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The influence of Varieties of Capitalism and other contextual determinants on start-ups' innovativeness

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Abstract

This thesis sets out to study the influence of institutional diversity at the national level as an explanation of a start-up's innovativeness by conducting a transnational comparison of 940 start-ups. As the complexity of the various current sustainability challenges requires novel systemic approaches, innovation will play a key role in tackling issues such as climate change and a growing human population. Start-ups can provide radical technological (niche) innovations which can lead to a change in the current system. The literature on entrepreneurship and venture creation highlights differences in the degree of start-up innovativeness, but has not yet systematically investigated the reasons for this distinction. This is, however, problematic because we need a methodical understanding of the drivers of innovativeness to thoroughly understand what motivates entrepreneurs to develop different types of new products or services within the framework of new start-ups. Such knowledge is particularly important for policy-makers to effectively target their support policies towards the drivers of (different types of) start-up innovation. The important role of national institutions as a determinant for innovativeness has been defined for incumbent firms by the Varieties of Capitalism (VoC) literature. According to the VoC findings of Hall and Soskice (2001) liberal market economies (LMEs) like the United States (US) and the United Kingdom (UK) tend to have more radical technological innovations than coordinated market economies (CMEs) like Germany and the Netherlands. By assessing the degree of innovativeness of several hundred start-ups in these countries, this assumption is tested quantitatively with linear, ordinal and multinomial logistic regression. Besides testing the hypothesis that start-ups located in LMEs have a higher, i.e. more radical, degree of innovativeness, the influence of other contextual and start-up specific factors (e.g. industry and product-relatedness to sustainability) on its degree of innovativeness are analysed.

The results indicate that the VoC findings also apply to start-ups, as ventures in LMEs are more likely to be radically innovative than start-ups in CMEs. However, national institutions do not explain the whole variance of start-up innovativeness. Other factors like industry sector and knowledge-intensity, type of good and product-relatedness to sustainability, as well as the amount of total funding significantly impact the type of innovation of start-ups.

Keywords: Varieties of Capitalism, institutions, start-ups, innovation, sustainability, entrepreneurship

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List of Abbreviations

CME	Coordinated Market Economy
DV	Dependent Variable
EU	European Union
GEM	Global Entrepreneurship Monitor
HTM	High-technology Manufacturing Industry
IT	Information Technology
IV	Independent Variable
KIS	Knowledge-intensive Service
LKIS	Less knowledge-intensive Service
LME	Liberal Market Economy
LTM	Low Technology Manufacturing Industry
MHTM	Medium-high-technology Manufacturing Industry
MLTM	Medium-low-technology Manufacturing Industry
NSI	National Systems of Innovation
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
SaaS	Software as a Service
SMEs	Small- and Medium-sized Enterprises
UK	United Kingdom
US	United States of America
VET	Vocational Education Training
VoC	Varieties of Capitalism

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1. Introduction

As the complexity of the various current sustainability challenges requires novel systemic approaches, innovation will play a key role in tackling issues such as climate change and a growing human population. Start-ups are regarded as "a major source of innovation, as they employ emerging technologies to invent products and reinvent business models" (Kohler, 2016, p. 347). Thus, they can provide radical technological niche innovations which can lead to a change of the current system (Geels & Schot, 2007). Besides contributions to a sustainability transition, innovations also foster economic growth on a national as well as on a firm level. Innovativeness is therefore a crucial factor for a company's competitiveness and long-term success (Darroch & McNaughton, 2002). Moreover, innovation is "one of the main factors underlying countries' international competitiveness and their productivity, output and employment performance" (Becheikh, Landry, & Amara, 2006, p. 644). Various researchers, like Dosi (1988), Hurley and Hult (1998), Porter (1990), and Schumpeter (1934), have shown that the capacity to innovate increases a firm's competitiveness and provides the basis for the survival of a company in the long-term. Although it is generally acknowledged that innovation contributes to business success, the drivers of innovativeness and their relation to a firm's external environment are less explored (Hult, Hurley, & Knight, 2004).

The literature on entrepreneurship and venture creation highlights differences in the degree of start-up innovativeness (GEM Global Entrepreneurship Monitor, 2017), but has not yet systematically investigated the reasons for this difference. Although there are various studies on the factors that influence a start-up's success (Segarra & Callejón, 2002), there is very limited research on the determinants of a start-up's degree of innovativeness and these studies have come to different findings (Abratt & van Altena Lombard, 1993; Henard & Szymanski, 2001; Poolton & Barclay, 1998). This is, however, problematic as we need a systematic understanding of the drivers of innovativeness to better understand what motivates entrepreneurs to develop different types of new products or services. Moreover, it is important to shed light on the different determinants of radical and incremental innovations, as different types of innovations require diverse financial and labour inputs (Hall & Soskice, 2001; Koberg, Detienne, & Heppard, 2003).

The important role of national institutions as a determinant for innovativeness has been defined for incumbent firms by the Varieties of Capitalism (VoC) literature. According to the VoC findings of Hall and Soskice (2001) liberal market economies (LMEs) like the United States (US) and the United Kingdom (UK) tend to have more radical technological innovations than coordinated market economies (CMEs) like Germany and the Netherlands. Studies of the entrepreneurial ecosystem also found that entrepreneurial activity differs across nations (Hechavarria & Reynolds, 2009; Stenholm, Acs, & Wuebker, 2013; Wennekers, van Wennekers, Thurik, & Reynolds, 2005). These differences are

a result of national factors like economic development, demography, culture and institutions. Because these aspects influence a country's entrepreneurial activities, they should be considered in entrepreneurship policies (Ács, Autio, & Szerb, 2014; Busenitz, Gomez, & Spencer, 2000; Hechavarria & Reynolds, 2009; Wennekers et al., 2005; Wong, Ho, & Autio, 2005). However, the exact reasons for these variances are still ambiguous. Moreover, the influence of different types of capitalism as described in the VoC literature has not been analysed for entrepreneurial ventures. Furthermore, studies on the global variance of entrepreneurial activity have neglected the type and quality of entrepreneurial activity and thus the type of innovativeness (Koberg et al., 2003; Stenholm et al., 2013). It is hence unexplored if the VoC theory not only applies to incumbents but also to start-ups.

This thesis aims to fill this gap by exploring the internal and external factors driving a start-up's innovativeness, concentrating on the start-up's institutional environment as described by the VoC literature. The latter will be a key focus in this thesis, as a nation's influence on start-ups' development and innovativeness has been less explored (Hult et al., 2004). As the VoC literature states, liberal market economies (LMEs) tend to have more radical technological innovations than coordinated market economies (CMEs) (Hall & Soskice, 2001). By assessing the degree of innovativeness of 940 start-ups in LME and CME countries, this assumption will be tested with multinomial logistic regression. Based on the VoC literature and the commonly used scientific classifications of innovations into radical and incremental (Darroch & McNaughton, 2002; Poorkavoos, Duan, Edwards, & Ramanathan, 2016), the author will adopt a similar approach for analysing start-ups' degrees of innovativeness. *Incremental innovations* are hereby defined as small-scale improvements of existing products or services, whereas *radical innovations* are novel products or services that did not exist before on the market or require new technologies that did not exist previously.

The main **research question** of this thesis is thus: *How important are national institutions as drivers of a start-up's degree of innovativeness?*

Corresponding **sub-questions** are:

1) How can start-ups be classified according to their innovativeness?
2) What are important factors that could influence a start-up's innovativeness and how can these be operationalized?
3) To what extent do contextual factors like a start-up's national institutional framework and industry affect start-up's degree of innovativeness?
4) To what extent do internal factors like a start-up's type of good and product-relatedness to sustainability affect a start-up's degree of innovativeness?

Answering this research question is **scientifically relevant**, as the phenomenon of entrepreneurial innovativeness is not yet sufficiently understood. There is currently very limited research on the start-

up specific and contextual determinants of (radical and incremental) innovations. Fostering a better understanding of types of entrepreneurial innovations and their determinants is important as different types of innovation require different input factors (Hall & Soskice, 2001; Porter, 1990). While most studies focus on incumbents' innovativeness, there are only few studies that address small- and medium-sized enterprises (SMEs) and even fewer that analyse start-ups' innovativeness. Furthermore, hardly any studies distinguish between different innovation types (Koberg et al., 2003) which is why this thesis differentiates between radical and incremental innovation. Lastly, researchers have come to mixed and ambiguous results regarding the determinants of a firm's innovativeness and have neglected the interplay of these variables (ibid.). By utilising multinomial logistic regression this thesis contributes to filling this gap and provides recommendations for further research to better understand the phenomena of entrepreneurial innovations. This research will aid in developing a systematic understanding of the drivers of innovativeness to better comprehend what motivates entrepreneurs to develop different types of new products or services. Besides filling a gap in scientific research, this knowledge is **societally relevant** as it will help policy-makers to effectively target their support policies towards the drivers of (different types of) start-up innovation. By gaining insights on the internal and external factors that impact start-ups, policy-makers, venture capitalists and start-up founders will be able to make better choices for fostering start-up innovativeness and success. In addition to economic growth, a higher degree of innovativeness can also contribute to solving global sustainability challenges through facilitating socio-technical transitions (Cooke, 2010; Geels, 2012; Geels & Schot, 2007; Hockerts & Wüstenhagen, 2010; Markard, Raven, & Truffer, 2012).

