Commercialization of University research: Global policies and local practice

The case of the University of Oslo

Nana Revazishvili

Master of Philosophy in Comparative and International Education

Faculty of Education

UNIVERSITY OF OSLO

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Abstract

Commercialization of University research: Global policies and local practice- The case of the University of Oslo is written by Nana Revazishvili for a *Master of Philosophy* degree in *Comparative and International Education,* specialization area *Education policy and planning.* The study aims at contributing to a better comprehension of the phenomenon of university research commercialization.

Commercialization of university research is increasingly viewed as one of the sufficient ways for contributing to economic and social advance. This belief motivates policymakers to implement policies and policy instruments to promote commercialization activities at universities. Commercialization policies represent the focus of my study. The issue is analyzed within globalization perspective. Homogenization of national commercialization policies is the point of departure here. It appears that some policy trends are dominating in commercialization policies of nation states. The Bayh-Dole legislation of 1980 is a good example of "popular" policies that has been implemented in many European countries (Geuna & Nesta, 2006; Sampat, 2006). However, it is argued that a successful policy and/or policy instrument will not necessarily be sufficient in all situations. This implies that a policy should undergo a deep evaluation before it can be implemented in other context.

The discussion on different commercialization policy approaches (Goldfarb & Henrekson, 2003) and commercialization systems in the three countries: the US, Sweden and Australia will work as a conceptual framework for the analysis of Norwegian commercialization policies. Further, the respond of the University of Oslo to new government regulations will be observed through the analysis of official documents and the interviews with academics.

Norwegian government policies have been analyzed to identify the global commercialization policy trends in Norwegian commercialization policies. The analysis revealed that similar to other European countries the main aspects of the Bayh-Dole act have been implemented here too. As a result of legislative changes that took place in the beginning of 21st century,

universities became directly responsible for commercializing research. First, through annulling the “teacher exemption clause” they became owners of the inventions generated through academic research. Second, the universities got the “third mission” of communicating university-generated knowledge to public, which made them officially responsible for commercialization.

The interview analysis, on the other hand, was considered an important way to observe how new regulations work in academics’ commercialization practices at the University of Oslo. Because of a small sample, we cannot draw any conclusions. However, the analysis of the interviews has revealed a positive attitude of the informants towards new government regulations.

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1. Introduction

1.1 The aim and purpose of the study

The aim of the study is to contribute to a better comprehension of research commercialization processes at universities. The interest of the policymakers in commercialization is increasing on a global scale, as it is considered one of the most productive mechanisms for contributing to social and economic advance. This has resulted in implementation of a number of polices aiming at promoting direct commercialization of academic research**.** The policy issue is the interest area of my study. Government policies on commercialization will be viewed from a globalization perspective. Globalization has a profound impact on Higher Education (HE) at many levels (Carnoy, 1999). The way it influences commercialization policies represents the focus of my study. It can be assumed that some global trends dominate in national commercialization policies. This issue will be further explored in the study on the example of Norwegian government policies and the University of Oslo (UO).

1.1.1 Changing environment for a research university. Globalization

Globalization has become a cliché of our time. It is a phenomenon that has influenced all realms of social life. According to Tomlinson (1999 cited in Singh, Kenway & Apple, 2005:4), "Globalization refers to the rapidly developing and ever-denser network of interconnections and interdependences that characterize modern social life". This "complex connectivity" (*ibid.*) is a result of accelerated technological development in communications and transportations. We are living in a world with no boundaries and geographical constraints. Globalization is "blurring national boundaries" (Stormquist, 2002:23) and brings market principles into all spheres of social life not least education. Knowledge becomes

increasingly seen as a central driver of the new economy. As Carnoy (1999: 14) puts it, "two of the main bases of globalization are information and innovation, and they, in turn, are highly knowledge intensive". Due to these developments, universities are viewed as central drivers of the economic development and social advance. Accordingly, the expectations of the governments and society towards these institutions are growing. This is clearly reflected in new government regulations for universities worldwide. They are forced to take on the "third mission" of "turning science into business" also referred to as knowledge commercialization. This, in turn, means the extension of the concepts of knowledge production and dissemination, which have long been considered the main missions of the university. As a result of global changes, a university is increasingly expected to take into consideration the demands of different actors and become an active participant in social and economic development of nation-states. As Laredo and Mustar (2001: 504) put it, a university "is no longer a public reservoir of knowledge, where firms come to fish for the knowledge they need, but a public reservoir of competences mobilized by actors in society, both public and private to help them resolve the problems they face". Thus, universities are expected to not only produce new knowledge, but also make feasible products and services out of this knowledge and put them to market in order to benefit society. With this respect, university becomes a third actor contributing to economic development, equal to government and industry (Etzkowitz, 2002).

Scientists do not always agree on the novelty of these developments. Some argue that the changes associated with contribution to economic development as a "third mission" of the university are not new and represent just an extension of earlier patterns (Etzkowitz & Webster, 1998). On the other hand, some scientists criticize the recent developments in academia and consider them a pure result of external pressures that has nothing to do with traditional university. In his article about German universities, Block (1990:45) argues that ongoing pervasive changes are transforming European universities in a service institution like a "modern land grant university". He maintains that acceptance of these utilitarian functions by the university "represents departure from the idealistic philosophy of the university" (*ibid.*). Wasser (1990 cited in Etzkowitz &Webster, 1998:40) also claims that these changes are radical and can lead to a fact that many institutions would no longer fit "the time-honored definition of a university". This view suggests that traditional university

values are under threat because of increasing university involvement in business kind activities. As Bok (2003:208) puts it, "confounding expectations, the hopes for profit often fail to materialize, while the damage to academic standards and institutional integrity proves to be all too real. By this time…the process may be irreversible".

