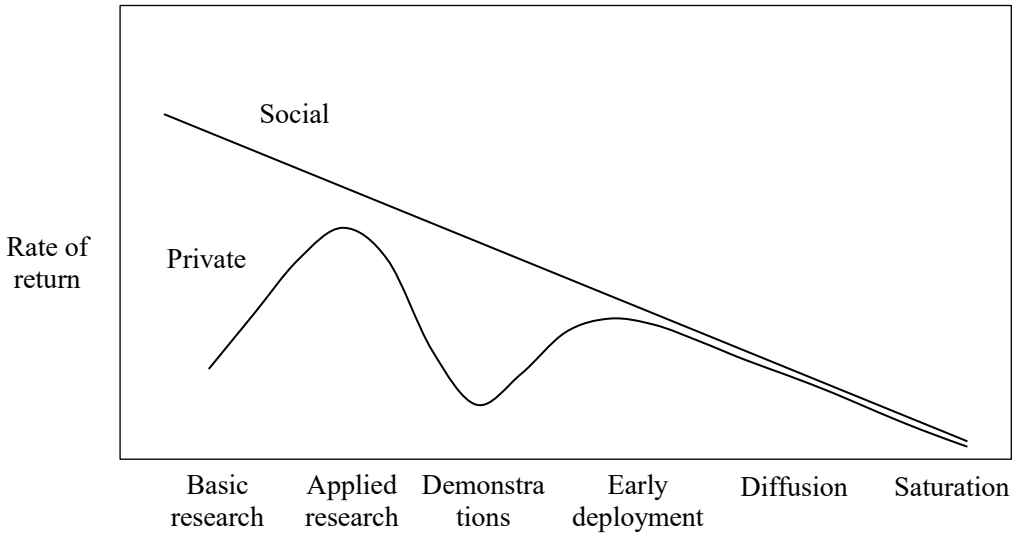

Figure 2 Innovation stages and private and social rates of return (Adapted from Nemet et al. 2018)

The demonstration for firms is challenging as it sets at the halfway of evolution, as depicted in figure 2. It has passed the research phase but has not reached commercialization. (Nemet et al. 2018.) This stage consists of pilot tests and demonstration plants. The pilot tests are perceived as laboratory experimentation concentrated on proving the feasibility in a real word environment, whereas demonstration plants are a wider test environment near to production. (Frishammar et al. 2015.) The size of the gap between the private and social rate of return increases nearly to its widest extent in this stage. The causes for high spillovers are due to an ample amount of capital required, high technology risk and uncertainty in market demand which are all borne by the private firm alone. For instance, demonstration plants can require capital millions of dollars that are eventually sunk costs for the firms.

Moreover, the amount of capital could skyrocket as the firm might need to build multiple demonstration plants to learn and reduce the risk in technology before the commercialization phase. (Nemet et al. 2018, 155–156.) According to Sahal (1985), the cost might as well increase during the upscaling as generally, new issues occur that were not visible at smaller scales.

At the last three stages after the demonstration phase in figure 2, the gap between private and social returns are negligible. Decreasing returns exist in adoption as companies are capable of properly defend their proprietary assets, while market risk and uncertainty are reduced considerably. (Nemet et al. 2018.)

However, Le and Jaffe (2017) argue that the primary purpose for a public authority to subsidize R&D investments is to generate spillovers. If assisted firms produce solely incremental innovations or imitative products, they may not create enough spillovers to validate the subsidies. Thus, the government might be inquisitive of the nature of innovations requiring R&D support and the novelty level of those products. Bérubé and Mohnen (2009) found in their study that firms participating in R&D grant programs produce more world-first innovations which generate positive externalities, consequently claiming the program accelerates innovations specifically in the highest sphere of spillovers.

Compared to common innovations, spillovers are more considerable in early-stage green technologies (Bai et al. 2019, 821), specifically among hydropower, carbon capture and storage or new engines and electric vehicles (Howell 2017, 1139). Bi et al. (2016, 277) underlined this statement and expressed dual externality in low-carbon innovation emerging from positive R&D spillovers and reduction in damaging environmental externalities. Wang and Han (2017) agree and state that upstream innovation can significantly decrease impurities and emissions downstream via intermediate products.

The issue with underinvestment in green innovations could be further exacerbated as the gap between the social and private rate of return is more massive due to higher costs of (novel) green technology compared with conventional innovation (Bi et al. 2016) or traditional energy technologies as these are not as much capitally constrained (Howell 2017, 1139). Besides, the market undervalues environmental benefits resulting in a competitive disadvantage for sustainable firms compared to traditional technologies reducing private profits. Because every actor in the economy can enjoy the environmental benefits regardless of whether they contributed or not, small sustainable firms are unable to escape from this "green prison". (Pacheco et al. 2010, 464, 468–470.) Consequently, the number of environmental entrepreneurs will be insufficient, resulting in less green innovation and societal welfare.

An example of alleviating these environmental externalities and encouraging more sustainable R&D would be to incentivize green innovation by internalizing the cost of pollution. Supporting Nicolaides (2013), Dean and McMullen (2007, 62) propose trading carbon allowances, which would alleviate the market failure. On the contrary, Acemoglu

et al. (2016) found out that optimal public policy is firmly in favour of research grants. Postponing government intervention by solely depending on carbon taxes would imply considerable stress on welfare. Nevertheless, the government can mitigate this strain on environmental and economic welfare as the income from carbon taxes or cap-and-trade system could be distributed to improvement and creation of clean technologies that reduce emissions (Islam et al. 2018). Popp's (2006) research provides combining perspectives by evidencing that government subsidies do stimulate a higher amount of R&D compared to a carbon tax, yet R&D subsidies cannot act as a sole substitution for other climate policies. The line of reasoning is based on the reality that R&D subsidies are unable to address the environmental externality as a carbon tax does.

Even though firms would benefit from projects with poor spillovers, this is unlikely to gratify the government, whose primary objective is to improve the welfare of the whole economy (Wei & Zuo 2018, 618). If the government should subsidize projects with the highest spillovers, which projects would receive the grant? According to Nemet et al.'s (2018) illustration in figure 2, projects in basic research and demonstrations have the highest spillovers and should be granted R&D subsidies. However, evaluating the gap between the social and private rate of return is challenging and complicated. Previous theoretical research contemplates measures to evaluate the profitability of a project, whereas less effort is concentrated on examining comprehensive indicators estimating social surplus (Vas 2017, 456). According to Mansfield (1991, 24), utilizing past data and statistics as well as holding other variables constant, private return for R&D at the firm or industry level can be approximately estimated when evaluating the relationship between output and R&D expenditures. In measuring the total social returns, Mansfield (1991, 24) states that competing firms' lost rents and research expenses of similarly failed innovators should be included as well as profits and benefits of innovators and consumers.

Following Mansfield's (1991, 24–25) method to calculate returns of R&D for industrial innovations, economists realize social returns to be reasonably large, median return reaching as high as 50%. Later, the author studied 20 innovations and found out the social returns were even more significant, achieving double the private rate of returns. Nevertheless, the social returns vary between periods, environments and industries. From 1959 to 1973, the social returns for private R&D was estimated to increase from 10% to 35%. Depending on the nature of innovation, the range of social returns can be further dispersed.

The prior research indicates that social returns could vary from 40 % in agriculture to as high as 200 % in the medical industry. (Mansfield, 1991; Griliches 1992.) Takalo et al. (2013) examined welfare impacts in Finland with structural econometric modelling utilizing rich project-level data and share similar results expressing social returns of 30–50%. However, they found evidence of substantial heterogeneity in subsidy effects and that the R&D subsidy has a higher impact on the firm's profits than spillover benefits for society. According to the model of Takalo et al. (2013, 270), the spillovers are anticipated to increase 0.25–0.5 euros per one euro of invested R&D, and spillovers are higher among larger firms as well as in technically demanding projects. Finally, utilizing patent citations, it is possible to approximate the knowledge spillovers. Recent studies have found that R&D in clean energy embodies at the greatest 40 % higher spillovers than other novel technologies such as nano-, IT-, or biotechnologies recommending higher social value. (Popp & Newell 2012; Dechezlepretre et al. 2017.)

Moreover, the social rate of returns has been generally assessed as average returns by economists. While generating useful information marginal rate of returns would be a more suitable measure than average returns. Marginal returns would illustrate the effectiveness of additional dollar spent and indicate whether under investment occurs in R&D. (Mansfield, 1991, 26.)

The existing literature proposes that spillover issues are more severe among smaller companies because those firms are not frequently capable of preserving their intangible assets or enjoy the full economic rents of their products (Mansfield et al. 1977). The challenge could be explained by SMEs' small market power or the lack of resources available. This capital market imperfection and difficulties to utilize various funding sources for high-tech SMEs are addressed more profoundly in chapter 3.1.

2.2 Subsidy impact on implementation and R&D input

2.2.1 Deadweight effects

The role and effects of R&D subsidies on innovation input, output and behavioural additionality are controversial. Companies receiving public subsidies will utilize the resources to implement projects and generate new products or innovations to market. Despite the available additional public funds, there exists no guarantee that the firm would allocate all of the subsidies for its specific project or that the firm would have executed the project regardless of the subsidy. The degree to which the subsidized project would have been

implemented without receiving any assistance is defined as deadweight (Sipikal et al. 2013, 31).

According to Lenihan (2004, 231), the definition of deadweight includes various degrees of time, scale and location. If the firm had not implemented the project without assistance, the scenario would be defined as zero deadweight. On the contrary, partial deadweight is regarded as a situation where a project would have been implemented without financial assistance but at a reduced scale, different time or location.

In order to maximize the sufficiency of public funds, the deadweight could be minimized by concentrating the financial support for feasible projects that would not be realized without public aid. However, if the deadweight is considerable, the consequent changes, such as employment, are insignificant because the achievement would be accomplished without the subsidy. Hence, to maximize the impact and added value of public subsidies, projects with no or minimum deadweight effect should be targeted. (Tokila et al. 2008, 587–588, 596.)

However, the deadweight effect can be quite considerable, creating stress for the public sector to manage the subsidy programs more effectively, particularly during an economic downturn when public revenues are affected negatively (Sipikal et al. 2013). This issue expresses the importance of ex-ante evaluations methods to maximize the reach and effectiveness of these programs. According to Lenihan (2004), it is not any more adequate to solely evaluate estimates of deadweight but instead direct the attention to certain firm factors, which all could impact the underlying estimates. To address this question, Lenihan (2004) conducted concurrently econometric model and interviews with project managers mainly in Ireland-based SMEs, which received grants for expansions purposes, capital investments, or R&D. The analysis identified grant type and investment appraisal as essential factors affecting deadweight.

The results indicate that the firm receiving an employment grant is almost six times more likely to cause deadweight than companies that obtained grants for other activities. In turn, SMEs which obtained investment grant was found to have a decreasing effect in deadweight, indicating a genuine need for support. As opposed to Lenihan (2004), Sipikal et al. (2013) indicate that a company receiving an investment grant is four times more likely to cause deadweight and recognize a positive correlation between the magnitude of budget and the degree of deadweight.

The amount of grant may have a different effect on SMEs than on large enterprises. Lenihan (2004) argues a minor grant could result in higher levels of deadweight in companies reasoning that the impact of a small grant could barely affect, and the project could have been implemented in any case. Moreover, based on her analysis, Lenihan (2004) argues that SMEs have a lower probability of deadweight than large enterprises. This could be the case due to difficult access for SMEs to acquire optional funding and the lack of slack resources.

In addition to Lenihan (2004) and Sipikal et al. (2013), Tokila et al. (2008) studied zero deadweight investment projects in Finland during 2001–2003. They identified that firm, investment characteristics, and location has a remarkable impact on zero deadweight. Interestingly, Lenihan (2003) claims that the deadweight effect is most suitably addressed at the individual level of the firms, whereas Tokila et al. (2008) discovered the deadweight effect being dependent on the industry. The authors also identified that increasing project costs, distance from major cities, and relative intensity of assistance all have a positive impact on the probability of zero deadweight. On the contrary to Sipikal et al. (2013), results prove that there exists a negative correlation between project costs and the degree of deadweight.

A similar but even stronger negative correlation on zero deadweight was noticed in relative intensity of assistance, which expresses the ratio of investment subsidy to project costs. Doubling the relative intensity of assistance doubles the probability of zero deadweight as well. (Tokila et al. 2008, 595–596.) Conversely, this could be interpreted that when the project costs are high relative to investment subsidy, the impact of grant is smaller and could barely have an effect, as Lenihan (2004) stated. However, it could be argued that in this case, even the small grant could have a higher marginal benefit.

According to the EU's assessment of its framework programs, approximately 4 out of 5 H2020 projects would not have advanced without H2020 financing, indicating a low degree of deadweight. The report also corroborates the findings of Tokila et al. (2008) as different industries are shown to have varying deadweight effects. The impact of H2020 funding on project implementation is found to be substantial among novel technologies and green innovation. For instance, 95 % of the projects in the Future Emerging Technologies (FET) program would not have either advanced at all or would go ahead with significant modifications. The numbers in green innovation projects from the EU's Societal Challenges (SC) program for different focus areas are as follows: 93 % for smart, green and integrated transport (SC4), secure clean and efficient energy 85 % (SC3) and climate

action, environment, resource efficiency and raw materials 92 % (SC5) respectively. (European Commission 2017A.)

Interestingly, on average, only 14 % of the projects would have advanced with none or minor modifications suggesting partial deadweight. Nevertheless, the number could be exaggerated as subsidy recipients tend to overestimate their ability to carry out projects without EU funds and thus, only a few failed applicants are successful in executing their projects. Findings of FP7, the EU's predecessor program of H2020, revealed that only 1 in 20 applicants were successful in implementing their projects with no or minimal adaptions as they failed to receive a grant. It is important to recognize that the aforementioned 5 % are projects of the highest quality, which fulfilled all requirements and were barely inframarginal with evaluation points compared to the last approved application. (European Commission 2017A.)

The deadweight effect is not similar for all grants, and as evidenced, the effect also varies concerning multiple characteristics between an individual firm or industry. Although existing subsidy programs direct more attention to select projects with the best potential performance, the probability of deadweight is most suitable in such projects. In practice, due to information asymmetries, the complete elimination of the deadweight effect is not possible. (Sipikal et al. 2013, 31, 38.)

2.2.2 Crowding effects

One of the objectives of public subsidy policies for R&D is to induce private investments and companies' resources to increase the level of R&D expenditure. Public subsidies can impact R&D expenditure in three ways. Subsidies either do not affect, crowd-in or crowd-out private investments. In the literature, crowding-in and crowding-out effects have been examined extensively. The former is defined as complementary spending attracting additional resources, and the latter as substitution or reduction of funds in expenditures. In theory, both outcomes are feasible. (Bianchini et al. 2019, 65.)

Although crowding effect have been comprehensively studied, there is no consensus among researchers supporting crowding-in or -out effects unilaterally and a disparity in conclusions exist. Zúñiga-Vicente et al. (2014) surveyed empirical research primarily from the EU over the past five decades finding substantial variation and heterogeneity in the results. However, the majority of the research acknowledged positive crowding effects in private R&D. The difference in crowding effects can be addressed by examining changing subsidy policies over time (Zúñiga-Vicente et al. 2014), in-depth interviews or

econometric methods applied (Catozella and Vivarelli 2016; Li 2017), and the different industry or evolution stages inside the firm (Clausen 2009). For instance, Clausen (2009) identified that the subsidy has a different impact on research and development spending, finding stimulation in the former but substitution in the latter. This might be explained by increasing financial constraints, and decreasing attractiveness as development is often more capital-intensive.

There are multiple alternatives to how public subsidies can influence a company's input additionality. The first pillar, illustrated in figure 3, expresses the firm's actual situation before receiving any form of subsidy. Only in the first case subsidy can induce private R&D expenditures and create additionality. In the last four cases, the subsidy either does not affect private R&D expenditures or creates substitution reducing the firm's original firm-financed endeavours, that is, crowding-out. Generally, according to literature, the crowding effect lies somewhere between additionality and partial crowding-out. To the author's best knowledge, Wallsten (2000) is the only researcher to find a full dollar-for-dollar substitution effect for firm-financed R&D.

However, researchers have found other aspects to consider regarding crowding -out effects. Wallsten (2000) recognized that while the grant may not have increased the R&D input, presented as a second case in figure 3, it is possible the firm was able to continue its current project at an equal level preventing the elimination of the project with future potential. Moreover, according to Lerner (1999, 297), in several instances, small high-tech firms are established by or developed around an indispensable scientist and a key engineer. Therefore, it might be impossible to hasten the progress of the project by investing more in R&D and thus adding more research personnel. In this situation, it is reasonable for the small firm to keep its spending rate constant and utilize the funds to protract the time before the requirement of new capital.

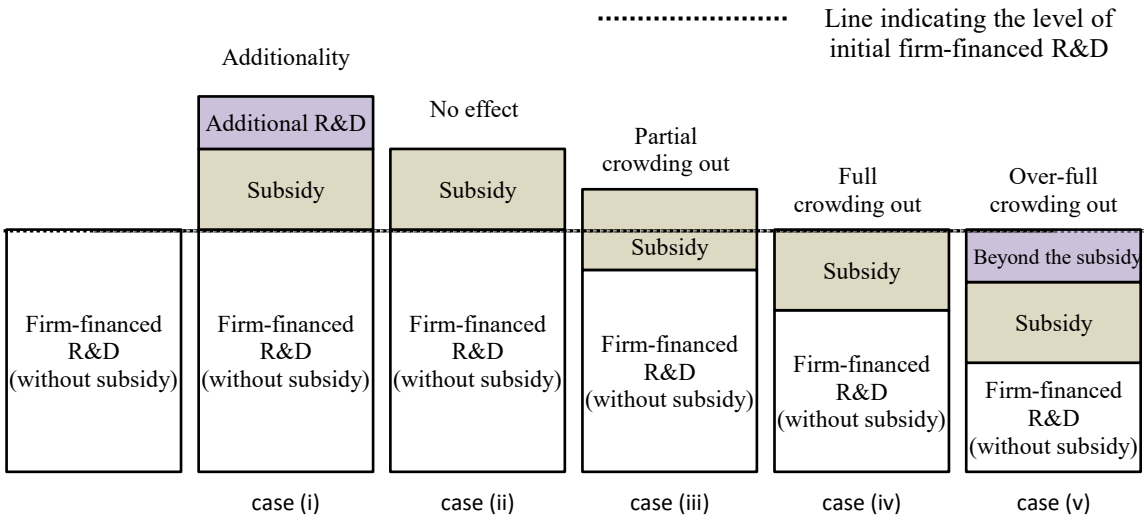

Figure 3 The influence of R&D subsidies on R&D expenditure (Adapted from Dimos & Pugh 2016)

Receiving the grant for a crucial project could also divert or dismiss employees from less critical projects, which, at a reduced scale, would not need as much R&D expenditures as in previous activities, expressed in a third case. Therefore, additionality in one project can reveal a form of substitution in others. (Radas & Anić 2013.) This phenomenon could be interpreted conversely as well. Although in many subsidy programs, the grant is precisely targeted on a specific project, this does not possibly suggest zero additionality in the firm like the second case would imply in figure 3 as the grant may set free the firm's resources for other supporting activities. Radas and Anić (2013) found supporting evidence from an innovation subsidy program targeting Croatian SMEs, which invested in other business functions after receiving the grant. The subsidized project could benefit from improved functions, for instance, as negligible marketing operations might endanger commercialization efforts. Nonetheless, literature interprets such diversion of resources as crowding-out.

To ensure the best probabilities for success, a firm might apply for multiple subsidies to maximize resources for its project, considering modest application costs. This has raised a question among researchers and the public as well could the source of funds be a factor of crowding effects. Zúñiga-Vicente et al. (2014) express possible substitution in private R&D spending when the firm obtains funds from multiple agencies, particularly in the case of small projects and superfluous resources. However, Czarnitzki and Lopes-Bento (2014) examined high-tech funding in Germany, discovering there do not exist considerable differences whether the firm receives subsidies from the EU or a national

government, indicating the funding sources are irrelevant. Czarnitzki and Lopes-Bento (2013) also identified similar results in innovative Belgian SMEs, concluding that several grants which are admitted simultaneously, whether from national or EU, do not result in crowding-out effects.

The relationship between the amount of subsidy and crowding effects is complicated and nonlinear. According to Guellec and Pottelsberge (2000), an inverted U-shaped curve stands between privately funded R&D and subsidies. They discovered a marginal and decreasing effect to a specific threshold with a moderate amount of subsidy indicating crowding-in and crowding-out after the threshold level. Yu et al. (2016) agree and identifies a threshold as well as inverted U-relationship while investigating the impact of government subsidies on private R&D investment behaviour in China's renewable energy sector. Their results present two threshold values of 0.6 % and 10.1 %, indicating that negligible or too generous intensity of public subsidies leads to insufficient incentives and crowding-out effects in private R&D input. (Yu et al. 2016, 111.)

Zúñiga-Vicente et al. (2014, 58) support the threshold effect, assuming that other things under equal conditions, the likelihood of substitution is anticipated to increase with the amount of subsidy received. The magnitude of the business reflects the resources available for the firm limiting the capabilities for R&D operations which are expected to become inelastic after a certain level. If the firm can obtain public assistance for an extensive project and consequently stretching its internal resources at the peak level, the firm may consider abandoning or delaying other projects and redistributing R&D funds to the largest project.

Overall, the evidence presents that the EU's framework programs have developed over time in terms of firms' internal financial leverage. Szücs (2020) examined the EU's three previous framework programs and found results that express crowding out in sixth and seventh framework programs but crowding in effect in the H2020 program. The author also recognized that high-intensive R&D firms remarkably expand their R&D, whereas low-intensity R&D firms reduce theirs. Moreover, the crowding in effect is stronger among smaller projects. Findings indicated that in small projects, R&D budgets and spending was increased by approximately 20 %. However, the small projects could be relatively large as the threshold was 7 million euros. The EU's previous report supports these findings quite accurately as its results indicate that teams that received funding from the framework program increased their R&D budgets by roughly 22 % (European Commission 2017A).

In conclusion, subsidies can solely encourage private investments in R&D if the government supports the best innovation schemes which are privately unprofitable (Wallsten, 2000). According to Clausen (2009, 251), public aid has a more significant stimulation impact when spillovers in R&D investment are high. Therefore, the author suggests granting subsidies for novel and risky projects which are far from the market. He also discovered that subsidies that fund these type of projects tend to increase subsequent R&D budgets and investments inside the company over time.

2.3 Horizon 2020 subsidy program

Multiple countries have implemented own subsidy programs to address market failures and increase the competitiveness of a national economy. The specific objectives and emphasis of these programs vary but generally, they address predefined policy targets such as collaboration between research institutions and private firms, support the export-oriented businesses' innovation diffusion, or promote sustainable technologies. Due to financial constraints and significant economic contribution for employment, growth and innovation, special attention is concentrated on direct R&D subsidy programs for innovative high-tech SMEs. These type of programs can be featured in various economies, such as the KMO program in Belgium, DPF in Germany, BF schemes in Finland and SBIR in the U.S., among others. The projects accepted into these programs are more ambitious and larger, thus pushing outward the technological frontier. Therefore, these programs have a higher potential to improve competitiveness and breakthrough innovations. (Lerner 1999; Czarnitzki & Lopez 2013; Czarnitzki & Lopez 2014; Business Finland 2020A.)

Alongside national governments, the EU provides multiple large funding programs that allocate funds either indirectly via national and regional authorities or directly by European Institutions. Indirect funding, representing 80 % of the EU's budget, is distributed via European Structural and Investment Funds primarily concentrating on regional and urban development, economic convergence of developing regions, social inclusion and agricultural improvements. (European Union 2020.) Despite the importance of indirect funding to Europe's economic development and integration, these funds do not specifically focus on technological development and innovation. Therefore, since 1984, the EU established successive multiannual Framework Programs to enhance research, technological development and innovation activities. The current, 8th, framework program, H2020, is ongoing and running from 2014 to 2020 (European Commission 2020C).

H2020, with its budget of close to 80 billion euros, is the most extensive EU research and innovation program ever established. The program's objective is to support state-of-the-art science, reduce barriers to innovation, and alleviate the collaboration between private and public sectors to produce world-first innovations from the laboratory to world markets. Everyone can participate in calls of proposals, and H2020 emphasizes an uncomplicated structure allowing participants to concentrate on their core capabilities, thus enabling faster inception of projects. (European Commission 2020D.)

Compared to previous framework programs, H2020 has a higher focus on SMEs, which is realized as increased participation and funding in R&D and innovation projects. Overall, H2020 consists of three pillars, excellent science, industrial leadership and societal challenges, of which part of the budgets are allocated notably to support SMEs. As of March 2020, the objective of the direct funding support for SMEs was exceeded and totalled over 9 billion euros. (European Commission 2020E; European Commission 2020F.)

In addition to research and innovation action (RIA) and innovation action (IA) grants, which aim to improve competitiveness as well as R&D activities, H2020 introduced a brand new SME instrument. The SME instrument's objective is to provide assistance and funding for early-stage high-risk SMEs, focusing on research and innovation for breakthrough inventions, with high potential and ambition of becoming market leaders. During the first three years, the majority of the SME instrument funding was allocated to novel innovations in healthcare, clean technology and energy industries (Čučković &Vučković 2018, 119). Although the EU has different funding programs for SMEs, such as Competitiveness of Enterprises and SMEs (COSME), the H2020 mainly aims to transform disruptive concepts into market solutions instead of supporting competitive capital-constrained SMEs in general. Moreover, compared to COSME, the H2020 offers much larger grants providing direct and equity-free financing instead of guarantees, loans or traditional equity investments without diluting any ownership stake. (Čučković &Vučković 2018; European Commission 2020G.)

According to Mazzucato (2013, 43), the state's role is not merely to enable knowledge creation via laboratories and universities but also to stimulate resource mobilization and thus knowledge diffusion across economies. Therefore, the EU aims to achieve a leverage effect and attract additional funding multiplying the H2020 budget from its initial 80 billion euros. Also, to decrease the perceived risk, interest rates and strict collateral requirements, the SME instrument is also called ‘a soft blending tool’: a grant that can attract

private investment. At the end of 2017, firms funded by the SME instrument had collected 1.35 billion euros of private follow-up investments primarily from equity finance, indicating a leverage ratio of 1.6. This is a significant increase from the end of 2015, where the ratio was only 0.9, revealing the instrument's growing awareness and potential. SMEs verifies the instrument's benefit, stating it has improved their growth, client base and attracted investments. (European Commission 2020H, 47.)