To answer the research question, a theoretical framework on the contextual and internal determinants of innovativeness is developed. After deriving the hypotheses, the methodological approach and operationalization of variables is explained. Finally, the results of the data analysis are reported and discussed. Moreover, recommendations for future research are given.

2. Theoretical framework and hypotheses development

2.1 The influence of national institutions on differing degrees of firm innovativeness

Various studies have shown that incumbent firms have differing degrees of innovativeness. Often these degrees of innovativeness are analysed according to innovation types. Based on the literature, one can distinguish between the following types of innovation: "administrative and technical, product and process, technological and architectural, and incremental and radical" (Koberg et al., 2003, p. 23). Whereas the distinction between radical and incremental innovation is often unclear. This categorization can be also applied for organizational change, where incremental changes are in favour of the status quo and radical changes are restructuring former patterns of consistency (Koberg et al.,

2003). This differentiation is important as there are different drivers of radical and incremental innovations and there are organizational differences between the two types of innovation.

Incremental innovations are hereby regarded as market-pull innovations and are the most common innovation type. They are usually extensions of a product line or a modification of an existing product (Darroch & McNaughton, 2002). *Radical innovations*, on the other hand, do not build on existing knowledge, but are often competence-destroying as they make existing knowledge redundant. These 'higher order' innovations create novel industries, products, or markets so that older technologies are made obsolete (Koberg et al., 2003). Radical innovations pose a higher risk as their successful commercialization is more difficult and unpredictable. Nevertheless, these innovations are essential for a firm's long-term success since they foster the creation and implementation of new technologies and can thus alter prevailing market structures and revolutionize industries (Chell, 2001; Hall & Soskice, 2001). They can be categorized in new-to-the-industry and new-to-the-world innovations. Especially the latter represents "a pioneering breakthrough or a new combination of existing technologies"(Darroch & McNaughton, 2002, p. 213).

The above-mentioned different types and degrees of innovativeness require different input factors. In the *Competitive Advantage of Nations* Michael Porter (1990) discusses the strong influence of nation-states on the competitive strengths of the respectively located firms. He distinguishes between factor conditions like infrastructure, demand conditions (especially from the home market), related and supporting industries (especially regarding suppliers and innovation processes), as well as firm strategy, structure and rivalry.

Especially the National Systems of Innovation (NSI) (Zoltán J. Acs, Audretsch, Lehmann, & Licht, 2016; Freeman, 1995) and VoC literature (Hall & Soskice, 2001) have analysed the influence of national institutions on innovation activities. By examining the characteristics of coordinated and liberal market economies, Hall and Soskice (2001) find that CMEs are better at fostering incremental innovation. One of the reasons for this is secure employment, as employees are skilled and secure enough to suggest product or process changes without risking their job situation. Furthermore, workers need sufficient work autonomy to see the creation of incremental improvements as part of their job description. "Thus, incremental innovation should be most feasible where corporate organization provides workers with secure employment, autonomy from close monitoring, and opportunities to influence the decisions of the firm" (Hall & Soskice, 2001, p. 38). Moreover, workers should have strong industry-specific technical skills and inter-firm collaborations between clients and suppliers should be fostered to create incremental product and process improvements (Hall & Soskice, 2001). While the inter-firm collaborative networks in CMEs foster the gradual dispersion of technology, they inhibit companies' access to entirely new technologies by acquiring other firms. Moreover, consensus decision-making

and strong worker representations hinder radical firm restructurings. The long-term employment contracts hamper firms to hire large numbers of new personnel for developing novel technologies. These characteristics distinguish CMEs from LMEs as the latter tend to limit a businesses' ability for incremental innovation, but foster radical innovation instead.

LMEs are characterized by fluid labour markets and short-term work contracts, whereby employees focus more on their own personal career than improving a firm's success. By developing more general skills than industry- or company-specific skills, workers in LMEs lack the know-how needed for incremental innovation. Furthermore, the financial market arrangements value short-term profitability and hierarchical corporate structures that undermine employee's willingness to innovate and take risks. Not only intra-firm collaboration for incremental product development is discouraged, but also inter-firm collaboration, as these are undermined by very complex contract and antitrust laws. However, the institutional structure of LMEs is highly beneficial for radical innovation. As their labour markets are more flexible and the labour mobility rate is higher, companies can easily hire new experts for developing a novel product line. This is an advantage for companies as they can also easily release personnel if the innovative product is unprofitable. Moreover, there is higher availability of venture capital and fewer restrictions on mergers and acquisitions than in CMEs. This allows businesses to simply acquire radically new technologies through buying other companies. Moreover, scientists and engineers can easily access capital to bring their ideas to market. (Hall & Soskice, 2001)

Differing degrees of innovativeness have been found not only for incumbents, but also for start-up firms. According to Koellinger (2008), there are different types and degrees of novelty that entrepreneurs bring to the market. Wong et al. (2005) found that at the national level, new business creation and technological innovation are not the same phenomena as only a small number of entrepreneurs produce true technology innovation. The factors that influence entrepreneurial innovativeness are both individual and context-dependent. Koellinger (2008, p. 21) found that "high educational attainment, unemployment, and a high degree of self-confidence are significantly associated with entrepreneurial innovativeness at the individual level". Moreover, the dispersion of innovative and imitative entrepreneurship differs across nations as there are more innovative than imitative entrepreneurs in higher developed countries (ibid.). Sternberg and Wennekers (2005) found a U-shaped relationship between the rate of entrepreneurial activity and the level of economic development. This is interesting as also the rate and type of entrepreneurial activity vary in their influence on a nation's innovativeness and economic growth.

The Global Entrepreneurship Monitor (GEM) is "the only globally harmonized data set dedicated to the study of individual-level entrepreneurial behaviors across countries" (Levie, Autio, Acs, & Hart, 2014, p. 437). By clustering the data across countries, various studies investigated the determinants of

entrepreneurial nations and found that countries largely differ in their rate of entrepreneurial activity (Levie et al., 2014; Veciana & Urbano, 2008). Bowen and De Clercq (2008) were the first to scientifically illustrate that a nation's institutional characteristics influence the allocation of high-growth entrepreneurial activities. However, while the type of entrepreneurship has been investigated with the help of GEM data, entrepreneurship research has neglected to systematically analyse the types and degrees of innovativeness of entrepreneurial ventures and their determinants. Although the self-reported data of the GEM provides some information on the product novelty of entrepreneurial ventures by asking about market and technological newness, it does not distinguish between radical and incremental innovations (Global Entrepreneurship Research Association, 2017). Furthermore, while the NSI and VoC strands of literature have focused on the impact of national institutional systems on incumbent firms, they have neglected to analyse the influence of institutions on entrepreneurship. Thus, "a 'systemic' understanding of the role of entrepreneurial activity in national and regional economies remains under-developed" (Ács et al., 2014, p. 477). This thesis will shed light on this issue by analysing to what extent national institutions can explain the above-mentioned differences in entrepreneurial innovativeness. Thus, the main **hypothesis** that will be tested is:

H1: Start-ups in LMEs have a higher degree of innovativeness (i.e. radical innovations) than start-ups in CMEs.

In addition to this hypothesis, also other potential determinants of start-up innovativeness that have been debated in the entrepreneurship and innovation literature will be investigated and discussed below.

2.2 Further determinants of innovativeness and hypotheses

While the determinants of start-ups' innovativeness have been rarely analysed, the organizational and contextual factors of incumbent firms' innovativeness have been investigated by various researchers (Becheikh et al., 2006; Koberg et al., 2003; Özsomer, Calantone, & Di Bonetto, 1997). Koberg et al. (2003) analysed the influence of various variables on incremental and radical innovation in the aerospace, electronics and telecommunications industries. The authors found that increasing age and size of the firm foster incremental innovation. Radical innovation is, on the other hand, nurtured by environmental dynamism and experimentation. Intra-firm structural linkages were found to foster both innovation types. The authors highlight the need to distinguish the degree of innovation and to further investigate the influence of environmental and organizational interrelated factors (Koberg et al., 2003). Numerous researchers have started to investigate other factors for a firm's innovativeness, such as knowledge accumulation and organization size (Forés & Camisón, 2016) as well as leadership style (Domínguez Escrig, Mallén Broch, Chiva Gómez, & Lapiedra Alcamí, 2016). Ganter and Hecker (2014) distinguish between product and process innovations and analyse the interrelationships

between innovativeness determinants such as firm size, competition, education, and knowledge sources. The authors propose the further investigation of organizational innovation by including additional factors for a firm's innovativeness at the company level (e.g. degree of internationalization and characteristics of the leadership team) as well as at the industry level (e.g. knowledge intensity of an industry). Furthermore, they highlight the need to analyse potential country-level factors, such as a country's institutional environment and cultural influences. Becheikh et al. (2006) conducted a literature review on the determinants of firms' innovativeness in the manufacturing industry and found approximately 60 variables that influence a firm's innovation. The authors derived from 108 analysed articles an integrative framework, which shows the variables of innovation and distinguishes between *internal factors* (i.e. specific to the firm) and *contextual factors* (i.e. related to the firm's environment) influencing it. This thesis builds on this framework by also differentiating between internal and contextual factors of a start-up's type of innovation (for a summary of these factors see figure 1).