1.1.2 The role of government policies

Despite much criticism towards the new developments associated with academic involvement in market activities, government policies worldwide support and promote commercialization processes at research institutions. This way of knowledge transfer from university to industry sector is increasingly seen as essential to social and economic progress. Industrial utilization of university research is not a new phenomenon. However, it has been generally recognized that industry needs the help of academics to translate this research into usable products (Etzkowitz, Webster, & Healey, 1998). This need becomes one of the driving forces behind a strong policy focus on academic involvement in commercialization activities at universities. Government policies will be the first step in the analysis of commercialization processes at the UO.

The discussion on recent government policies will provide a conceptual framework for a small empirical investigation on Norwegian government policies on research commercialization and the commercialization environment at the UO. I will observe how global policy trends affect Norwegian government policies addressing research commercialization, what is the Norwegian policy approach and how the UO is responding to the policy directives, i.e. what the commercialization environment in the institution is like today.

Therefore, the main research questions will be the following:

1. What global trends can be identified in government policies addressing research commercialization?
2. How these trends influence the Norwegian government polices on commercialization?
3. What are the responses from the UO on policy shifts?

4. How researchers at the UO experience the results of policy changes?

1.1.3 Delimitations

The phenomenon of research commercialization involves a number of processes and activities. What they all have in common is the importance of strong links between the public and private spheres, academe and industry. My goal is not to cover all these processes. Nevertheless, I will describe two main commercialization modes and mention the differences and similarities between them. Nevertheless, the focus will be the "science-directed" (Gulbrandsen & Slipersæter, 2007) commercialization activities, which are patenting, licensing and creation of spin-off companies. They will be analyzed in light of government policies addressing commercialization. Secondly, government policies that will be the focus throughout the thesis are of course covering commercialization processes in universities, colleges and research institutions. However, my interest area lies in university research, more specifically, the University of Oslo.

1.2 Approach and methodology

The first step in the research process was to choose the research approach suitable for my topic. Identifying the correct and most useful design in a specific situation is considered by Patton (2002) an important challenge for a researcher.

The intention of the thesis is to provide an insight in commercialization processes and government policies promoting research commercialization at universities. Having this as a purpose, I found a qualitative approach a suitable strategy for "defining and understanding specific circumstances from an overall perspective" (Befring, 2004: 76). As qualitative research is concerned with generating an overall analysis of the problem, using of multiple data sources is usual. This aims at providing different perspectives on the issue and ensures a

multifaceted understanding of the problem. As for my thesis, the intentions of policymakers have been presented through government policy documents; scientists' reflections on ongoing commercialization processes are given through literature reviews; the intentions and responses on new government directives from university administration are presented through university policy documents, whilst interviews with researchers serve as the source for providing commercialization processes at the university from an academic perspective. Thus, the following data sources have been used during the research process to illuminate various aspects of the phenomenon: literature review, government and university document analysis, secondary statistical data and interviews. The use of a variety of data sources in a study is according to Denzin (1978 cited in Janesick, 1994) called data triangulation, which is one of the four basic types of triangulation. Data triangulation refers to comparing and cross-checking the consistency of obtained information (Patton, 2002). Thus, the final goal of triangulation is to ensure an in-depth analysis of a studied problem.

Another characteristic of a qualitative study that I found suitable for my research strategy is an inductive approach used by qualitative researchers. This implies that a researcher has identified some problem, or some interest area which he/she wants to have a closer look at (Befring, 2004). Unlike deductive approach qualitative researchers approach observation inductively which means that they are not constrained by existing theories and categories which, in turn, makes the research process more flexible (Durrheim, 2002). In other words the intention is not to test some theory, but to learn a specific issue and produce categories, themes and patterns, and in some cases theory, based on the data gathered during the research process (Janesick, 1994).

The goal of my study was to explore the phenomenon of research commercialization, identify the global trends in government policies addressing commercialization, and provide an insight in the academics' experiences of commercialization processes at the university.

Next step was associated with identifying the strategy of inquiry. According to Denzin and Lincoln (1994b: 202), the latter "comprises the skills, assumptions, and practices used by the researcher-as-*bricoleur* when moving from a paradigm and a research design to the

collection of empirical materials". In other words, the researcher should find specific methods for collecting and analyzing empirical materials (*ibid*). As my intention was to focus on a specific phenomenon of commercialization and study the commercialization polices and environment at the UO, I found a case study as the suitable strategy of inquiry. However, there are different opinions about what the case study is. Stake (1994: 236) argues that "case study is not a methodological choice, but a choice of object to be studied". A case study implies that a researcher is interested in a subject, a process, a phenomenon that becomes the subject of his/her in-depth analysis. A case study can be simple or complex taking into consideration what is being studied, e.g. a child or a classroom (*ibid*.). According to this criterion, my case study is complex because of its relatively broad focus which lies in Norwegian government policies and the UO.

1.2.1 Methods of data collection and analysis

A case study generally relies on document analysis, observation and interviewing as the main methods of data collection. In order to provide reliable findings on contemporary commercialization processes in Norwegian context, Norwegian government policy documents have been analyzed; the UO has been chosen to observe how government policies are reflected in the university strategic documents and the academics' commercialization practice. In order to fulfill this goal, the following data have been used: literature review on commercialization processes, Norwegian government policy documents, the UO papers addressing research policy at the institution, and, interviews with researchers involved in commercialization processes at the university. In the following table, data collecting method, data sources and purpose of each source will be presented.