H2020 and its predecessor framework programs are not the first programs to target R&D, innovation and SMEs. SBIR, one of the first R&D programs for SMEs, was established in the U.S. in 1982, just two years before the EU's first framework program. Much evidence has been presented in favour of the effectiveness of the SBIR program, for instance, on employment and sales (Lerner 1999), innovation propensity (Galope 2016), resource acquisition (Howell 2017; Islam 2018; Lanahan & Armanios 2018) and spillovers for the entire society. (Wessner 2000.)

The H2020 SME instrument is in a way based upon the SBIR program's model to address and fill the funding gaps for high-tech SMEs. The funding gap and different instruments to mitigate this issue is illustrated in figure 4. As technology evolves, the number of public resources poured into the firm diminishes and is eventually replaced by private investments. Nevertheless, there is a 'valley of death' between public and private funding where many SMEs fail to reach for sufficient finance and are thus incapable of transferring research and developed ideas into the marketplace (Weyant 2011, 674). According to Nemet et al. (2018, 154), large-scale radical innovations and technologies addressing climate change are more prone to the valley of death.

To support R&D and innovation efforts in high-tech SMEs, the EU has a few specific instruments for different stages of a firm's progress. The horizontal axis in figure 4 demonstrates SME's technological readiness level (TRL), divided into nine categories based on the evolution and capabilities of its technology. Firms' R&D starts after TRL 3, experimental proof of concept, and ends after TRL 8, where the system is complete and qualified. (Business Finland 2020B.)

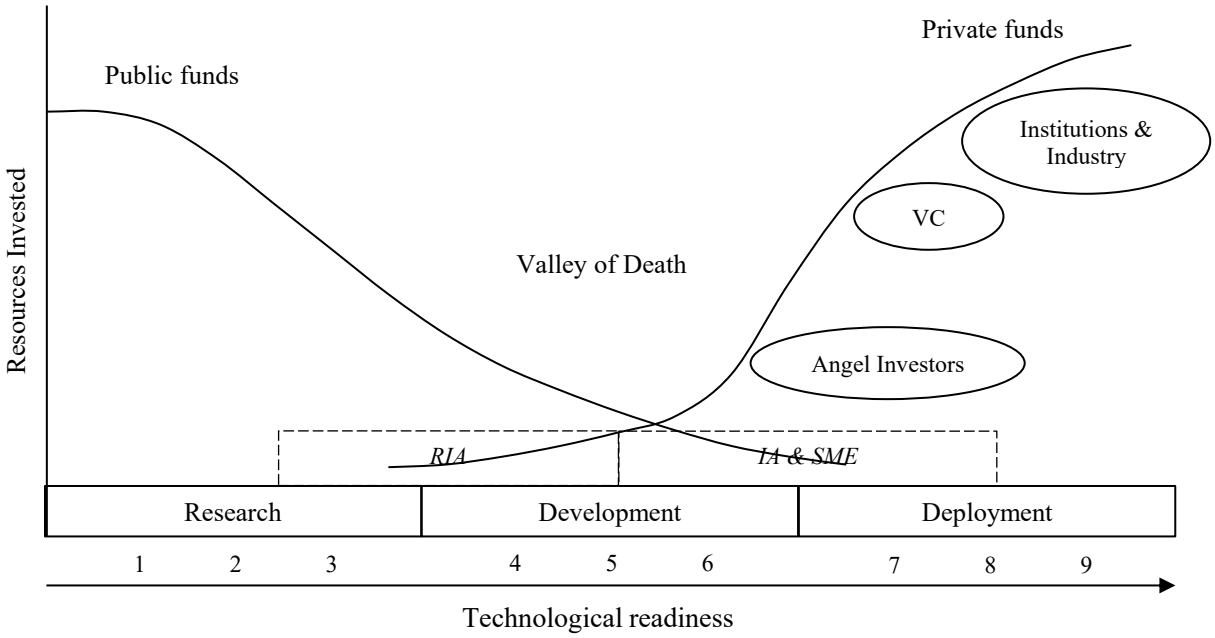

Figure 4 Illustration of a subsidy program for high-tech SMEs (Adapted from multiple studies and EU research)

The two horizontal broken-line boxes in figure 4 visualize three specific equity- and interest-free instruments that SMEs are eligible to apply for their R&D and further innovation efforts. The RIA instrument is for activities to create new knowledge or examine the feasibility of new technological improvements. The grant covers 100 % of eligible costs to a maximum of 15 million euros and includes typically 5 to 15 partners from a minimum of 3 countries. The TRL is defined in the project call but generally lies at 3-6. In turn, the IA instrument is quite similar to RIA, but the time horizon and the focus of R&D are closer to commercialization and altering the improved technology. However, with the IA instrument, the grant only covers 70 % of eligible costs for for-profit firms, and the TRL is higher, at levels 5-8. (Business Finland 2020C.)

Compared to RIA and IA, the SME instrument does not require multiple partners but can be applied by a single applicant. Although the funding rate is the equivalent at 70 %, the maximum grant is limited to 2.5 million euros. However, at least TRL 6 is required as the SME instrument's emphasis is on finalizing R&D and business development rather than closer to strong technological advancements. Moreover, the SME instrument might provide more freedom in applying since the call topic is free compared to RIA and IA. (Business Finland 2020C.)

The SME instrument itself is divided into three phases, emphasising the amount and nature of the funding. However, these three phases are not as clearly defined according

to TRL as the RIA, IA or SME instruments. Phase I is concentrated on concepts and market feasibility assessments such as risk appraisal or intellectual property management. The grant is a lump sum of 50 000 euros per project and should eventually describe the innovative idea and preliminary business plan. In turn, the Phase II grant requires a sound business plan with an elaborate commercialization strategy and a realizable description of how to obtain private capital. The funding varies from 0.5 to 2.5 million euros and is primarily focused on innovation, yet in exceptional cases, research can be a dominant component. Lastly, Phase III prioritizes commercialization of innovation results from Phase II by providing extensive support to access risk finance, reach out for customers and help in networking opportunities. At the end of Phase III, the SME should have introduced innovations to the market and improved its competitiveness. Phase III differs from the previous two Phases as it does not provide financial assistance at all. (European Commission 2020I.)

Moreover, Phase I is not a requirement to receive Phase II funding; the SME can apply directly for the latter. However, this might not be beneficial because, according to interviews with SMEs stakeholders, Phase I helps firms with no prior public financing experience. They found applying for Phase II challenging and more complex. The data supports the stakeholder's view as the success rate after Phase I is almost 80 % higher in relation to directly applying for Phase II. (European Court of Auditors 2020.) Also, the documentation process can be so burdensome that once an SME obtains a Phase I grant and can attract private funding, it is not perhaps worth applying for Phase II anymore (Howell 2017, 1152).

Although the focus, emphasis and nature of the instruments vary slightly, all of them have relatively low approval rates between 5-15 %. This could be not only due to a large number of applications but high threshold value and criteria of evaluation as well. (Business Finland 2020C; European Commission 2020I.)

Nevertheless, as figure 5 illustrates, the RIA instrument is directed more for research and early development instead of commercialization, prototyping and demonstration of the technology in a relevant operational environment as is the case with SME and IA instruments. Albeit these three instruments are somewhat categorized in each stage of development, they still overlap each other to some extent. Put differently, the R&D phase, demonstration and deployment could have distinct weights, but the boundaries between them might be blurred as some R&D can occur in the deployment phase and vice versa. (Cort et al. 2010.) Howell's (2017) empirical research on the U.S. Department of Energy's

SBIR program supports this statement by presenting evidence where Phase II grant was utilized in basic R&D and testing existing as well as new technologies.

Research exists on how the Phases of the H2020 SME instrument have influenced the SMEs per se, but not detailed studies or evaluations between and among different industries. In SBIR, Howell (2017) discovered that the Phase I grant is most beneficial in sectors where positive spillover effects are substantial. For instance, Phase I grant is highly effective in enhancing the survival of wave, tidal, biomass, fuel cell and hydrogen technologies. Unsurprisingly, the effect was insignificant on conventional energy technologies, such as gas or coal, proposing that they are not encountering capital constraints. However, the author also found that the Phase I grant was not effective on biofuels or recycling technologies. The reason might be that while the two are perceived as green and clean, they are old and incumbent technologies. Therefore, in contrast to all clean technologies, the grant seems to create the highest impact on the most novel and immature technologies. (Howell 2017, 1155.) The financial effects of government certification on SMEs is addressed more profoundly in chapter 3.2.3.

3 SUBSIDIES IN THE COMPANY CONTEXT

A large and persistent obstacle for SMEs has been the inaccessibility and utilization of different financing options. Over 50 % of formal micro or SMEs are estimated to have difficulties obtaining finance, accumulating a shortage of 1–2 trillion dollars globally. Regardless of the more sophisticated financial system in the OECD area, SMEs' funding deficit is roughly estimated at 0.5 trillion dollars. This spread and financial barriers are suggested to be even more severe among innovative green SMEs. (Stein et al. 2013; Verdolini et al. 2018.) According to Verdolini et al. (2018, 4), access to finance and technology are equally important, considering improvements in eco-innovation. Moreover, subsidies from a respectable body might improve companies' legitimacy, further alleviating attracting resources for companies' disposal. These aforementioned concerns are addressed in the following subsections.

3.1 Capital constraints in high-tech SMEs

If the evidence indicates that, on the contrary to large enterprises with vast resources, SMEs are facing challenges acquiring finance from the markets, why not rely on internal funds instead of obtaining subsidies? The utilization of internal funds would be a decent option for traditional and conventional small firms, but not for rapidly growing highly innovative SMEs with insufficient internal finance or inadequate revenue to sustain its growth (Čučković & Vučković 2018). Revest and Sapio (2012) find this problematic since European technology-based small firms generally rely on internal finance, that is, retained earnings, when implementing new projects. Additionally, managers could be major owners and might find investing more private wealth as a too high risk for their personal economy. In the absence of internal finance, depending on the size and resources, SMEs can utilize external finance such as debt or equity. According to Myers and Majluf (1984), firms prioritize their funding sources, considering the capital cost. The approach and preference for financing, that is, pecking order theory, is presented in figure 5.

Although the pecking order theory is based initially on Donaldson's (1961) study of the financing methods of large enterprises, and the majority of research includes public enterprises, the theory is found to be valid in SMEs as well (Bartholdy et al. 2015; Zeidan et al. 2018; Tong & Serrasqueiro 2020). However, it is argued that pecking order theory is a complicated phenomenon that only partially applies (Sjögren and Zackrisson 2005) and poorly adjusts for growth companies with many intangible assets (Shyam-Sunders &

Myers 1999). Despite the contradictory evidence for SMEs, the pecking order theory in this chapter is applied as a tool to demonstrate and justify the need for a subsidy for highly innovative SMEs as well as to illustrate the deficiency of different financing sources.

Following the pecking order theory, the model in figure 5 suggests that firms prefer internal finance before issuing debt or raising equity due to the increasing cost of finance. As the managers are better informed of the firm than external financiers, the cost of capital rises in the presence of asymmetric information (Myers & Majluf 1984). In the lack or depletion of internal funds, the firm will first issue the safest and least costly security, that is, debt and subsequently hybrid instruments such as convertible bonds, before acquiring equity with higher costs. (Myers 1984). Nevertheless, issuing debt securities incurs costs and concerns primarily large enterprises. Hence bank loans would be more suitable for SMEs operating in a bank-oriented environment such as Europe. Interestingly, some SMEs are found to decline debt due to pride-related behaviour concerning borrowing. (Sjögren & Zackrisson 2005, 79, 93.)

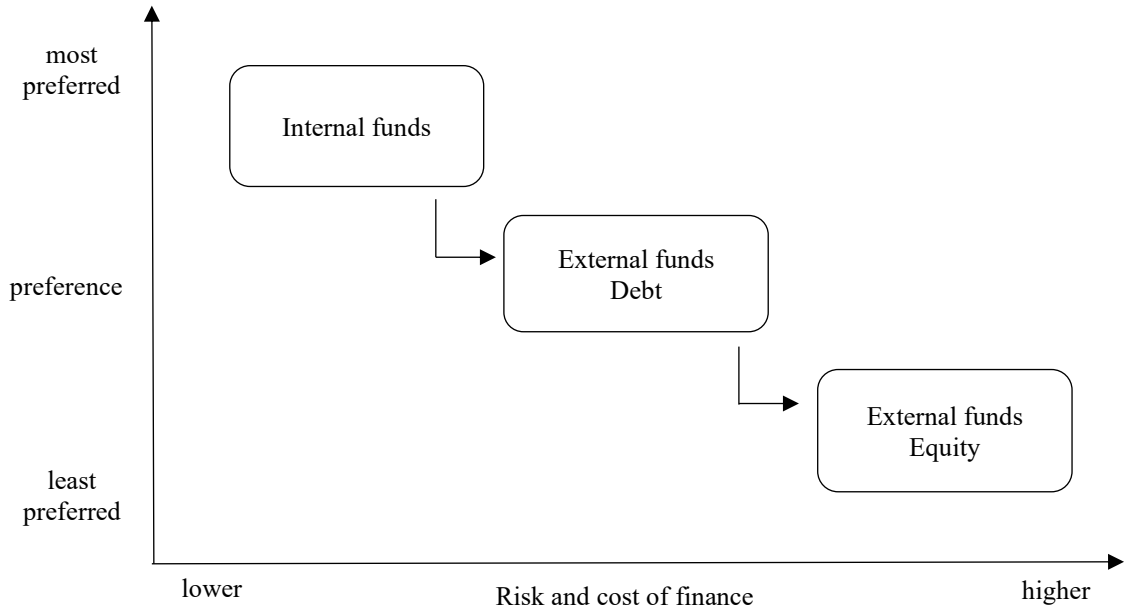

Figure 5 Pecking Order Model (Adapted from Myers & Majluf 1984)

Regardless of personal reasons, commercial banks might be reluctant to issue loans, particularly for green and innovative SMEs. According to Yang et al. (2019), renewable energy SMEs have the features of huge investment risk, long horizon on returns and obscure reimbursement sources. Banks may be cautious since alleviating information asymmetry is more challenging as the new technology could be too complex to understand, and technology-based SMEs display great possibility for default (Meuleman & De Maeseneire 2012). Moreover, banks emphasize the project's income stability and favors firms

with a large scale because servicing debt postulates a steady cash flow stream, which is unusual for innovative high-tech SMEs (Hall 2002; Wang & Wen 2016). The nature of resources in highly innovative SMEs is primarily intangible, such as human capital, which is not visible in the balance sheet and cannot act as collateral (Lerner 1999; Revest & Sapio 2012). Consequently, evaluation of prospective cash flows and profitability of R&D projects might be infeasible. Besides, banks could be unwilling to give loans as they are doubtful that SMEs would cross-finance other risky projects. However, raising the interest rate only creates moral hazard and will not bring equilibrium to the markets (Vas 2017).

Finally, as presented in figure 5, if the firm is not able to acquire loans, external equity is an option. Raising capital could be extremely costly (Lerner 1999) and is realized as a last resort. Although acquiring new equity in younger technology-based SME is more reasonable than in the large established enterprise, the dilution of ownership may not be an attractive alternative for SMEs. (Sjögren & Zackrisson 2005; Revest & Sapio 2012). The dilution might decrease SMEs owners' motivation and effort to thrive for success and in the presence of asymmetric information and rational investors, resulting in a higher premium for external equity. Verdolini et al. (2018) state that the lack of equity and capital investments into green SMEs are due to disclosure disputes and non-transparency, which makes the identification of proper opportunities extremely difficult. The effectiveness of more comprehensive disclosure, and thus reduction in asymmetric information, can be circumscribed in the presence of imitation threats on innovation (Hall 2002), although appropriate patent protection potentially mitigates the issue.

According to Spoz (2014), the empirical evidence supports pecking order theory in the EU, indicating that 92 % of SMEs finance their projects with internal funds, followed by bank loans as a second source. However, equity finance could be more suitable for high technology green SMEs than debt. First, the cost of debt capital might be too high due to the intangible nature of assets. Second, as Sjögren and Zackrisson (2005) indicate, high technology small firms prefer equity financing over debt. In their study, they found out SMEs rank VC as the most attractive source of external funds. Instead of addressing pecking order theory only in the perspective of financial resources, they praise the significance of competence defined as knowledge and skills of VCs at disposal for SMEs. (Sjögren & Zackrisson 2005, 81, 93.) Cressy and Olofsson (1997) found evidence that partly opposes these findings. They claim that albeit Swedish SMEs were cognizant that external equity investment, which relinquishes control to some extent, would enhance

survival, profit and performance, the SMEs did not perceive the offset as a sufficient tradeoff. In turn, the SMEs experienced debt as a suitable second alternative to internal funds. The effect was reversed among owners of the younger SMEs who emphasized equity investments as a 'package': the loss of control is tolerable if compensated by required management skills.

The specific industry concentrated knowledge might be one justification of why VCs are more willing to invest in high-risk technology-based SMEs than other private investors or risk-averse financial institutions. Besides, innovation is an uncertain activity; the evidence indicates that profits from innovations are highly skewed. The Pareto-like distribution of profits makes it difficult to utilize traditional evaluation techniques for SME investments. (Pisár et al. 2020, 122.) Hall (2002, 37) agrees that R&D projects which will not present positive expected value might be worth implementing despite the tiny possibility of enormous success due to unique characteristics of variance. According to Scherer (1998), the distribution of quasi-rents for drugs in the 1970s and 1980s provided similar results, as Pisar et al. (2020) and Hall (2002) express. He recognized that the best-performing drugs, consisting of a decile of the group, provided over 50% of the quasi-rents. The top-performing drug generated more than five times the average R&D costs of the sample group.

However, Čučković and Vučković (according to Wessner 2008) state that although VCs offer finance for emerging technologies at the development stage, they could still see SMEs as overly risky or insignificant, indicating the active role of the government. Hall (2002, 48) concurs, explaining that VC cannot solve all issues of innovation finance. The scale of investment could be too grand for SMEs, and VC has the propensity to concentrate on a small number of sectors over a certain period. The focus of VC finance on technology-based SMEs inside these specific sectors is even further concentrated as only 30 % of private R&D expenditures have attracted nearly 70 % of VC investments (Gans & Stern 2003, 362).

Despite the potential profits to be gained and investments in green technology, O'Rourke (2010) agrees and claims it continues to be challenging for green SMEs to receive VC funding. The characteristics of VC, primarily rapid accrual of returns, do not support the nature of green innovation. The issue is confirmed by Kenney (2011, 10, 13), who proposes that clean technology is less apt to offer outstanding profits underscoring the lack of events where clean technology company would have generated massive profits such as Google. Besides, he asserts that the interest of VCs concerning clean technology

is positively correlated with the oil price. Therefore, a low price of oil does not attract and incentivize investments for green alternatives as the returns might remain poor.

Although one could argue which external source of finance should be preferred over one another, overall, it still appears that the acquirement of alternative funding sources is a major issue for high-tech firms participating in the H2020 program. Over 90 % of the firms that decided not to advance with their H2020 projects stated they did not find alternative sources of funding for their project activities (European Commission 2017A).

3.2 Legitimacy theory and certification effect

3.2.1 Impact of legitimacy

New ventures frequently face difficulties obtaining resources due to the considerable uncertainty concerning the nature of the business and whether the firm is resolving a genuine need (Tolbert et al. 2011). According to the institutional theory, when a venture manages to demonstrate its operations are valuable or eligible for the industry, then the company can help mitigate uncertainty as a result of its newness and enhance accessibility to resources (Suchman, 1995; Zott & Huy, 2007). A way to overpower the liability of newness is to gain legitimacy, a social acceptance or appropriateness, which helps to encourage investors and signals that the firm conforms to widely accepted values, norms and rules. The signal indicates it is appropriate to invest in the new firm regardless of the prevailing uncertainty of future performance. (Zimmerman & Zeitz 2002, 416–417.)

Zimmerman and Zeitz (2002) and Sine et al. (2007) state legitimacy should be seen as a valuable resource itself as well as a means for obtaining other equally essential resources for new ventures, such as top managers, highly competent and talented employees, capital, technology, customer goodwill, networks and public subsidies. Despite the importance of legitimacy, it has not transferable financial value. Thus, it is not eligible to be reckoned precisely as an asset for a firm. Due to its intangible nature, multiple new ventures might not recognize that they have achieved legitimacy. (Nagy et al. 2017.) The relationship between legitimacy, resource and growth are particularly essential for new ventures searching for resources as they usually have little to none previous commercial activities on which the owners of the resources could compare them. Following Zimmerman and Zeitz (2002), legitimacy is perceived as a critical component for young ventures' prosperity (Starr & MacMillan 1990).

Usually, legitimacy is addressed retroactively, indicating that the existence of the firm suggests the presence of legitimacy. Nevertheless, examining the survival of novel ventures retroactively does not enlighten how the novel ventures obtain legitimacy in order to remain in the market. In the ever-changing environment of the novel ventures where the failure rate is relatively high during the first years of activity, the concentration on the role of legitimacy should not be at the profit level as multiple novel ventures never make that level. (Zimmerman & Zeitz, 2002, 414.)

Contrarily to the novel ventures that aspire endorsements from trustworthy stakeholders to overpower the liability of newness to improve financing options, public recognition and legitimacy (Lounsbury & Glynn 2001), an organisation is evaluated by society as suitable partially due to its previous performance. Generally, capitalist institutions like sound business companies fulfil public expectations about contemporary society. They do not face controversial questions regarding legitimacy because inside a capitalist system, economic institutions and procedures have become routinised and approved (Scherer et al. 2013). Therefore, it is less troublesome for mature organisations and established firms to acquire resources due to their already accumulated legitimacy and proven track record (Zimmerman & Zeitz 2002, 417).

However, in the absence of excessive resources, the industry itself might provide legitimacy for the novel ventures. According to Suchman (1995), the amount of legitimacy varies among industries, and it is possible to confer it upon the companies functioning in them. The differing degrees of legitimacy among industries are affected by the collective activities of the industry actors. For instance, Exxon's oil spill on the coast of Alaska damaged the reputation of the whole oil industry in 1989, and the chemical industry has been challenged by environmental groups affecting the level of legitimacy. Nevertheless, multiple long-standing and conventional industries have a high degree of legitimacy, such as medicine and banking. (Zimmerman & Zeitz, 2002, 421.) Additionally, Deeds et al. (2004) emphasise the importance and the problematic nature of the process of legitimation in novel technologies, such as renewable energy. Obtaining legitimacy is suggested as especially troublesome in energy and transport sectors where prevailing technologies and organisations have been operating multiple decades, ensuring and strengthening their accepted statuses as well as protecting their directly and indirectly subsidised investments (Bergek et al. 2008, 581).

Occasionally comparatively new industries may be perceived as the industries of the future, the most recent example being the IT industry in the U.S. during the dot.com period. The IT industry was able to obtain a high degree of legitimacy, possibly because it was recognised as coherent with values appreciated in the U.S., that is, innovation, progress and future orientation. A novel venture related to the IT industry was inevitably evaluated as suitable for support in the form of capital, managers or networks. (Zimmerman & Zeitz, 2002, 421.) Considering the financial performance metrics, namely the P/E ratio, which measures share price to its earnings, in the IT industry, it is rational to assume the support that the IT industry obtained was based on legitimacy instead of purely economic factors (Zimmerman & Zeitz 2002, 421).

In turn, a relatively new industry might not contribute enough legitimacy for firms due to a lack of history and strong existing standards or new methods (Aldrich & Fiol, 1994). Bergek et al. (2008) and Zimmerman and Zeitz (2002) concur and state that the novel venture in a new industry needs to see extra effort to develop its legitimacy as there does not exist much knowledge about the industry, recognition of actors in the industry is low, and the continuance of the industry is uncertain. According to McKnight and Zietsma (2018, 495–496), in a new disruptive industry such as cleantech, new ventures are not only facing challenges against other cleantech ventures but with legitimised, market and political power exerting incumbent firms as well. The literature recognises that when new ventures are contingent on resources from well-established companies, they face issues obtaining legitimacy.

Ansari et al. (2016) present a 'disruptor's dilemma' implying that young entrants encounter dependence on incumbents while trying to take their products to market. For instance, cleantech ventures operating with energy conservation or generation technologies need to request permission to gain access and connect to incumbents' grid or persuade fossil fuel companies to include biofuel in their traditional fuels (McKnight and Zietsma 2018, 495).

Furthermore, radical technologies might pose severe legitimacy challenges since it is rather demanding for audiences to comprehend these technologies (Ansari et al. 2016). Aldrich and Fiol (1994) propose that within emerging industries, innovative ventures ought to collaborate to legitimatize the industry. However, after the ventures have crossed a legitimacy threshold level, McKnight and Zietsma (2018) suggest the ventures should differentiate as much as they can.

New ventures struggling with legitimacy issues due to liability of newness are also very likely later at some point to encounter similar challenge than established multinational enterprises operating in a foreign environment, namely liability of foreignness. Even though the well-established large companies from developed countries may benefit due to their western originality in emerging economies, these companies should contemplate the significance of legitimacy cautiously because their presence and business activities might be questioned in detail as opposed to their domestic market. (Ahlstrom & Bruton, 2001.) Miller and Parkhe (2002) concur and add that liability of foreignness is a result of inequitable and discriminatory actions performed by the host country's firms, institutions and consumers.

To reduce the issues of discriminatory acts by the local audience, companies from overseas must obtain and preserve legitimacy in the foreign setting. However, this is more difficult in emerging economies than in advanced countries primarily due to a lack of history between developing economies and private companies, changing and evolving institutions in transition economies and relatively firm and unforeseeable influence of the government. Considering the active intervention of the government, gaining political legitimacy is crucial for foreign companies. (Zhang et al. 2019, 253–254.) Therefore, multiple variables influence gaining legitimacy, especially for a new venture, affecting the degree of legitimacy threshold.

3.2.2 Legitimacy threshold and multiple stakeholders

In the literature, researchers have addressed the notion of legitimacy in organisations as dichotomous by positing that either the organisation is legitimate or it is not, although legitimacy should be perceived as a changing variable through time. (Aldrich, 1995.) In other words, an organisation's legitimacy is not static but instead could vary from low to high. However, legitimacy cannot be precisely observed or measured. Eventually, legitimacy is perceived differently within stakeholders who might address and reflect it unconsciously in their decision making (Zimmerman & Zeitz 2002, 418.): financial groups assess the future value of the company, customers might focus on opinions from skilled professionals, and the government could be interested in following prevailing norms and laws (Rutherford et al. 2016). As a bilateral concept, legitimacy is best comprehended by studying both entrepreneur and stakeholder (Nagy et al. 2017, 51). Considering knowledge, effort and time constraints of multiple stakeholders, the evaluation, interpretations and perceptions of legitimacy might include heuristics (Stevens et al. 2016).