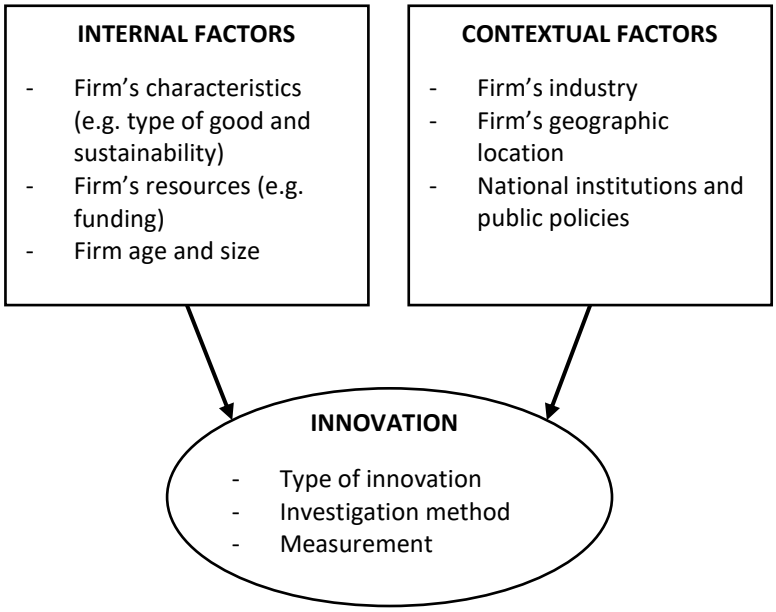

Figure 1: Theoretical framework for integrating innovation findings (own illustration based on Becheikh et al., 2006)

Avlonitis et al. (1994) highlight the need to consider the differences in innovativeness on an industry level, as several researchers found that industry conditions influence a firm's innovativeness. Findings illustrate that high-tech industries (e.g. electronics, IT, telecommunication, aerospace, chemicals, biotech) have a higher degree of innovativeness than traditional, low-tech industries, like textile, wood and paper, and food (Becheikh et al., 2006; Veugelers & Cassiman, 1999). As "[t]he significant effect of industry and regional characteristics on the innovative capacity of firms is widely accepted in the literature" (Becheikh et al., 2006, p. 656), this thesis will focus on these contextual determinants of innovation by analysing start-ups from various industries and national institutional frameworks. It will thus test the following hypotheses:

H2a: Start-ups in technology- and knowledge-intensive industries have a higher (i.e. radical) degree of innovativeness than start-ups in low-tech industries.

As not only the technology- and knowledge-intensity of industries affects firm innovativeness, the industry sector will be analysed as well. Hipp and Grupp (2005) argue that there are different types of

innovations in the service sector than in the manufacturing industry. The authors find that products in the service sector have a lower degree of innovativeness than those of the manufacturing sector. Therefore, in addition to H2a, H2b is tested:

H2b: Start-ups in the manufacturing sector have a higher degree of innovativeness than start-ups in the service sector.

Besides the industry sector, it is probable that a start-up's type of good also influences its form of innovation. Since the characteristics of products differ from those of services, it is likely that the innovativeness of products and services varies. Moreover, product and service innovations require different kinds of inputs (Nijssen, Hillebrand, Vermeulen, & Kemp, 2006). As services are more easily imitable, there are more incremental than radical service innovations (Hipp & Grupp, 2005). Hence, the third hypothesis tests the influence of a start-up's type of good on its degree of innovativeness:

H3: Product-producing start-ups are more likely to have a higher degree of innovativeness than service-producing start-ups.

In addition to the influence of a start-up's industry and type of good on its degree of innovativeness, it is also of interest to analyse the relationship between a start-up's product-relatedness to sustainability on its innovativeness. Nations can influence through environmental regulations a company's sustainability and can thus foster the development of sustainability-related products (Evans & Stroud, 2016; Mikler & Harrison, 2012). As incremental changes will not be sufficient to combat the global sustainability challenges, there is a need to foster radical innovations for sustainable development. Start-ups can provide with new and radical technologies the nuclei for a socio-technical transition (Cooke, 2010; Geels, 2012; Geels & Schot, 2007; Hockerts & Wüstenhagen, 2010; Markard et al., 2012). Therefore, hypothesis 4 is derived:

H4: Start-ups with a higher product-relatedness to sustainability have a higher (i.e. radical) degree of innovativeness.

3. Methodology

3.1 The data

The target population are start-ups incorporated in OECD countries, which can be classified as CME or LME according to the VoC literature. The timeframe of four years was chosen for greater comparability. Start-ups that have existed for at least three years are in a similar development stage as these have past the 'idea' and 'prototyping' stages and are still young enough to be regarded as start-ups (Robehmed, 2013). Furthermore, the study only targeted operating start-ups which have brought their innovation to market and survived the first four crucial years of business. Gartner et al. (1999) state

that a start-up's capability to survive at least four years is a key indicator for its success and other scholars state that the chances of business failure are the highest in the first two years of operation (Bartelsman, Scarpetta, & Schivardi, 2005).

The data for answering the above-mentioned research question will be retrieved from *Crunchbase* (2017), as it is one of the world's largest start-up databases and covers a wide variety of start-ups worldwide. Moreover it has been used by other scholars for research purposes (Liang & Yuan, 2016). Based on the selection criteria for the target population, the author only analyses start-ups that were founded in 2013, are listed as operating in the *Crunchbase* database (Crunchbase, 2017) and are based in an OECD member country (that can be classified as CME or LME). The sample is taken as a representative of the above-mentioned target population. Hence, the unit of analysis are start-ups in CMEs and LMEs that have been incorporated in 2013. By grouping start-ups into their nationalities and distinguishing between CME and LME countries, the VoC theory can be tested. The countries are hereby chosen according to the nations that have been analysed by Hall and Soskice (2001) for their VoC theory[1]. Table 1 shows the total number of start-ups with founding date in 2013 in the *Crunchbase* database. One can notice the high number of US-based start-ups, which could result from the greater popularity of *Crunchbase* in the USA, since the company is also based there. As this large number of American start-ups could lead to bias, the author randomly selected a representative sample of all the countries with more than 100 start-ups. To reduce bias, equal distribution of start-ups in the CME and LME clusters was ensured, resulting in a total sample of 940 analysed start-ups[2].

Table 1: Start-ups in the Crunchbase database with founding year 2013

Country	VoC classification	Operating start-ups with founding date in 2013	Total sample # randomly selected start-ups for rating	Final sample # of rated start-ups
Australia	LME	188	100	76
Austria	CME	66	66	58
Belgium	CME	54	54	41
Canada	LME	385	100	73
Denmark	CME	50	50	29
Finland	CME	46	46	34
Germany	CME	242	172	136
Ireland	LME	79	79	62
Japan	CME	100	100	39
Netherlands	CME	107	107	79
Sweden	CME	43	43	27

[1] "The LMEs include Australia, Canada, Great Britain, Ireland, New Zealand, and the United States. The CMEs include Austria, Belgium, Denmark, Finland, Germany, Japan, Netherlands, Norway, Sweden, and Switzerland. […] Countries such as Luxembourg and Iceland are eliminated from the VOC typology because of their small size, while others, such as Mexico, are disqualified because they are developing nations." (Taylor, 2004, p. 609)

[2] Of the 7083 operating start-ups in the *Crunchbase* database with founding date in 2013, 1215 ventures were randomly selected for the analysis. However, as some of these companies had stopped their operations (indicated e.g. through a non-functioning website), the final sample comprises 940 start-ups.

Switzerland	CME	33	33	27
United Kingdom	LME	788	112	82
United States	LME	4902	153	177
SUM		**7083**	**1215**	**940**
Start-ups in CMEs		741	671	470
Start-ups in LMEs		6342	544	470

3.2 Measurement of innovativeness

"A major drawback of any innovation research is measurement; there is no easy way or standardized way to measure organizational innovation" (Koberg et al., 2003).

Koberg et al. (2003), Becheikh et al. (2006) and Poorkavoos et al. (2016) come to similar findings as they found that there are differing approaches to assess innovation. The complexity of innovation and its various interacting components make its measurement difficult. While often two indirect indicators, i.e. research and development (R&D) and patent data, have been used to assess innovation, these fail to capture the complexity of the phenomenon (Hipp & Grupp, 2005; OECD & Eurostat, 2005). Thus, there is the need to find more suitable indicators as, for instance, not all innovations originate from R&D and not all innovations are patented. Direct innovation indicators that have been commonly used are innovation count (object approach) and firm-based surveys (subject approach) (Becheikh et al., 2006; Poorkavoos et al., 2016). However, these measures also have shortcomings as the first excludes unsuccessful innovations and the latter often lacks specific indicators for assessing innovation newness (Becheikh et al., 2006; OECD & Eurostat, 2005). As the measurement of innovation newness is a rather new research field, there is a lack of a common assessment approach. However, most researchers assess the newness of product innovations on the two dimensions technology and markets (Chandy & Tellis, 1998). Kleinschmidt and Cooper (1991) also distinguish between *market newness* and *technological newness* in their study on product innovativeness (figure 2), which is often cited by other researchers (Vantrijp & Vankleef, 2008). The authors use the six-category-scheme by Booz-Allen & Hamilton and develop three classifications of innovativeness, i.e. highly innovative products, moderately innovative products and low innovativeness products. As the two dimensions market and