Table 1: Sources of data

Method	**Data sources**	**Purpose**
Literature analysis	Literature reviews on research commercialization	Get acquainted with ongoing processes of commercialization; Provide description of the phenomenon
Documentary analysis	Norwegian government policy documents; UO official policy documents	Acquire knowledge about commercialization policy tendencies in Norway
Statistics	Official statistics on patents, licenses and spin-offs from Birkeland Innovation	Follow up the development of commercialization processes at UO
Interviews	Four semi-structured interviews with academics involved in commercialization activities at UO	Observe the impacts of policy changes on commercialization practices of researchers

In order to obtain general knowledge and insight in research commercialization concept and processes, I started my study by searching and reviewing the literature addressing this issue. The first phase in data collection process was searching for relevant literature through the library database BIBSYS, and subject database ERIC. I started with more recent literature in order to get insight in contemporary trends in commercialization processes and, not least, delimit a voluminous material dealing with the topic. The search resulted in a large amount of scientific literature. In addition to this, I reviewed reference lists of the books and scientific articles which gave me important sources. The main challenge was the fact that case studies entirely dominate in this field and I had to read a lot of material to gain some general understanding of the processes associated with my research topic. Simultaneously, I started collecting the government policy documents addressing research policy of higher education in Norway. This type of data was pretty easy to obtain as they are systematically

kept and easily available at the library as well as on Norwegian government's official website. Like government policy documents, the University strategic policy papers were also easily available on the UO's website and at the UO library.

I found it very important to provide a description of the phenomenon of research commercialization which is given in different perspectives. The concept of research commercialization refers to a number of processes. That is why it was crucial to define at the beginning that my study was supposed to concentrate on "science-directed" commercialization and the processes this mode covers.

Another goal in the early stage of my research was to get acquainted with government polices addressing commercialization at research institutions. After having reviewed a number of articles and books, the tendency of homogenization in national commercialization policies became evident. There is a global policy trend originated from the US which is recognized as the most sufficient and productive commercialization policy at the time (Sampat, 2006; Geuna & Nesta, 2006). This tendency has raised the interest of observing a global dimension in Norwegian government polices addressing commercialization. Therefore, a number of recent articles have been read to identify the global dimensions in commercialization policies in order to make it possible to find them in Norwegian policy context. This at the same time was supposed to construct a conceptual framework for analysis of the Norwegian case. To accomplish this goal, I had to select some countries that could represent global policy trends. As mentioned, the US is recognized as a leading country with its commercialization practice at research institutions. Hence, it was more than natural to take the US as the first example. Sweden and Australia have been chosen as the other two countries to be analyzed in commercialization policy perspective. This choice had its reasons: after having collected a voluminous literature reviews, it became clear that both countries have a strong focus on research commercialization polices and, not least, they relatively dominate in recent literature reviews on commercialization. Besides, the theory of two different approaches to commercialization polices has served as another criterion for choosing these countries (Goldfarb & Henrekson, 2003). The US and Sweden are considered the classic examples of two different approaches which are: "bottom-up" (the US) and "top-down" (Sweden). On the other hand, Australia is argued to be an example of a combined

policy approach. This motivated me to take the case of Australia as the third country to discuss (Harman & Harman, 2004).

It should be noted that theoretical material dominates in my study as literature reviews together with government policy papers and university documents comprise the main part of the thesis.

The qualitative data sources as policy documents and scientific literature are regarded as "unobtrusive measures" of observation (Bryman, 2004: 215). According to Denzin's definition of the term (1970 cited in *ibid*), it is "a method of observation that directly removes the observer from the set of interactions or events being studied". Unobtrusive measures and methods of data collection are the opposite of their conventional (reactive) counterparts which are structured interviewing, structured observation, self-administered questionnaire etc. The advantage of unobtrusive methods of data collection in social research is that they tend to be more reliable than their conventional counterparts: It has been argued that when people know they are participating in a study, their answers might be influenced by this fact, and as a result their answers might be untypical. On the contrary, official documents and existed scientific literature can be regarded as unobtrusive sources of data in which we can put a great deal confidence (Bryman, 2004).

In addition to these sources, secondary data have been collected and used in the research. As Befring (2004: 160) defines it, "this includes data that already exists in some form or other, perhaps information that is collected, and often systematized, with a view to other primary aims". In my study, official statistics gathered and kept by Birkeland Innovation represent a classical example of secondary data. It covers statistics on patents, licenses and spin-off companies at the UO kept from the very establishment of the Technology Transfer Office (TTO) until the point the data was collected which is October 2007. The data was obtained through e-mail after my request sent to the TTO representatives. It also should be noted that apart from the pure numbers, the data also includes some comments on ongoing commercialization procedures at the TTO, and not least, explanations for specific terminology, which turned out to be very helpful.

The above discussed data sources have been collected on the early phase of my work. In order to provide insight into researchers' experiences of commercialization processes at UO, semi-structured interviews have been conducted with four professors at UO. The main focus of my questions was on commercialization practices before and after the policy changes in order to identify how these changes have influenced researchers' commercialization practices at the university[1]. The intention of my small empirical exploration was to provide a different perspective on the issue and not to generalize to a broader group.

According to Patton (2002: 244), "there are no rules for sample size in qualitative inquiry". In other words, qualitative design is flexible also when it comes to sampling strategy. There are a number of sampling strategies that a qualitative researcher can use. The principle common to all of them is to select information-rich cases, i.e. cases that will provide a researcher an important and in-depth knowledge on the research subject *(ibid.).* There are identified two main types of sampling each of which has a number of sub-categories depending on the purpose of sampling. These are random probability sampling and purposeful sampling. In my investigation, I used purposeful sampling which involves "selecting information-rich cases strategically" (Patton, 2002). More specifically, I used criterion sampling which implies that all samples to be interviewed met some criterion, in my case the criterion was the experience of "science-directed" commercialization activities as patenting, licensing and creation of spin-offs. Thus, the point of departure for selecting the interview samples was that participants should be representative of the same experience.

