Emergence of Cleantech as an Investment Category ? Public Discourse and Venture Capital Investment

Michael Migendt
EBS Business School
Innovation Management and Entrepreneurship
michael.migendt@ebs.edu

Florian A. Täube
EBS University for Business and Law
Strascheg Institute for Innovation and Entrepreneurship (SII)
florian.taeube@ebs.edu

Paschen von Flotow
Sustainable Business Institute (SBI)
flotow@instoec.de

Brett Gilbert
Rutgers University
Management & Global Business
bagilbert@business.rutgers.edu

Abstract
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1 Introduction

Sustainability and cleantech seem to be common in everyone’s ears nowadays. But this has not been like that in the past. Topics like renewable energy, energy efficiency and alternative transportation have been technological inventions in the 1990s and earlier and developed to be household knowledge and important business sectors until today. Venture capital has been rising in importance as well in recent years. We are bringing these two topics together in order to investigate the emergence of a new industry and new investment category.

Venture capital has been researched to be one of the major drivers of innovation and as well commercialization of technology. (Bygrave & Timmons 1992; Samila & Sorenson 2010) The venture capital industry is known for helping with the development of certain high technology industries. It was a driver for growth in the semiconductor software, hardware and biotechnology sector (Florida & Kenney 1988; Chen et al. 2009) and as well as a driver for different industries in certain countries like Israel and Taiwan (Avnimelech et al. 2004; Avnimelech & Teubal 2006; Dodgson et al. 2008).

The cleantech sector as a multi-industry sector has different characteristics than classical sectors like software, information technology or internet. It encloses parts of these sectors but is in its own definition a new sector. We observe the formation and emergence of the topic cleantech as an investment category within the venture capital industry. The development of industry trends is well connected with the financial support for these topics. The term cleantech itself has evolved from the investment community and it is widely regarded as a description of a major investment category or even asset class. Some describe different companies having a focus on green and sustainable technologies as cleantech or part of a cleantech industry.
To analyze the historical events we use a quantitative content analysis of a database of press articles about venture capital. We can observe important milestones of the evolution on a textual base by analyzing the public discourse. We regard the media data as a good measure of developments at certain points in time. The observation of the emergence of cleantech related words, themes and connections within the media data is a key strength of our approach. It can be observed which technologies, topics and themes have been dominant at certain stages of industry development. This allows an analysis with high scrutiny and leads to thorough understanding of influencing factors. This paper addresses the evolution of cleantech venture capital by studying the emergence of this new investment category and patterns in the following expansion. We also discuss the role of public discourse in the life cycle and show implications of sentiment in press articles for investments in the venture capital industry.

Section 2 of the paper presents its theoretical background. Section 3 describes the research methods used. Section 4 offers the results of the analysis of our media database matched with the investment data. Section 5 examines the results and delivers our interpretation of the emergence and evolution as well as interpretation of the public discourse and use of sentiment analysis. We additionally come up with several prepositions and discuss the paper’s limitations, and suggest some future research.

2 Theory

Cleantech Emergence & Evolution

The cleantech sector as a collection of several different industries has several interesting characteristics which open a host of scholarly opportunities. Research in the field of investments
through venture capital in the field of cleantech or some of its niches is still rare. Works of Diefendorf (2000) Sonntag-O’Brien & Usher (2003), O’Rourke (2004) Randjelovic et al. (2003) Wüstenhagen et al. (2006) or Ghosh & Nanda (2010) show the characteristics and advantages of green VC but also problems of certain sectors of cleantech to obtain financing as well as policy preferences of VCs. Research on the emergence (Santos & Eisenhardt 2010; Woolley 2010) of innovation and as well venture capital investment in this field suggests there has been an evolutionary development (Nelson & Winter 1982; McGrath 1998) that is connected with the entrepreneurial activity in the cleantech sector. We combine the emergence of cleantech investment within the overall (venture capital) industry life cycle.