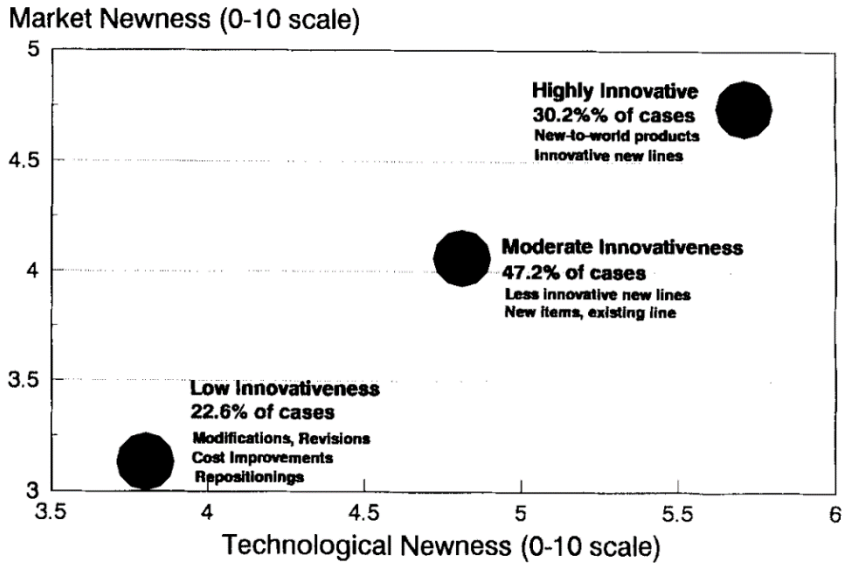

Figure 2: Market and technological newness map by Kleinschmidt (1991, p. 244)

technology are widely used by other researchers and applicable not only to incumbents, but also for small firms, Kleinschmidt and Cooper's newness map was chosen as measurement approach for start-up innovativeness. "Innovations are **new to the market** when the firm is the first to introduce the innovation on its market, [i.e. its competitive environment]"(OECD & Eurostat, 2005, p. 58). The geographical scope of *market newness* can thus vary, as it depends on the location of the firms' competitors. "An innovation is **new to the world** when the firm is the first to introduce the innovation for all markets and industries, domestic and international" (ibid.). Thus, new to the world products have a greater degree of novelty than products who are new to their market. *Technological newness* indicates "the extent to which the technology involved in a new product is different from prior technologies" (Chandy & Tellis, 1998, p. 476).

Highly and less innovative products are often defined as radical and incremental by other researchers. Poorkavoos et al. (2016) developed assessment criteria for distinguishing between radical and incremental innovations, which are similar to Kleinschmidt and Cooper's (1991) definitions of high and low product innovativeness. Incremental innovations are defined as adaptations of existing products or services, whereas radical innovations are novel products or services that did not exist before on the market or require new technologies that did not exist previously (ibid.). Abetti (2000), on the other hand, highlights the need to capture the true nature of innovations, as they are in reality not all black or white, thus he distinguishes between five types of innovations (from highly radical to minor incremental). Due to the need for parsimony Kleinschmidt (1991) summarized most of the above innovativeness indicators into three categories: high, medium, and low. This approach will be adopted by developing three categories for start-up innovativeness: radical, moderate, and incremental. By using these three classifications of innovativeness, a comprehensive assessment framework for defining the innovativeness of a start-up's product or service was constructed. Highly innovative (i.e. radical) products are hereby defined as "new-to-the-world products and innovative new product lines to the company" (Kleinschmidt & Cooper, 1991, p. 243). Moderately innovative products are less innovative new product lines or new features that are added to existing product lines, and low innovativeness (i.e. incremental) products are defined as "modifications to existing products; redesigned products to achieve cost reductions; and repositionings" (ibid.). These definitions match the explanations of radical and incremental innovations in the VoC literature. Hall and Soskice (2001, pp. 38–39) define *radical innovations* as "substantial shifts in product lines, the development of entirely new goods, or major changes to the production processes" and *incremental innovations* as "continuous but small-scale improvements to existing product lines and production processes" (ibid.). These criteria are used in this study to determine the *degree of innovativeness* of start-ups. In addition to this dependent variable, the two dimensions *market newness* and *technological newness* are separately assessed and adapted to the specific characteristics of start-ups in this thesis (table 2). While

some variables like a 'new sales force' have been removed, some criteria have been added from a study by Dahlqvist and Wiklund (2012), which measures the market newness of new ventures. The two variables 'no equivalence to product or service' and 'customers not served with similar products by firms' were added to the innovativeness indicator of this study (Dahlqvist & Wiklund, 2012; Kleinschmidt & Cooper, 1991). All variables were coded in the direction of their likelihood to influence a start-up's degree of innovativeness.

Table 2: Operationalization of dependent variables

Dependent Variable	Operationalization	Unit/Scale	Coding
Degree of innovativeness	How innovative is the start-up's product or process?	Ordinal: Incremental (modifications/ revisions; cost improvements; repositionings), moderate (less innovative new product line; new items to existing product line), radical innovation (new-to-world product; innovative new product line) (Kleinschmidt & Cooper, 1991)	Incremental = 1 Moderate = 2 Radical = 3
Market newness	No equivalence to product or service in nation/world (Dahlqvist & Wiklund, 2012)	Ordinal: No market newness; new to the nation; new to the world	No = 1 Nation = 2 World = 3
Technological newness	New technology, product/service or production process to the industry? (Kleinschmidt & Cooper, 1991)	Ordinal: No; Partly; Yes	No = 1 Partly = 2 Yes = 3

To rate the innovativeness of start-ups the venture's website and description were checked (e.g. for mentioned patents, description of technology etc.), then a Google search about the company was done to find further information like news articles about the novelty and innovativeness of the start-up. Lastly, the main product or service of the company (sometimes in combination with the country, e.g. "crowdfunding platform Austria") was googled to find competitors to determine the market newness of the start-up. Hereby similar questions like in the Global Entrepreneurship Monitor (GEM) were asked, e.g. how many other businesses are offering the same product or service (many, few, or no) and for how long the technologies or processes for the product or service have been available (for less than a year, between one to five years, or longer than five years) (Global Entrepreneurship Research Association, 2017). Table 7 in the appendix provides examples for each type of innovativeness.

3.3 Operationalization of the independent variables

The indicators that are used to operationalize the above-mentioned research question and hypotheses are listed in table 3 below. The main independent variable (IV) is the classification of the country, in which the start-up is incorporated in, as CME or LME according to the VoC theory (Hall & Soskice, 2001) (hypothesis H1).

The *industry* (H2) of each start-up was defined according to the *Eurostat Technology Classifications of NACE Rev. 2 Industry Codes* (European Union, n.d.). In a second step, this industry classification was sub-divided into two sub-variables, i.e. *industry sector* and *industry technology- and knowledge-intensity*. The first variable indicates if the start-up belongs to a service or manufacturing industry. The second variable designates the technology-intensity, if the start-up belongs to the manufacturing sector, and the knowledge-intensity, if the start-up belongs to the service sector (table 3). The six *NACE* classifications were summarized into 'technology/knowledge intensive industry' (knowledge-intensive service, medium-high technology manufacturing industry, high-technology manufacturing industry) and 'less technology/knowledge intensive industry' (less knowledge-intensive service, low technology manufacturing industry, medium-low technology manufacturing industry).

The IV *type of good* (H3) was operationalized by allocating the ventures into 'product' or 'service' producing start-ups. As several ventures have a combination of these two, a third category 'product and service combination' was introduced. For this classification the definition by Nijssen et al. (2006, p. 245) was chosen, which defines *services* as "solutions for customer problems characterized by high intangibility, co-production with customer and perishability" and *products* as " solutions that are highly tangible, manufactured and can be stored". However, in the case of start-ups not all products are necessarily manufactured, as they can also represent digital products, e.g. like an application or a software that is sold. However, if the software is sold as a service (SaaS) and e.g. billed on a monthly basis, the start-up's good would be regarded as a service. An example of a product and service combination would e.g. be the start-up Juno Fertility who are producing a home-test-kit (product) for ovarian reserve testing and provide a detailed fertility analysis (service).

As *sustainability* (H4) is a very complex phenomenon, there is a lack of a precise and mutually-agreeable definition of the term (White, 2013). However, most of these definitions comprise a social and environmental aspect of sustainability and sustainable entrepreneurship. Particularly the definitions by Kates et al. (2005) were chosen as a point of reference as these link the widely used Brundtland definition to environmental (e.g. air, land, and water quality) and societal systems (e.g. peace, health, equity) (White, 2013). The start-ups of the sample were then classified into 'not sustainable', 'partly sustainable' and 'sustainable' ventures. 'Not sustainable' meaning that the start-up does not actively contribute to a social or environmental cause. Not socially or ecologically sustainable ventures were e.g. online game start-ups, a start-up that offers a platform for lawyers or a SaaS for booking and managing flights. 'Partly sustainable' start-ups are ventures which do not have sustainability at their core business, but contribute to sustainability as a side-effect. Most of these ventures are active in the healthcare or educational sectors, and can thus be argued to contribute to a social cause such as health and equity. Examples for these ventures are, for instance, the start-up *EDYOU*, which provides safe communication solutions for schools to students, parents and teachers

(EDYOU, 2017) or *Cells Power*, which aims to increase life expectancy and quality through the clinical use of cell technologies (Cells Power Japan, 2017). 'Sustainable' ventures contribute actively to the solution of a societal challenge with their core product or service and often have this cause defined in their mission statement. Examples for these are the Dutch company *Watly*, which offers solar water purifiers and electric power stations (watly, 2017) as well as the American venture *Bluer Denim*, which manufactures jeans locally in a sustainable way and has a *Buy One, Give One* philanthropic mission (BLUER, 2017).