Zimmerman & Zeitz (2002, 427) propose that a particular 'legitimacy threshold' exists where ventures beneath the threshold fight for survival and possibly disappears. In contrast, ventures above can acquire additional legitimacy benefits and resources. This concept is illustrated in figure 6. The existence of the legitimacy threshold among new ventures is widely approved and further elaborated by Fisher et al. (2016). Eventually, the failed new venture is not capable of obtaining the right and relevant types of legitimacy to survive, falling below the threshold and perish.

On the other hand, the other new venture that will initially thrive attains slightly more legitimacy than the failing venture. Nevertheless, the amount of legitimacy obtained will be sufficient to exceed the threshold. Difficulty in crossing the legitimacy threshold varies and is contingent on a venture's context, such as institutional elements and venture-specific resource components (Oliver, 1991).

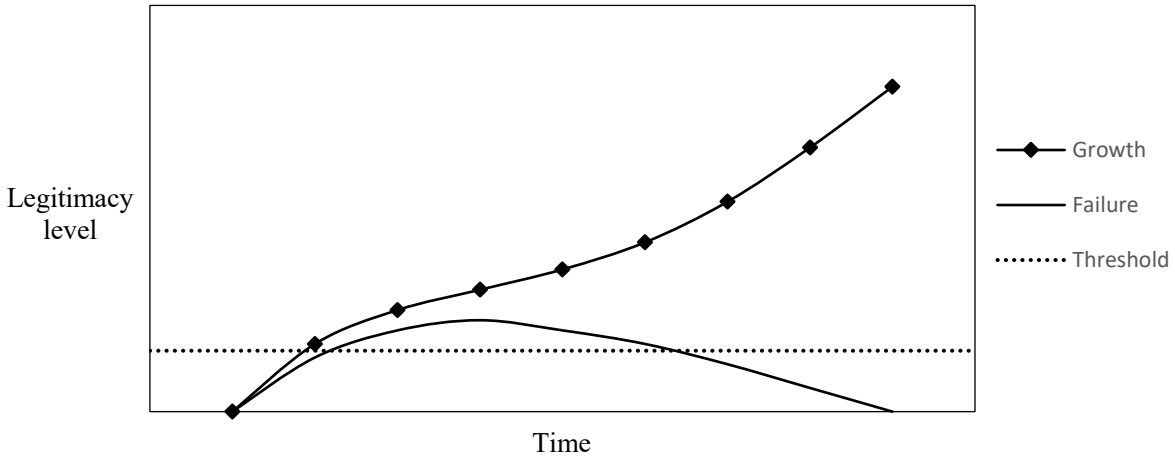

Figure 6 Legitimacy threshold (Adapted from Zimmerman & Zeitz 2002)

To increase the level of legitimacy above the threshold in figure 6, the firm should satisfy different types of legitimacy such as regulatory, normative and cognitive. Regulatory legitimacy addresses conformity with laws and regulations. Normative legitimacy refers to complying with commonly accepted beliefs and values in society, whereas cognitive legitimacy can be associated with how a firm is perceived, comprehended or taken for granted. (Markard et al. 2016, 331.) However, it might be beneficial to add these sources of legitimacy in a particular order since legitimacy obtained from less identified sources will be most valuable when added subsequently to more recognised sources of legitimacy. Additionally, a new venture can increase its legitimacy by utilising creation,

manipulation, selection and conformance strategies simultaneously or successively, depending on the circumstances. (Zimmerman & Zeitz 2002, 426–427.)

Eventually, as figure 6 illustrates, the notion of legitimacy threshold comprises the dichotomous and continuous perspectives. Put differently, the firm either has or has not gained legitimacy, demonstrated as a base level, that is, the threshold. Also, the firm might strategically and continuously try to increase its legitimacy level to access the required resources to expand its activities. (Zimmerman and Zeitz, 2002, 428.) Scholars have pursued to accurately estimate, develop and quantify the legitimacy threshold level by utilising models and interviews. For example, Rutherford and Buller (2007) interviewed entrepreneurs to find out whether they have perceived a particular legitimacy threshold in the venture's existence and their different experiences before and after surpassing the threshold. The results expressed multiple methods managers perform both before and after acquiring legitimacy but, on the contrary, no single activity or organisational instance that could indicate the achievement of legitimacy.

Multiple legitimacy thresholds

Extending Zimmerman and Zeitz's (2002) construct of legitimacy threshold, Fisher et al. (2016) propose multiple legitimacy thresholds when considering the heterogeneity of different stakeholders. Because these stakeholders change eventually over the years and various stakeholders have different institutional habits, the standards and criteria to evaluate legitimacy ought to change uniformly as well. Moreover, since expectations and thus, the degree of perceived legitimacy towards a venture becomes gradually more demanding as the venture evolves, the venture will be evaluated against increasingly matured firms (Boeker & Wiltbank 2005). As a result, Fisher et al. (2016, 394) posit that the criteria for legitimacy might both vary in comparison to ventures in the initial phases of development as well as become further rigorous when the venture matures and expands. The updated concept of venture legitimacy is presented in figure 7.

Identifying organisational life cycles Kazanjian (1988) proposes a specific model for technology-based ventures dividing the stages to conception, commercialisation, growth and stability. For new ventures pursuing to acquire legitimacy, the first three stages are relevant, the last being appropriate for established firms and hence is not further elaborated. At the conception stage, the focus is on development or technical issues, while the cooperative action is primarily with a university or a research institution. In addition to

university funds, technological research at the conception stage attracts funding from government grants such as from the SBIR program. Thereby, the audience who is judging the legitimacy consists also of governmental grant officials. The main objective of resource providers at this stage is to assist in long-term technological advancements which improve the welfare of the entire society rather than emphasising commercial success. Due to the highest degree of technological and economic uncertainty in the three stages and the lack of concrete performance measures, such as turnover or cash flow, the venture could resort to symbolic mechanisms which are easier to comprehend, for instance, public certifications such as subsidies. (Fisher et al. 2016, 389–391.)

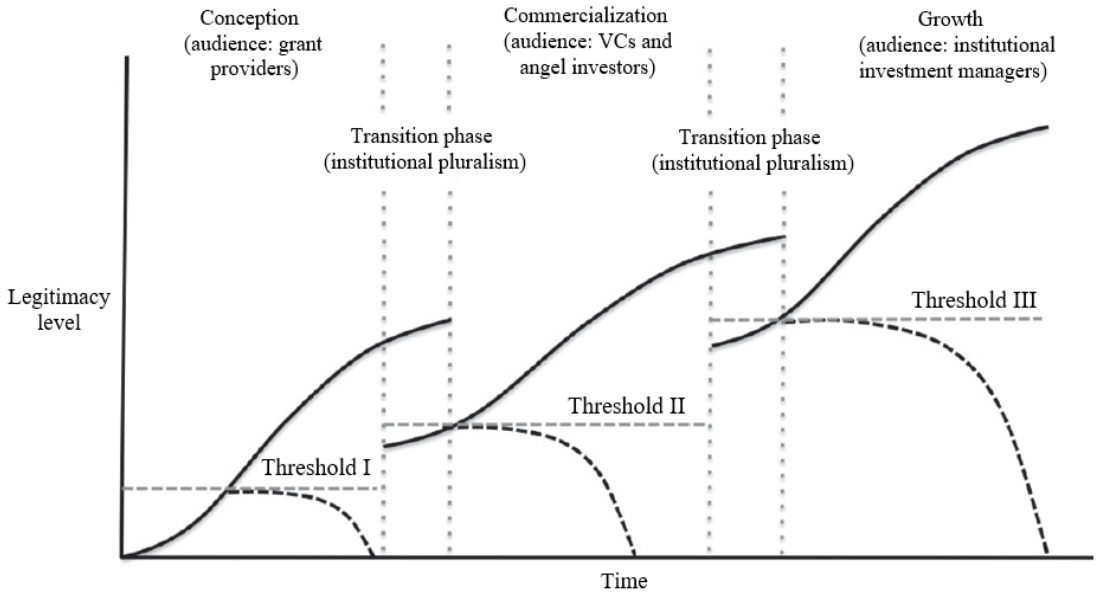

Figure 7 Revised concept of venture legitimacy over time (Adapted from Fisher et al. (2016)

As figure 7 illustrates, a new venture will advance to the commercialisation stage, where it has been able to solve technical issues and reduce the risk of its products. In turn, the government urges the ventures to acquire funding from private sources. Therefore, attention focuses, for instance, on VCs and angel investors. However, the objective and investment time horizon of VCs deviate from the government. As the government seeks high spillovers and long-term horizon, VCs prefer the highest economic rents in the medium-term. At the commercialisation stage, the legitimacy judgements are reflected on perceived market potential, demonstrated technological advancements and remarkable venture achievements acknowledged by a third party (Fisher et al. 2016, 390–391), for instance, innovation award or competitive public subsidy like the H2020.

Despite the reduction in the level of uncertainty compared to the conception stage, Hallen (2008) argues that the applied symbolic affiliations to enhance the perception of legitimacy appears to change from intangible to tangible measures. Hallen and Eisenhardt (2012, 46) outline how a venture is effectively capable of expressing legitimacy for securing capital from VCs by arranging the funding round near verifiable 'proofpoints', which they define as a favourable signal of remarkable venture achievement of a significant milestone corroborated by key external actors.

Considering milestones are confirmed by external bodies, proofpoints are regarded as especially plausible and challenging-to-falsify measures. Therefore, they serve as robust signals of information, presumably attracting possible partners. (Hallen & Eisenhardt, 2012, 48.) However, to maximise the strength of the signal, the proofpoint should be relatively recent to be more effective. Individuals overemphasise recency (De Bondt & Thaler 1985), and possible partners exaggerate the quality of achievements on the grounds of immediacy and disregard distant or accumulated accomplishments (Hallen & Eisenhardt 2012, 48). Therefore, a fresh proofpoint indicates a compelling signal.

Nevertheless, entrepreneurs and managers identify challenges while trying to time around proofpoints. The recognition of resource necessity in uncertain markets in the future is difficult. Although delaying does not demand foresight, it usually entails tribulation, such as sacrificing compensation, thus, hampering activities and threatening morale. Altogether it obliges a thorough connection and recognition of venture achievements and the needs for resources to time around proofpoints. (Hallen & Eisenhardt, 2012, 48.)

The last of the three legitimacy threshold stages in figure 7 is the growth stage, where the venture needs to increase the number of employees, focus on the level of production costs, and serve increasing customer pool in the market (Kazanjian 1988, 264–265). According to Fisher et al. (2016, 392–393), ventures are trying to broaden the audience to obtain financial resources, mainly including institutional investors, before the stock possibly becomes publicly available. At this stage, risks in the market and technology are remarkably mitigated. The criteria to evaluate a venture's legitimacy is on economic performance, and the significance of symbolic affiliations becomes less important because the performance of managers among institutional investors is measured by short-term financial profits.

Although all three stages have different stakeholders with diverse objectives, stakeholder theory suggests that not a single stakeholder should be ignored or dismissed over another. Otherwise, the venture might risk damaging the normative acceptance resulting

in controversial legitimacy and impairing its intangible resources since every legitimate stakeholder's interest have intrinsic value. (Jones & Wicks, 1999, 207.)

Legitimacy buffer and threshold transition

After recognising and introducing multiple legitimacy thresholds in figure 7, Fisher et al. (2016) specify factors that affect the venture's efforts to surpass these thresholds, primarily institutional pluralism and legitimacy buffering. Institutional pluralism occurs when a venture is transitioning from a stage to another and, at the same time, appeals to two different stakeholder groups. Therefore, if a venture has activities in several institutional realms and institutions are comprehended as 'rules of the game', then the venture is playing two games simultaneously. This occurrence naturally creates challenges. Fisher et al. (2016) present an example where Powell & Sandholtz (2012) explain how at the conception stage, a disclosure of crucial scientific information and results in a quality journal might be perceived as suitable from government's and grant providers' perspectives. However, VCs may see this as undesirable in light of patent protection or endangerment of competitive advantage.

Legitimacy buffer can serve as an essential asset since, once accumulated, it can draw several resources, namely stakeholders as well as financial and human capital. Besides, a venture may amass a good reputation and positive perceptions that occasionally enables deviation from the status quo or jointly accepted social norms without disturbing its position in the market. (Suchman 1995.) Therefore Fisher et al. (2016, 399) suggest that a positive legitimacy gained in one institutional sphere allows a venture more room to manoeuvre, that is, utilise a buffer, and veer from socially accepted norms in the new sphere.

The legitimacy buffer that a venture can leverage could be obtained from various sources, including the prestige of founders and managers, the venture's past accomplishments or the respectable and well-known reputation of existing resource providers at earlier stages (Fisher et al. 2016, 399). The legitimacy accrued by a venture's prior achievements can be a result of awards and certifications from competitions (Hallen & Eisdenhardt 2012, 48), which may deliver advantages during later activities. In turn, Rutherford et al. (2016, 757) express a 'bandwagon effect' where a new venture has been able to attain early legitimacy from a few crucial stakeholders signalling to others credibility and trustworthiness, thus attracting even more interest.

Which of the external stakeholders are the most challenging to convince and thus gain legitimacy to surpass the threshold and advance to another stage? Although it depends on the persons making the judgements and situational context, Ardichvili et al. (2003) posit that it is the most difficult to gain legitimacy from financier stakeholder groups, such as VCs. Financiers are the most probable group of conducting scrupulous due diligence because if the venture underachieves, it will not only impair the viability of the financier but also the reputation and future endeavours. Moreover, the illiquid nature of the investment, that is, a binding debt agreement relationship or an ownership interest, which are both problematic to repeal, emphasise the detailed examination. Rutherford et al. (2016, 773) verify that after a new venture has obtained approval and legitimacy from financier stakeholders, it has achieved crucial progress in its development.

In search of financial legitimacy threshold in emerging ventures, Rutherford et al. (2016, 771) discovered that new ventures are eventually on the verge of gaining financial legitimacy and hence, reducing the liability of newness, while being 12 years old, employing six workers and having sales of approximately 380 000 dollars. Even though it could seem bizarre that a company needs to have 12 years of activity to offset the liability of newness, existing literature proves this to be correct considering that social connections and intellectual assets, which helps to gain legitimacy, usually take more than a decade to create. Nevertheless, naturally these figures are not absolute indicators as the numbers might vary according to the nature of the markets, industry and its competitiveness, geographic area and the choices of the entrepreneurs (Rutherford et al. 2016, 773).

Overall, even though resources are an extensive construct containing both tangible and intangible properties, resources acquired from public stakeholders ought to provide a competitive advantage or possibly more turnover (Peng 2004). Given that resources limit a new venture, it should leverage legitimacy-increasing activities with minimum to no expenses, for instance, certifications. If a new venture is capable of doing this, it might surpass a particular legitimacy threshold and gain access to necessary resources. (Zimmerman & Zeitz, 2002, 417.) Especially at earlier stages in the venture's life cycle, when there does not probably exist evident production processes or a proven record of performance, certification might enable a venture to achieve the pursued threshold by demonstrating technical and commercial quality and function as a concrete proof of compliance with existing rules and norms (Sine et al. 2007; Lanahan & Armanios, 2018). Supporting Zimmerman and Zeitz (2002), Ullah et al. (2014) address that since certification is not

granted without effort, and ventures need to invest considerable time and energy to persuade officials (Rao 1994), costs will be incurred. Therefore, certification can be realised as a strategic action to obtain legitimacy and perhaps competitive advantage.

3.2.3 Certification as a legitimation and resource acquisition strategy

In Suchman's (1995, 572) extensive article of legitimacy, he addresses strategic legitimating actions whereupon enterprises "instrumentally manipulate and deploy evocative symbols in order to garner societal support". According to Sine et al. (2007, 578), acquiring endorsements from core institutional parties is an example of strategic legitimating action. The vast existing literature supports these statements by concurring that acquiring certification is a strategic action and as well an essential way for firms to attain legitimacy (Zimmerman & Zeitz 2002; Zott & Huy 2007; Fisher et al. 2016; Lanahan & Armanios 2018; Liu & Wang 2019; Zhang et al. 2019). In conclusion, the quality ‘stamp’ or ‘label’ of certification may serve as a symbol of legitimisation, increasing the trust of stakeholders in doubt and hence improves the possibilities of a venture to acquire necessary resources.

Sine et al. (2007, 578) define certification as "a process in which a central institutional actor with authority or status formally acknowledges that a venture meets a particular standard". Nevertheless, on various occasions, separate constituents are recognised to have differing criteria for a particular standard (Marquis & Lounsbury 2007). In such a case, King et al. (2005) address that certification could still be beneficial by unveiling evidence of otherwise concealed firm-specific characteristics. According to Sine et al. (2007, 579), this argumentation proposes that the benefit a certification enables is essentially derived from its capability to supply information regarding the firm's traits which in other cases might be challenging to notice. In fact, on any occasion when asymmetric information is present, financiers pay attention to signals prior to any investment decisions as to the recognition of potential or quality between high- and low-level investments could be challenging and, in some instances, even impossible (Davila et al. 2003). Despite the information value that the certification can provide, Zott and Huy (2007) suggest that there exists considerable symbolic value as well, which is not contingent on its information content.

Research conducted in the Western markets, such as Meuleman and De Maeseneire's (2012), proposes that when SMEs can succeed in governmental R&D programs, they earn

certification and hence improve their access to different capital options. An essential objective of this type of governmental recognition is to leverage private resources utilising a certification effect and thus to assist SMEs, for instance, to obtain bank credit instead of pouring public funds into them. Naturally, on multiple occasions, public R&D subsidies provide only partial coverage for firms' R&D funding requirements and, thus, create an automatic need for additional funding. Therefore, firms might have to apply for bank loans or attract VC investments (Wang & Wen 2016). Besides the access to private capital, essential features of certification effect for SMEs primarily include confirming the high quality of the firm and mitigating an imbalance in information without adding proprietary costs as SMEs need to disclose business details (Li et al. 2019, 242).

As a strategic legitimising action, how has the acquisition of government R&D subsidies and thus the certifying effect affected high-tech SMEs? Although the literature often addresses financial benefits and effects on public aid for R&D, some non-monetary impacts occur as well. A receipt of public R&D subsidy may have a positive impact on how stakeholders perceive the SME in other areas as well, that is, indicating a halo effect. Sine et al. (2007) concur and express that certification alleviates the acquisition of resources in several fields. Roper and Hewitt-Dundas (2016) purport that R&D subsidy from the government might trigger a halo effect by improving the reputation of an SME, enabling cooperation and result sharing in R&D. This is supported by Lerner (1999, 313) and Cassiman and Veugelers (2002) who found that public aid for R&D may enhance the capability to absorb external knowledge, for instance, attract talented human capital such as top-quality managers.

The financial effect of certification

Table 1 presents 11 relatively recent studies which express the certification effect of public R&D and government subsidies primarily on SMEs' resource acquisition. The studies are virtually unanimous, confirming the positive certification effect of public R&D on high-tech SMEs. According to Li et al. (2019, 242), the mobilization and leverage of private capital are evident as the amount of government R&D subsidies is far less than the afterwards acquired private resources such as bank loans. For example, the Chinese Troch Program in 2012 awarded R&D subsidies for high-tech SMEs worth approximately 300 million U.S. dollars. In contrast, ensuing private investments, primarily bank finance, totalled almost nine billion U.S. dollars, indicating a leverage ratio of 30.

A convenient way to examine has the government certification improved access to external funds and reduced the amount of information asymmetry by verifying the quality of an SME is to observe banks' behaviour. From the view of banks, SMEs acquiring long-term debt have a higher risk of failing to meet their obligations and are more subject to moral hazard. When the banks lend long-term debt for SMEs, they might face issues with loss of control as there could be a lack of regular inspections, especially if the loan is repaid in full in one instalment at the end of the loan period. In turn, shareholders can prefer the firm to undertake riskier investment opportunities as they are entirely entitled to the profits from these investments after the principal and interest are paid back to the debtholders. In the case of unsuccessful investments and company insolvency, the shareholders are not liable for the company's debts. (Wang & Wen 2016; Bellucci et al. 2019.)

Thus, it might not be the banks' interest to lend long-term debt for the risky SMEs, although borrowers would like to refinance as much as possible at once to keep the control to themselves. Therefore, short-term debt facilitates the conflict of interest between shareholders and debtholders. Short-term debt ensures that the SMEs strive to stay financially fit and of good quality to secure future bank funding. Moreover, short-term debt might include fewer covenants and a lower interest rate for SMEs compared to long-term debt. On the other hand, short-term debt enables tighter and more frequent control over SMEs by offering an alternative for the banks to stop lending as well as revealing information about the SMEs annually. (Diamond 1991; 1993.)

Multiple authors have recognized how government certification can, in fact, rebalance SMEs' debt structure favouring long-term debt over short-term (Meuleman & De Maeseneire 2012; Martí & Quas 2018; Bellucci et al. 2019), indicating a quality certification and reduction in information asymmetry. Meuleman and De Maeseneire (2012) present that acquiring R&D subsidy alleviates access for equity financing as well, yet the effect of the certification is more significant on debt than external equity. This is because, in informationally opaque high-tech SMEs, equity is usually raised from existing shareholders who are not subject to asymmetric information to the same extent as outside stakeholders. Although, on the other hand, some risk-averse banks adhere to conservative strategies and find long-term debt too risky, even when the SME is government certified (Wang & Wen 2016).

Table 1 Studies of certification effects on SMEs resource acquisition

Author(s)	Results	Data sample and method
Lerner (1999)	Government R&D subsidies played an important role in certifying firm quality, and the SBIR awardees were four times more likely to attract VC financing. The superior performance was pronounced in high-tech industries, yet multiple awards did not increase performance	541 awardees and 894 matching U.S. SMEs. Multiple regressions, OLS
Meuleman & De Maeseneire (2012)	R&D subsidy provides a positive signal about SME quality and results in better access to long-term debt. The certifying nature creates an even stronger signal for start-up SMEs, providing a positive effect on external equity finance	1608 Belgian SMEs' projects. Regression analysis, conditional fixed effect logit model
Guerini & Quas (2016)	Receipt of government-managed VC remarkably enhances high-tech entrepreneurial firms' probability to receive private VC – in the 1st round three times more likely and in the 2nd round more likely than in other VC investments	183 funded and a control group of 8094 unfunded European firms in seven countries. Regression model, semi-parametric Cox and logit model
Galope (2016)	No evidence of significant certification effect of SBIR award on follow-up investment. Different effect – awardees more likely to attract external patents	Over 4000 U.S. small firms. Regression analysis, propensity score matching
Howell (2017)	R&D grant generates over twice as many VC deals and investments in dollars as well as improves, even more, all other private financing options for small high-tech energy firms. The grant has larger effects on immature technologies compared to all clean technologies	7436 U.S. small firms. Regression discontinuity design, OLS
Hottenrott et al. (2018)	Receipt of public grants increases the likelihood of new ventures acquiring bank financing as well as raising a higher volume of debt. The certification effect is stronger among young high-tech and knowledge-intensive firms in more information-opaque sectors	2745 German start-ups. Probit and Tobit regression models
Islam et al. (2018)	Early-stage start-ups in the U.S. clean energy sector are 12 % more likely to benefit from follow-on VC funding after receiving the government research grant. The positive effect decays after half a year	256 U.S. start-ups. Logistic regression, propensity score analysis
Lanahan & Armanios (2018)	Certification broadening generally increases a firm's ability to acquire private resources, whereas certification redundancy normally decreases the effect	736 U.S. small firms. Regressions, OLS, DD model
Martí & Quas (2018)	Participative loans from the government improve high-tech SME's access to external financial debt by 31.5 %. The certification effect is negligible for firms that were already certified and supported by another government agency, whereas VC backing had no such redundant impact.	488 and a control group of 719 Spanish SMEs. Probit regression model
Bellucci et al. (2019)	Regional R&D subsidies for innovation investments facilitate the change in firms' debt structure. Subsidized firms decreased short-term debt and increased long-term debt by at least 18 %, while the reduction in the average cost of debt ranged from 1.9 to 3.3 percentage points.	176 and a control group of 5127 Italian SMEs. Propensity score matching, DID and Kernel nonparametric estimators
Li et al. (2019)	Obtaining R&D subsidies has a positive certification effect on the acquisition of both short- and long-term bank loans in entrepreneurial (primarily SMEs) innovative firms. The effect is more profound in unlisted firms as well as in areas where IPR protection is weak	549 listed and 192 unlisted Chinese entrepreneurial firms. Fixed effect logit panel model, regressions

In addition to rebalancing the debt structure, Martí and Quas (2018) discovered that the SMEs operating in a high-technology sector were able to increase their financial debt remarkably, far exceeding the amount of the original loan itself. Moreover, they recognised that receiving a loan from the government enabled SMEs to raise their collaterals' value, further alleviating access to financial debt.

Table 1 also present studies that indicate how government certification can affect positively both the volume and cost of debt, particularly in informationally opaque sectors (Hottenrott et al. 2018; Bellucci et al. 2019). As a government subsidy certifies the quality

of a high-tech SME, the risk and the cost of information acquisition is lower for financiers, which is reflected in the cost of debt. Moreover, while the perceived risk is lower, banks might be more willing to lend a higher volume of debt. On the other hand, as the subsidy covers a certain share of the total cost of SME's project, the need and the amount of external debt could be lower, thus reducing the bank's risk and interest rate, respectively.

Li et al. (2019) support the findings of Hottenrott et al. (2018) and identify the positive but even stronger effect on the reduction of asymmetric information between banks and unlisted innovative SMEs in areas where intellectual property rights (IPR) protection is insufficient. The correlation between the positive certification effect and weak IPR protection might be a result of the high proprietary cost of information disclosure for SMEs. The more beneficial effect for unlisted SMEs in comparison with listed can be explained by the fact that listed firms must comply with rigorous listing rules and reporting for which banks are accustomed to.

It is also worth noting that VC certification can have similar effects on high-tech SMEs' debt finance regardless of whether the VC funding is acquired from the private sector or from the government (Guerini & Quas 2016; Wu & Xu 2020). In the public sector, the certification effect could be even stronger on governmental VC than on typical R&D subsidies for SMEs because governmental VC might have a temptation to select beneficiaries that can primarily provide upcoming large returns (Guerini & Quas 2016, 179). On the contrary, generally, R&D subsidies are gratuitous grants with no strict private monetary interest.