Venture capital is an important mean of funding for entrepreneurs and innovation. Big technology firms have been funded by venture capitalists. Venture Capital has become well researched topic in the entrepreneurship field. (Bygrave & Timmons 1992; Sapienza 1992; Gompers & Lerner 1999; Kortum & Lerner 2000) It is recognized driver for growth in the several high technology sectors (Florida & Kenney 1988; Chen et al. 2009) and as well in national innovation systems (Avnimelech & Teubal 2006; Dodgson et al. 2008).

Categories are defined as sharing common features and having common identities. (Navis & Glynn 2010; Khaire & Wadhwan 2010) The cleantech investment category in a very broad sense includes investments in companies mitigating and adapting to climate change.

Avnimelech et al. (2004) developed a venture capital life cycle model we are building on to describe the evolution of the investment category. The base for our research stems from emergence and industry formation literature (Abernathy & Utterback 1978; Klepper 1996, 1997;
Malerba & Orsenigo 1996). In a nutshell, extant literature uses four phases to describe emergence and evolution of industries.

**Hypothesis 1:** New investment categories emerge and evolve following a life cycle pattern.

*Public Discourse on Venture Capital Investment*

Utilizing discourse analysis we observe the media perception of socially constructed objects and their positions within the investment category frame. The total attention towards terms can be tracked for new technologies (Munir & Phillips 2005)

**Hypothesis 2:** Public discourse is a proxy for VC industry capital flows.

*Sentiment Analysis*

Using discourse methods and content analysis it is possible to analyze tone and sentiment in texts. This method used has been introduced in financial literature. (Antweiler, Frank 2004; Tetlock 2007; Tetlock et al. 2008) To approach the sentiment in texts with a financial background standard dictionaries have been remodeled to show a more focused use of words in a negative context. (Loughran & McDonald 2011). Commonly stock market developments are analyzed using company publications or social media discourse but the use of sentiment dictionaries in other fields especially connected to the financial markets is a possible approach. We see the Venture Capital market as a field for testing.
Hypothesis 3: Sentiment analysis can be used in private (equity) markets.

3 Research methodology

A set of different methods is used for our study. We conduct a content analysis of press articles and public discourse, a method which has found increasing prominence in organizational research of late (Wuthnow 1989; Phillips & Hardy 2002; Ventresca & Mohr 2002). We therefore use the press publications of several major international newspapers. Source of these articles is the Lexis Nexis database with its records of important international press. Within the database we select the subset of “Major World Newspapers” which comprise 79 major international newspapers. We use all publications mentioning “Venture Capital” and related word patterns. Through this selection of global articles we are able to observe the development of the venture capital sector through press discourse. The regarded timeframe spans from January 1st 1995 to December 31st 2011. We have 17 years divided into 68 quarters. There are a total of 84,259 articles mentioning “Venture Capital”. We can clearly observe the increasing public importance of venture capital in the late 1990s. Starting in the first quarter of 1995 there were 491 articles published in the newspapers. After a steady increase of numbers the articles published peak in the second quarter of 2000 with a number of 3097. After that peak the number of articles drops to a range between 707 and 1035 in the years 2008 and 2011.
Using the Wordstat 6.1 software package we can not only use verbal counts (Berelson 1952) but also co-occurrence of words and several statistical methods (Neuendorf 2002; Krippendorff 2004). Through the use of computer processing it is possible to handle large data sets and do a more detailed analysis. The approach of analyzing textual data has been used in psychology and sociology and other disciplines. The method has been used to research the historic shifting composition of actors and frames in corporate environmentalism (Hoffmann 1999) and the construction of market categories in the computer workstation market (Kennedy 2005).