Table 3: Operationalization of independent variables and control variables

Independent Variables				
Variable	**Operationalization**	**Unit/Scale**	**Coding**	**Factor or covariate**
Country in which start-up is incorporated and classified according to VoC (labelled as *VoC*)	CME or LME according to Hall and Soskice (2001)	Nominal: CME or LME	Austria, Belgium, Denmark, Finland, Germany, Japan, Netherlands, Norway, Sweden, and Switzerland = CME = 1 Australia, Canada, Great Britain, Ireland, New Zealand, United States = LME = 2 "Countries such as Luxembourg and Iceland are eliminated from the VOC typology because of their small size, while others, such as Mexico, are disqualified because they are developing nations."	Factor
Industry (sub-divided into *industry sector* and *technology- and knowledge-intensity*)	What is the primary industry (industry group according to the Global Industry Classification Standard (GICS)) that the start-up is active in?	Nominal (6 industries according to NACE): High-technology manufacturing industry (HTM) Medium-high-technology manufacturing industry (MHTM) Medium-low-technology manufacturing industry (MLTM) Low technology manufacturing industry (LTM) Knowledge-intensive service (KIS) Less knowledge-intensive service (LKIS)	*Industry sector:* LKIS, KIS = service = 1 HTM, MHTM, MLTM, LTM = manufacturing = 2	Factor
			Industry technology- and knowledge-intensity: LKIS, LTM, MLTM = less innovation intensive industry = 1 KIS, HTM, MHTM = innovation intensive industry = 2	Factor

Type of good	What type of good is the start-up's core product?	Nominal: Service; Product and service combination; Product	Service = 1 Product and service combination = 2 Product = 3	Factor
Product-relatedness to sustainability (labelled as *sustainability*)	Does the start-up's product or service tackle a societal or environmental problem?	Ordinal: Not sustainable (e.g. gaming); Partly sustainable (e.g. healthcare or education); Sustainable (official mission to solve a social/environmental issue)	Not sustainable = 1 Partly sustainable = 2 Sustainable = 3	Factor
Control variables				
Variable	**Operationalization**	**Unit/Scale**	**Coding**	**Factor or covariate**
Firm size	Number of founders	Continuous/metrical: 1,2,3,4,5,6, 20, etc.	1 = 1 2 = 2 3 = 3 >3 = 4	Treated as covariate
	Number of employees	**Ordinal**/Interval: 1-10, 11-50, 51-100, 101-250, 251-500, 501-1000, 1001+	1-10 = 1 11-50 = 2 51-100 = 3 >100 = 4	Treated as covariate
Funding amount	Total Funding Amount (raised up to date) in US-Dollar	Continuous/metrical, e.g. $11,500,000	1.000-50.000$=1 50.001-150.000$ = 2 150.001-300.000$ = 3 300.001-500.000$ = 4 500.001-1.000.000$ = 5 1.000.001-1.500.000$ = 6 1.500.001-2.500.000$ = 7 2.500.001-4.000.000$ = 8 4.000.001-15.000.000$ = 9 15.000.001 – 300.000.000$ = 10	Treated as covariate

Based on various innovation studies by other researchers, it was found that *firm size* and *age* are the most commonly used **control variables** as they can significantly influence ventures' innovativeness (Becheikh et al., 2006; Rhee, Park, & Lee, 2010). By selecting only ventures that were founded in 2013, the author already controlled for age. As some studies found a positive link between firm size and innovation as well as a positive relation between availability of financial capital or R&D expenditures with innovation, firm size (measured as *number of employees* and *number of founders*) and *total funding amount* were chosen as control variables (Arvanitis & Stucki, 2012; de Jong & Vermeulen, 2006; EBRD, 2014; OECD & Eurostat, 2005). The reason why *firm size* and *funding amount* were not chosen as independent variables is that the direction of the causality is unclear, as researchers found that higher-order innovations influence firm growth and make ventures more attractive to investors (de Jong & Vermeulen, 2006). The operationalization of these control variables is illustrated in table 3.

3.4 Analysis of data

As the conducted research is of a quantitative-deductive nature, the obtained data is statistically analysed. Statistical analysis allowed to test the influence of the above-mentioned independent variables on a start-up's innovativeness (Bryman & Cramer, 2005). This was done with multinomial logistic regression in SPSS. This method is most suitable as it tests the influence of two or more independent variables on a nominal dependent variable with more than two levels (in this case the dependent variable *degree of innovativeness* has three levels). By analysing over 100 innovation related articles, Becheikh et al. (2006) found that multiple regression analysis is the most often used methodological approach to study innovation. Depending on the metric of the dependent variable, also other regression models were used. "In all these models, the dependent variable (i.e. innovation) was regressed on a set of factors integrated into the equation as explanatory variables" (Becheikh et al., 2006, p. 649). Thus, also multiple linear and ordinal logistic regression were conducted to ensure the robustness of the multinomial logistic regression model, as explained in the results below.

4. Results

In the following section, the descriptive statistics of the analysed data and the results of the OLS and multinomial logistic regression are presented.

4.1 Descriptive Statistics

Of the 940 analysed start-ups, 400 (42.6%) were rated as incremental, 385 (41.0%) as moderate and 155 (16.5%) as having a radical degree of innovativeness (figure 3). Start-ups were rated on the three-point scale with an average of 1.74 (standard deviation = .723). This large percentage of moderately innovative start-ups mirrors the findings of Kleinschmidt and Cooper (1991), who report a share of 47.2% of moderately innovative products, which are e.g. new items to existing product lines, but not new to the world.

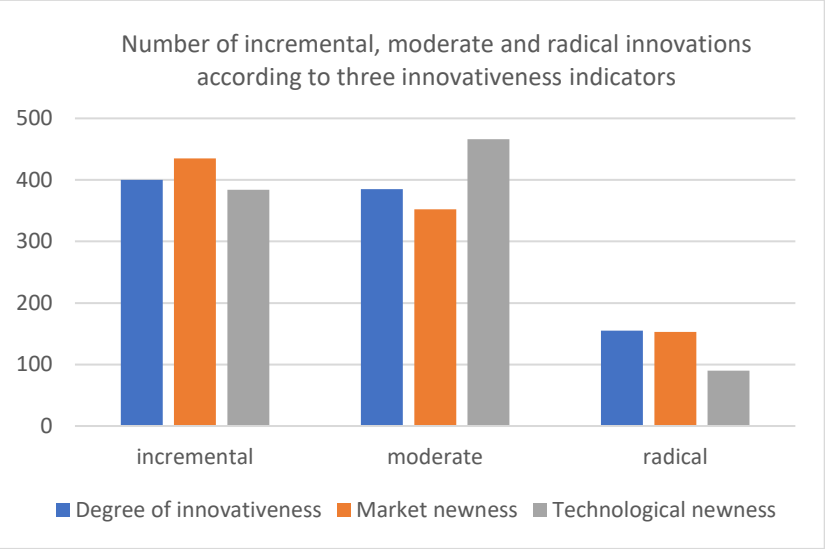

Figure 3: Number of incremental, moderate and radical innovations according to three innovativeness indicators; n=940

As figure 3 shows, the results of the three innovativeness indicators are similarly distributed. Since *degree of innovativeness* encompasses criteria of *market newness* (e.g. new to the world products being radically innovative) and *technological newness* (e.g. new

technologies to the industry being radically innovative), it was chosen as the dependent variable for further analysis.

By crosstabulation with the *VoC* variable it was discovered that there is a larger number of start-ups with a low degree of innovativeness (incremental) in CMEs and a higher number of moderate and radical innovative companies in LMEs (figure 4). This is a first indication of the potential transferability of VoC findings to start-ups.

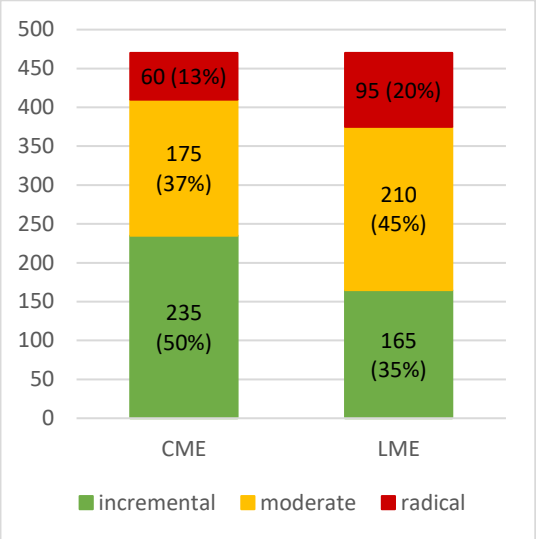

Figure 4: Distribution of degree of innovativeness of 940 start-ups in CMEs and LMEs; n=940

Regarding the ventures' *industry*, the majority of start-ups (818 or 87%) was allocated to the service sector and to a knowledge- or technology-intensive industry (583 or 62%). This predominance of the service sector fits the findings of other researchers such as Arvantis and Stucki (2012), as 83% of their analysed firms also belong to the service industry. These results illustrate the rise of the tertiary sector in OECD countries in recent years. In OECD member countries, services represent 74% of GDP, whereas the manufacturing sector contributes merely 15% to GDP (OECD, 2005; The World Bank Group, 2015a, 2015b). Moreover, it was found that there are more start-ups with a higher degree of innovativeness in knowledge- or technology-intensive industries and a larger share of start-ups with a moderate and radical degree of innovativeness in the manufacturing than in the service sector. Although the latter seems to be less innovative than the manufacturing sector, innovation and new product development occur often in knowledge-intensive services such as financial services or information technology (IT) in order to meet changing customer demands or increase competitiveness (OECD, 2000).