Although Howell (2017) and Islam et al. (2018) found the government certification to leverage VC funding substantially for clean, high-tech energy SMEs, the positive effect is not as unequivocal as it might appear. The effect on follow-up VC funding is recognized to diminish relatively quickly as financiers tend to emphasize immediacy and recency (Hallen & Eisenhardt 2012; Howell 2017; Islam et al. 2018). In other words, the value of the information is reduced over time as circumstances change. For instance, Janney and Folta (2006) realized that the underpinning value of a signal at one specific moment might impair if the presumptions under which the signal was evaluated have altered. Therefore, as the information loses its recency and becomes more or less outdated, it could have no longer importance in decision making. Moreover, Lerner (1999) discovered large positive effects on high-tech SBIR awardees, particularly in regions such as

Massachusetts or California, where VC activity is significant. Naturally, VCs might prefer to invest in high-tech ventures in these regional clusters as the firms are not dispersed, lowering the monitoring cost, and VCs could have a better knowledge of local firms.

Conversely to Lerner (1999), Galope (2016) did not detect any substantial halo or certification effect on SBIR awardees concerning external finance irrespective of the source. Instead, he recognised a phenomenon described as a different certification effect, where SBIR awardees had a greater likelihood to capture external patents. The reasoning behind this argument is that the original holders of the patents might be more eager to license their intangible assets for SBIR awardees who, in turn, are perceived to thrive and generate more innovation by utilising these patents and thus, providing a stable income stream (Galope 2016, 379).

As research indicates, an early-stage grant can mitigate capital constraints for high-tech subsidy beneficiaries through two mechanisms: certification or funding. Interestingly, Howell (2017) realized that while the government SBIR award embodies information value about SMEs credentials, it probably does not explain the effect of the grant. The latter mechanism, funding, can be further divided into two channels, that is equity and prototyping. The money does not only enable the entrepreneur to preserve a higher equity stake in the SME and thus create incentives for more innovative activities but allows demonstrations and proof-of-concept prototyping as well. The prototyping channel is critical as it provides a concrete mean to develop the technology and reduce uncertainty regarding the product instead of a governmental guarantee of firm quality that would mitigate information asymmetry.

Multiple accomplished partners, VCs and angel investors confirm and support the view. Howell (2017) conducted thirty interviews with highly experienced private equity financiers who perceived that the SBIR grant itself has little to no information value and consider it completely immaterial. Surprisingly, the grantees shared a similar view with the investors as the former thought the grant does not reflect the value of their technology.

Multiple certifications and certifiers

As table 1 expresses an almost uniform positive certification effect on funding, an essential question concerning certification effect on SMEs is, does more certification generate additional benefits and provide even more legitimacy? In institutional theory exists a presumption that additional certifications enhance a firm's possibility to succeed (Lanahan

& Armanios 2016, 931). Research results indicate that firms obtaining more certifications by winning awards through competitions have a greater survival rate (Rao 1994), thus positing amplifying cumulative effect on additional certifications.

Nevertheless, Lerner (1999) and Dineen and Allen (2016) present evidence of sharply decreasing marginal value and statistical insignificance of multiple certifications and awards. Concurrently the cost of striving for additional certifications increases as the focus of managers are diverted from other business activities. In addition, the pursuit for these awards could present further distortions when the size or quantity of subsidies grow. As a consequence, firms that have obtained several grants previously have a higher likelihood to be under scrutiny, thus further distracting management from core operations. (Lerner 1999.)

Despite the ambivalent results of additional certification effects, Lanahan and Armanios (2016) and Martí and Quas (2018) observed that the acquisition of private resources is improved by certification broadening and decreased by certification redundancy. Both studies also assert that under some circumstances, additional certification might be counterproductive for the firm. This argument is based on both who is certifying and what information is disclosed. As King et al. (2005) expressed that certification reveals otherwise hidden information, the value of that information might not be equal. When the receipt of additional certification is from another institution than the original certifier, the unveiled information is more of value due to its novelty compared to the previous certification. For instance, while the government praises the technical merits of innovations, this might not be sufficient for scientific industries where commercial viability is crucial as well.

In other words, obtaining additional comparable certification may indicate that there does not exist a consensus among constituents regarding the firm's future potential in different fields of activities (Lanahan & Armanios 2016, 933–934). Martí and Quas (2018) and Pollock et al. (2010) concur by observing that several certifications from resembling actors do not give extra benefit and provide decreasing positive effects on investor's analysis of firm characteristics. Besides, Pollock et al. (2010) support and propose that certifications from other institutional agents reconcile one another.

Utilising VCs as a target audience, Lanahan and Armanios (2016) recognised that excess certifications lead to a lower probability to invest in SMEs. However, in the event of investment, VCs tend to reduce the risk of failure by injecting less money into these SMEs. For certification broadening, the authors found the opposite effect to be true in

both instances. As some SMEs aspire to pursue, in some cases repeatedly, multiple subsidies, private funders might fear or perceive that an SME's business does not provide any additional value and hence is not profitable in the long-term. Lerner's (1999) research might support this view presenting that the superior performance of SBIR awardees received modest subsidies. The finding could indicate awardees' clear financial discipline and vision with no slack resources to achieve its objectives. Nevertheless, the certification broadening is seen to be effective in crowdfunding, primarily in early-stage innovation in high-tech science-based industries, where financial and social elements are firm. (Lanahan & Armanios 2016.)

According to multiple authors in table 1, subsidies, especially R&D, can indirectly impact ventures by changing attitudes and beliefs of external stakeholders, such as investors and banks, towards SMEs which have received subsidies. Therefore, Wei and Zuo (2018, 616) claim that receipt of certification entails an indirect effect as investors' behaviours and preferences can be revised by subsidies, thus, improving the acquisition of resources for SMEs. In her research, Wu (2017, 344) ponders the causality between certification effect on R&D subsidies and external capital, namely, does the acquiring of R&D subsidies improve SMEs funding from other sources or are R&D subsidies a precondition for investors to invest capital. The investors replied in their interviews that although SMEs are encouraged to pursue subsidies, it is not a requirement to receive funding.

The prestige of the certifier

In some instances, the lack of requirement of obtaining subsidies to receive funding could be explained by examining who is certifying the SME. According to Wei and Zuo (2018, 616), the subsidy distribution could be altered by individual motives of officials and hence, it is contradictory if subsidies could act as a signal of certification. In addition to officials' personal incentives, the central government might not have different objectives only with VC investors but with local governments as well. The different nature and certification effect on R&D subsidies of central and local government is presented in figure 8.

As illustrated in figure 8, central and local governments have heterogeneous incentives to make an intervention. Generally, the central government prioritises the aggregate welfare of the whole economy and thus supports projects with high spillovers and low

appropriability, as presented in chapter 2.1.2. These types of R&D projects provide knowledge spillovers to other economic zones as well. In the event of success, these projects will generate long-term economic growth and possibly a competitive edge in international markets. (Wei & Zuo, 2018, 618.)

However, investors might avoid these radical and novel R&D projects considering the high risk and duration to achieve commercial activities. Therefore, the receipt of R&D subsidies from the central government conveys a negative remark for investors and could damage the prospects of capital acquirement for ventures. This negative certification effect from the central government is verified by Wei and Zuo (2018). They present evidence that in the following year, the effect of the central government's R&D subsidies on venture's obtained equity capital is substantially negative. In turn, their results indicate the opposite effect on equity investments when the local government grants R&D subsidies.

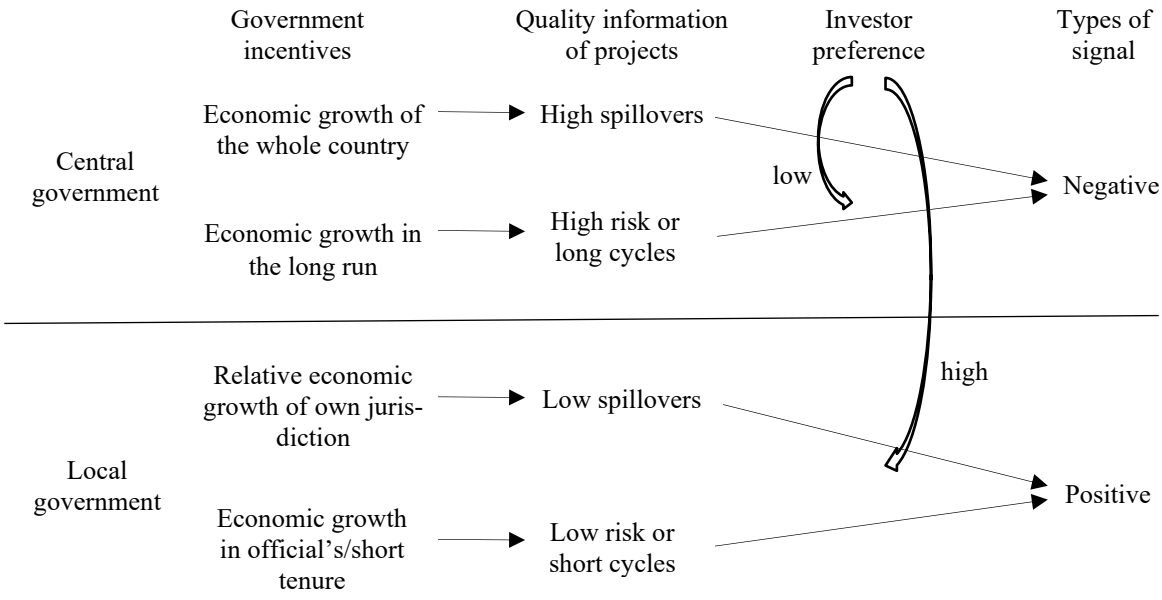

Figure 8 The certification effect of R&D subsidies from central and local governments (Adapted from Wei & Zuo 2018)

The possible explanation for the reverse effect of the signal in figure 8 could be understood when considering public choice theory, where political behaviour is guided by the maximisation of an individual's utility (Dimos & Pugh 2016). For example, in China, the incumbency of a local public official is typically approximately three years, while their evaluation and probability of promotion are contingent on the performance and results during the term (Li & Zhou 2005, 1744).

As the successful R&D projects serve as an impulse for economic growth, public officials in the local government have an incentive to allocate R&D subsidies to projects with negligible risk and quick cycles. Since their reputation is at stake, and the performance is assessed based on the financial results during the short tenure, local officials tend to maximise the gains of their jurisdiction by subsidising R&D projects with low spillovers. Therefore, the high appropriability for these R&D investments attract external investors' capital and provides a positive certification effect on R&D subsidies from the local government. (Wei & Zuo 2018, 618–619.) This certification effect on R&D subsidies from central and local governments is more profound in transitions and developing economies where institutional quality is weak.

However, in light of the existing theory and previous research on certification broadening and the nature of the certifier, Lanahan and Armanios (2016) discovered fascinating mixed results. As research has shown, the continuance of the same public funding scheme under the same public authority should not provide any additional benefit and thus crowd out private investments. In turn, the author's empirical evidence counterintuitively indicates public financing to be higher in this case. The evidence might further support Wei & Zuo's (2018) findings where institutions have heterogeneous objectives.

Besides Wei and Zuo (2018), Wu (2017) examined the relationship between the nature of the ownership and the certification effect. She discovered that obtaining R&D subsidies increased the probability of attracting investors, yet the state-owned enterprises received a greater number of subsidies than private firms. Wu (2017, 342) claims that governments might create criteria that are favourable to state-owned enterprises, giving them an edge over private firms. Consequently, enlightened investors recognise this behaviour and pay regard to allocation while making R&D investments in state-owned enterprises. Therefore, the certification effect on R&D subsidies is stronger in private firms than in government-owned enterprises.

3.3 SMEs and EU subsidies

A company has multiple alternative public R&D subsidy program agencies from where to apply for subsidies. These agencies and their programs operate at different levels within EU countries, national and regional areas. Supposing that companies know these programs exist, their decision to undertake R&D operations will consider the probability of receiving subsidies. In theory, if costs for applying are sufficiently low and eligibility requirements are moderate instead of restrictive, it can be assumed that all companies are

inclined to apply for a subsidy even if their R&D project would be profitable without one. However, in practice, companies evaluate the subsidy's expected value and decide whether or not to apply. (Blanes & Busom 2004, 1460, 1463.)

On the contrary, Takalo et al. (2013, 267) argue that the more profitable a company's project is, the less likely it is pursuing a subsidy. This is evident when considering a large part of the application costs is, in fact, opportunity costs. In high-tech SMEs with a low number of employees, the application process might stress SMEs' top management and divert their time away from core activities, indicating higher opportunity cost. SMEs with high-value products or services may have more complex R&D projects that are more burdensome to document. Howell's (2017, 1139) study verifies the arduous application process as interviewed SBIR Phase II awardees stated that the process took one to two months for a full-time employee. Private funding does not include such application costs, but companies have to pay a market rate for private funds, which can be a barrier for high-tech green SMEs.

Despite the possible high application costs, primarily opportunity cost of time, Takalo et al. (2013) identified a steep learning curve. They discovered that one prior application reduced application costs by 21 % and four by 60 % among Finnish subsidy applicants. Companies might also hire consultants responsible for the application process and pay a fixed compensation or a success fee based on the outcome.

As companies can apply for national subsidies from their own government, why should they consider participating and applying for EU-level subsidy programs? The empirical evidence and previous studies express quite a diverse set of results regarding perceived benefits and disadvantages, primarily for bureaucracy, time-to-grant, grant sizes, success rates and partnerships. Although Čučković and Vučković (2018) state it is corroborated that SME participation in EU programs can provide remarkable beneficial impacts, the economic effect is rather indirect than direct. Thus, the effect depends on the firms' ability to utilize its internal factors and knowledge.

According to Czarnitzki and Lopes-Bento (2014), national agencies' reactions are more sensitive to previous innovation experience when choosing beneficiaries compared to EU funding authorities. Their study also evidenced that the availability of internal funds is more essential for national than EU agencies. Thereby, national agencies appear to focus on the ability to carry out R&D and private monetary resources. The phenomenon could be explained by national governments' incentive to pick winners and maximize the

benefit of their subsidy program in their economic area. However, this preference could endanger the viability of new high-tech SMEs, which lack resources.

It is commonly recognized that to enjoy the advantages of the subsidies, companies need to lobby, create R&D plan proposals, conform to precise accounting standards, and satisfy authorities' reporting obligations. Moreover, the criteria and administrative and bureaucratic requirements vary depending on whether the subsidy is granted by the EU or national authorities. The strict requirements force the subsidy recipients to accurately register costs, deliverables, action plans and schedules. (Czarnitzki & Lopes-Bento 2014, 381–383.) Although the strict reporting obligations drain companies' time and resources, accomplishing a co-funded project by the EU enforces administrative and managerial expertise crucial for successful management of a project. It may also result in obtaining valuable experience in project work with other entities such as ministries and universities. (Bialy & Zarnovsky 2017.)

Nevertheless, Spoz (2014) analysed secondary data and found the main barriers to utilising EU funds by SMEs, primarily in the areas of project financing, institutional efficiency and information systems. SMEs stated that the perceived barriers included payment delays to beneficiaries, project budgets were inflexible, considerable verification time for payments applications, low quality of service, dispersed and scattered information regarding available funding instruments and unclear structure of websites. The evidence is partly supported by Sipikal et al. (2013), who discovered lengthy delays in the EU's subsidy evaluation process. Thus, the enterprises did not report time savings but instead time delays in implementing the projects.

According to the H2020 program's annual monitoring report in 2014, grants signed on time for successful projects represented only 2 % for Phase I and 37 % for Phase II applications, whereas time-to-grant benchmarks were three and six months, respectively. In 2015, Phases I and II combined, the percentage of signed applications within eight months was 63 %, indicating long and relatively varying time-to-grant for applications. (European Commission 2016A.)

For companies, the EU funds are among the most inexpensive alternatives for acquiring finance for their activities (Spoz 2014). Compared with the national funding H2020 program offers higher funding rates and pre-payments for projects (Business Finland 2019) and much larger grants than its counterpart programs (Czarnitzki & Lopes-Bento 2014). Yet, participation in the H2020 program does not exclude utilizing other EU funding programs. Importantly, green high-tech SMEs could need to apply for other EU funds

also as national subsidies might not be sufficient to develop expensive socially valuable technologies. Of the firms that did not advance with their H2020 projects, 80 % responded that the necessary amount of funding is larger than could be available from national or regional programs (European Commission 2017A).

Nevertheless, a significant part of entrepreneurs has inadequate information regarding available funding sources (Collewaert et al. 2010) and might resort to traditional bank loans. For instance, according to Spoz (2014), although 95 % of SME entrepreneurs in Poland knew something about EU funding opportunities, 67 % of them found it rather challenging to use. The difficulty among SMEs has led to the infrequent utilization of EU funding. This experience, however, can be quite different from founder-owners of high-tech SMEs. They might have prior experience of scientific work in universities or research institutes where they are more accustomed to applying for EU funding.

In terms of cooperation features, EU projects enable networking possibilities and joint undertakings with partners abroad. The majority of SMEs stated they had formed strategic partnerships and obtained access to new networks where they initiated follow-up projects and increased competitiveness. (Čučković and Vučković 2018.)

There are still reasons why all companies do not find collaboration and consortia projects as lucrative alternatives to gain funding and new contacts. As companies might conduct R&D activities close to the market, the information and core knowledge can be too valuable and confidential to share in an open EU consortium. Additionally, Finnish pharmaceutical companies have felt the reluctance to collaborate due to fear of knowledge leaks. (Luukkonen 2000.) Therefore, as core research is often kept secret, there could be disincentives for open cooperation in networks such as in H2020 consortia.

In previous EU framework programs, for large Finnish firms, EU funds were not as essential as for SMEs, which had a higher tendency towards short-term economic objectives for participation (Luukkonen 2000). This finding might not come as a surprise considering the resources at disposal for SMEs. On the other hand, extensive networks can draw highly skilled researchers' attention to the company and create a positive reputation.

The Horizon SME instrument's receipt is also recognized to increase a firm’s reputation, and Phase II of the instrument is held in high esteem among all stakeholders. Moreover, having the EU label and branding improves firms’ chances to obtain new investments. (European Court of Auditors 2020.) According to the SME instrument Impact Report 2017, the SME instrument reduces the time to get additional investment for a firm

from 32 to 9 months and improves its negotiation position with new investors. (European Commission 2017B.)

H2020 grants have no limit on how many times a firm may apply for them. There is a continuous open call for proposals with four cut-off dates a year for the SME instrument. Nevertheless, resubmitting the application of rejected proposals drifts management attention and decreases the success rate, thus discouraging participation in the program for applicants. (European Court of Auditors 2020) Konopielko et al. (2019, 556) underline the statement and posit that particularly during the first years of the programs, as the percentage of unsuccessful proposals reach a high number, a feeling of despair and hopelessness can occur among applicants. Despite the low success rates in the H2020 program and the possible subsequent discouragement to apply, McCarthy (2017) states the real success rate could be much higher if the quality of proposals is taken into account. He evidenced that reported success rates for the SME instrument can be as low as 6.5 % when all eligible proposals are included. However, the real success rate can rise to almost 28 % as only high-quality proposals are considered, indicating a fourfold increase. According to McCarthy's calculations, for instance, in energy and climate calls, the real success rates reached as high as 47 % and 24 %, respectively.

Finally, a small firm or a start-up could desire to apply for EU funds, yet it is impossible for them due to ownership issues. An enterprise is not considered an SME if a 25 % or higher portion of its capital or voting rights are in the possession or under the control of public bodies. However, there exist exceptions with universities or VCs in some cases. According to Howell's (2017, 1152) study of the U.S. Department of Energy SBIR program, some SMEs might trade too high a stake of ownership for new equity after acquiring Phase I feasibility study and proof of concept funding. Therefore, they cannot apply for Phase II funding, that is to evaluate commercial feasibility and to continue R&D efforts since SMEs are not applicable to the program if an external investor owns over 50 %. This could be consistent as 55 % of SMEs that obtained VC funding within two years of Phase I did not apply for Phase II.

4 EMPIRICAL FINDINGS

4.1 Data collection, case companies and interviewees

This study's case companies were selected from the EU Funding and tender opportunities portal, which provides detailed information on funded projects from the H2020 program. However, as green SMEs are at the centre of research, what is the definition of a green firm and thus, what SMEs are suitable for this study? Although the definition of green has subtle differences in the literature, green practices and eco-innovations are interpreted as a way of doing business that protects the natural environment by improving climate, ecology, or sustainable development. (Beise & Rennings 2005; Chen et al. 2006; Oltra & Saint Jeant 2009). The definition is in line with the EU that defines green business as "innovative products to decrease environmental impacts and use fewer resources, as well as services that facilitate a better match between supply and demand of eco-innovative solutions and help eco-innovation into the market." (European Commission 2020J). Thereby, the SMEs selected for this study are based on the previous definitions.

In January 2021, 589 participations from 388 different SMEs for H2020 was registered in Finland, and only for-profit SMEs that had applied for RIA, IA or SME instruments were qualified eligible for the sample of this study, as the purpose is to examine SMEs that have received H2020 subsidy for R&D and innovation activities. Besides, it must first be determined which SMEs meet the definition of a green company before the individual characteristics and eligibility of H2020 subsidy recipient SMEs for participation in the study can be considered. As the precise classification of a green business is fairly obscure in the H2020 Funding and tender opportunities portal, the companies were classified according to the ready-made categories of the portal to decrease the subjectiveness of the author when qualifying the SMEs.

To determine which SMEs operate in the green sector and are eligible for the study altogether, the SMEs were compartmentalized based on five broad focus areas. Two were recognized as relevant classifications: low-carbon and climate-resilient future and circular economy. Even though the circular economy is an ambiguous concept, it was found as an appropriate focus area due to its umbrella-type term for resource efficiency, material savings and energy frugality (Blomsma & Brennan 2017; Ruokonen 2019). This approach did not yield sufficient results as, of the five broad focus areas, the EU's Funding and tender opportunities portal classifies 95 % of the SMEs in the category of 'not applicable'.

Therefore, the classification of the SMEs in the EU's Funding and tender opportunities portal was further divided into smaller parts and the SMEs were compartmentalized by thematic priorities, which included 22 separate categories. Five of these categories were recognized as relevant for green activities and are as follows:

- Climate Action, environment, resource efficiency and raw materials.
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research.
- Innovation in SMEs.
- Secure clean and efficient energy.
- Smart, green, and integrated transport.

Although Innovation in SMEs is a broad category, it was selected as the category might include multiple SMEs that meet the criteria of green business. The eligibility was verified by examining project descriptions from CORDIS that is the primary source of information and results from the projects funded by H2020. After excluding the non-green high-technology SMEs that had not received RIA, IA or SME subsidy instruments, company-specific characteristics were examined to assess which of the remaining SMEs would be suitable for the interviews.

The remaining green SMEs were recognized as eligible and fruitful to examine, and eventually, the case companies included in the study were selected based on the following characteristics regarding H2020 subsidies. For instance, SMEs that have received many subsidies in terms of euros were seen as relevant to examine as larger subsidies can have different degree of effects on the subsidy recipients and their technologies' development. In turn, the SMEs that have received several H2020 subsidies or participated multiple times in consortia can have varying motives to do so, such as seeking networking opportunities or excess certifications. Moreover, the utilization of the subsidies in communications could differ among one-time recipients compared to multi-time recipients. The study also sought to include SMEs that have been members of the consortium or consortia because the nature of collaboration and reasons to apply for these H2020 instruments can be pretty distinct compared to individual subsidy schemes. As H2020 consortia projects include several members, IPR-related concerns might be a relevant factor to consider, and the cooperation between project participants from different EU countries can create complexity. In addition, the H2020 program has continued from 2014 onwards, that is, over six years by the time of this study. The utilization and leverage of the H2020 subsidy can have various impacts among recipients since not all effects are realized immediately, and the early receipt of the subsidy near the initiation of the H2020 program can be perceived

differently by stakeholders. Although it is challenging to identify SMEs that have applied for but did not receive H2020 subsidies, such a company enables to examine hypothetical additionality in relation to other firms and is found essential to include in the case companies.

Next, these intriguing SMEs for the study that possessed the aforementioned characteristics were examined in more detail as suitable candidates were considered for the interviews. Primarily, the interviewees were selected based on their knowledge and status in the SME as well as on their experience and responsibility with the H2020 project on behalf of their firm. Therefore, founders and executive-level members were prioritized for the interviews. Additionally, employees with extensive work history and experience from financing, for instance, with H2020 funding, in the SME were found essential to interview. The eligibility of the interviewees was first verified by utilizing company websites and LinkedIn. As the H2020 projects could last multiple years and its effects might not be seen immediately, it was ideal to select interviewees that have worked in the SME both before and after the receipt of the H2020 subsidy. However, several SMEs and interviewees were excluded from the study because the SMEs were not operating anymore, or the executive-level member(s) did not fit the requirements, such as time spent in the firm.

Finally, while selecting eligible and interesting case companies, triangulation of data (Eriksson & Kovalainen 2008) was utilized when searching for further information. Evidence from multiple empirical sources was used to cross-check and seek details about the companies and H2020 subsidies. These sources included CORDIS, companies' websites, LinkedIn, and web articles primarily.

Ultimately, ten green SMEs participated, and a total of 11 executive-level members were interviewed. Although all the case companies were selected from the green sector, the nature and the focus of the companies somewhat vary. The sample includes wave energy technologies, maritime solutions, distributed power generation, fuel cells, small turbine manufacturing, energy storage, sustainable packaging materials, solar desalination, and biotechnologies. The variation among case companies in terms of nature, the number of subsidies and the number of participations is quite heterogenous. The smallest case includes one-time participation of SME1 feasibility study subsidy, which equals 50 000 euros, and the largest case is over 10-time recipient who has received more than 10 million euros. Put differently, the sample includes companies that have received only one of the three specified subsidy instruments, all of them or multiple times the same

instrument, such as IA. Two of the case companies are among the first firms in Finland to receive the H2020 subsidies. Besides, the company that got SME1 and applied for a second H2020 subsidy, which would have been large compared to the firm, did not receive. Therefore, the company was perceived as important to interview regardless of the subsidy rejection as it allowed to interview what kind of an effect the subsidy could have had.

The case companies were founded between 2003–2015, and the average age of a case company is approximately 11 years. The revenue distribution ranged from zero to one million euros, and all the companies are currently unprofitable, generating annual losses of 300 thousand to 3 million euros. The average numbers for revenue and profit are around 400 thousand and negative 2 million euros, respectively. Even though the number of case companies accounts for only 6 % of their respective Finnish green counterparts in H2020, they represent 30 % of the subsidies received, totalling nearly 43 million euros. The amount equates to 28 participation in H2020 projects. However, even if the companies are entitled to receive over 40 million euros, the amount has not materialized completely as partners in the consortium realize their share when they commence their phase of the project. Moreover, in one instance, the subsidy contract was terminated, resulting in a subsidy payback.