The names of the possible interviewees have been suggested by a senior researcher on research commercialization in Norway. I contacted the professors through e-mail and made appointments regarding interview date and time. Each interview took about an hour and was conducted in the respondent's office. I used the semi-structured interview also called a "qualitative interview" due to its frequent use in qualitative research (Bryman, 2004: 319). I had prepared the interview guide where I had listed the topics that I wanted to be covered by the respondents. Naturally, the interviews were flexible. Therefore, they turned to be quite

[1] See attachment A

different from one another. The questions asked were open-ended. It gave me a possibility to give the interviews the form of dialogue and to avoid short yes- or no- answers. Apart from my focus questions, the interviewees were asked at the end to tell their story of commercialization experiences which they did not get a possibility to share in the course of the main interviewing process. This, in fact, gave me some important additional information. All the four interviews were tape recorded and transcribed right after the interviews were finished.

As mentioned earlier, I had analyzed several institutional documents ranging from government policy documents to the university strategic plans. As Miller (1997 cited in Patton, 2002: 498) puts it, these texts are "socially constructed realities that warrant study in their own right". Content analysis was used in making sense of government as well as institutional policy documents. Content analysis involves searching the core meanings in the text. They are often referred to as patterns or themes (Patton, 2002). By finding and identifying the main meanings and consistencies in the text, content analysis aims at reducing the voluminous qualitative data through making sense of a studied text. Searching for patterns in the text and identifying similar themes and meanings in other documents helped me to focus on important aspects highlighted in policy papers. I began with reading through all obtained documents and attaching Post-it notes with my comments. These comments helped me later in organizing the data into topics and categories. Several readings were necessary to identify all the important categories that I was going to use in my analysis. One of the challenges in identifying categories was to see what fits together, or as Guba (1978 cited in Patton, 2002: 465) refers to it the challenge of *convergence*. I had to search for regularities in the texts that I sorted later into categories. The categories should satisfy the following criteria: first is *internal homogeneity* and second, *external heterogeneity*. The first means that the data that belong to the same category hold together, whilst the other implies that different categories do not overlap (*ibid*.).

I analyzed interview transcripts also using the content analysis and the above described categorizing method. In analyzing interviews, a researcher has an option of constructing interview analysis as a case analysis or cross-case analysis. The first means that a researcher writes a case analysis for each person while in cross-case analysis a researcher structures the

answers of different interviewees according to common topics (Patton, 2002). I found the latter more suitable for my study taking into consideration the small size of samples. I used an interview guide approach which entails that the main topics of the analysis have been taken from my interview guide. As a result, my interview guide constituted an analytical framework for analysis. I tried to balance description and interpretation in the interview analysis. Both are very important to a qualitative study. According to Patton (2002: 503), "description and quotations provide the foundation of qualitative reporting". Hence, I have used direct quotations in order "to allow the reader to enter into the situation and thoughts of the people represented" (*ibid.*). The rest I have communicated to the reader through interpretation. "An interpretive understanding of human experience" (Denzin & Lincoln, 1994a: 4) is another important characteristic of qualitative study. The researcher is "the instrument of observation" (Durrheim, 2002: 46). This makes it particularly important how he/she experiences the problem while working on it. According to Patton (2002), this aspect of qualitative inquiry represents potential weakness of the approach as the quality of such an inquiry is very much dependent on inquirer's skills, knowledge, creativity and intellect.

1.2.2 Limitations and weaknesses of the thesis

The overall purpose of my thesis was to analyze government policies on commercialization and their impacts on commercialization environment in a global perspective. Thus, commercialization was studied on two levels: the government level where policy development process is observed through official policy papers; and the university level which is supposed to reveal the development process at the UO. In contrast to the government policies which are a rich and available data source and covers quite a long time period, the official statistics on commercialization activities at the UO until the establishment of Birkeland Innovation is pretty poor. This makes the observation of the development process at the university level difficult. With this regard the interviews are a valuable source for observing the eventual differences in academics' experiences as the result of government policy changes.

Another weakness of the thesis is the fact that the researchers who have participated in my modest investigation belong to the disciplines of natural sciences where commercialization is more natural: Biotechnology, Medicine, Information and Communication technology (ICT), and Physics. It could also be very interesting to observe the attitude of the researchers from other disciplines where commercialization is not that usual, e.g. Humanities.

1.3 Thesis outline

The thesis comprises 7 chapters: the first is the introduction part where the aim of the study is defined and methodological choices are analyzed.

Chapter 2 deals with the concept of commercialization. Here I will describe the phenomenon of commercialization. I will present the definitions given by different authors. This will be followed by discussion on commercialization processes and two main commercialization modes and their mechanisms. I will identify similarities and differences between the modes. However, it should be noted that my interest area throughout the work is "science-directed" commercialization mode which covers patenting, licensing and creation of spin-offs. These mechanisms will be described in details further in chapter 2.

Chapter 3 focuses on government policies directed towards research commercialization generally. The increasing focus of policymakers towards the issue will be viewed in light of globalization. This implies the tendency of implementing global dimensions in commercialization policies. More specifically, how global policy trends impact national government policies on research commercialization. In the same chapter, I will discuss the main areas addressed generally by government policies which are: academic motivation, commercialization infrastructure, and financial support to academics involved in commercialization activities. Apart from this, two main policy approaches to research commercialization will be analyzed. The discussion on global policy trends and approaches

will provide a conceptual framework for my case study which is the Norwegian government policies on commercialization and their effects on the commercialization practices at UO.

Accordingly, chapter 4 deals with Norwegian government policies and policy instruments that have been implemented to encourage and facilitate commercialization processes at research institutions.