Besides being mostly active in the service sector, the majority of ventures (58.0%) also offers services rather than products as their *type of good*. Half of these service innovations are of incremental nature and merely 11.6% of service innovations are radical. Product-producing start-ups, on the other hand, have a share of 30.8% of radical innovations.

Moreover, 19.4% of all goods are contributing to *sustainability*. As Mikler and Harrison (2012) found, there are slightly more sustainable innovations in CMEs than in LMEs. Although the distribution of not sustainable and (partly) sustainable start-ups is distributed rather evenly in this sample, one can see a slight tendency of CMEs to have more 'sustainable' start-ups. Although only one fifth of start-ups contributes to sustainability, these ventures were found to have a larger share (32.7%) of radical

innovations than start-ups whose products were not enhancing sustainability. These had a share of merely 13.9% of radical innovations.

Regarding the general characteristics of the start-ups, 93.7% of start-ups had less than 50 *employees* and the majority (61.5%) of ventures had between one and ten *employees*. Moreover, only one quarter of start-ups had more than two *founders* and one fifth of ventures had a *total funding amount* of more than four million USD.

Table 4 summarizes the descriptive statistics of the dependent, independent and control variables used in the model. Since some of these variables have an ordinal scale and the data is not normally distributed, Spearman's correlation was used. *Industry sector* and *type of good* (r_s = .359, p < .01) as well as *funding amount* and *number of employees* (r_s = .532, p < .01) show the strongest correlations. A higher amount of capital helps firms to increase their workforce which explains the strong correlation found between the control variables *funding amount* and *number of employees*. Although many pairs of variables had significant correlations, the IVs are adequately distinct for further use in the analysis. There was no multicollinearity in the data as computed variance inflation factors (VIFs) ranged from 1.050 to 1.436, which is far below the multicollinearity threshold of 10.0 (de Jong & Vermeulen, 2006; Rhee et al., 2010).

Table 4: Descriptive statistics of dependent, independent and control variables (pairwise deletion, n=940)

		N	Min	Max	Mean	Std. Dev.	Spearman Correlation							
							1	2	3	4	5	6	7	8
	Dependent variable													
	Degree of innovativeness	940	1	3	1.74	.723								
	Control variables													
1	Number of founders	628	1	4	2.00	0.960	1							
2	Number of employees	829	1	4	1.48	.704	.147**	1						
3	Funding Amount	427	1	10	5.61	2.830	.145**	.532**	1					
	Independent variables													
4	CME or LME (VoC)	940	1	2	1.50	.500	-.087*	-.006	-.007	1				
5	Industry sector	940	1	2	1.13	.336	.062	.030	.135**	-.032	1			
6	Industry knowledge-intensity	940	1	2	1.62	.486	.035	.013	.078	.072*	.100**	1		
7	Type of good	940	1	3	1.58	.745	.103**	.003	.041	-.033	.359**	.097**	1	
8	Product-relatedness to sustainability	940	1	3	1.25	.538	.046	-.012	.087	-.005	.249**	.148**	.096*	1

*** p-value < .01 (2-tailed)*
** p-value <.05 (2-tailed)*

4.2 Results of the OLS and multinomial logistic regression

Table 5 shows the results of the linear regression assessing the influence of start-up specific and contextual factors on start-ups' degree of innovativeness. Besides conducting a step-wise regression to determine the most influential variables, three main models were constructed for the multinomial logistic and linear regression. Model 1 comprises solely the three control variables, model 2 consists of the independent variables and model 3 combines models 1 and 2 and thus represents the full model of control variables and independent variables.

Table 5: OLS regression analyses of degree of innovativeness (listwise exclusion)

DV: Degree of innovativeness	**Model 1** Only controls	**Model 2** IVs (without control variables)	**Model 3** Full model (IVs + controls)
Variables	*b* (S.E.)	*b* (S.E.)	*b* (S.E.)
Constant	1.950 (.125)**	.285 (.124)*	.496 (.233)*
Control variables			
Number of founders	-.098 (.040)*		-.079 (.038)*
Number of employees	-.071 (.058)		-.009 (.055)
Funding amount	.054 (.016)**		.033 (.015)*
Main IVs			
CME or LME (VoC)		.223 (.044)**	.238 (.073)**
Industry sector		.233 (.073)**	.304 (.112)**
Industry knowledge-intensity		.235 (.046)**	.232 (.076)**
Type of good		.138 (.032)**	.058 (.052)
Sustainability		.208 (0.42)**	.196 (.065)**
F	5,300**	31.146**	9.353**
R^2	.044	.143	.179
N	352	940	352

*** p-value < .01*
** p-value <.05*

As table 5 shows, the tests of all three models against the corresponding constant-only model are statistically significant. Thus, the independent and control variables reliably influence the degree of start-ups' innovativeness. The model fit is further indicated by the R^2, which is with .179 the highest for the full model (model 3). This shows that the predictors explain almost 20% of the variability of start-up innovativeness. As model 2 confirms, all independent variables are significant predictors on at least a .05 level for start-ups' innovativeness. However, the control variable *number of employees* is not statistically significant. These findings are robust as the same predictors remain statistically significant or insignificant across all three models. One exception is the IV *type of good* which is in model 3 not significant anymore. The main reason for this could be the reduced sample size due to missing data. as the inclusion of the control variables reduces the sample from 940 to 352 start-ups[3].

[3] Including the control variable funding amount decreased the sample by half, as 54.6% of start-ups had no information on their funding. Moreover, 68 start-ups provided no information on their firm size, which further decreased the sample size of the final model.

All variables, except *firm size* (measured as *number of founders* and *number of employees*), show a positive relationship with the *degree of innovativeness*. These findings suggest that increasing firm size could have a slightly negative effect on innovativeness, although these results are not particular significant. The results of other researchers regarding the influence of firm size on innovativeness vary, as some scholars find that increasing firm size fosters (e.g. by higher availability of capital) innovation, whereas some researchers report the opposite and many find no significant effect (Rhee et al., 2010; Rogers, 2004).

By conducting **multinomial logistic regression** with the full model (model 3), it was found that most of the predictors remain significant when examining the influence of these factors on radical innovativeness compared to incremental innovativeness (table 6). Nonetheless, *type of good* and *number of employees* remain insignificant. As in the prior linear regression, one reason for this is that the sample size is significantly reduced when including the control variables, due to missing data. This could reduce the significance levels, as *type of good* had a significant influence on innovativeness in model 2 and has a high significance (p=.001) when conducting the multinomial logistic regression with 940 start-ups. Moreover, the variables *number of founders* and *sustainability* reduce their significance from a .05 level to a .1 level, indicating that other predictors have a stronger influence on innovativeness. With a pseudo R^2 of .242, the final model explains roughly one quarter of the variance within start-up innovativeness.

The results in table 6 provide empirical evidence for the author's first hypothesis (H1) at a .01 significance level, as start-ups in LMEs are more likely to have a higher degree of innovativeness (i.e. radical innovations) than start-ups in CMEs. Being incorporated in a CME decreases the odds of being radical rather than incremental by a factor of .347 while holding all other variables in the model constant.

Table 6: Multinomial logistic regression analyses of degree of innovativeness (final model, n=352)

DV: Degree of innovativeness		*95% CI for Odds Ratio*		
Variables	*b* (S.E.)	*Lower*	*Odds Ratio*	*Upper*
Moderate degree of innovativeness				
Intercept	2.616 (.966)***			
Control variables				
Number of founders	-.273 (.142)*	.575	.761	1.006
Number of employees	-.136 (.207)	.582	.873	1.311
Funding Amount	.116 (.058)**	1.002	1.122	1.258
Main IVs				
VoC = CME	-.417 (.278)	.382	.659	1.137
Industry sector = service sector	-2.035 (.676)***	.035	.131	.492
Industry knowledge intensity = less knowledge-intensive	-.848 (.278)***	.249	.428	.738

Type of good = service	.491 (.455)	.669	1.634	3.988
Type of good = product & service comb.	.647 (.482)	.742	1.909	4.911
Sustainability = not sustainable	-.084 (.671)	.247	.919	3.428
Sustainability = partly sustainable	.820 (.830)	.447	2.271	11.550
Radical degree of innovativeness				
Intercept	3.538 (1.024)***			
Number of founders	-.338 (.180)*	.502	.713	1.014
Number of employees	-.029 (.255)	.589	.972	1.603
Funding amount	.151 (.073)**	1.008	1.162	1.341
VoC = CME	-1.057 (.343)***	.177	.347	.680
Industry sector = service sector	-2.040 (.713)***	.032	.130	.526
Industry knowledge-intensity = less knowledge-intensive	-.878 (.358)**	.206	.416	.838
Type of good = service	-.352 (.509)	.259	.703	1.906
Type of good = product & service comb.	.067 (.534)	.375	1.069	3.048
Sustainability = not sustainable	-1.292 (.679)*	.073	.275	1.039
Sustainability = partly sustainable	.072 (.845)	.205	1.075	5.633

**** p-value < .01*
*** p-value <.05*
** p-value <.1*
Note: N=352, R^2=.213 (Cox and Snell), .242 (Nagelkerke), Reference category=incremental

Based on the second hypothesis, it was anticipated that start-ups in knowledge- and technology-intensive industries have a higher, i.e. radical, degree of innovativeness (H2b). Moreover, it was assumed that start-ups in the manufacturing sector have a higher degree of innovativeness than start-ups in the service industry (H2a). The results in table 6 display empirical support for hypotheses H2a and H2b at either .05 or .01 significance levels. Ventures in the service *sector* are 87% less likely than start-ups in the manufacturing industry to be radically innovative rather than incrementally innovative. The *knowledge- and technology-intensity* of the industry also significantly influences a start-up's innovativeness. Less knowledge intensive industries decrease the likelihood of a venture to be radical rather than incremental by a factor of .416 (or 58.4%) compared to start-ups in knowledge- and technology-intensive industries like the electronics industry. Thus, H2 can be confirmed as start-ups in service and less knowledge-intensive industries are less likely to have higher degree of innovativeness compared to ventures in the manufacturing and technology-intensive industries.