In all case companies, either the Chief Executive Officer (CEO) or other executive-level member had a relevant and sufficient combination of requirements to qualify as eligible to interview. The interview questions were sent to the interviewees in advance to ensure they have a sufficient amount of time to get acquainted with the subject and prepare for the questions. The interview questions can be found at the end of the study in appendix 1. Each interview proceeded according to the pre-defined themes, but depending on the interviewees' responses, the follow-up questions could have overlapped with the themes to some extent. Thereby, flexibility in the interview was enabled for more in-depth discussion.

However, two case companies were more familiar with the interviewer, who might have responded with more detailed answers. The benefit of being acquainted with the firm increases the possibility to develop contextual knowledge that is a major point in qualitative research (Eriksson & Kovalainen 2008). Besides, a frequently used option to recognize potential participants in qualitative research is to utilize existing connections

for snowballing or network sampling techniques (Patton 1990). In this study, two interviewees were identified and contacted via recommendations of other participants and employees in the case companies.

The interviews were conducted between December 2020 and January 2021. The interviewee, work experience in the SME, position in the firm, date of the interview and interview duration can be found in table 2. The work experience is expressed in years if the interviewee has not been employed in the case company since it was established but has joined in later stages of development. The distinction is due to the emphasis on the nature of participants for the research as the companies' founders have possibly the best understanding of the company. Therefore, the split by no means reflects any lack of experience or knowledge for other participants. The work experience in the firm is rounded to the nearest year, and the position depicts the current title.

Table 2 Interview Information

Interviewee	Work experience in a firm	Position in a firm	Date of interview	Interview duration
Alpha	8 years	CFO	07.01.2021	51 min
Bravo	Founder	CEO	21.01.2021	1h 18 min
Echo	Co-founder	CEO	23.12.2020	56 min
Kilo	8 years	COO	27.01.2021	56 min
Papa	Founder	CEO	05.01.2021	49 min
Sierra	Co-founder	CEO	22.12.2020	53 min
Tango	Co-founder	CEO	28.01.2021	43 min
Whiskey	Co-founder	CEO	21.12.2020	48 min
Yankee 1 Yankee 2	2 years Founder	CSO CEO	18.01.2021	1h 5 min
Zulu	9 years	CTO	14.01.2021	1h 7 min

As table 2 depicts, all but four of the interviewees have been the founders of the firms, and every CEO have been operating in their position incessantly since the firm's establishment except for Bravo, who has although been a full-time board member as well. The CEOs have been involved in a wide range of business activities during their firm's life cycles from early technology development to closer commercialization and could be to some extent defined as 'jack of all trades'. Besides, the non-CEO executive-level members have also been actively engaged through their current or previous roles, and one of them was previously awarded as the CTO of the year. However, all the interviewees have

experience in resource acquisition regarding subsidies or private funding either in their current role or from previous occupations. The applied subsidy programs include instruments from both national and EU-level such as Business Finland or primarily H2020.

All the interviews were conducted remotely either by phone or via Zoom due to COVID-19 restrictions and recorded for transcription with the permission of the participant. The transcribed text was grouped into themes and analysed based on the study's research questions. In this way, the purpose was to identify similarities, differences, or controversies in the discussed topics among interviewees. Moreover, the interviewees were given the option to see the transcription in case of misunderstandings and misinterpretations. To guarantee confidentiality, the study uses pseudonyms for the cases. Moreover, to respect the privacy of both the interviewee and the company, this study does not specifically elaborate or combine subsidy instruments and the nature of operations with the case companies.

4.2 Factors and motives to apply for the H2020 subsidies

4.2.1 Sources and difficulties of funding

Generally, the case companies have previously acquired financing from both private and public sources. Private financing includes various options such as equity or loans from VCs, individual angel investments, family funds, crowdfunding and bank loans. When the interviewees were asked to reflect how difficult it was to acquire funding before H2020 funding, the answers were reasonably heterogeneous and contradictory. Papa addressed that the Achilles' heel of deep-technology companies in Europe is the fact that they are funded rather narrowly, and the financial culture is different compared to the U.S. In contrast, Echo stated that although Finland has relatively few financiers, obtaining international funding is laborious.

Zulu perceived that the real challenge is basically the environment, which is similar to running a real business, but the company does not have an actual business yet. Therefore, bank finance has not been available for all case companies. For instance, Sierra shared similar views and stated that the company had raised family funds and angel investments, but not bank loans at all.

> *"Bank finance only works when you have positive cash flows, head above the water. We still burn cash and invest in the future." – Sierra*

Although Echo has obtained loans from banks, it was still perceived as more challenging to acquire than from VCs. Because banks primarily require a stable income stream to provide a loan, private investors could be the most significant funding source, as Yankee 1 concurs, adding that the company's loans are not from the bank but from the investors. However, not all companies have had difficulties obtaining funding from the private sector. Alpha explained that even though acquiring funding has been challenging at times, the company has always been able to acquire it. In turn, Kilo has been operating with VC money since the interviewee arrived in the company eight years ago. Some projects have advanced so logically that Whiskey stated every time the company had needed finance, they have gotten that. The interviewee even added that they had not utilized bank finance as they have had equity available, whereas the most difficult funding to get has been the H2020.

Even though early-stage technologies include much uncertainty, the investors might still be willing to invest when the technology is fresh, and thus, the enthusiasm to invest is much higher. The market is perceived to have many small opportunistic funders willing to finance with a small amount, such as seed funds. When the case companies' operations began to approach demonstration and scaling stages, multiple interviewees agreed it is more challenging to attract financiers. Large investments for construction, testing, and full-scale demos cost millions of euros and funders for these test phases' risks are really challenging to find, as Zulu and Echo expressed. The problem is even more demanding the closer the company got to actual commercialization. Investors are much more reserved to put funds into the company in these stages.

> *"Then when we go to the stage where we are now, that we should have more capital to be able to grow, to penetrate the market and to get at the beginning of growth, it has been recognized that access to finance is much more difficult. You need more capital, you may not have an extensive customer reference base, you do not have widespread demand yet, as you are that much in the early stages".*
> *– Echo*

Sierra corroborates and affirms that the company's immense challenge in terms of funding is scaling, which means, in this particular case, building a factory. However, the

investment is high as the scaling is a binary option where the firm can not build an intermediate factory model that is relatively expensive at full-scale. In an interview with Bravo, it was perceived as extremely difficult to get financing at the demonstration stage in the industry where a single device is shockingly expensive to build, as the cost might be multiple times higher compared to a final product. The number of funds required for demonstrations is so high that the EU programs were seen as the only ones that can provide the funds for this development stage concerning other public money.

> *"Then again, Business Finland is already pretty cold for us. No more money can be acquired from there for this need. And you can't get funding from Finnvera or Tesi when we do not have a turnover, so we are out of those programs. Here is exactly this valley of death stage that technology exists, and commercial projects are lacking, so subsidies are really poorly available for this [demonstration]."* – *Bravo*

The valley of death stage was also recognized by Yankee 1, who explained how the company used Business Finland subsidies at the beginning, but their policy denies further support until the subsidy recipient has commercialized the product. Therefore, as Business Finland's subsidy was already implemented, the H2020 SME instrument is considered the most significant funding source for the company and a huge reason to apply for the H2020 program.

In some instances, national funding has not been available for case companies. However, it has not contributed to the fact that the company would apply for or receive H2020 subsidies; in fact, the other way around. National funding was not available for a case company as Business Finland perceived that the company no longer need support for the industrialization of their technology. Interestingly, Business Finland justified their decision by explaining how the case company had already received so much support from H2020 programs. They believed Finnish taxpayers had already paid the company's EU subsidies when Finland has paid the EU's contributions.

> *"We would have wanted to build a factory, and we asked Business Finland if it would be nice if we built a factory and created jobs in Finland. They replied that it would be really great, and they would be happy to help. We made an application and sent it. There came a message that no, it is such a thing that building factories*

are a large companies' job. You have already received so much EU support that we are not going to help you." – Kilo

However, Echo stated that the H2020 program offers higher subsidy percentages than national funding programs in Finland has affected their decision to apply for the H2020 instruments. Whereas in H2020, there is a 70 % subsidy for demonstration projects and 100 % for product development, in Finland, one can obtain a maximum of 70 % loan or 50 % subsidy. In turn, lower subsidy percentages might not be such critical factors as Alpha explained it would not have mattered as the subsidy instrument fit well with the company's business. Moreover, the H2020 volume is more significant than national subsidies, and consequently, the company has a lot more money to spend on its activities. Sierra also agreed and indicated that the company knew H2020 offers one to two million euros funding which the company do not have to pay back. In general, but not surprisingly, all but one interviewee emphasized that the funding was a factor or played a significant role to apply for H2020 funding. The shortage and constant need for funding were highlighted during the interviews, and the H2020 grant amount was perceived as an essential mean to develop the technology, which brought concrete results. Zulu agrees and expressed that although the company might have on some occasions utilized external recognition, such as the H2020 stamp to acquire legitimacy, more has been done to build credibility through technology and its presentation.

"The support has contributed to our progress and helped to develop prototypes. Of course, as soon as you have something concrete to present to new investors, it will help a lot." – Yankee 1

"But in these EU projects, as in our case, for example, what is more important and why it is such good money is that it practically brings some kind of a concrete project." – Papa

Nevertheless, that funding is considered a crucial factor in applying for H2020 subsidies, Kilo is the only interviewee who precisely emphasizes that the H2020 program has never been about the money, and the funding has always been a secondary issue. H2020 funding does not eventually solve financing issues. The company has refused over nine times out of 10 when they have been offered a role in a consortium and instead chooses

the ones that support their current technology. Contrary to money, the focus in H2020 projects has been value, cooperation and open innovation. Although the company has acquired multiple H2020 grants, Kilo stresses that it has only focused on what the industry needs. Therefore, there have been multiple projects the company fits into, yet the purpose of participating has always been strategic. The company has never gone into consortia where technology has not fully met their need or where partners will not support its business in the future. The focus on strategic efforts and objectives has paid off as the company has been quite successful in its H2020 projects.

> *"We succeed really often when we get involved, and we have a completely different success rate than usual. I cannot say yet about this year's results, but overall, we have a success rate of around 50 %. We have a pretty good track record, and that is why we are also a pretty desirable partner. We get a lot of requests to go along." – Kilo*

Moreover, Kilo presented that although the company has been participating in many consortia, it does not apply multiple times. If the company applied repeatedly it would apply for all instruments, but this is not the case. One of the reasons why there are a lot of subsidies, from the outsiders perspective, is that the company has done the right things that the markets demand. As the success rate indicates the EU, customers and partners have been pleased and the company has been in Brussels to discuss about how the EU projects should be implemented.

4.2.2 Certifications, awards and legitimacy

An SME can obtain certification and awards for its technologies to increase awareness or gain credibility and legitimacy among stakeholders, such as funders or customers. There exist multiple innovation competitions in different industries where an SME can participate and get recognition, but not all events were perceived as essential for gaining legitimacy. Papa had participated in innovation competitions before and won a clean-technology award in 2018, yet the interviewee considered innovation competitions as more of a start-up buzz and not necessarily in a positive sense. According to the interviewee, startups or high-tech companies should be divided into two groups by different criteria: Slush-type technology companies with gimmicks and deep-tech companies which commercialize technology based on technical university research.

”For us, that kind of Slush buzz is nonsense and negative. It is [buzz] kind of fairy dust, but some companies like Supercell and others make a lot of money. I do not want to belittle them.” – Papa

On the other hand, the certificates were not realized to provide any added value but rather seen as a must-have. The company operates in a highly regulated market and produces power generation units. Therefore, certificates are mandatory in terms of safety and functionality. The interviewee stated that the company does not garner certificates from huge actors to gain legitimacy and can not deliver a single device without proper certification. Papa clarified that the company had not utilized external recognition to gain legitimacy and internationalize as the recognition in the industry is derived from somewhere else. Instead of recognition from innovation competitions, legitimacy is rather obtained through a concrete presentation of technology in collaboration with credible actors.

Sierra expressed similar experiences that certifications are a must-have for the company to survive and get around the table with big players. In turn, the company did not participate in innovation competitions to get a stamp from the credible actor, but the real purpose of participation was claimed to be dichotomous. Although the competitions are mean to get visibility and coverage, the jury often consists of investors and potential customers that expand the contact network. The interviewee added that the phenomenon above has also been one factor when applying for the H2020 project. The certification from the EU was also realized as an essential feature.

”Points for the EU that if you are a good applicant but you do not get enough points in evaluations, you still get a certification for your good technology. That does not cost too much for the EU to distribute, and they still could improve firms’ opportunities.” – Sierra

The H2020 stamp was not a relevant factor when applying for H2020 subsidies and to gain legitimacy. However, Echo perceived it as a credible indicator that the company operates in accordance with the financing terms. The H2020 stamp could act as a reference, not similar to recurring customers but still an explicit acknowledgement that the company can win competitions. Nevertheless, a project was considered a different issue

than competing for an innovation award that was seen purely as marketing, confirmed by Zulu and Whiskey.

While, according to the interviews, innovation competitions are perceived among few recipients as a 'bling-bling" type of events where the firm must produce a ton of material and waste its resources, the EU is perceived much more credible actor. Yet, the stamp is recognized neutral or at least "not bad" but has not contributed for applying the H2020 instrument. Kilo addressed that the company has not applied for H2020 subsidies because of it and Tango expressed the only great thing about the H2020 grant is that it includes the funds. The company used to participate in innovation competitions but does not want to profile as a startup anymore. Thus, the additional quality labels from different parties do not provide any added value, but the H2020 labels could not hurt the company either. The interviewee even raised a question if some stakeholder could consider that the firm has applied for EU funding because it has not received funding through the actual business itself.

According to Whiskey, different types of technology grants exist, and the firms compare those grants and decide where they start to apply. Therefore the stamp is not considered as a crucial element for the company, but rather the suitability for the instrument is essential. As the interviewee explained, it is excellent to obtain funding from the EU, but it is not relevant where the stamp for that finance has come from. Interestingly, the impact or motives of obtaining the certification for gaining legitimacy and credibility might differ as to the case companies' age vary. As the H2020 program was initiated in 2014, the early subsidy recipients could have had different reasons to apply since the stamp of the program may have had novelty value. Alpha was one of the first Finnish companies to receive the H2020 subsidy, yet funds were considered the dominant factor to apply, and the H2020 stamp, or certification, was not perceived as significant.

> *"Money is more important than certification and credibility brought by the EU. Perhaps in retrospect, it has had certain credibility benefits, especially since we and [another case company] were among the first Finnish companies to receive the H2020 subsidies. It is a good quality label, but maybe not otherwise.... or, of course, there is something positive about receiving EU-level funding, but money is the most important thing." – Alpha*

As the EU certification label could have played a reasonably neutral role and might be considered a by-product that comes with the funds, the companies perceived that the benefits of the stamp alone, and thus visibility without funds included, would not be worth it considered the effort of obtaining it. The EU has a specific certification instrument for companies that exceeded the quality threshold and got good enough evaluation points from the application, but due to budget constraints, could not receive funding. These companies are granted automatically the Seal of Excellence as the EU delivers the evaluation results. Two case companies indeed have received the Seal of Excellence, although it is not an instrument that is specifically applied per se. Also, even if the quality stamp is from an established actor, such as the EU, it could be perceived that the company was not good enough to receive funding, albeit its technology got certified by the EU. Moreover, as the Seal of Excellence does not provide any funds, the instrument can not be leveraged with private money to the same extent as H2020 projects. As Yankee 1 expressed, the stamp has affected their decision to apply, but the company would not make such a massive effort for an H2020 subsidy just for the sake of visibility.

4.2.3 Networking and visibility

One of the motives to apply for the H2020 subsidy has included networking with partners and consortia members. Zulu expresses that although consortia can include a varying number of companies, usually the consortia include multiple participants and thus, connecting with other industry actors or members of supply chains might be valuable. The connection with large firms became evident as it was mentioned as a reason to go into an H2020 consortium project. Moreover, there could exist multiplier effects with new contacts as the prominent consortium participants might reach out to other industry actors and share their information about the SMEs.

> *"Networking is also one huge factor. We have sought to network with these consortium companies. Dissemination of information is much easier and [in a consortium] is also a bigger company involved. Of course, the kind of raising the profile and making ourselves known to the big players who may have more contacts in different ways is important." – Zulu*

When applying for EU subsidies and entering into a consortium, it is also recognized as an advantage that the company will get new connections and disclose information

about the case company itself, according to Bravo. The close collaboration with larger actors helps create mutual trust and confidence as the case company can present its abilities more concretely with an actual project. In some instances, the H2020 consortium project might be a secondary issue if the consortium includes a reliable and exciting business partner. Building a linkage with a large energy enterprise can create a valuable reference and enable future collaboration or contracts.

> *"One interesting aspect, for example, is when we applied for the EU funds, it also gave us the opportunity that when we proposed [the project] to [a huge energy giant], it enabled close cooperation and it allowed us to give them a huge amount of information about us and our abilities. It is such a positive thing. Similarly, when we were invited to the EU program, it also involves [a large energy conglomerate], which is a giant of renewable energies and a hugely interesting and positive company to work with. It matters pretty much when we think like if that project is even interesting, but [the energy giant] is more interesting. That is, by going into the program, we can build a relationship." – Bravo*

Despite that in the consortium, companies are able to network and garner new business contacts or future references, the interviews revealed that consortia might be too laborious or could involve participants that do not take business forward as fast as other participants would like them to. Tango stated that several consortia had approached the company, but it perceives those projects too time-consuming and elaborates that the challenge is how much time to invest into those consortia projects in such a small company when one should try to develop the business itself. The consortia were considered longshots, and the company has yet to find a perfect match where to join.

As consortia are perceived as a way to network with other companies, and the consortia involve multiple participants, sharing the knowledge might be a controversial issue. Even though the consortia's purpose is to collaborate, create and disseminate information with other members, IPR related questions can affect companies' willingness to enter such entities. According to the interviews, IPR was not considered as a disincentivizing factor to apply for consortia instruments. For instance, Zulu had made separate IPR agreements with consortia partners, yet the process was recognized to be cumbersome and time consuming on both sides. IPR was found to restrict cooperation to some extent in the consortium, and the bigger the partner is, the more challenging the issue is perceived.

Bravo explained that the company had not had any IPR issues in the consortium because they have always had partners that are not considered a competitive risk. The roles have been so different that there has been no fear of misbehaviour regarding IPR.

However, interestingly two interviewees addressed that even though there have been no IPR fears in the consortium, more concern has been what information is taken to the consortium and what IPR is shared. Sierra presents that when the company participates in a consortium project, it first tests the ice with a stick if it is a new area. Everything too close to what the company does explicitly may not want to be brought into the consortium.

> *"First, a project might lock us and our agility to execute core strategies. Second, in consortium EU projects, these IPR terms are the kind that I would not want to bring any of our core competencies too close to there. Because if someone builds something over it, that could bring growth restrictions on us. In that sense, as a start-up, our preference in those is more like that in SME instruments where you do not have to build a consortium for a project, but instead, it can be a one partner project." – Sierra*

Sierra elaborates and clarifies that it could be still true that the results have to be shared with the consortium as the EU wants to share the information and make it available at the widest possible extent. The company perceives that they do not want the information to be available to the broadest extent but rather as narrowly as possible. That is a fundamental reason why the company cannot bring to the EU's consortium projects anything related to their core competencies but instead something that is not as relevant and can be shared with other consortium members.

In turn, Kilo has had no IPR issues in any of their multiple consortia projects and has very openly brought their core competencies. The interviewee stressed that potential IPR disputes had not affected the decision to apply for consortium projects. When the consortium is divided correctly, there are no such issues, and the information can be shared freely. It was seen perhaps as the original sin of Finnish companies that engineers and scientists keep everything in secret and do not share that information only to find that the product that had been developed is not sufficient for customers.

> *"We are trying to fight this not-invented-here syndrome, and of course, the papers [IPR] need to be in order. There have probably been situations where someone*

has misused the situation, but nothing dramatic has happened. People today have so many ideas of their own that they do not have time to steal the ideas of others."
– Kilo

Applying and receiving the H2020 projects also brings visibility for the company as the information is publicly available. The public information could be utilized by industry competitors who might create challenges for the subsidy recipients, especially if the competitors are large and aggressive. However, the interviewees stated that public visibility is no concern and has not affected at all to apply for H2020 subsidy. During the interviews, it was explained that the SME instrument's marketing and communications group is active in social media to share different messages and encourage reporters to communicate with project partners. Both Papa and Sierra praised the awareness and promotion of the H2020 project on behalf of the EU. Moreover, Alpha claims the company has not perceived any aggressiveness or patent disputes from industry competitors. Although at the early stages of the technology development, Yankee 2 admits that available public information can be quite risky, but as the company has been operating for over six years, they want all stakeholders to be aware of their technology. The fact that a company has received an H2020 subsidy and thereby shown in the EU's database is considered a merit.

4.2.4 H2020 application process and utilization of consultants

Before initiating the H2020 projects and applying for subsidies, multiple interviewees responded that they monitor and receive information about subsidies via various channels. Papa stated that one of the essential tasks of the CEO and the Board of Directors is to secure the company's funding, including subsidies as an option for financing activities. Zulu confirms and mentions that the management team members follow where to get subsidies on their own initiative. Moreover, information on various subsidy options is acquired from newsletters and events, primarily those Business Finland organizes.

No interviewee express that the firm would precisely follow or specifically target only EU subsidies. In many instances, the interviewee became aware of H2020 subsidy options from consultant firms or investor. According to Alpha, the company examined different subsidy models and used a consulting firm that suggested the SME instrument for them. Sierra agrees and states that although they have worked with two consulting

firms, it is not the consulting firm's benevolence but rather a recurring business opportunity to write the applications. On the other hand, the arrangement frees the company's resources for its core activities.

> *"So, naturally, they [consulting firm] tell us if there is an opportunity. And of course, this is that kind of a model that works for start-ups, let the consultant do the work and collect the information of new opportunities. It is easy for us when they send a message from time to time when there is a new opportunity, and we assess those case by case." – Sierra*

Supporting Sierra's view, the interviews revealed that all the case companies utilized consulting firms while applying for H2020 subsidies. Besides that the companies can focus on their core activities, it became apparent that although the case companies bring the substance, the consultants know how to formulate the H2020 applications accordingly so the reviewers can see them the right way. As Kilo and Bravo addressed, no company should do activities that are not its core competencies, especially when the subsidy competition is so fierce that writing an application is an art of its own. Formulating the content might be the most challenging task instead of applying for H2020 per se.

> *"The application needs to be formulated in just the right way, and that application process has not been able to evolve in the direction of seeing what the project is really trying to achieve. Rather, that application will be made into a cake that needs to have the right number of cherries and strawberries to see which real magic words are mentioned and based on those words, the projects will be funded this year." – Bravo*

However, despite the high fixed or success-based fees regarding the H2020 project applications that the consulting firms charge, the case companies also utilized them to reflect the original application itself. Kilo perceives that an excellent consulting company that is reasonably priced should not only be thought of as an application writer but as an evaluator of one's own activities and provider of valuable feedback. Nevertheless, the interviewee expresses that there are differences among the consulting firms when applying for subsidies. Even if the cooperation with the consulting firm would be seamless and applying for subsidies would be indicated as an easy effort, it does not necessarily mean

that the application will get sufficient evaluation points. For instance, with the H2020 subsidies, the seemingly easy effort of applying could be reflected on the score as the application might get only half of the 15 evaluation points.

> *"Let's just say my own opinion is that the kind of consulting firm that says it is easy to apply for this money, then most likely it can be easy to apply, but the evaluation of the application will probably be 8/15. A company that feels demanding when making an application and keeps the level high is often one that gets the job done… Another thing that benefits from writing an application, especially with an experienced consulting firm like this, is that it gives you a mirror where you can see what your own business looks like." – Kilo*

In addition to using consulting firms with subsidy applications, the case companies give different emphasis on applying for subsidies. As some case companies involve multiple executive-level members or employees to write different sections of the applications, others tend to specifically assign or hire a single or few employees dedicated to that task. The recruitment enables higher commitment and focus on subsidies and possibly enhance the likelihood of receiving one. For instance, Alpha has recruited employees who have applied for Horizon grants previously.

> *"We have had individuals who have been particularly dedicated to that [applying subsidies]. Unfortunately, one person who had been with us for a long time switched to another employer, and we have not found a replacement, despite the effort and time we have used. It tells something about how important part this is. If you are thinking about EU projects, in practice, the company must have a project officer who not only monitors the project and handles reporting but also searches for new similar subsidies at the same time. So, it is a function, among others." – Papa*

Proper investment in applying for H2020 subsidies is necessary as the success rates are relatively low. Therefore Echo, Bravo and Yankee 1 concur that the chances for success and instruments are carefully studied and influence the decision to apply. Nevertheless, low success rates have instead contributed to the fact that the case companies have utilized consulting firms instead of having an effect on not applying. Because the H2020

subsidy is perceived as challenging to obtain, outsourcing the application altogether does not require as much effort. For an SME with no turnover, the investment is seen as too high, and thus the consulting fees are success-based. Although fixed fee could be considered riskier from SME's perspective, Alpha explained the change from fixed to success-based fees affected their decision not to utilize one consulting service.

The fact that the success rates for H2020 subsidies are relatively low has led to the perception that not all firms count H2020 as a reliable financing option. Sierra considers H2020 funding as additional bonus money that could be received but would not plan any project dependent on those funds. Interestingly, Echo and Sierra both addressed the H2020 funds as a 'lottery ticket' due to its low success rates.

> *"After all, it is extremely competitive money, and we decided not to apply for maybe ten times like some firms have done and perhaps eventually manage to obtain the 'lottery ticket' and move forward." – Echo*

In turn, the interviews revealed that in consortia, larger firms might be willing to pay the consultancy fees and concurrently, the SME can focus on its own work, which Bravo perceived as a more comfortable gamble. Moreover, in consortia, good partners were seen as an essential factor for success as well. Although there were no devotion or loyalty among interviewees to utilize the same consulting firm, Kilo stated that there are differences in consulting firms with chosen favourites. The further the cooperation has gone, the better the consulting firms know them, and they do not have to start from the clean table explaining their values over again.

4.3 Subsidy process and H2020 program

4.3.1 Reporting obligations

The H2020 projects usually last few years, and as the subsidy instruments could include a single applicant or multiple in consortia, the nature of reporting might differ. However, whether the case companies have received SME, IA or RIA instruments, the interviewees' consensus was that the H2020 reporting obligations are pretty heavy but not insurmountable. Multiple interviewees emphasized that even though reporting is more burdensome than with Business Finland, it is worth the money. The interviewees understand the obligation as the amount of subsidies is larger.