The purpose of chapter 5 is to describe commercialization strategies at UO. My focus will be how the university responded to government policies promoting direct involvement of university administration and academics in commercialization activities. After analyzing some important official papers, I will describe the commercialization infrastructure at the university and provide statistical data on commercialization activities at the UO collected by Birkeland Innovation.

Chapter 6 presents a small empirical exploration based on topical interviews with academics involved in commercialization processes at the UO. The results of this study will be analyzed in light of policy changes in Norway.

Chapter 7 concludes the thesis. Here the main findings will be presented. In addition to this, the weaknesses and limitations of the study will be discussed and possible topic for further research- suggested.

2. Commercialization of university research

A university has always been a strategically important institution in service to society. It is a part of a rapidly changing environment which urges the university to revise its missions and priorities from time to time. One important change brought by globalized and ever demanding environment is to make universities commercialize the research they produce i.e. put knowledge into products or services that will benefit society.

Commercialization of university research has become a focus of the government policies last decades. The concept of university research commercialization describes the process of transferring ideas, inventions and, more generally, university-generated knowledge into products and services that can benefit society. It should be noted that there is nothing new in the fact that academic research is supposed to benefit the public, for it has been its important mission since the time academic research was born. Universities have contributed to public wealth and economic growth as e.g. education, publications, scientific conferences, and informal knowledge exchange through several channels. These ways are still considered essential channels of knowledge transfer from university to society. However, governments' focus on research commercialization as one particular way of knowledge transfer has been significantly strengthened recently. The reason could be the belief that if academics will follow up their inventions until the point they are ready to be acquired by industry, chances for benefiting from that research would be maximized and time interval between the idea and its application- diminished. To make this work, universities are encouraged to view research commercialization as the "third mission" after teaching and research. The biggest barrier to active academic involvement in commercialization activities becomes the dividing line between the academia and business, which has always existed as a symbol of existing difference between the two worlds. Governments launch different policies and provide incentives for the university administration and academics to get them directly involved in business side activities. Although it is still unclear what the final impacts of these changes on academic values would be.

The following chapter is based on literature reviews and aims at exploring the concept of research commercialization, the main modes of commercialization and mechanisms associated with them.

2.1 The concept of knowledge commercialization

Before describing and analyzing different initiatives and policies directed towards university knowledge commercialization, it is necessary to define in more details what commercialization of research implies, describe the mechanisms, also called ways or channels of commercialization, the infrastructure for commercialization set up by universities, and the process of knowledge transfer itself.

The literature about commercialization offers a number of definitions of the concept. Most of them overlap one another. Some authors also use different terminology to refer to the same phenomenon. It should be emphasized that research commercialization represents a specific area of the broad issue of innovation debated in countries worldwide.

According to Harman and Harman (2004:154), commercialization of university research means "the process of turning scientific discoveries and inventions into marketable products and services". They also point out that "research commercialization" and "technology transfer" are often used as synonyms. However, there are some important differences in their meanings. The term "technology transfer" is broader than what "research commercialization" means. The first refers to the movement of knowledge, experience, ideas from one organization to another (Bozeman, 2000). The reason why "technology transfer" is often used as a substitute to "research commercialization" is that most commonly "technology transfer" is used in relation to knowledge transfer from research institutions (Harman & Harman, 2004). The definition of commercialization given by Chiesa and Piccaluga (1998 cited in Spilling and Godø, 2008:104) is similar to that of Harman and Harman. They define

commercialization as “the process of transferring and transforming theoretical knowledge as existing in an academic research institution, into some kind of commercial activity”.

According to Feller (1997:8), “technology transfer covers many functions and activities that relate in different ways to the basic and applied research and technical assistance activities of faculty and universities”. It is obvious from the definition that the concept of technology transfer has many sides and, consequently, it is not simple to give a clear definition of the phenomenon. Matkin (1990 cited in Feller, 1997) gives a more specific definition of the term “technology transfer” related to the university. The author describes technology transfer as “…the transfer of the results of basic and applied research to the design, development, production, and commercialization of new or improved products, services, or processes. That which is transferred often is not really technology but rather a particular kind of knowledge that is a precursor of technology” (pp. 8-9). Thus, in Matkin’s definition of the phenomenon the term “technology” is not used with its primary meaning; rather it is related to some “particular kind of knowledge” that eventually will become a technology. The description of “technology transfer” given by Larsen and Wigand (1987 cited in *ibid*.) is similar to that by Matkin. According to them, it is a process of transferring results from both basic and applied research to potential users. Similar to the authors above, a number of other scientists use the term “technology transfer” to refer to knowledge commercialization at universities. It should be mentioned that not all authors give definitions of their working terms in the beginning of the article or book, which can be confusing to readers. This is simply because university research commercialization is just one side of the phenomenon, which implies that the term can be used in other contexts as well.

2.1.1 Commercialization process

The process of commercialization is often seen as a “stage model”. This means that it consists of different stages associated with some specific activities and actors. The first stage is the technology- driven basic development of new knowledge; an incubation process in which experts consider the commercial value of the invention and explore the business opportunities follows this and, finally, there is the culmination stage in which the invention

is established as a business activity positioned in the market (Spilling & Godø, 2008). The stage model of commercialization is very much like the linear model of innovation in that each phase is followed by the other, has its goal and is carried out in specific environment by specific actors. The linear model of innovation postulates that innovation starts with basic research, is followed by applied research and development and ends with marketing of the product (Laperche, 2002). However, according to some critics, a linear model increasingly becomes insufficient in innovation process analysis as the roles of different actors often overlap and make stage boundaries unclear. As a result, collaboration between public and private sectors takes place at different points and it is important that the analysis take better account of these interactions. The development of interactive innovation model was an attempt to create an alternative model of innovation analysis, which did not overlook the complexity of the transformation process from idea into marketable product.