The conjecture of H3 that product-producing start-ups have a higher degree of innovativeness than service-providing start-ups can only be partially confirmed. While the chances for start-ups to be radically innovative compared to incrementally innovative decrease by a factor of .703 (or 29.7%) for service-offering start-ups compared to product-producing start-ups, the results are not statistically significant and, thus, provide no empirical evidence for H3.

Ventures that do not contribute to *sustainability* are 72.5% less likely to be radically innovative, compared to sustainable start-ups. These results confirm H4 at a .1 significance level.

Regarding the control variable *firm size*, although the *number of employees* is not significant, the *number of founders* is with $p < .1$ slightly significant and reduces the chances for a start-up to have a higher degree of innovativeness. The control variable *funding amount* had, on the other hand, a significant influence on start-up innovativeness at a $p < .05$ level. A one-unit increase in *funding amount* increases the odds of being radical compared to incremental by a factor of 1.162 (or 16.2%). The likelihood of being moderate compared to incremental are increased by a factor of 1.122 (or 12.2%).

4.3 Robustness, validity and reliability

As mentioned above, the robustness of the model was tested by assessing the changes in results (direction and significance of variables) across different models. It was further checked by conducting stepwise regression and substitution of variables. Moreover, testing the model with three different regression methods (OLS, ordinal and multinomial logistic regression) yielded similar results. By substituting the DV *degree of innovativeness* with the other innovativeness indicators *market newness* and *technological newness*, the robustness and model fit were further confirmed, although utilizing *degree of innovativeness* produced more significant results.

The null hypothesis of the *goodness of fit test* was rejected which indicates that the model fits well. The highly significant model fitting information as well as the pseudo-R^2 of more than 20% further confirmed the validity of the model. Furthermore, tests for multicollinearity and the *Spearman correlations* between the IVs were conducted. By using control variables, the validity of the model was further ensured. The accuracy of the model was conclusively examined by cross-validation which confirmed the model's fit for both randomly split data halves. Lastly, the statistical significance was verified.

5. Discussion

The findings of this paper indicate that national institutions but also contextual and internal determinants influence the innovativeness of start-ups. By assessing the degree of this characteristic of 940 newly founded firms in LME and CME countries, the applicability of the VoC theory and other innovativeness determinants on start-ups was tested with linear and multinomial logistic regression.

The results of the quantitative analysis show that the influence of the respective institutional environment (hypothesis H1) and industry (hypotheses H2) on a start-up's type of innovativeness is highly significant. The main hypothesis, i.e. the *national institutional environment's* influence on the venture's innovativeness, was confirmed. Start-ups in LMEs are significantly more likely to yield radical product or service innovations than those in CMEs. This result appropriately matches the findings of Hall and Soskice's (2001) VoC theory. Thus, we can extend the conclusions of several other researchers about the influence of different varieties of capitalism on incumbents' innovativeness to start-ups. The

stronger orientation of LMEs to competitive markets fosters the innovativeness of small and large firms similarly. LMEs support entrepreneurs to seize market opportunities free from governmental intervention or societal responsibilities. This helps their start-ups to rapidly develop new products and ideas for exploiting new market opportunities. Anti-trust laws in the US and other LMEs hinder ventures from collaborating and foster short-term, more competitive relations between firms. Long-term cooperation in CMEs, on the other hand, decreases start-ups' likelihood to rapidly adjust and pursue new ideas. This is one of the reasons why CMEs foster incremental rather than radical innovations, as denser corporate networks facilitate long-term and less market-focused incremental improvements of technologies. Moreover, 'patient capital' and long-term employees with firm-specific skills constrain firms to focus on improving their existing products and services (Hall & Soskice, 2001; Mikler & Harrison, 2012). Because of these characteristics CMEs have a comparative advantage in more traditional industries with incremental patterns of innovation, while LMEs enable with their capital and labour fluidity more efficient production in novel industries with radical patterns of innovation (Witt & Jackson, 2016). Thus, comparative advantages of CMEs in incremental start-ups and of LMEs in radical entrepreneurial innovations can be confirmed.

While the VoC theory can explain a large part of the varying degrees of start-up innovativeness between different nations, it is not the only determinant. It was found that other company specific and contextual factors influence start-ups' innovativeness. Especially a venture's *industry (H2)* influences its degree of innovativeness to a large extent. The findings indicate that new entrants in high-technology and knowledge-intensive industries have a higher likelihood of producing radical innovations than those in less knowledge-intensive industries. Moreover, start-ups in the manufacturing sector are more probable to be radically innovative than the ones in the service sector. These findings are similar to those of other researchers who conclude that technological innovations are more likely to occur in the electronics industry and other science-based sectors (Becheikh et al., 2006; Forsman, 2011; Quadros, Furtado, Bernardes, & Franco, 2001; Schneider & Paunescu, 2012; Veugelers & Cassiman, 1999). Hall and Soskice (2001) highlight the need for radical innovation in certain industry sectors like biotechnology, information technologies and telecommunications systems. Incremental innovation, on the other hand, is more important for the production of capital goods. According to Akkermans et al. (2009) LMEs produce more radical innovations in the manufacturing sector than CMEs.

Besides this strong influence of contextual determinants also internal factors (H3 and H4) foster different types of innovations. Although these results were less significant than those of the contextual factors in the logistic regression, linear regression provided empirical support for the influence of a start-up's *type of good* (H3) and product-relatedness to *sustainability* (H4) on its degree of innovation. H3, i.e. product-producing start-ups being more likely to be radically innovative than service-providing

start-ups, can only be partially confirmed. Although linear regression showed a positive influence of products (compared to services) on higher degrees of innovativeness, these results were not statistically confirmed by multinomial logistic regression. Services were found to be less innovative than products or product and service combinations. Other researchers like Hipp and Grupp (2005) confirm the incremental nature of services, as often already existing services are imitated. Particularly services that require physical labour (e.g. repair) or are very rule-bound (e.g. sports) are less innovative. However, as services contribute more than 60% to total economic activity in the OECD, services will continue to play an important role for innovation (OECD, 2000).

Finally, H4 that assumes that a start-up's product-relatedness to s*ustainability* positively influences its degree of innovativeness can be confirmed. It was found that start-ups who are contributing directly or indirectly to sustainability are more likely to have a higher degree of innovativeness. However, although LMEs provide a better environment for radical technological innovations, CMEs tend to have slightly more radical *sustainable* innovations. By setting environmental regulatory targets CMEs provide a better framework for sustainable start-ups. This could subsequently lead to more radical innovations towards improving societal and environmental issues (Mikler & Harrison, 2012). Mikler and Harrison (2012) suggest that a lack of leadership and political will on climate change could hamper the progress of LMEs towards sustainability. Especially the European Union (EU) aims to achieve sustainable economic growth and the formation of a green economy with its policies (Evans & Stroud, 2016). Changes towards a green economy enabled by more sustainable employee skills were more dynamic in CMEs like Germany due to strong vocational education training (VET) frameworks and a wider development of environmental innovation. In LMEs like the UK, on the other hand, significant barriers towards the 'greening' of skills are still in place. As potential reasons for this divide, Evans and Stroud (2016) state the development paradigm that firms in LMEs are more driven by short-term benefits and have a limited focus on environmental compliance. Technological innovations are crucial for combating climate change. Yet, also changes in business organisation, land use, transportation, lifestyle as well as novel financial instruments like e.g. carbon trading are necessary to reduce greenhouse gas emissions. These innovations do not necessarily need to be radical technological changes but could also be incremental improvements to existing products or processes. They can emerge and amass to important developments, such as the wide spread use of electric cars enabled by improved batteries. More than half of climate change mitigation could be achieved through these modifications of existing technologies as the evolutionary character of incremental innovations can lead to radical changes (IPCC, 2007; Mikler & Harrison, 2012). Besides political will, 'patient capital' is necessary to encourage radical climate change mitigation technologies, as these will require long-term investments. Since venture capital is, due to its profit and short-term focus, unlikely to provide this, LMEs will therefore need to increase their public funding for sustainable innovations (Hall & Soskice,

2001; Mikler & Harrison, 2012). Fostering social entrepreneurs could thus contribute to increasing levels of innovation.