> *"Personally, I feel that if you get a million, you must do a little bureaucracy to get that money. It is the price of the money that is obtained." – Echo*

The H2020 reporting was also occasionally perceived as unclear. Zulu explained there is a lot of H2020 instructional material and one issue that arises is a lack of capacity to examine and read all guides. During the interview with Zulu, it also became apparent that reporting includes risks that may not be recognized or thought of in advance in an SME. For instance, the risk is associated with financing and interim reports in consortia as the interruptions might disrupt the payment of subsidies and delay the project.

> *"Once the interim report has been drawn up and approved after the meetings, the EU will have three or four months to pay the next instalment. Whenever reporting is interrupted because, for example, the EU requires further clarification and asks more questions, the three months starts again from the beginning. We also have ten partners, so we did not rely on the activity of the partners, but we were very active in this matter." – Zulu*

Reporting in consortium instruments are considered more laborious compared to SME, where obligations are found much lighter. According to Sierra, the company is used to writing the EU's consortium projects that are like thick bricks, but SME reporting is negligible concerning consortia projects. Although the SME reporting was realized less burdensome, Sierra requested a service package for the whole project's duration, so the consulting firm writes the reports for the EU.

> *"Basically, they deliver us a Word document where they just say you only need to fill these sections, and then they write the report for us. The cost is something like 5 000 to 10 000 euros a year, so we gladly pay for that because it [reporting] is more than one month worth of work if someone of us would have started doing the report." – Sierra*

Zulu and Whiskey agree that the reporting required one month of their full-time work to get the H2020 documentation done for the EU. However, if the EU subsidies are an integral and recurring part of the company's activities, in that case, the relevant staff must

be hired and supporting processes need to be established. It was mentioned in an interview that one company had hired two doctors to do the reporting in addition to Kilo's responsibilities. Moreover, the company had to organize hourly and employee time tracking on a project-by-project basis to meet auditing and EU requirements.

> *"The entire company is obliged to share the necessary information with the people who do the reporting. These two people do not do that job, but it is everyone's business, and two people compile that information according to the provisions of the reports. Also, we have CFO and accountants up to their necks in audits, but that is the point. When grants exceed certain amounts, audits are inevitable." – Kilo*

Other interviewees supported the view who corroborated that when the company applies for multiple H2020 instruments, it is essential to have clear processes. There becomes a specific routine to do the reporting. The investment in the necessary subsidy processes was recognized as fruitful and beneficial, especially when the audits were conducted. The benefits of appropriate processes were highlighted by Kilo, who explained that when the EU performed the final audit, the variance for a multi-million-euro project was only 17 euros. The evidence of this accurate tracking and execution saves time as there is perhaps no need for excessive follow-up reporting or corrective action.

Despite the heavy reporting obligations, the interviewees were prepared to allocate resources for the documentation, and thus, the amount of work did not come as a total surprise. Contrary to others, Papa was the only interviewee who expressed the H2020 reporting was not too heavy or complex. The interviewee explained that the H2020 has ready-made report templates, and as the project is initiated, the CEOs will be invited to Brussels for a two-day training course on what kind of reporting is desired.

> *"We were taught how to self-check reports and what that reporting really is. After visiting there, you realized that this is actually really easy. You know the template in advance, and you know what is required, so you put it into the project policy. In other words, the team works so that the report is generated in practice by a copy-paste in accordance with internal reports. It is a straightforward process, but if you start doing the report at the point when the reporting time is up, it is difficult for sure." – Papa*

Nevertheless, reporting responsibility in multiple case companies is divided for a few employees, yet the obligation still requires executive-level members' effort. During the interviews, it became evident that the technical and financial side of reporting is primarily concentrated on top management. Reporting responsibilities can also be even higher if the company wants to be a consortium coordinator. Although it was perceived as a strategic choice not to be a coordinator, Zulu presented that the EU rejected them as a potential coordinator because it did not meet specific financing or turnover criteria. However, the company could make an arrangement to be the actual coordinator behind the curtains.

> *"It easily happens that a company like ours does not meet the criteria, and therefore another company in the consortium is the coordinator. This coordination is divided so that we are the scientific coordinator, and the official coordinator is a larger firm. However, we have a gentlemen's agreement that I will take care of most of the coordinator's work." – Zulu*

Although reporting was perceived as time-consuming and relatively heavy, the obligations might not end straightafter completing the H2020 project. Whiskey explained regardless that the project has been verified and checked by an independent auditor, the company is again collecting material for the EU although the H2020 project ended two years ago.

4.3.2 Flexibility and cooperation in H2020 projects

Collaboration with a major party, such as the EU, could entail bureaucratic measures as the activities tend to be inflexible among large operators. However, the case companies have primarily experienced cooperation with the H2020 program quite fluent and flexible. During the subsidy periods, there have existed various delays, and the projects have been extended multiple times, yet the officials have been reasonably compliant and understanding. The case companies perceived the H2020 program's discretion favourably as some of the changes could be independent of the case companies' decisions. For instance, companies inside the consortium might cease to exist, and external challenges will inevitably appear, such as an unexpected COVID-19 pandemic. In an interview with Echo, it was stated that naturally, everyone's objective and interest are to promote the industry and get

the projects to a reasonable conclusion rather than hit sticks in the strollers or kill the projects.

The smoothness to get the change proposals accepted were even a surprise to interviewees. The assumption was that the H2020 projects are pretty inflexible. What is written in the report must be conducted, but this presumption was not consistent with the results from the interviewees. The EU's project officers were very accurate and fast to respond, which made contact more convenient.

> *"We have asked for changes to be made and justified why. We have contacted our project officer and explained that this kind of change is coming, what should we do? The project officer has told us exactly what needs to be done, how and when. We have always done exactly as requested by the project officer, and it has probably not been a week since we have received approval for a change to the project." – Papa*

Even though the H2020 project officers have been reachable, few interviewees still discerned bureaucratic measures or lack of judgement that could be said to reach beyond conventional wisdom. As Whiskey explained, the company has gotten every proposal eventually approved, but the program has its own "law-books" from what the project officers can not deviate. Thus, the interviewee stated the collaboration with the EU's officials is non-customer friendly and would rate the smoothness a seven on a scale from 4 to 10. Surprisingly, Zulu perceived that minor adjustments to the project plans were relatively inflexible even though the budgets and cost calculations were done several years ago at the beginning of the project. The lack of common sense was stressed to cause an unreasonable workload for an SME, although the magnitude of the change in costs was negligible.

> *"Our project is less than five million, and we dropped one cost item or felt that it was not smart to invest in such a thing. The cost was around 5 000 for that small portion. I happened to ask that this amount can certainly be transferred to something else. We had a two-week discussion and a kilometre of email on how and where this amount will be allocated next. This is incomprehensible in the sense that these equipment investments are made close to a million." – Zulu*

The logic behind such a consuming conversation was difficult to justify as the unnecessary workload for minor adjustments prevents SMEs agility and could create further delays in other projects. Bravo addressed that, in theory, the H2020 program is flexible if the project could be executed without time constraints. However, in reality, the objective is to develop a product. If there are observations that indicate particular material is not working or suitable for the product, then it should be possible to discontinue the current solution. The insufficient amount of leeway could tie the company's resources for multiple years through the whole H2020 project as the plan is initially documented at the beginning.

> *"If it is documented in the EU application that through the whole process, this particular issue will be clarified in another five years, then it cannot just be dumped aside, but it hangs with it. Then again, if some new observation is made that now we should go in that direction and it does not happen to match the content of the application, then it may not be possible." – Bravo*

In problem situations, Bravo has faced other severe challenges regarding the stoppage of the H2020 project. In fact, not advancing with the project might not be optimal for the company, even if it seems that the project will not work or be profitable. Moreover, discontinuing the project might be eventually more challenging than masking the new direction behind the original idea.

> *"We had one project that we interrupted, so we heard afterwards that the most foolish thing you can do is to interrupt a project. If we think from a business perspective that we have a project that explores a particular technology and we find that this is not going to be a commercial product, then shouldn't business people first think that okay, the project will be stopped? We were so stupid that we ended that project. You do not do that with the EU project. You must ask for a change and disguise it as something else and finish the project. There will be problems if you end the project [early]." – Bravo*

Discontinuing the original documented H2020 project plan will lead to freezing future EU instalments and a demand to pay previous financial payments back because of contractual deviation. The controversial situation of continuing economically non-viable

project puts the firm in a problematic stance. The firm must invest its own funds for the ongoing project and investors' as well, creating a conflict of interests between parties involved. The position is especially tricky for the SME, which is in shortage of funds with low turnover and dependence on external financiers.

> *"The initial payment that the EU has paid will be demanded back, and everything will get stuck, so it [ending the project early] must not be done. This sounds quite insane that if we are doing something that indicates there is no benefit, it makes no sense for the company to put its own resources into it, and yet you have the private money invested as well. Moreover, all expenses are always paid in advance. If you cannot pay them and you find that there is no point in doing this particular thing ... for example, we had to find an industrial partner, and when we found that the results are not so good [with the project] to get this industrial partner then we do not get any money in." – Bravo*

The repayment of the H2020 subsidy to the EU led the company to organize a funding round of approximately one million euros to collect necessary funds. The company had other activities delayed due to COVID-19, and thus, no extra funds in the account at disposal to be returned. The financial settlement was perceived understandable as the company had received EU subsidies that they had not spent yet for the project. However, in an SME, the received money might not be sitting in the account waiting to be returned. Bravo expected that the EU would provide a reasonable payment period for such a large number of subsidies, but the schedule was realized as surprisingly strict. With a full bank guarantee, the EU stated a certain payment period could be granted; otherwise, a two-week payment period will be imposed. The repayment would not be critical on a reasonable schedule, but it ties a huge number of resources that are too much to bear for the company as a lump-sum payment.

> *"It is kind of pointless if you have to repay that amount at once. After all, no [small] company can stand up to that. If these subsidies are intended to help companies develop technologies, then there should be no elements among them that could overthrow the company. There should be an opportunity to negotiate with common sense in such a way that not everything is squeezed according to certain procedures." – Bravo*

The interview with Kilo revealed that the task of an H2020 project is not always necessary to bring success which elucidates the inflexibility and reluctance of the H2020 program to let the subsidy recipient abandon the project in case of an economic failure. Even if the subject that has been explored during the project might not be financially reasonable to examine anymore, the project is required to continue as initially proposed because other companies do not have to explore the matter further. As long as the challenge results from scientific or technical reasons, the EU will continue to support the project. The company has always managed to find a new route to the same or better results. However, the interviewee agreed that one could not endlessly put funds into a project if new ways are eventually unavailable.

> *"They [the EU] understand if you start testing some new technology and it just does not simply work because now, in light of the new knowledge, it seems that the laws of physics do not allow it. There is no point in complaining. Then one can come up with a new way to get the same result, or if these are not found, then we need to raise our hands and stop wasting people's money." – Kilo*

The case companies that have been members of H2020 consortia disclosed in the interviews that they have had quite varying experiences on collaboration with other participants. The consortia include companies from multiple countries, which naturally creates cultural differences in working and communications. Papa expressed that the EU consortia are no different from any other consortium model. That is, the consortium is just as bad as the consortium's weakest partner is. In some instances, the weakest partner might not be the firm itself but rather the contact person representing the company. For instance, professional pride was perceived as a small barrier to communication with university personnel from Central Europe. However, it was emphasized that the EU is not to blame for such issues. Still, the differences can create tensions between participants in the consortium.

> *"These EU projects often involve universities, especially in these consortium projects…at least in Central Europe, there are professors who need to be called Mr or Mrs Professor and whatnot. And then they are well aware of their own field and want to talk and talk about it and refuse to listen to others." – Papa*

Yankee 1 has also experienced various cultural challenges in working with South European partners, but the interviewee stresses that the differences depend a lot on the organization and the person. Cooperation was also presented troublesome with one participant in terms of issues with communication. The partnership included long periods of silence, yet suddenly tasks were required to be finished for the following day.

One of the risks in a big consortium and collaboration with its participants was realized when the consortium includes many large firms. It is evident that people and processes change in large firms, and the interest might partially cease, after which the execution of the project becomes challenging. Zulu expressed that, in general, the consortium firms should be such that they have a genuine interest in the activity in a clear and broader area instead of eager firms with only an objective to be involved in a consortium per se. The firms that want to be in the consortium without an explicit focus or just for the sake of involvement may not bring any added value for other participants or the project itself. The view was shared by Yankee 1 who explained how the company addressed a consortium member that they did not find as particularly meaningful.

> *"In the project that I coordinated a year and a half ago, we tried to exclude one partner because we found that there is not much added value in it. The firm got angry about it a lot. It was an entrepreneur who had a rather small company and whose activities are largely based on H2020 projects. It had all kinds of drama. In the end, we decided to keep the company and define its role better."*
> *– Yankee 1*

Another potential cooperation issue identified is that the consortia might be artificially composed to some extent. The consortia may not have a great deal of solidarity as participants' objectives can be very different. It was recognized that the consortium agreements do not cover all issues, which creates uncertainty of responsibilities. In such a situation, some participants were realized trying to capitalize on the conflict in the consortium at the expense of participants whose primary target was to achieve the project's objective. The issue was experienced more profound in a multiyear consortium where there are several companies from different countries. The importance of reliable project partners in the consortium was highlighted as well. It was perceived as a possible risk that a participant begins to default on its obligations and ultimately does not want to be involved

at all. Replacing a significant participant causes delays, and at worst, due to conflict of interests, other participants might leave the consortium as well.

In an interview with Bravo appeared an example of conflict of interest and a clear incident of default on obligations in an H2020 consortium project. A consortium participant did not meet its obligations on time which hugely delayed the start of the whole project. Hence, the project was frozen as the participant could not obtain their own funding. However, the participant pursued to extort a large Finnish enterprise as it was perceived as more financially robust in the consortium. Eventually, the dispute resulted in excluding the consortium participant, yet the connection to another consortium member became problematic.

> *"They were frantically trying to capitalize. They had to be left out at that point, and the rest of us moved to [another site] where there was existing infrastructure. Then one consulting firm left the consortium because it was a close partner to this [another participant]. So the consulting firm left for solidarity reasons because the other partner was dropped out, and it would have been bad for their local business relationship if they had moved with us [to another site]." – Bravo*

Of all the case companies interviewed, Kilo has participated the most in consortia with multiple participants across Europe. Although Kilo has been a member of various consortia projects, the interviewee stated there had been no significant problems with the projects. According to the interviewee, the firm has gone through every conceivable scenario. They have had three audits simultaneously, left a bunch of consortia due to acquisitions or bankruptcies, and jumped into consortia to cover departing firms. However, Kilo has been very flexible to make consortia work properly, and the company has gotten praise for that as well.

> *"Perhaps the most bitter experience is that we have done a lot for others, and then we have not received that gratitude. I mean, others have tried to move mountains to get the job done. But all in all, nothing more serious has happened there. If these things start to get annoying, then you just have to grow a thicker skin." – Kilo*

The fact that could have contributed to the fluent collaboration with consortia participants is that Kilo expressed the company carefully selects the consortia where are the right partners. If there exist economic conflicts, competing companies or a large number of universities that have not an objective to commercialize any results, the company will not get involved in the consortium.

4.4 Leverage and impacts of the H2020 subsidy instruments

4.4.1 Utilization and leverage

According to the interviewees, the H2020 subsidy was primarily utilized in all case companies for either technology development or demonstration and scaling purposes. The difference in companies' age and technology level affects how the subsidy was targeted between development stages. The technology development included larger-scale demonstrations rather than basic design and engineering work. Concurrently, multiple interviewees stated that the subsidy was allocated to salaries to keep the staff developing the products. Moreover, the companies were able to hire new employees and expand their staff, although only a few case companies recruited permanent employees. It was perceived to be more common to hire temporary employees to support product development. The increase in the staff was rather seen to result from natural growth in companies' life cycles. The multiplier effects of the subsidy on employment increase might have come indirectly as subcontractors were utilized for non-core business activities.

Also, hiring permanent employees was controversial as the case companies do not have sufficient turnover. As Zulu expressed, the H2020 subsidy is a project subsidy meant for the execution of the project instead of support for the company. The interviewee addressed that although the firm did not hire any permanent employees for the H2020 project, it hopes to do so as the technology will become more mature and commercially viable.

> "*Of course, this funding is meant to run the project, not the company. Hiring permanent employees to a company with no turnover is challenging to justify. We have not had any recruitments for this [H2020 project], but we hope that based on the results of the project, what we can show for others, will take the company forward so much or build that stairway that at some point we will get to the point where we can recruit employees." – Zulu*

Nevertheless, not all case companies hired even temporary employees. Concerning other case companies, an interview with Kilo revealed that the company has a habit of not hiring project employees. Instead, the staff are hired as full-time employees who will work for the company also in the future. This policy was explained to support the fact that the company is not applying for H2020 projects just for the funds but because they genuinely want to do the stated activities in the project proposal. Altogether, as the H2020 project might last multiple years, Bravo explains it could be challenging on some occasions to specify how the subsidy have been used precisely. In fast-growing technology-based SMEs, the funds are constantly in use and are not necessarily earmarked.

> *"It is difficult to specify for what exactly that support is used. After all, we have grown up all the time. The truth is that in a small business when money comes in then it is used for everything, and when money is tight then an attempt is made to pull it from somewhere else for a certain need." – Bravo*

Besides hiring employees, the interviewees were asked to have they utilized the H2020 certification label as leverage to attract new employees. Most companies had leveraged and mentioned the H2020 when hiring new employees, but none of the interviewees perceived it would have had a significant impact. The promotion and utilization of the H2020 label or recognition was rather seen as a 'thing among others' and not leveraged quite actively while attracting new talents. The label was not perceived as an essential factor as time has passed because its novelty decays overtime. As technology develops at an ever-increasing rate, the H2020 quality label might not be of value and should or could be leveraged close to the subsidy's receipt, as Alpha explained. While hiring new employees, the H2020 subsidy was leveraged closer to the receipt of the subsidy but not actively anymore.

> *"We have not leveraged it [H2020 label] anymore. It has been more positive considering fundraising back in the 2015-2016 near the receipt of the subsidy." – Alpha*

Compared to attracting new employees, the H2020 subsidy was found more important with leveraging funding and raising external capital. The capital leverage was

acknowledged as beneficial for attracting financiers. It is also easier, for instance, for VCs to get more out of their initial investment when another part of the funding is from a non-diluting subsidy. The non-diluting monetary 'double benefit' was perceived positively among interviewees as well. Several case companies had leveraged the receipt of the H2020 subsidy simultaneously while acquiring funding because it was perceived as a valuable opportunity to obtain more capital for development. Bravo realized that eventually, the public subsidy should be leveraged with private capital or otherwise, the opportunity is lost and later, the effect might not be as helpful anymore. However, the company did not leverage the H2020 subsidy as clearly as with earlier Business Finland projects when acquiring private funding.

> *"At some point, I started to think that you always must have a certain proportion of your own money, so these [subsidies] should be scheduled in a way that if you apply for a subsidy, the funding round should be organized to leverage those funds. It is kind of wasted if you take in equity but do not get public money leveraged at the same time." – Bravo*

Yankee 1 agree with Bravo and states the company indeed had a chance to leverage external funds as the company secured eligibility for a convertible loan from Finnish Industry Investment Ltd (Tesi), but only in the case of a complementary investment, such as with the receipt of the H2020 subsidy. On the other hand, Alpha and Tango explained the companies did not specifically target funding rounds near the H2020 subsidy. The companies have either needed growth funding all the time or have applied for the H2020 subsidy multiple times and just happened to raise capital at the same time. Therefore, the H2020 subsidy was not perceived or utilized as a leverage per se. Perhaps the receipt of the H2020 funding might not be significant merit to leverage if there are no concrete results to prove. Hence, the demonstration and prototyping of the underlying technology are emphasized more, as Zulu puts it.

"It [H2020 subsidy] has been involved [in negotiations] and perhaps not the fact that we received a grant, but the project itself and the results have been involved in the financial negotiations much more" – Zulu

During the interviews, it became evident that the case companies are obliged by the EU to recognize and acknowledge the H2020 project support on their websites. Even if the obligation would not be mandatory, Yankee 2 expresses that the company is proud to promote the EU's recognition as the receipt is genuinely a badge of quality. The company does that of necessity and also of choice. Yet, the leverage of the H2020 recognition is varying among case companies as some of the companies' websites do not highlight the reception almost at all. The lack of a clear H2020 mention was revealed in a few interviews when it was explained that the leverage of a subsidy recognition might not bring any additional credit even if the recognition comes from credible actors such as Business Finland or the EU. For instance, when an interviewee was asked does the company perceive that different certifiers would bring more legitimacy and strengthen their position in the eyes of stakeholders, the answer was twofold.

The subsidy recognition by different credible certifiers can be leveraged with certain things but not in all situations. Tango addressed that the company has received previously Business Finland subsidies and mentioned the receipt on some occasions, but excess recognition might be harmful in the long term. Although the receipt of a subsidy, such as the H2020, is an evidence of appreciated due diligence, the company would like to grow through real business and has tried to maintain a lower profile with the promotion of the receipt of the subsidies.

> *"We have mentioned Business Finland in some things, but if there are only such recognitions or certifications, then it starts to look like we are doing business only with applications and subsidies. But we want to grow the real business, and therefore we have tried to keep it to a minimum. In some situations, it is good to express that [subsidy] because it shows that someone has done the due diligence. It is beneficial, for example, in the case of selling equipment to a government body."* – *Tango*

Tango also expressed that if the company had received the H2020 SME Phase II instrument, they would not have made any special mention of the recognition or brought it up in public except in certain contexts. Tango clarified that at the beginning stages of the company's and its technology's development, they leveraged the acknowledgement of the subsidy stamp with stakeholder communication. However, the company does not see any added value from the recognition anymore. The company has received a Seal of

Excellence from the EU admitted to subsidy applicants who did not get H2020 funding due to the EU's budgetary constraints. Nevertheless, Tango expressed that the company does not want to be perceived as a startup in front of stakeholders as startups are considered less reliable partners. As the company has matured, its objectives have changed, and the subsidy recognition has lost its relevance and value.

> "*At first, we used it to some extent [Seal of Excellence], but we want to profile less as a startup. If we profile ourselves as a startup, it reduces credibility because if someone buys our equipment, they want to buy it from a solvent company they trust and have good security of supply. A startup is often perceived as a risky partner, so we have not wanted to promote innovation competitions or that type of Seal of Excellence stamps anymore. It was a different thing when in the beginning we had different goals." – Tango*

Interestingly, Kilo shared similar perceptions with Tango regarding the leverage of the EU subsidies. It was found true that an SME can attract better when it has a stamp from a larger body such as the EU. This recognition potential was perceived so important that Kilo had been innovating the Seal of Excellence certification for the EU. Besides, before Kilo joined the company, the latter received funding for Young Innovative Companies from Business Finland. The reception was recognized as an advantage to get external private funding as the company received a nationally highest grant. Moreover, the recognition also aroused interest in the eyes of international investors.

Despite the positive leverage effect, Kilo also shared the same view with Tango, that the subsidy could act as a 'double-edged sword'. During the interview, Kilo also explained that the H2020 certification might provide additional value for the company at the beginning stages, but not anymore as the industrialization of the technologies should take place. The stakeholders might not find a heavily and repeatedly subsidized firm as a legitimate actor even though the subsidies would have been granted for different EU projects.

> *"We have [leveraged the H2020 certification label], but it is a double-edged sword. Let's say that when companies want to invest in start-ups, then there is some benefit from these [labels]. But we are no longer a startup, we would like to industrialize our technologies, and at that point, if there are many subsidies, it*

> *may not be a good thing anymore. If, for example, we make a declaration about our company, then we will no longer mention that we have received many subsidies. Everyone wants to see that we are a commercial operator and not one firm that has received many grants. Then as the company becomes a little more mature, it is no longer appropriate to advertise this side anymore." – Kilo*

In other words, the H2020 subsidy could be leveraged beneficially, but the positive effect might not be sufficient in all stages of the development. Moreover, abundant subsidization can turn against the company and harm its reputational capital among stakeholders. Therefore, the interviewees stressed that the company might need to be selective when utilizing and promoting subsidies, such as the H2020.

4.4.2 Effects of the H2020 subsidy

In general, the H2020 project was perceived as highly relevant to the case companies as the project has played a pivotal role in developing their technologies. The projects allowed a transition from pilot to prototype and demonstration scale, and as Kilo explained, the project that the SME instrument enabled is precisely the one that put their technology platform in order so the company can do other activities. The H2020 project was also realized, to some extent, even crucial in terms of a firm's development. Whiskey expressed that the company would not be in its current position in technological development without the H2020 subsidy. The project not only provided direct effects, such as monetary benefits but indirect as well when the company was able to get new customers and hence receive valuable references.

> *"Well, in that phase, it was really essential. We would not be this far without the subsidy. We developed the product a lot further, and we got an important reference that took us a step forward." – Whiskey*

In addition to Whiskey's view of the subsidy importance, Alpha agreed that the H2020 subsidy allowed the company to take the project forward at full speed on the fastest possible schedule. Despite the H2020 projects' significance for the companies' technology development, Bravo revealed contradictory feelings about the project and wondered if it would have been better if it had never gotten involved in the project. They have

had very negative experiences with it. The interviewee explained that the company perceived the purpose of the H2020 subsidy was to execute the project proposal and not provide the best results. As markets and technology develop, the company is tied with the long-term project plan that might not eventually generate the highest impact.

> *"One unfortunate feature, especially in such large, longer-term projects, is that the project plan is created when the subsidy is applied for, and the plan should then be followed. The typical task of a project is to complete the project and not so much to get the most useful results from it." – Bravo*

Although the financial leverage effect of the H2020 subsidy might be perceived as beneficial by the interviewees, the experiences of the actual impact on funding differs. In an interview with Whiskey, it was revealed that the H2020 subsidy had alleviated the access to finance from all sources, and the company has had good equity investment rounds after the H2020 subsidy, indicating a favourable as well as positive impact. Interestingly, several interviewees expressed the opposite effect on immediate private funding. According to Bravo, the company did not see any clear positive impact or instant effect on funding regarding the receipt of the H2020 subsidy. Echo and Zulu stated that there was no positive impact on attracting external capital as the funders perceived the case company has enough funds for the near future after the H2020 subsidy was secured. In turn, the funders assume that the need for capital is automatically shifted and postponed for later activities without necessarily realizing that the H2020 project funding is allocated and committed to a specific purpose.