The same is the case with regard to the stage model of commercialization. The process is not as simple and linear as the stage model might imply (Spilling and Godø, 2008). On the contrary, it is complex and "chaotic". Actors may go back and forth between stages, combine some aspects from different phases of development, communicate and collaborate with different external actors and so on. Besides, the process undergoes a considerable change from technology-driven process to more market-driven one (*ibid*.). Technological knowledge is crucial on early phases in order to identify the development opportunities of the product whilst in final stages market experience becomes more important as it is crucial that the product meets market needs (*ibid.*).

Several other definitions refer to commercialization process as a stage model. Jolly (1997 cited in Spilling and Godø, 2008:104) gives the following definition:

[Commercialization is] the process that starts with the techno-market insight and ends with the sustaining functions of the market-competent product. The problems of commercialization include links between technological discoveries and opportunities, demonstration of technology to opinion leaders, incubation of technology, resources for

successful demonstration, market acceptance and transfer of benefits, and selection of proper business tools.

Jolly's definition reveals a number of possible problems involved in commercialization process ranging from capacity to identify commercializable ideas to resources and infrastructural institutions.

Yet another definition of commercialization process identified by Ndonzuau, Pirnay and Surlemont (2002 cited in Spilling, 2008:128-129) is connected to the stage model of commercialization. These authors refer to the four stages: 1. Generate business ideas from research; 2. Finalize new venture projects out of ideas; 3. Launch spin-off firms from projects; 4. Strengthen the creation of economic value by spin-off firms. In this model, a spin-off firm becomes a necessary led of the chain. However, it is worth mentioning that commercialization also refers to patenting and licensing activities, which do not necessarily involve spin-off formation at universities.

Laperche (2002:150) gives us the following definition of research commercialization:"… the transformation of basic knowledge into marketable new products and services". As she puts it in other words, it is about "making the results of research available to the private sector" (*ibid*.). According to Laperche, collaboration between public research institutions and enterprises and mobility of researchers are key aspects of university research commercialization. She identifies the following ways of commercializing public research outputs:

a) Research contracts between universities and private companies.

b) Patenting and licensing of research results, which she refers to as a commercial exploitation of the research.

c) Researcher mobility. Laperche identifies two types of research mobility: when a doctoral student graduates research in a company which co funds this research and when a researcher or a team of researchers provide scientific assistance to a company.

d) Creation of a spin-off by a researcher. In this case, he acts as an entrepreneur.

Laperche (*ibid*.) argues that not all these ways of research commercialization are new. She maintains that contract research and different types of researcher mobility have been long practiced by universities. According to her, "the two genuinely new ways of commercializing public research… are the ability to file and exploit intellectual property rights and to create enterprises to capitalize on research" (*ibid*: 151). Thus according to Laperche, awareness of the intellectual property rights and its exploitation and spin-off creation are new ways of research commercialization.

2.1.2 Entrepreneurial activities

The notion of entrepreneurial activities is also related to the concept of knowledge commercialization. The rise of entrepreneurial university (Etzkowitz, Webster, Gebhardt, & Terra, 2000) in recent years has been associated to a number of institutional and organizational changes going on at the university. These changes encompass more active academic involvement in economic and social development, more intense commercialization of university research and the shift in academics' behavior towards more industry-oriented attitude to research activities. Thus, Etzkowitz and his colleagues argue that research commercialization is one characteristic of an entrepreneurial university.

According to Jacob, Lundqvist and Hellsmark (2003) university based entrepreneurship encompasses both commercialization and commodification. They give a slightly different explanation of sub-categories: by commercialization, they mean e.g. consultancy, custom-made further education courses and extension activities, while patenting, licensing and faculty or student owned start-ups come into the category of commodification. The concept of academic entrepreneur encompasses all academics who are involved in entrepreneurial activities, no matter which of them. The notion of entrepreneurship itself, as Jacob and colleagues claim, has been changed. One of the new features that the concept has got is related to our topic and maintains that "entrepreneurship is a skill that can be taught" (p.1556). This aspect is very important as there is a strong belief that a university can become entrepreneurial by learning specific skills. However, the empirical evidence shows that this transformation into entrepreneurial university model is related to a number of difficulties,

particularly for non-technological universities, as their ties with industry are not historically strong. This makes some authors doubt that there are no entrepreneurial academics; there are entrepreneurial universities (Lockett *et al*., 2003).

O'Gorman, Byrne and Pandya (2008) argue that entrepreneurship is one way of commercializing new knowledge. They base their discussion on the Knowledge Spillover Theory of Entrepreneurship advanced by Acs, Audretsch, Braunerhjelm, & Carlsson in 2004. According to the theory, "entrepreneurship serves as a key mechanism by which knowledge created in one organization becomes commercialized in a new organization" (*ibid:* 24). The theory explains how and in which circumstances academics do commercialize their knowledge via entrepreneurship, i.e. licensing and spin-offs. They point to the barriers that should be overcome to make academics commercialize their research via entrepreneurship. First, scientists should be aware of personal benefits that commercialization activities will generate; second, they should recognize the commercial value of new knowledge; the third factor is the positive attitude of the external actors who would be willing to invest in new ideas after having recognized their market value (*ibid*.). The authors conclude that technology transfer offices help academics to overcome these barriers by offering them a number of services and expert advice. This make the TTOs very important.