The findings of Hall & Soskice (2001) of higher availability of venture capital in LMEs, which foster radical innovation, can be further confirmed. By controlling for *total funding amount*, it was found that increases in funding lead to higher degrees of innovativeness. Moreover, it was found that start-ups in LMEs have on average 120% more funding than start-ups in CMEs[4]. These findings are similar to those of the OECD (2016, p. 136), which report that 85% of total venture capital investments in the OECD occur in the US. While almost 60 billion USD were invested in the US in 2015, only 4.2 billion USD of venture capital were invested in Europe. As this type of equity financing is vital for fostering the growth and innovativeness of start-ups, LMEs have a comparative advantage for more radically innovative start-ups. These findings are in line with those of other researchers who found that increases in funding and financial independence foster innovation by facilitating, for instance, higher investments in R&D (Becheikh et al., 2006; Florida & Kenney, 1988). As *firm size* did not have a significant effect on the *degree of innovativeness* in this paper, it can be concluded that the *number of employees* is not an important determinant of start-up innovativeness.

6. Conclusions and further research

This paper contributes to filling the research gap on the applicability of Hall and Soskice's (2001) VoC theory to start-ups. It can be concluded that a nation's institutional environment significantly influences start-ups' degree of innovativeness. CMEs were found to provide a better environment for incremental start-ups, whereas LMEs foster radical innovations of start-ups. Market competition, availability of venture capital and other financial support, legislative regulations (e.g. for patents), a sound infrastructure and educational system, as well as innovation and environmental policies create comparative advantages for different kinds of innovativeness (Koberg et al., 2003; OECD & Eurostat, 2005). Moreover, a start-up's industry, type of good and its product-relatedness to sustainability can influence its degree of innovativeness. To foster start-up innovations, policy-makers should promote competition in various industry sectors by reducing entry barriers for start-ups and encouraging internationalization. Moreover, depending on the kind of innovation they desire, policies should support either manufacturing and technology-intensive industries (for radical innovations) or service and less knowledge-intensive industries (for incremental innovations). Financial support in the form of venture capital, loans or subsidies can also aid innovation activities (Zoltan J. Acs, Desai, & Hessels, 2008; Becheikh et al., 2006). By knowing how to foster different kinds of innovation, nations can

[4] Start-ups in CMEs in the sample received on average 3.9 million USD in funding, whereas start-ups in LMEs received 8.6 million USD in funding.

improve their international competitiveness, productivity and employment statistics (Becheikh et al., 2006).

As any study, also this paper has a few limitations. Although the sample comprises 940 start-ups, only 358 ventures could be used for the multinomial logistic regression analysis due to incomplete data sets. However, by applying descriptive statistics and correlation analysis with pairwise deletion the validity of the model was proven. Moreover, due to its complexity measuring innovativeness is a challenging task for researchers (OECD, 1997). By rating the start-ups objectively, following coherent guidelines and not relying on self-reported data, bias was reduced as many start-ups would be inclined to overrate their innovativeness. However, conducting an additional survey could help to validate the findings in this paper. The risk of subjectivity when rating the start-ups was reduced to the utmost extent possible by defining a clear rating process and applying innovativeness indicators used by other researchers such as Kleinschmidt and Cooper (1991). Furthermore, a concise market research was conducted for each company. Ultimately, three different ways of measuring innovativeness, i.e. degree of innovativeness, market newness and technological newness, were performed, which came to similar results.

A suggestion for further research would be to collect self-reported data (by distributing a survey to approximately 1.000 start-ups) which would offer the possibility to include other potential factors for start-up innovativeness. The resource-based view of the firm proposes other factors like a firm's strategy, innovation and human resource management, and other internal competences that could influence a firm's degree of innovativeness (Herrmann, Gassmann, & Eisert, 2007; Poorkavoos et al., 2016). Thus, it would be interesting to analyse the influence of various characteristics such as the diversity and experience of the founder team and employees on a start-up's innovativeness. Besides these internal factors, further contextual determinants of innovation could be explored. These are e.g. a firm's industry related variables like demand growth, a firm's regional variables like geographic location, networking activities of the firm, knowledge and technology acquisition, public policies and external financial support, as well as the surrounding culture (Becheikh et al., 2006; Koberg et al., 2003; OECD & Eurostat, 2005, p. 43).

Another possibility for subsequent studies would be the analysis of national institutions not only on a CME/LME level but on a national level. By comparing policies and subsidies for start-ups, the influence of these measures on the innovativeness and sustainability of start-ups could be examined. Furthermore, an evaluation of the influence of transnational activities of start-ups would be an interesting opportunity. Moreover, one could compare the innovativeness of start-ups over several years, as the national institutional configurations of the VoC could change over time (Schneider & Paunescu, 2012).

Despite these limitations, this study contributes to the VoC, entrepreneurship and innovation literature by shedding light on the determinants of specific kinds of start-up innovations. While the national institutions influence significantly start-ups' degree of innovativeness, other factors such as the venture's industry, funding amount, type of good, and product-relatedness to sustainability influence similarly its type of innovation. Policy-makers should consider these determinants to foster specific kinds of innovation and gain an understanding about the influence of their nation's institutional framework on entrepreneurship. In addition to economic growth, a higher degree of innovativeness in entrepreneurship can also contribute to solving global sustainability challenges by facilitating socio-technical transitions (Cooke, 2010; Geels, 2012; Geels & Schot, 2007; Hockerts & Wüstenhagen, 2010; Markard et al., 2012).

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Appendix

Table 7: Examples of different types of innovativeness

Start-up	Type of good	Industry	Description	Knowledge intensity	Innovativeness explanation	Degree of innovativeness	Market newness	Technological newness
Examples for "radical innovativeness"								
Imandra (imandra.ai)	Service	Knowledge-intensive service	service (1)	high (2)	Imandra offers " the world's first platform using formal verification for blockchain-backed smart contracts" (Coleman, 2016).	radical (3)	world (3)	yes (3)
Pulmocide (pulmocide.com)	Product	High-technology manufacturing	manufacturing (2)	high (2)	Pulmocide is "developing novel, potent first-in-class anti-infective agents for delivery by inhaled administration for life-threatening lower respiratory infections" (Pulmocide, 2017).	radical (3)	world (3)	partly (2)
Sedicii (sedicii.com)	Service	Knowledge-intensive service	service (1)	high (2)	"patented zero knowledge proof authentication service" Start-tup of the year 2014: "The innovative methodology that Sedicii uses to authenticate and verify identity provides the architecture to address both current and evolving web, mobile and Internet of Things authentication needs. Based on Sedicii's patented technology for authenticating without exchanging, storing or exposing the personal identifiable information required to authenticate, Sedicii has refined and launched a number of solutions with initial prototypes during the year." (Leslie, 2015)	radical (3)	world (3)	yes (3)
Examples for "moderate innovativeness"								
Start-up	**Type of good**	**Industry**			**Innovativeness explanation**	**Innovativeness rating**		
Juno Fertility (juno-fertility.com)	Product and service	Knowledge-intensive service	service (1)	high (2)	Juno Fertility has developed a home-test-kit for ovarian reserve testing. The result of the test is a detailed 5-6-page fertility analysis. There exist some similar products in the US, but it is new in Austria and Juno Fertility is developing another novel test kit.	moderate (2)	nation (2)	partly (2)
Virta Ltd. (virta.global)	Product and service	Medium-high-technology manufacturing	manufacturing (2)	high (2)	"Virta is the innovation leader in electric vehicle charging services" (Crunchbase, 2017) With its scalable smart grid solutions Virta supports the world's transition to sustainable energy. The start-up's electric vehicle charging platform allows running EV charging services of any size anywhere in the world. Competitors are e.g. EV Solutions (evsolutions.com).	moderate (2)	nation (2)	partly (2)
16Lab (16lab.net)	Product	High-technology manufacturing	manufacturing (2)	high (2)	16Lab produces a personal computing ring-device, which has some novel features. However, the patent for a wearable ring computing device belongs to their competitor Fin Robotics, which is based in the US (Fin Robotics, 2014; Kumparak, 2014).	moderate (2)	nation (2)	partly (2)
Examples for "incremental innovativeness"								
Start-up	**Type of good**	**Industry**			**Innovativeness explanation**	**Innovativeness rating**		
Advanced Marcomm (advancedmarcomm.com)	Service	Less knowledge-intensive service	service (1)	low (1)	Marketing Middleware Developer & High Tech Marketing Agency that offers strategic marketing services. The venture is similar to other hi-tech marketing agencies like Maverick (maverick-intl.com).	incremental (1)	no (1)	no (1)
SAMAPOS (samapos.com)	Service	Less knowledge-intensive service	service (1)	low (1)	SAMAPOS offers a Cloud Point-Of-Sale software for grocery stores with a full inventory management service. The software is similar to other POS systems, e.g. kounta (kounta.com) (Capterra, 2017).	incremental (1)	no (1)	no (1)
Smartest Finance (smartestfinance.com)	Service	Knowledge-intensive service	service (1)	low (1)	"Smartest Finance-Website offers Forex real-time charts, quotes, news and tools. No. 1 FX-portal" (Crunchbase, 2017). Smartest Finance offers realtime forex trading and news. It is similar to e.g. FXCM (fxcm.com)from the US.	incremental (1)	no (1)	no (1)