> *"Unfortunately, I might see it in such a way that it [receiving H2020 subsidy] has not made it [obtaining funding] easier. These particular parties who have invested in us have also expressed that you now have money for this project so use it, without any understanding of how we have committed to spend those funds." – Zulu*

Sierra agreed and clarified that despite receiving the H2020 funding, ultimately, investors do their evaluations, and thus, the positive financial impact might not be as clear and unambiguous. The company has although secured and closed more investments with investors after the H2020 subsidy. However, the impact was perceived to result from more mature technology, not by the recognition itself. Surprisingly, even though in an interview

with Yankee 2, the H2020 subsidy was seen to enable easier access to private funders, the company had mixed feelings about the impact of the subsidy itself on the company. As the interviewee explained, the EU is practically the largest funder with the H2020 subsidy for the company's projects. This relationship creates a certain sense of gratitude but not perhaps in a positive way.

> *"I am just really observing that if you are a young company and your entire operation is funded by a single EU project, which is almost the case for us, you are beholden, you are stuck in a certain sense with a rather old-fashioned parent who determines when you cannot leave your bedroom. It is a little bit like that." – Yankee 2*

On the other hand, the receipt of the H2020 subsidy was perceived positively among current employees in the case companies. Although the receipt of the H2020 subsidy gave an additional boost to some extent, the overall effect was found relatively neutral. In addition to the significant financial contribution of the subsidy, it was recognized that the certifier's prestige might have affected the mindset of the employees. Bravo stated that on some occasions, nervousness could be felt among employees whether projects will proceed or not. However, as the H2020 contribution was received from a large and credible body, the employees might feel a sense of stability, according to the interviewee. Put differently, the impact of a certification from a large and worthy body might bring security and affect internal legitimacy inside the company.

> *"In this company, all the employees sense that sometimes there is a tight tension about whether projects will continue. When the decision comes from a bigger authority that projects continue, it brings security and continuity." – Bravo*

Overall, all the interviewees agreed that the stakeholders perceive the receipt of the H2020 subsidy favourably, and the positive impact on the legitimacy has alleviated to get new customer references and finance. Nevertheless, all financiers might not see it in a positive light. According to Papa, those VCs that operate in the same industry and have sufficient knowledge might recognize the receipt of the 2020 subsidy as a good sign, but others probably not. Moreover, Alpha clarified that although the subsidy's impact on

stakeholders' perceptions about the company has been positive, it is challenging to judge how significant that contribution has been.

Interestingly, Bravo revealed that the receipt of the H2020 subsidy has impacted how some customers perceive the case company, particularly in good light. The interviewee emphasized how the recognition of the H2020 subsidy was received highly favourably among Chinese who perceived that when the company's technology is acknowledged by a large body, such as the EU, the company must have something of great importance. In China, state involvement was seen as a favourable act, but the interviewee has not recognized a similar impact in other countries.

> *"At one point, we had a lot of discussion with the Chinese, and they greatly appreciated the fact that either the Finnish state or the EU has noticed [an H2020 recipient] and there are joint projects that either one funds. That had huge relevance to them. In other words, for some reason, they have a view like this that when there is a state involvement, then it is something important and successful. They gave much weight to it, and we were advised to bring it up in China with anyone I talked to. In there [China] it was more appreciated, but I have not noticed the same effect elsewhere that it would be of great importance." – Bravo*

Tango agreed that the receipt of the H2020 subsidy from a large body might have a positive impact, especially in remote countries or continents, such as in Africa. Yet, the interviewee expressed ISO certificates are more of value than EU certificates or recognition. For instance, considering UN procurement, the interviewee explained that ISO certificates are a prerequisite for many projects and have a higher impact on business activities than EU recognition, such as H2020, which are less critical.

As the H2020 project was found, according to the interviews, of great importance for the companies' technological development, the interviewees were asked about the degree of deadweight. That is, would the project have been implemented at all without the H2020 subsidy. In general, the H2020 subsidy was recognized as such an important financial instrument for the companies that multiple interviewees stated the project would have implemented on a much smaller scale or not at all. Few interviewees wondered where the company would be at the moment or from where the funds would have been even obtained if they would not have received the H2020 contribution for their technology. Interestingly, the receipt of the H2020 subsidy might have affected the nature of the companies'

business model as well. Yankee 1 addressed that in the case of rejection, they would have perhaps ended up as a company that just licenses patents as they would not have been able to do the costly technology demonstration work. Moreover, according to Kilo, the company's cutting-edge technologies would not even probably exist without the support. The EU subsidy brought the company to the same level as other collaborators, which was crucial in understanding what the markets need.

> *"Many of our spearhead technologies today would not even possibly exist without these EU subsidies. After all, we would not even know that our partners would have liked these things if we could not have been on the same playing field with them. That is what you get from these EU projects that you get to play with other players in a safe sandbox." – Kilo*

However, not all case companies perceived the H2020 subsidy as vital support for implementing their technologies. In the interviews, the impact of the H2020 subsidy was addressed as essential but not indispensable for the execution of the project. Alpha revealed that although the company would have implemented the project on the same scale regardless, they would probably have had to apply for another type of financing for the project, such as equity financing, which would dilute ownership. Tango explained that even though the company did not receive the SME2 instrument, they have done all the same activities and development. Nevertheless, certain things could have been done with a larger budget. Bravo agreed and revealed that in addition to the sufficiency of private money for the project implementation, the H2020 funds could lead to oversized projects. As the projects might last several years, there is reserved extra leeway in the budget, and the project could be implemented with less money.

> *"We would have carried out the projects on a much smaller scale, and we would probably have managed with the same private money, which means that I do not see it as absolute that we should have gone to that [apply for H2020] in that sense. It easily leads to the fact that these projects become easily oversized. Once you have a predetermined budget, then it will be used. Then applications are made five years ahead and in a hurry, so those budgets are made loose. Yes, that money is, to some extent, wasted. Let's do things that would not need to be necessarily*

done, or that could be done, if we thought more thoroughly, with much less money." – Bravo

Additional external funding, such as the H2020 subsidy, could also impact the usage of the case companies' internal funds. Is there an impact on how the case companies allocate internal funds for the H2020 project? As the companies receive external funds, on some occasions, the companies might direct their internal funds to other projects, which would indicate a crowding-out effect. According to the interviews, it became evident that, in general, there does not exist significant positive or negative monetary crowding effects. Multiple interviewees expressed that the company is so resource-constrained that they do not have any additional internal funds to leverage the H2020 project further. Many case companies have already put everything they got into those projects. On the other hand, the H2020 project might play such a huge role that the company itself is operating around it as Yankee 2 expressed. Hence, it is possible that there are not any non-H2020 related project or activity in the company that the existing internal funds would be allocated to. Nevertheless, Zulu stated that the company did implement other functions simultaneously with the H2020 project, but those activities would have been done regardless of the project. It could be perceived that there do not seem to be monetary crowding out effects since no case company expressed they possessed existing internal funds that would have been earmarked to the project before receiving the subsidy and would have been used for other purposes than the H2020 project after obtaining the grant.

Despite the lack of additional or reserved internal funds to invest in the H2020 project, the companies might have reallocated other resources, such as employees, after obtaining the subsidy. Therefore, the case companies could have transferred some of the employees to other projects or functions and create a less visible crowding out effect, even unknowingly or subconsciously. According to the interviews, the effect was quite the opposite as the H2020 project has tied up rather than freed other non-monetary resources. However, Zulu perceived it as a positive issue because, without the subsidy, the company might not have been able to allocate those resources to the H2020 project. Moreover, it could be the case that without the subsidy, the resources tied up to the H2020 project would not have been justified as the internal investment had not been enough to implement it at a reasonable scale. Thus, the reallocation might not only jeopardize the success of the H2020 project but other functions as well. On some occasions, as Bravo

continue, the EU projects have been so huge compared to the company in overall, that virtually all the energy and effort have been under those projects.

However, the monetary crowding in effect can sometimes take a while due to uncertainty. As the technology development got further and risks might become lower, the company could be more willing to give a favourable funding decision, as Kilo addressed. The H2020 support has helped the project receive internal funding later because it has been easier to sell the idea inside the company when there are both subsidy and favourable results to show. Therefore, the crowding in effect might not be immediate but come with a delay instead.

> *"At the point where the project starts to show promising results and the technology goes forward and arouses interest, it is easier to get financing or sell the idea internally. You can show that hey, we built the pilot, now it produces, and there is a customer who wants the product, so how if we would focus on this? Of course, then you get the resources. The EU project has helped to get those resources internally compared to marching in front of the board and saying I have a good idea; I have never tried it, but now I would need 2 million. This project will help to make it so complete that it can be sold internally." – Kilo*

Interestingly, an interview with Echo revealed that sometimes the crowding-in effect might not result from voluntary or additional capital investment to boost the project even further. On some occasions, the instruments in H2020 funding might include 100 % coverage; that is, the recipient does not, in theory, have to invest its own money at all. Still, the funding ceiling is fixed, so all expenses that will exceed the ceiling will have to be paid by the subsidy recipient itself. Bravo agreed with Echo and claimed that nearly all projects surpass the budget on behalf of the company, and the EU project officers do not approve all expenses. This could create a 'forced' crowding-in effect as the companies might need to invest more of their own capital for the project if they cannot get external private funding.

> *"There are many expenses that are not accepted. In reality, if the self-financing rate is 30 %, then it is really 40 or 50 %. It is delusive because if you imagine that it is only 30 % then pretty quickly you run out of money." – Bravo*

Finally, as large H2020 subsidies can accelerate the development of the case companies' technologies and impact increasing the company's legitimacy, the interviewees were asked to reflect if the H2020 subsidies would have distortionary effects on competition. The interviewees did not recognize any specific moment in the firms' development that would have precisely accelerated their operations and enabled an apparent leap forward. Although the H2020 subsidy has impacted the development of the case companies' technologies, several interviewees stated they could not mention a single point that would have played a major role alone in the companies' development. Instead, the development of green technologies is a long process that does not happen overnight. Thereby the H2020 subsidy was not seen as a pure 'game changer' in the companies.

Nevertheless, Bravo admitted that the company indeed expected such an impact after the final installation of their high-power device, which would feed electricity to the grid and allow the company to get customer projects forward. Eventually, the EU suspended the project, and the company's partner risk realized, which caused a delay. The H2020 project is, however, seen considerable milestones for the company, as Echo presented. The successful demonstration of the technology might increase the company's legitimacy and act as an essential reference. Still, the interviewee did not indicate that after the company got the H2020 funding, there would suddenly be a burst of rapid growth.

> *"That Italian case [H2020 project] is a demonstration. Of course, when we go there to demonstrate, it is a reference and a key milestone for us. But I would not say now that we get [H2020 funding] or end a project, and then miracles happen, and the business starts to grow exponentially because of that project. I do not feel that way." – Echo*

Surprisingly, multiple interviewees agreed that the H2020 subsidy would not distort competition or have a meaningful impact. It was admitted that an enormous contribution from the EU enables the development of the technology and might create a competitive advantage but only temporarily; in the long run, it matters what the added value and competitive edge of the product is. Even though few interviewees addressed distortion in market competition to some extent, it was perceived as justified because the positive spillovers to the society should be significant and thereby, these technologies should be subsidized. Moreover, as the H2020 subsidies are open for all to apply, the receipt of the subsidy was not seen to distort because nothing should prevent an applicant from applying

for EU funding. The H2020 subsidy application process already cuts the unfit companies from receiving the grant, so the subsidy would rather be perceived to create a market-distortionary impact if the funds would be allocated to weak firms.

The subsidies were also perceived to have quite a different distortionary impact on competition than to re-enforce the companies and trends that already exist in the markets. In an interview, Bravo stated that the green companies in the same sector are reliant on the available subsidies and has no option but to get involved with the public support. Financiers demand the companies apply for these subsidies as their own investments are thereby less. The effect was seen strong, and companies in Europe was said to be in this kind of spiral.

> *"I would believe that all companies in our sector are in such a spiral that they are fully dependent on these subsidies. At least all European competitors are in this spiral. These firms are forced to go into this support jungle. When an opportunity exists, it is not just an option but a must-do. The VC funds require that the grants are applied for. They see that their own contribution would be lower if the firm receives public subsidies." – Bravo*

Put differently, the subsidies distort the competition in such a way that if the company do not apply for the subsidies, then it is no longer involved 'in the game'. Overall, in the big picture, the subsidies are essential instruments to get new forms of energy or clean technologies to move forward, regardless of negligible distortionary impacts. Without those, the companies would be at the mercy of private investors alone. According to Bravo, the development of these technologies requires very generous financiers that have not been seen in the sector.

5 DISCUSSION

5.1 Discussion of the research results

To address the motives and factors applying for the H2020 subsidies, the interviewees were asked about where the companies have obtained funding and how challenging has been the acquirement of funds in different stages of development. The purpose of this question was to shed light on how big a role the financial situation has had in applying for subsidies since, according to existing research, green high-tech SMEs encounter severe financial constraints (Čučković & Vučković 2018). As Myers and Maljuf's (1984) pecking order model illustrated, the case companies have had challenges to obtain private funding, but not to the extent what the theory indicates. Naturally, all the case companies did not have sufficient turnover to cover their R&D and innovation efforts. Surprisingly, the interviews revealed that the case companies had acquired funding from both the private and public sector, such as BF, VCs, banks, crowdfunding and angel investors. Nevertheless, according to the interviews, there was no unanimous factor that would have restricted or impaired the acquirement of external funding. However, several interviewees stated that access to bank finance is difficult, supported by Hall (2002), as the banks usually fund stable businesses.

Albeit previous empirical research present favourable results of green high-tech SMEs and pecking order theory in Europe (Spoz 2014), interestingly, the interviewees addressed other fascinating reasons to apply for external funding, that is, the EU's H2020 subsidies. Multiple interviewers shared a similar view that as the technology got closer to large-scale demonstrations and commercialization, the demos cost millions of euros, and the funders for these expensive activities are difficult to find, corroborating the view of Nemet et al. (2018). Moreover, the cost of developing those technologies is so huge that EU subsidies are perceived as sufficient to provide the necessary funds. This was recognized especially in the case when national subsidies, such as BF, could not be used anymore. Thereby, the valley of death, between the end of public funding and the start of private funding, was recognized as the case companies encountered a financial gap between the stages of R&D development. In general, but not surprisingly, all but one interviewee stated that funding was an important factor to apply for the H2020 subsidies as the companies are in constant need of funding. This observation can be seen in Table 3, which presents the summary of the key findings.

Table 3 Summary of key findings

Cases	Alpha	Bravo	Echo	Kilo	Papa	Sierra	Tango	Whiskey	Yankee 1 & 2	Zulu
Motives and factors to apply for the H2020 subsidies	Money more important than certification and credibility by the EU	Funds and networking more important than recognition by the EU. National funding not available or sufficient	Networking, subsidy percentages higher in EU than domestically	Funding is a secondary issue, properly chosen partners and open innovation are essential. Stamp by the EU not vital	Funding, awareness and visibility are considered pivotal	Funding alone not enough, expand contact network and visibility	Grant is the only important factor, stamp not so much	EU stamp in finance not so relevant, grant size more valuable	Benchmarking with EU strategies and a gateway to EU markets. Not a huge effort only to get visibility, national funding unavailable	Networking, awareness and funding. Stamp not as important
Reporting and collaboration in the H2020 program	Quite burdensome reporting, very compliant and cooperative	Reporting not terribly massive, quite inflexible collaboration	Reasonably heavy but not insurmountable, understanding and flexible collaboration	Considerably heavy, fluent cooperation	Not difficult or heavy obligations, fluent cooperation	Outsourced reporting, surprisingly flexible communication	Did no receive SME2, thus no reporting or communication	Rather heavy and burdensome, not customer-friendly	Really much work in reporting, flexible cooperation	Heavy and always not quite clear, reachable and flexible, but too microscopic
Deadweight and crowding effect	Would have implemented it on exactly the same scale anyway. Partial crowding in effect	Would have carried out the projects on a much smaller scale. Includes forced crowding in effect	Project would not have been implemented as such. No immediate effect, but might include forced crowding in later	Many projects would not have been done at all. Delayed crowding in effect as projects start to show promising results	Project would not have been implemented even with adjustments	Would have not implemented at the same scale. No crowding in effects	Have done all the activities that would have been done, but with larger scale. Crowding effects unavailable to study	Project would not have been implemented without the grant at all. No crowding in effect	Project would have been done on a different scale or not at all. No crowding-in effect	Project would certainly not have been done on this scale and to this extent. No crowding in effect
Stakeholder reception of the H2020 subsidy	Primarily positive, challenging to judge	Some stakeholders perceive positively, especially Chinese	Positive, BF values but VCs not crucially. Immediate funding difficult to obtain	Positive perception among stakeholders, particularly funders appreciate	Positive, banks appreciate and only knowledgeable VCs	Positive effect, attracted more investors' funds	Primarily positive among stakeholders	Every stakeholder has perceived the reception positively	Funders, such as BF, emphasize positively	Primarily positive, although funding might not be easier to obtain
Utilization and leverage of the H2020 instruments	Utilized the stamp in crowdfunding near receipt of the grant, though not specifically targeted round after H2020	No high emphasis on external communication, slightly leveraged private funding near investment round	No immediate leverage effect on private funding, ' stamp' not important in communication	H2020 stamp utilized only in early communication. Multiple grants could be found inappropriate among stakeholders (double-edged sword)	No instant effect on funding, H2020 project emphasized in the firm' s website	Utilized partly in communication with customers and investors, H2020 not purposely leveraged with private funding	No purposeful leverage of private money close to a funding round, stamp utilized only in early-stage communication	EU certification promoted and leveraged, succesfull equity investment rounds after H2020	Utilized fresh receipt of the H2020 grant when acquiring funds from private investors. Certification also applied in communications	Leveraged funding round near receipt of H2020, stamp less involved in communications than technology results

According to the interviews, it also became evident that the higher subsidy percentages compared to national programs had affected the decision to apply for the H2020 subsidies as there is more money to use. Unlike national aid, the EU subsidy percentages could be multiple percentage points higher, which can be realized as a lucrative option for the resource-constrained case companies. Overall, it was perceived that the large funding provided by the H2020 enabled the development of the case companies' technologies and thus mitigated to take a leap forward.

However, the case companies' advancement was precisely seen as a result of the development and demonstration of their technologies, rather than stemming from the certification effect of the H2020 subsidies. Yet, unexpectedly, the H2020 certification was not considered as a primary factor in applying for the subsidies. Although this finding supports existing research results by Howell (2017), who found that credibility comes through concrete results rather than quality stamps, it was surprising how little emphasis the case companies gave to the H2020 certification considering the vast positive evidence of government certification for resource acquisition. According to the interviewees, it did not matter that much who is the certifying body, perhaps because it was also perceived that some stakeholders do not crucially appreciate the H2020 label. The lack of appreciation, for instance, from financiers might stem from not understanding the value of the certification or not knowing how to leverage the H2020 stamp correctly. Conversely, it could also be an indication that the financiers only consider the funds and find no additional value from the H2020 certification as it either does not reveal any new information (King et al. 2005) or they realize that government might support companies with large spillovers for the society with low appropriability (Wei & Zuo 2018).

Nevertheless, the neutral perception or lack of significance regarding the H2020 certification from the case companies' perspectives to apply for the subsidy is highly interesting when compared to the EU's intentions. On the contrary to case companies' perspectives, the EU has a quite different viewpoint for the certification effect as it has precisely created an instrument, the Seal of Excellence, that does not provide any funding due to EU's H2020 budget limitations, but only the certification of the quality instead. If the companies see that they are only able or willing to utilize the H2020 subsidy to leverage additional funds, and the private financiers do exactly the same, that is leverage the H2020 subsidy to get more out of their own investment, the pure certifying nature of the quality label might not be enough or essential. Therefore, based on the interviews, it seems that multiple parties, such as the EU, external financiers and the H2020 subsidy

recipients, perceive the benefits of the certification differently. Consequently, the differing perceptions might not only affect applying for the subsidy but also the case companies' utilization of the H2020 certification.

In addition to financial leverage with private capital that the H2020 might enable for the case companies, the certification from a trustworthy and respectable body can bring legitimacy that the novel early-stage companies have not yet accrued (Fisher et al. 2016). The legitimacy amassed by a venture's prior achievements were expressed as a result of awards and certifications from competitions (Hallen & Eisdenhardt 2012), which may deliver advantages during later activities. More legitimate actors, for instance, the H2020 recipients, might be able to attract other resources than purely monetary, such as talented employees or public approval. Nonetheless, a reason why the case companies perhaps did not see the certification as a primary motive to apply for the H2020 subsidy is that the interviewees corroborated the case companies have not had a habit of participating in innovation competitions to obtain certifications or recognition to increase legitimacy. Yet, the H2020 certification and the EU were not seen as an essential or different body to get recognition from. Interestingly, this could indicate that the case companies do not value the EU certification much more than the national recognition. However, regardless of who is the certifying body, it was expressed in an interview that the industry's recognition is derived from somewhere else, such as from industry actors.

Also, the participation in innovation competitions, and thus perhaps gaining legitimacy, was seen as a mean to get visibility and contacts rather than as pure merit to be leveraged per se. In accordance with the findings of Čučković and Vučković (2018), the H2020 subsidies were recognized to enable networking with other industry actors, especially in consortia which include multiple members usually from the same industry. Disclosing information and raising the company's profile were seen as quite pivotal motives to apply, especially since an interviewee perceived that the H2020 program itself was not too intriguing, but rather what connections the program enabled is valuable. Considering networking effects, IPR concerns did not influence the decision to apply for the H2020 subsidies, such as RIA or IA consortia instruments, contrary to Luukkonen's (2000) evidence from Finnish pharmaceuticals. Although IPR related issues can be disincentivizing due to appropriability concerns, yet those did not affect the decision to apply but instead what know-how to bring in the consortia. In turn, on some occasions, the interviewees expressed that the members in the consortium are divided or selected so carefully that there is no risk of IPR issues.

In addition to the motives and factors to apply for the H2020 subsidies, the reporting obligations and collaboration in the H2020 program was examined as the H2020 projects might last multiple years. During the interviews, it became evident that although the H2020 programs include much reporting, the actions were worth the money. In fact, multiple interviewees expected that if the company can obtain a couple of million euros, there is some reporting to be done. However, the complexity and excess pedantry were expressed to impose a heavy burden in some instances. The bureaucracy with the EU can be even more ponderous if there are several consortium members.

The perceived fluency in the H2020 reporting among case companies was recognized to differ, partly due to the nature of the instruments and the number how many times the companies had been involved with the H2020 program. For instance, Kilo had participated multiple times in the H2020 program, and the company had even built necessary subsidy processes for this. Despite the different experiences on the reporting obligations, it was found time and resource-consuming as executive-level members were writing the reports that could take approximately one employee month to complete. Therefore, the opportunity cost for time-consuming applying and reporting could be quite high, as Takalo et al. (2013) and Howell (2017) presented.

Although usually, cooperation with a large body can be bureaucratic, generally, the interviewees did not perceive that as such. The EU's project officers were easy to approach even though few interviewees expressed frustration due to strict compliance with the "law-books" that had to be followed. Moreover, the issue with a lack of common sense was perceived to create an unreasonable workload as some cost variations or allocations had to be discussed profoundly, aligned with Sipikal et al.'s (2013) findings. The time consumed in such debates hampers the case companies' agility and, thus, might delay other projects. Furthermore, the inflexibility of the program was addressed by Bravo, who explained troubles with cooperation in the H2020 program. It was evidenced that stopping a project might not be straightforward as the EU can reclaim the admitted subsidies. Interestingly, however, continuing with the project could not be in the interest of all parties, such as private investors, creating a conflict of interest.

In turn, the cooperation in consortia could involve multiple members from countries across the EU area in addition to the EU project officers. Nevertheless, the interviewees did not face any severe cooperation challenges overall. Some actions in cooperation were perceived to be a result of cultural differences among Northern and Southern Europe ra-

ther than intentional actions. Surprisingly, the close connections between previously familiar members were explained to be a potential issue in the consortium. In the event that a member starts to default on its obligations, it might not be easy to exclude the member without harming or delaying the whole consortium if the defaulting member is able to attract other participants to leave as well due to solidarity reasons, as Bravo evidenced. The issues in the consortia created by the close relationships between partners is a fascinating finding as existing research (Sipikal et al. 2013; Spoz 2014; Čučković & Vučković 2018) has not addressed this perspective.

Also, it was addressed in an interview that the consortium companies should be such that those have a fundamental objective to be included in the consortium instead of just being a member per se. Perhaps this might be one reason for misunderstandings and delinquency that the interviewees expressed. Besides, a large consortium involves multiple members, and as people and companies change, so does the interest of the participants. Therefore, the cooperation might vary and be quite different compared to, for instance, SME instrument, which most often includes just one participant. It is possible this phenomenon could be a factor not to apply for the H2020 subsidy in the case that the consortium instrument would be an only suitable option for the SMEs. Overall, it was interesting what kind of troubles and risks were recognized and expressed by the interviewees regarding the participation in the H2020 projects because existing research has not included such factors (Sipikal et al. 2013; Spoz 2014).

While examining the utilization of the H2020 subsidies in the case companies, it was realized that the funds were primarily allocated to either technology development or scaling. Besides, the subsidies were also allocated to the salaries to keep the development active, yet it was found common to hire temporary employees instead of permanent. As the case companies do have low or insufficient turnover, justifying the recruitment of new permanent employees was perceived difficult. However, the statement was challenged by Kilo, who stated that the company has a policy only to hire permanent employees, further expressing that they do not participate in the H2020 program only for money. According to the interviews, obtaining the H2020 subsidies were unanimously recognized to be highly essential for the companies and their technologies development as the subsidies enabled the transition from pilot to prototype and demonstration stage. Yet, surprisingly one interviewee expressed the opposite view and even wondered if it would have been better had the company never received the H2020 subsidy as there had been multiple obstacles during the project period. Because the H2020 project might last multiple years,

it can lock the company in its chosen path for a relatively long period without generating optimal or commercially viable results, especially from the company's perspective.

Although it became evident during the interviews that the case companies did not crucially appreciate the H2020 certification or apply solely to get the recognition of quality, they still utilized it while acquiring external funds. The H2020 stamp and funds were leveraged to get more capital with the subsidies, but on some occasions, it was considered more of a coincidence as the companies have been in constant need of funds. Therefore, it seems that the H2020 subsidy was not perceived as a remarkable proofpoint for which to explicitly target a funding round per se to secure more capital from financiers, as Hallen and Eisenhardt (2012) suggested. Nevertheless, according to Zimmerman and Zeitz (2002), given that the resources constrain a novel venture, it ought to leverage inexpensive activities that increase legitimacy, such as certifications and awards. Based on the interviews, however, the utilization of the H2020 certification in communications and promotion with stakeholders might not be entirely at the discretion of the subsidy recipient. The leverage of the H2020 label was found voluntary as well as mandatory at the same time because the subsidy recipients are obliged by the EU to mention the H2020 subsidy on their websites.