We combine the use of historical analysis of texts and the sentiment analysis on our sample of press articles. For analyzing the emerging topics of cleantech industries within the venture capital articles we developed a dictionary to apply within the Wordstat software. As a base for structuring the cleantech sector we used the taxonomy developed by the Cleantech Group. The Cleantech Group is one of the leading market intelligence companies in the field of clean technologies and is widely seen as influencing for the establishment of the term “cleantech”. The Cleantech Group’s definition of the sector spans over 13 categories encompassing several different industries and technologies. We build our dictionary accordingly to these categories and introduced two overview categories to test a global cleantech and a global ecology topic. These
15 different categories plus an additional combined category were applied to the quarterly structured articles from the 17 years from 1995 to 2011.

Additionally we applied an existing dictionary developed by finance scholars for analyzing the sentiment in the articles. (Loughran, McDonald 2011) We used the dictionary not only on the whole sample of our press articles but also in a second step on the selection of articles which the cleantech dictionary has been recognized as including cleantech topics.

We match this data of the media discourse with information from the NVCA MoneyTree database for the same time span. This information regarding investments in the VC industry is entirely based on the US market. The venture capital industry in the USA is not only the most mature but as well the biggest and best documented (sources). We are confident the NVCA data is the best match available for the English textual media data.
Finally, we complement the press publication analysis and the financial data with interviews with relevant market participants. These interviews have been conducted with US and European experts from the field of cleantech VC who participated in the life-cycle of the industry over the past decade. The interviews have been conducted in the period from October 2011 to May 2012. This qualitative part of research leads to information missing from the pure analysis of press articles. The multi method approach offers opportunities to triangulate the results from the independent paths of research.

4 Results

Observing the results from our press analysis we can observe the development of the overall venture capital industry from 1995 until 2011. This 17 year period is a relevant time frame to study, even though the VC industry was formed much earlier [for a historical description see Kenney 2011]. Matching the press articles with the investment data we can show that the number of articles is a good proxy in regards to synchronous development. In the first quarter of 1995 there were 491 articles including “Venture Capital” published in the newspapers. In the same quarter a sum of $1.578bn was invested in 504 deals. After an increase in as well the investments and the articles published the number of investments and the amount peak in the first quarter 2000 with an amount invested of $27.140bn in 2.186 deals while 2.933 articles were published. The peak in published articles is one quarter lagged in the second quarter of 2000 with 3.097 articles increase of numbers the articles published peak in the second quarter of 2000 with a number of 3097. After that peak the number of articles drops to a range between 707 and 1035 in the years 2008 and 2011.
The results we received using the sentiment dictionary show a use of as negative classified words in the range between 1.1% and 1.6%. Higher percentages are interpreted as a more negative sentiment in the representative quarters. We see volatile results with frequent changes. Long term steady developments or quick changes in the result range are a measure of change in the sentiment towards the venture capital industry. In the 7 quarters between the first quarter of 1999 and the third quarter of 2000 there is just a change between 1.1% and 1.2%. After that we see a continuous increase over two years to a peak in the third quarter of 2002 of 1.5%. After three quarters at 1.5% we can observe a slow incline over 13 quarters to 1.1% in the second quarter 2006. After some volatility around 1.1% and 1.2% there is a sharp upswing from 1.1% in the second quarter of 2008 to 1.6% in the fourth quarter of 2008. After a fall back down to 1.2% there is a return to 1.5% negative words in the fourth quarter of 2011.
The results of our analysis with our cleantech dictionary show a low beginning of cleantech related articles in our database. There are steadily less than 3% of all articles related to cleantech until the second quarter of 2004. We see an increase in the prominence of cleantech related articles after that. We see a peak of the importance of cleantech in the fourth quarter of 2009 reaching 20.88% of all articles. We see a peak in the percentage of amount invested two quarters lagged in the second quarter of 2010 with 21.05% invested. All in all we see a high synchronicity of percentage of cleantech articles and amount invested in the cleantech sector but with certain lag of the investments to the media attention.

Figure 4 Sentiment VC
Discussion and Conclusion

The Venture Capital Life Cycle Model (Avnimelech et al. 2004) we apply to the development of the cleantech investment category needs certain adjustments to fit to our model of the emergence of a venture capital investment category.