2.2 Commercialization modes

In article on the third mission of the university, Gulbrandsen and Slipersæter (2007) distinguish between two different modes of commercialization. The first is "user-directed" commercialization. It covers all the traditional forms of university-industry relations as contract research, consultancy, and industrial sponsorship of academic research. The second mode identified by the authors is "science-directed" commercialization where academics play much more active role in commercialization process (*ibid*.). The most common forms of these activities are patenting of research results, licensing and creation of spin-offs. The authors claim that there are crucial differences between the two modes. In "user- directed" commercialization users play a central role as their demands become of great importance in

the way commercialization activities are fulfilled; these activities as expert advice, consultant work carried out by academics and industrial financing have a long history and are not considered to have any negative impacts on other aspects of university life. On the contrary, in "science-directed" commercialization mode academics are the main drivers in commercialization process. In addition, unlike to the first mode, much is said about possible negative consequences that patenting, licensing and creation of spin-offs might have on academic life in the long term.

The authors argue that there are important characteristics that distinguish the two modes: "science-directed" commercialization is a marginal phenomenon and seems to make a small fraction of the university-industry relations. On the other hand, the other mode of commercialization has old traditions and stands for the most part of the relationships between the two sectors. Not surprisingly, unlike the "user-directed" mode of commercialization, there is a lack of available data on university patents, licenses and spin-offs. Another dividing line between the two modes is that "user-directed" commercialization activities are integrated within the core of universities, whilst "science-directed" activities demand an extensive support infrastructure comprising different institutions and institutional arrangements as e.g.: TTOs, incubators, research parks, and seed funding. Thus, "science-directed" activities as patenting, licensing and creation of spin-offs are related to special facilities and support that the above-mentioned institutions are supposed to provide. One particular aspect distinguishing the "science-directed" mode is that policymakers are increasingly strengthening their focus on this mode, as they believe that licensing and spin-off activities can be of huge benefit to society and, more generally, nations. Their attempts to support "science-directed" commercialization are pervasive ranging from legislative changes to different programs for entrepreneurs and financial aid. These policies and different initiatives that aim to promote university research commercialization is the subject of my study.

The indicators of the two modes differ similar to the differences between them. Moreover, just as some overlaps within these activities, some measures of different commercialization modes can be the same. Consequently, Gulbrandsen and Slipersæter (2007) distinguish between three categories of indicators: 1. indicators of "user-directed" commercialization;

2. indicators of “science-directed” commercialization; 3. indicators of both modes.

The indicators of “user-directed” commercialization are as follows: authorship with industry; consultancy and expert advice to industry; confidential reports to industry; revenues from contract research for industry; exchange of graduates with industry.

Following indicators of “science-directed” commercialization are identified by authors: patents applied for by the institution or academic personnel; patents granted to academic personnel or institutions; licensing revenues; the establishment of spin-offs by institutions or academics; support organizations for commercial activities, e.g. TTOs, research parks, rules for redistribution of revenues from commercialization activities and , finally, entrepreneurship courses offered at institutions.

The common indicators of the modes are research results cited in patent applications; publications in scientific fields of interest for business; engagement in fields of science with a potential for commercialization and labour mobility between the two sectors of research institutions and industry.

Even though the indicators are identified, measuring the commercialization activities is often difficult. Especially the data on “science-directed” commercialization is poor as “universities seldom keep track of patents and spin-offs from their employees” (Gulbrandsen & Slipersæter, 2007:121). Licensing revenues are seldom large enough to be identified at all in the university budget. Thus, it is not reasonable to use single indicators for measuring commercialization. Instead, each of them should be used in combination with others to illustrate the real picture. The authors (*ibid*: 122) suggest a “combinatory approach” to be used for measuring commercialization and argue that indicators should always be considered in their contexts. This becomes important taken into account the evidence on that commercialization activities are mostly going on within technological, engineering and natural science fields and this aspect should not be overlooked when claiming the commercialization results of the university generally.

I wanted to make a note regarding the first dividing line between the two modes identified by Gulbrandsen and Slipersæter (*ibid.*). They underline that in the "user-directed" commercialization users' demands play a central role while in the second mode scientists become a driving force in commercialization process. This is, indeed, true. However, I think that the users' demands can not be considered a distinguishing criterion between the two modes as they play a central role in "science-directed" commercialization as well. Even though academics are the driving force in this mode, it is worth remembering that they are supposed to have on mind external demands when deciding what to commercialize. In fact, the authors also note that the distinction between two types is not clear-cut and some aspects of them overlap. Empirical evidence reveals a strong link between activities from different commercialization modes. For instance, industrial funding seems to have a positive influence on patenting activities of the university and other forms of knowledge utilization (Gulbrandsen & Slipersæter, 2007).

"Science-directed" commercialization is the focus of my thesis. In the following section, I will give a detailed description of the mechanisms for "science-directed" commercialization i.e. channels through which knowledge is commercialized in this mode.

2.3 Mechanisms for "science-directed" commercialization

Universities use several mechanisms for commercializing academic knowledge: licensing of inventions resulted from university-generated research, creation of spin-off companies, consultancies and expert advice, scientific publications and conferences, employing university graduates in business firms. As Harman and Harman (2004) claim, licensing and creation of spin-offs have been increasingly considered key mechanisms of knowledge commercialization by universities because of the belief that they are more promising when it comes to generating additional income. These are the activities that together with patenting were identified by Gulbrandsen and Slipersæter (2007) as the common channels for "science-directed" commercialization. Also Feller (1997:9) argues that "patents, licenses, royalties, and start-ups are the most visible manifestations of the university's newly aggressive efforts

to foster the commercialization of academic research". As I have also highlighted previously, policymakers are increasingly relying on the activities of s"cience-directed" commercialization considering them efficient ways of contributing to economic development. Through different policies and initiatives, they attempt to encourage academics to actively commercialize their research results, and facilitate universities to increase their commercialization capacities. This chapter aims at giving a more detailed description of patents, licenses and spin-off companies.