The certification, and thus, recognition from a respectable body is merit itself, yet it was realized as a burden in some case companies and hence not actively promoted. The reason not to promote was recognized to have a connection with the age and maturity of the company. The finding is partly consistent with Zimmerman and Zeitz (2002), who stated that the certification might provide value and be more useful during the early stage as there is no proven track record or production processes. However, according to the interviewees, the lack of promoting the H2020 certification was not purely because of, for instance, achieving a track record. Instead, the interviewees mentioned that the company wants to grow through real business rather than subsidies, which might harm the company's reputation. Also, the EU subsidies were seen as more valuable when the company is much younger, and its objectives are different. Therefore, the H2020 subsidy was stated as a "double-edged sword" in some cases due to its beneficial and potentially harmful effects, reducing its utilization. Because the case companies did not want to profile as start-ups anymore, it was found to be perhaps counterproductive to promote the receipt of the H2020 subsidy instrument(s) as Fisher et al. (2016) presented.

Moreover, according to Fisher et al. (2016), a company is encountering institutional pluralism as it transitions from one stage to another, for example, from conception to

commercialization, and appeals to two stakeholder groups. During the early stages, the audience who judges the legitimacy of the subsidy recipients is grant officials who might find funding high spillover projects beneficial and thus perceive the certification and the H2020 subsidies positively. However, the subsidization is not appropriate in the later stages as the legitimacy changes from intangible, such as certification of quality, to tangible measures like revenue, which was supported by the case companies. The empirical evidence clearly verifies Fisher et al.'s (2016) concept of institutional pluralism as the certification was not found beneficial to leverage with later stages of development when the focus with the stakeholder groups was not the same anymore. Besides, multiple instruments and heavy subsidization were not recognized to bring additional value for stakeholder communication as it could be found controversial to receive subsidies repeatedly. Therefore, excess certifications and subsidization, even if it would be obtained from different public bodies, may not provide more legitimacy buffer for later stages which are in contrast to Fisher et al.'s (2016) theory.

However, despite the varying degree of the H2020 certification's usefulness, generally, the interviewees perceived that all stakeholders appreciate the receipt of the H2020 subsidy. Interestingly, during an interview, it was addressed how the reception of the H2020 subsidy was seen extremely favourably among Chinese. This strong impact of the H2020 subsidy might result from appreciation towards state involvement, indicating a positive certification effect. Moreover, the effect might be explained considering the distance between China and Europe. As the Chinese might not be able to evaluate and verify the quality of the company's technology as easily compared to domestic VCs, the trust in recognition from the reputable body can act as some kind of confirmation. In addition to the information value that the EU's H2020 might provide for investors, Zott and Huy (2007) suggest that the certification might also offer symbolic value which is not dependent on its information content. Although the information content of the project is the same whether the project is funded by national authorities or the EU, it is possible that distant investors, such as the Chinese, emphasize large public bodies. Hence, the impact and utilization of the H2020 certification can be more essential outside the EU's economic area, as Bravo's case illustrated.

The positive impact of receiving the H2020 on attracting private funding was not recognized to be as strong as previous empirical research (Lerner 1999; Meuleman & De Maeseneire 2012; Howell 2017) states in table 3. Few interviewees even presented that the funding had quite the opposite effect actually as the financiers recognized that the

case company was not in need of additional funds when it has recently received a large subsidy. This statement was surprising since, according to Hallen and Eisenhardt (2012), to maximise the benefits of the certification, that is, the H2020 subsidy, the proofpoint should be relatively recent to be effective and could not probably be used later as successfully. In turn, the (existing) financiers might perceive that there is no productive use for extra funds after receiving a large H2020 subsidy. Yet, the receipt of the H2020 subsidy had a positive impact among current employees as a subsidy from a larger body might bring more security and a feeling of continuity.

The impact of the H2020 subsidies was also realized to be essential as the majority of the interviewees expressed that the project would not have been implemented without the subsidy, signifying a low or zero degree of deadweight. Furthermore, the interviewees added that the companies might not be in their current positions without the H2020 subsidies. It was perceived that if the companies would not have gotten the H2020 subsidy, they would probably have done something completely different or not at least implemented the project at the same level. The multiplier, or butterfly effect, could have been huge in terms of the companies' development as it was seen even to affect the nature of the whole company. It was stated in the interviews that without the H2020 subsidies, the companies' state-of-the-art technologies might not even exist and the company might be just licencing patents instead of concrete demonstrations work.

The low degree of deadweight in case companies is corroborated by Lenihan's (2004) analysis. The author states SMEs have a lower probability of deadweight compared to large firms due to minimal resources and challenges to acquire funding. Nevertheless, according to Lenihan (2003), the deadweight effect is most appropriately addressed with individual firms, as there might be unique variables that have to be taken into account. On the other hand, the empirical evidence supports Tokila et al.'s (2008) view where the deadweight effect correlates with a specific industry. The results from the interviews indicate that companies in the green industry would indeed have a low degree of deadweight, perhaps due to high development costs and difficulties to access finance, thus creating a genuine need for public funds.

However, two interviewees admitted that the company would have done the project either way and thus, the H2020 subsidy was not that crucial. In turn, the receipt of the subsidy enabled the company to retain more of its ownership stake. During an interview, it was a concern that these long-term projects easily become oversized and can lead to deadweight effects. As all the costs in the multi-year H2020 projects can be difficult to

precisely plan in advance, the possibility exists that the case companies inflate the project budget, ensuring the sufficiency of funds for developing their technologies. Therefore, public subsidies might be misallocated to projects that would not need such funds to that extent. Fascinatingly, Sipikal et al.'s (2013) results claim the opposite and express a negative correlation between project costs and the degree of deadweight. The difference between these findings might result from both deliberate and unintentional budgetary gaming behaviour. Additionally, as the whole high-tech green SME might consist of a single technology or be dependent on the project, the companies could inflate the project budget and verify that the funds will not run out and, in fact, overthrow the company.

Finally, besides the impact the H2020 subsidy allowed on technological development, it is interesting to identify, particularly from a public perspective, whether the public financial support leveraged case companies' internal funds and thus created crowding effects. According to the interviewees, the companies are so resource-constrained that they are not able to bring additional internal leverage and put all the currently available funds to the H2020 project. Moreover, as the case companies expressed, no slack resources are sitting or earmarked and waiting to be allocated for a specific project. Therefore, the case companies do not substitute private funds for the project with the H2020 subsidy and direct the existing funds to other projects or purposes as were recognized by Radas and Anić (2013) in Croatian SMEs.

In multiple subsidy programs, the grant is specifically targeted to a project, such as the H2020. Yet, it is possible that instead of pure monetary flows, the H2020 subsidies enabled the case companies to transfer some personnel to other projects, which would indicate a crowding-out effect. However, the interviews revealed this not be the case as the H2020 projects were perceived to be so huge that, on some occasions, virtually all the energy and resources have been under those projects. Despite the fact that the interviewees did not express immediate crowding-in effects, one interviewee stated that as the project starts to show promising results, there will be additional internal investments. Nevertheless, it is debatable if this is crowding-in anymore since betting later on an already 'winning horse' is not investing at early-stage R&D when obtaining the H2020 R&D grant.

Moreover, interestingly in some cases, it was perceived that the companies are to some extent 'forced' to inject additional internal funds. Naturally, as multiple subsidy instruments cover only part of the total costs, the recipients must invest some portion of their own money. In addition, as the H2020 subsidies do not cover all the expenses that

will accrue during the project period the case companies need to have extra funds to pay these costs. Therefore, the real subsidy percentage might be a lot lower than the EU states. To prepare for these additional costs, the case company can try to allocate possible internal funds for the project, which could indicate crowding-in effect, although it is not a voluntary choice but is instead forced to do this. The result from the interviews shared similar views with Spoz's (2014) findings of perceived main barriers to utilise EU funds, that is inflexible project budgets. Compared to existing research (Lerner 1999; Zúñiga-Vicente et al. 2014) this forced crowding-in effect might not appear as problematic since the empirical research done by statistical methods does not distinguish or recognize voluntary or forced internal investments. However, on paper the crowding-in could be seen as a positive leverage effect from the eyes of the government officials, but from the company's perspective the forced investment can be detrimental.

5.2 Evaluation of the research results

In the academic literature, research results are evaluated through validity, reliability and generalizability, which assess the quality of the research. Thereby, the concepts indicate how well a chosen method measures the underlying research. Reliability concerns the consistent nature of the measure, signifying whether the study's results might be replicated under similar circumstances. In turn, validity refers to the accuracy of the research. That is, do the conclusions from the research provide a proper explanation of what occurred and do the results represent what they ought to measure. (Eriksson & Kovalainen 2008.)

For this study, validity can be assessed from the perspective of the study's planning, research questions and the implementation of the empirical part. The purpose of this study was to gain a more thorough understanding of the motives and experiences of the case companies in regard to the H2020 subsidies. In the beginning, the purpose was to create a comprehensive plan for the implementation of the research processes and the appropriability of the suitable theories considering the topic of the study. As subsidies are not extensively studied by qualitative methods, this research relied on triangulation of theories to obtain the most accurate picture of the subject. The research questions were formed thereby that they could describe the underlying phenomenon in question as accurately as possible. In order to maintain a narrow focus on the research questions, the impacts of the subsidy on the case companies were restricted primarily to financial or legitimacy aspects

instead of physical output. The objective of the three research questions was to complement each other and to create a holistic picture that mitigates understanding and form sufficient conclusions. Therefore, the theoretical part of this study included both macro and micro-level perspectives.

For the empirical part of the study, the structure of the interviews was divided into three parts taking into account the topic to be addressed. The interviews were conducted as semi-structured theme interviews, yet the flexibility in questions was emphasized because too prespictive questions would restrict and affect the interviewees' answers. To ensure that the theme interviews would not expand outside of the study's scope, all the interviewees were sent the interview questions in advance. The themes and discussion during the interviews were based on these questions to give the interviewees an understanding what the specific topics are going to be discussed. The logic behind this choice was that all the interviewees were executive-level members. The purpose of sending tentative ready-made questions instead of blank broader themes for the interviewees was to ensure the interview could be conducted on time, as executive-level members are generally time-constrained. However, there exists a real risk of guiding and restricting the thoughts of the interviewees and thus, impairing the validity of the research.

The appropriate reliability was sought to verify by careful selection of the interviewees in addition to comparing the research results inside the themes that were addressed in the interviews. Therefore, the interviewees who were the founders or had worked multiple years in significant positions inside the company were chosen. To meet the criteria and ensure reliability, one company had two interviewees. The other interviewee had only two years of experience but qualified for the study due to experience with the H2020 program. The interviewees' extensive and long working history in the company was realized as a crucial factor when planning the study because two research questions considered motives to apply and impact the H2020 subsidies. Both research questions require taking into account the company's time horizon and the H2020 subsidy to get fruitful results and assure reliability. Thereby, it was necessary to exclude other possible interview candidates, such as employees with little background in the case companies.

However, one of the primary problems, considering reliability, with the chosen approach can be the respondents' effect (McKinnon 1998). The effect suggests that interviewees might intentionally underrate or, on some occasions, overstate the subsidies' impact for fear that the results could affect receiving subsidies in the future. To eliminate

the distress, this study anonymized the interviewees and minimized the connections between case companies and subsidy instruments, amounts and sectors. Another reliability issue was perceived with recall bias. The H2020 program was initiated in 2014, and few of the companies had received the H2020 subsidy six years ago. Naturally, this issue could have affected the research results, but therefore, this study included a flexible number of case companies to minimize the problem.

In contrast to statistical research methods, there exists no rule regarding how many cases should be included in the research while conducting a qualitative study. In turn, the number of cases may depend on the objectives and research questions of the study. In a multiple-case design, every case company could gradually improve the researcher's ability to generalize the study's findings. Eriksson and Kovalainen (2008) propose (according to Eisenhardt 1989) limiting the case companies to such a number that the marginal contribution of adding an extra company does not provide any value, for instance, four to ten companies. Moreover, as the research and interview questions reflected the interviewees' subjective experiences in the companies, the study aimed to include more case companies to increase the reliability and find similarities and deviations among case companies. Taking the marginal contribution of the case companies, subjective experiences of the interviewees, and the researcher's schedule into account, this study included 10 case companies.

Finally, to verify this study's generalizability, multiple case companies were included, although they represented only six per cent of the H2020 high-tech green SMEs in Finland. Moreover, the empirical context considers only a single industry which may decrease the generalizability of the research to other fields in the H2020 program.

According to the research results, the validity and reliability can be seen at a good level. In general, the interviewees' answers indicated common and similar patterns, although fruitful individual perspectives were recognized as well. The empirical part of the study was able to recognize supporting evidence from previous literature and empirical research, although there were found perspectives that were relatively new. In addition, the interviewees were able to provide a sufficient and reliable picture of the companies and the H2020 subsidies regarding the motives to apply, reporting and collaboration and finally, leverage and impacts.

6 SUMMARY AND CONCLUSIONS

The objective of this thesis was to examine Finnish green high-technology SMEs and the EU's Horizon 2020 framework program. The study aimed to focus on why the case companies have applied for the H2020 subsidies and what kind of effects the receipt of the subsidies have had. In addition to the subsidies' impacts on the companies, the thesis also pursued to study how the case companies have experienced the H2020 programs' reporting obligations and cooperation during the support period.

The objectives of the thesis were addressed through three research questions. The purpose of the first research question was to understand what kind of motives and factors have affected the applying for the H2020 subsidies since receiving the subsidy is quite challenging as only a small portion of applicants are awarded. The second research question intended to gain information on how the SMEs have experienced the reporting and cooperation during the H2020 support period. This research question had a more practical approach and nature than the other research questions as it was not based on specific theories. The third and final research question sought to gain a better understanding of how have the H2020 subsidies been leveraged in and impacted the SMEs. The purpose was to focus on how the case companies have utilized the instruments in their operations and have they been able to leverage more resources with the H2020 subsidies instead of addressing output measures.

At first, the theoretical part addresses the role of the R&D subsidies in the economy and explains the importance of R&D activities for economic development. An example of justification to support firms by R&D subsidies is expressed by Romp and De Haan (2007). Their evidence indicates that public investments, such as R&D programs, generate the highest multiplier effects. However, the effects of R&D subsidies on private firms might not be equal considering the firm's size and nature or the industry where it operates. Moreover, compared to other subsidy instruments, Hyytinen and Toivanen (2005) recognized that, in Finland, direct public subsidies have a high positive impact on R&D activities for financially constrained SMEs.

The importance of subsidies has also been recognized considering spillovers and externalities that lead to underinvestment in R&D. As Nelson (1959) and Arrow (1962) stated, firms are not willing to invest enough in research activities since R&D is a public good, the outcome of the results are uncertain, and due to challenges for capital-con-

strained firms to invest in costly R&D. Although the benefits of R&D for the whole society would be high, private rate of return might not be sufficient to approve the investment as the companies are not able to fully appropriate the fruits of their labour, resulting in spillovers. The issue is more severe in early-stage green SMEs, where the demonstrations of novel technologies are extremely expensive, yet the market demand could be negligible. However, everyone can enjoy green R&D and innovations, such as clean air, without directly paying for it, indicating a dual externality (Bi et al. 2016) and thus, put clean technologies at a competitive disadvantage in comparison with other industries. Without a full compensation of their R&D activities and outcomes, regardless of whether actors in the economy contributed or not, green high-technology SMEs might not be able to compete against innovative SMEs that will be perceived as more attractive investment opportunities for private resources (Pacheco et al. 2010). Therefore, the number of green SMEs will be less than optimal from the perspective of societal welfare.

To respond to the issue of underinvestment in high-technology R&D and to support the competitiveness of green innovation and national economies, the EU implemented its 8th framework program, Horizon 2020. The program aims to support state-of-the-art science, decrease barriers to innovation, and mitigate the cooperation between public and private sectors. In contrast to previous framework programs, H2020 emphasizes more small firms by introducing a financial instrument specifically targeted to early-stage high-risk SMEs with much global potential. Also, the H2020 pursues to cut red tape and ease the complex structure of framework programs to enable more fluent collaboration between parties involved. (European Commission 2020D.)

Furthermore, the focus is on the microlevel in individual SMEs, where it is addressed why these high-technology companies need the R&D subsidies and what kind of benefits those subsidies might provide. First, the financial barriers of high-technology SMEs are introduced by applying Myers and Maljuf's (1984) pecking order model, which illustratres why internal or external funds are not available for R&D activities. Because high-technology SMEs are often capital-constrained and have insufficient turnover, they must instead rely on external finance, such as bank loans or equity capital from VCs. Nevertheless, these options may be limited for SMEs due to the unstable income stream, intangible nature of their assets and too high cost of capital.

In addition to financial constraints, the novel early-stage green SMEs might face the liability of newness, further affecting their possibilities to acquire external resources for R&D. The liability of newness, both in the SMEs' novel technologies and green sector

compared to other established industry actors, can be overcome by obtaining legitimacy, that is, social acceptance from other stakeholders. However, as stakeholders have dissimilar objectives, the level of legitimacy is perceived and evaluated by different criteria. Therefore, SMEs are not only seen as either legitimate or not but rather face multiple legitimacy thresholds, for instance, among public bodies and private investors. (Zimmerman & Zeitz 2002; Fisher et al. 2016.)

Although some industries can be seen as more legitimate than others by considering their nature or values, such as clean and green technologies, the level of legitimacy for green high-tech SMEs could be low due to the novelty of their technologies and unproven track record (Zimmerman & Zeitz 2002). Thereby, these companies can pursue to obtain certification from a reputable and respected body such as governments to increase their legitimacy and, thus, resources. The certification, such as receiving highly competitive R&D subsidies from the government, can serve as a quality badge reducing information asymmetry for stakeholders. As the leverage of subsidies for companies internal R&D efforts and output measures are mixed (Zúñiga-Vicente et al. 2014), recent empirical research has found positive results from government certification for high-technology SMEs. (Howell 2017; Hottenrott et al. 2018; Islam et al. 2018, Li et al. 2019.) However, as the prestige of the certifier and the criteria of which the SMEs are evaluated can differ, not all R&D certifications are considered equal.

The empirical part of this study is conducted by interviews and examines 10 Finnish green high-technology SMEs that have received R&D and innovation subsidies from the H2020 program between 2015 and 2020. The interviews were conducted between December 2020 and January 2021, including a total of 11 executive-level members from the participating case companies.

According to the interviews, the primary motives to apply for the H2020 subsidies were the funds because the case companies were resource-constrained as the existing literature addresses. Developing the case companies' costly technologies, a larger amount of grants available from the H2020 and the lack of different public and private financing options were found as key factors why the funds were perceived as essential. In addition, networking and visibility were also recognized as motives to apply for the H2020 program. Participation in the H2020 project, especially in a consortium, enables connecting and partnering with other industry actors who could create more business opportunities in the future. However, rather surprisingly, it became evident during the interviews that

the H2020 certification was not perceived as an important factor in applying for the subsidy. The recognition, legitimacy and credibility were found to be derived from industry actors and through technology demonstration instead of a large certifying body. Multiple interviewees expressed that the quality certification by the EU is appreciated per se, but it is not important who is the certifier as not all stakeholders seem to value the H2020 certification crucially.

Nevertheless, even if the companies did not find the H2020 certification as an essential factor for applying, they still leveraged it to a varying degree. The H2020 subsidy was leveraged while raising external capital, but not always deliberately, as the receipt of the subsidy could have been an untimed coincidence. However, the H2020 certification was perceived as valid to leverage in stakeholder communication if the company pursues to profile as a start-up. For slightly more mature companies, it was recognized as a "double-edged sword" and potentially harmful, as the companies do not want to be seen as heavily subsidized but rather to operate through actual business.

In turn, the cooperation in the H2020 program was flexible as the project officers in the EU were reachable, which was a surprise to few interviewees. Similar views were shared among the interviewees considering the collaboration in the EU consortia projects. However, interestingly, it was revealed that as consortia might include multiple members from different countries, the interest might be different and change during the time of the project. In addition and surprisingly, the solidarity between consortium members during conflict situations can hamper the agility of the consortium and delay the whole project, creating an actual risk to be considered.

The impacts of the H2020 subsidies for developing the case companies' technologies were recognized as crucial. Multiple interviewees claimed that the company's technology would not perhaps even exist without the H2020 subsidy. Altogether, the majority of the case companies did not present deadweight effects. Most interviewees stated that the companies would not have implemented the project at such or at all without the H2020 subsidy. This result indicates that public funds, in fact, supported the development of technologies where spillovers are perceived to be at a high level.

Nevertheless, the H2020 subsidy's impact on external funding was not perceived to be as strong as previous empirical research (Lerner 1999; Howell 2017) would indicate. On some occasions, the funding was even more challenging to obtain as funders perceived the SMEs had sufficient funding situation after receipt of the H2020 subsidy without re-

alizing how the subsidy funding is tied. Surprisingly, on the other hand, the H2020 subsidy's impact on the leverage of internal funds, namely crowding effects, presented a forced crowding-in effect. On the contrary to existing research (Zúñiga-Vicente et al. 2014), the interviews revealed that as the H2020 program does not accept all costs, the case companies might be forced to invest their own funds in the H2020 project. Therefore, it is possible that the crowding-in effect is not voluntary and additional but rather mandatory and necessary.

As the case companies did not perceive the H2020 stamp to possess any meaningful value, it would be interesting for future research to examine statistically if the receipt of the H2020 subsidies in green high-technology SMEs has impacted private funding. The studies in the U.S. indicate (Galope 2016; Howell 2017; Islam et al. 2018) that the SBIR program has indeed mitigated to acquire both VC and bank finance. However, the financial markets in Europe are more bank-centric. Thereby future research could focus on measuring and comparing the impact on financial leverage for VC and bank financing separately. More specifically, as the Nordic countries tend to have similar characteristics and economic environment, it could be analyzed if the H2020 subsidies had any different impacts on financial leverage.

The second topic for future research could address the receipt of the H2020 program's SME, RIA, IA instruments and the Seal of Excellence. As multiple case companies stated funds to be the prevailing motive to apply for the H2020 program, it would be fascinating to examine to what extent SMEs have utilized the Seal of Excellence to obtain funding or in communications with stakeholders. Because the latter instrument does not provide immediate funding for the qualified applicants due to budgetary reasons, the leverage effect might not be as significant. However, the Seal of Excellence is a quality badge that precisely express the value recognition by the EU and alleviates other funding bodies to utilize the H2020 evaluation process.

The third subject for future research could study are there differences in attracting private capital in the European economic area, taking into account the institutional quality between countries. The institutional quality varies between countries and continents, affecting investor preferences to invest funds in companies that might generate high spillovers for the whole society, as Wei and Zuo (2018) evidenced. The study could emphasize a correlation between institutional quality and financial leverage effect with national subsidies and the EU H2020 subsidies, comparing the magnitude of the results.

The fourth and final topic for future research could concentrate on the H2020 financial leverage effect on green high-technology SMEs and the size of the spillovers in different stages of technology's development. That is, how much the green high-technology SMEs are able to attract private financial capital after receiving the H2020 subsidy when the spillovers are at the highest level. For instance, is there a difference in the H2020 leverage between the basic research and demonstration phase? From a public perspective, the results might be valuable as the cost of the demonstration phase among green high-technology SMEs is enormous. Yet, the stage is closer to commercialization and could provide a faster implementation of more mature technologies than basic research. Moreover, to get more accurate results, the study could try to understand the spread between the private and social rate of returns by conducting a survey with VCs to recognize what the required rate of return is for the invested capital in different stages of technology's development.

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APPENDICES

Appendix 1. Interview questions

1. Introductory questions

    - What kind of experience do you have in the company, and what your duties include?
    - What type of experience do you have for applying for subsidies?
    - For which project have you applied for the subsidy? How important is the project for the company?

2. Applying for the Horizon 2020 subsidy instruments

    - Where did the company get information regarding the different subsidy options, and how are these options monitored?
    - What kind of experience does the company have in applying for subsidies? Has the company previously applied for other direct subsidies before the Horizon 2020 subsidy instruments?
    - How did the company come to a conclusion to apply for a subsidy instrument from Horizon 2020? Who was involved in this decision-making process?
    - Why did the company apply for the subsidy at that specific time?
    - Have you participated in innovation competitions or obtained certificates for the functionality of your technology? If yes, for what competitions or what kind of certificates have you obtained? Why?
    - How difficult has it been previously to obtain subsidies and financing for your business idea or technology?
    - At what stage of the company's development has it been the most difficult to obtain subsidies or financing, and from what sources have the financing been obtained?
    - Why have the company applied for this particular Horizon 2020 subsidy instrument? Has the company always received a subsidy instrument when you have applied for it?
    - How did you come to a conclusion to apply for other Horizon 2020 subsidy instruments (RIA, IA, and SME)?
    - How has the public availability of information on Horizon 2020 subsidies influenced the decision to apply for the instrument? Has the market competition had an impact on the decision to apply? If yes, how have you perceived the market competition?

3. Subsidy process and the Horizon 2020 program

    - How have you experienced Horizon 2020 reporting obligations in the company?
    - How many resources have the Horizon 2020 subsidy application process taken from the company?
    - Who has been involved with the Horizon 2020 program's liaison officers during the subsidy period?
    - How fluent has the cooperation been in Horizon 2020 during the project?
    - How flexible has the Horizon 2020 program been? How have you perceived this?
    - What experiences has the company had as a member of the consortium with IA or RIA subsidy instruments?
    - How would you compare your experiences in the application processes of different instruments (RIA, IA, and SME)?

4. Effectiveness of the Horizon 2020 subsidies

    - How was the subsidy used in the company? What experiences do you have with the obligations and commitment of Horizon 2020 subsidies for specific purposes in the projects?
    - How did the receipt or rejection of the Horizon 2020 subsidy affect employees? How has the subsidy decision been reflected in the employees?
    - What kind of consequences and impacts has the company perceived after the subsidy decision? How has this been reflected in the company?
    - To what extent would the project have been implemented with or would have been implemented without Horizon 2020 support?
    - How has the receipt of Horizon 2020 subsidy been perceived with customers, funders, partners or the public sector?
    - What have been the advantages, disadvantages or opportunities of Horizon 2020 subsidies compared to other funding?
    - How do you think the Horizon 2020 subsidy instrument has benefited the company? How has the company utilized the Horizon 2020 subsidy instrument?
    - Which kind of significance do subsidies have for companies in your industry? How important is applying for subsidies for the company?
    - How do you assess the effects of the subsidies on the competitive situation in your industry?
    - Why have subsidies been applied or not applied for again?
    - Has the company considered applying for subsidy instruments from the new Horizon Europe program?