The conditions for the development of the cleantech investment category are developing in the first phase. (“background conditions phase”). We already have an established venture capital market financing over 500 deals with a volume of $1.5 billion in 1995. After an immense increase in venture capital funding during the dot-com boom we see the bubble burst in late 2001. Immediately investors are looking for new industries to invest in and settle as one of the selected
in cleantech. In the years up to 2002 there are R&D initiatives and young companies in diverse industries of the cleantech sector and single investments that qualify as cleantech companies. But there is not a trend towards a thoughtful investing yet. Public discourse in the field is mostly concerned about topics like emissions regulation and recycling. We classify the phase up to the end of 2001 as background conditions phase. We see steadily less than 1.5% of the total deal volume and less than 2.5% of media attention to cleantech related issues.

Growing early venture capital investments occur in the second phase (“pre-emergence phase”). There is a thought basis for these investments. The foundation of prominent market observers as for example the Cleantech Group fall in the beginning of this phase. Public discourse is picking up topics like “other cleantech” fields and solar is getting some attention. The investments during this phase are bringing companies to maturity for venture capital later round investments. As we see an increasing trend of investments now the trend is as well observable in press articles. We see roughly 2-3% of the total deal volume and 4% of media attention to cleantech related issues.

In 2004 the green wave initiative of the state of California which led to programs of the public pension funds CalPERS and CalSTERS was started. At the same time there is a substantial use of especially cleantech related words in articles.

In the “emergence phase” the investment category develops an own understanding and grows to a substantial size. Starting in early 2006 cleantech venture capital investments expand rapidly. By the end of this phase the category has become defined.

Following the emergence phase we observe together with the financial crisis at the end of 2008 the start of the “crisis phase” after which following we currently see the “consolidation phase”.

Figure 6 Industry development within cleantech sector

The synchronicity of press articles in the field of cleantech and the investment data can be observed in figure 5. Especially the amount invested is closely related to the amount of publications. We see some time lag of the investment data and are planning to check this topic quantitatively. We think that media does not only report about deals invested but does as well influence some of the investment decisions. Public discourse can be used to get a deeper understanding in field with a lack of rich data.

The sentiment analysis (see figure 4) which at this stage only is applied to the general VC article database shows the sentiment following the trends in venture capital funding and world economy.
Two time frames described before seem obvious for a negative trend and show so in our data. Firstly after the burst of the internet bubble in early 2000 we see a change of good sentiment to a much worse sentiment over two years to a peak in negative tonality in the third quarter of 2002. Following we can observe a change towards better sentiment in a long time span. The second event which leads to a quick change in sentiment is the world financial crisis in the third quarter of 2008 where in a time frame of two quarters the tonality in the VC articles changes dramatically to the worse. We come to the conclusion that a dictionary for textual sentiment analysis can also be used on press articles about the venture capital industry.

The research aims at analyzing the role of venture capital with respect to the development of and within the cleantech sector as evolutionary influences of the early and expansion stages of the life cycle of an investment category. We provide insights into the evolution of financing for the renewable energy and environmental technology sector considering the importance for a sustainable future. Our analysis of press publications and investment data with the background information from our interviews with actors of the categories development can help understanding historical turning points in the cleantech sector. Main factors like policy changes, political shifts in direction, investment programs and global trends or phenomena have direct influence on market growth and public perception. Deeper knowledge of the evolution of investment categories is key to understanding the triggers of the development of its own and the underlying industry. The understanding can support in the construction of public measures or supporting frameworks to foster innovation and job creation in certain selected industries. The results of our research can be used to identify success factors and barriers in the development of
investment categories, find future directions of asset allocation within the venture capital industry and help to foster a sustainable environment for new innovative sectors.

We investigate the role of public sentiment in individual life cycle stages. The combination of the analysis of sustainable technology innovations emergence and sustainable venture capital emergence should be transferable to research of other industries and other investment categories. Testing our findings in a more quantitative analysis could help to enrich the contribution and strengthening the transferability.
References