2.3.1 Patents and licenses

According to OECD (2005:41) compendium of patent statistics, "**patents** are an exclusive right issued by authorized bodies to inventors to make use of and exploit their inventions for a limited period of time (generally 20 years)". Once the patents are issued, patent holders have the legal authority to exclude others from commercially exploiting the invention. In return for the ownership rights, they have an obligation to disclose information relating to the invention for which protection is sought. Thus, the disclosure of the information is an important and necessary aspect of the patenting system. It is further stated that "a patent is a policy instrument intended to encourage the making of inventions and the subsequent innovative work that will put those inventions to practical use" (*ibid*: 41).

Patenting implies the idea that knowledge can be owned by someone. This contradicts to the concept of knowledge as a public good. "Basic research" conducted at universities is traditionally conceived as a public good which is supposed to be communicated to the public through publications without any restriction. According to Iversen, Gulbrandsen and Klitkou (2007: 396), "the commercial logic of applying for a patent - as well as a certain cultural factor- has traditionally made patenting the domain of industry". Therefore, the nature of basic research contradicts to what patent regime implies. Thus, the first fundamental obstacle dividing university research from the idea of patenting is the culture of the university. Another aspect that increases the gap between university research and patenting is that basic research seldom meets "patentability requirements" which entails its practical application

and even in case the research meets these requirements, economic incentives should outweigh the costs associated with patent application (*ibid*.).

According to Feller (1997:11), "patents are only one of several means (e.g. trade secrets) by which firms establish intellectual property rights". It is difficult to forecast the commercial value of patentable product as it depends on the further investments in development of the product and the competitive character of the innovation. Thus, a patent is regarded as "a limited measure of the extent to which technology, much less scientific and technological knowledge, is being transferred from universities to industry" (*ibid*: 11). Therefore, in his definition, Feller also emphasizes that patents are more common in transferring *technology* than scientific and technological knowledge.

There are different measures to assess the commercial value of academic patents. The first is the number of commercialized patents; the second is the amount of licensing revenues resulted from academic patents; yet another way is to examine the importance of the patent by considering how many times patents are cited by other patents (Feller, 1997).

Patenting and licensing activities in academic culture often raise question about academics' primary goals: the question arises about what the real role of patenting and licensing activities is. Can they be regarded as the productive channels for knowledge dissemination or is it financial interest that comes on the forefront?

It is a fact that few universities earn considerable revenues from their licensing activities. The distribution of revenues is highly skewed among patents too: "a small percentage of patents generate the largest share of revenues for any university with any appreciable number of patents" (Feller, 1997:13). The time lag between the patent issuance and income generation also makes it difficult to judge about the real economic value of patents. It has been agreed that licensing revenues comprise only a small fraction of university income (Gulbrandsen & Slipersæter, 2007). On, technology transfer officials claim that patenting and licensing offices are not intended to be profit centers, rather, their primary task is to serve

academic ends. However, it still is a fact that these institutions “are established to achieve a bundle of objectives - revenue (defined broadly now to include both license income and additional industrial research support), service to faculty and regional economic development” (*ibid*: 15).

Because applying for a patent is associated with quite a lot of money, it seems reasonable to first identify licensee before filling a patent application. This was claimed to be an emerging strategy of university technology licensing officials in the US in 1990s (Feller, 1997). According to this logic, “that what can be licensed is that which is patented” (*ibid*: 11).

As defined in Wikipedia, (the free encyclopedia), ‘the verb **license** or **grant license** means to give permission. The noun license is the document demonstrating that permission. License may be granted by a party ("licensor") to another party ("licensee") as an element of an agreement between those parties’. The idea behind this is that licensee or the company who buys a patent would develop often embryonic technology into useful product.

According to Rolf Lehming (2003) from US National Science Foundation, it is very difficult to estimate the real value of licenses and what happens often is that universities consistently overestimate it. He argues that even a small university start-up never starts just on one license; in fact, multiple licenses from multiple sources become the basis on which a start-up firm is established.

Lockett, Siegel, Wright and Ensley (2005: 982) maintain, “Licensing has traditionally been the dominant route for the commercialization of public sector intellectual property”. However, spin-offs are increasingly viewed as potentially important, but yet under-exploited option. Both in the US and in Europe policymakers’ focus on creation of spin-offs is strengthening through different programs and projects that are supposed to support new venture creation.

2.3.2 Spin-offs firms

Establishment of a spin-off firm is increasingly considered a very important mechanism for research commercialization. Shane (2004: 4) defines a **spin-off firm** as "a new company founded to exploit a piece of intellectual property created in an academic institution". According to him, the important aspect for considering a company as a spin-off is that it is based on an invention created in an academic institution. His definition differs from other definitions suggested by scientists. For example, according to the Roberts' (1991 cited in *ibid*: 5) definition, a company can be called a spin-off if it is founded by anyone who has studied or worked at a university.

Stankiewicz (1994 cited in Fontes, 2005: 341) describes spin-offs as "a heterogeneous group of firms performing different functions and playing their transfer role along a variety of modes". Thus, according to Stankiewicz, spin-off firms can be quite different depending on the modes of knowledge transfer they use. Spilling (2008:129) gives a commonly applied definition of a spin-off, which is "a company that is created based on knowledge resources in a parent organization, and which is organized independent, or at least partially independent, of the parent organization".

Shane (2004) argues that spin-offs are valuable in many ways: they contribute to local economic development; generate more revenues than licensing activities; help universities with their traditional missions of teaching and research and not least, they generate jobs. The author also states that spin-offs enhance the commercialization capacity of universities in two ways. First, they ensure development of technologies and ideas that private companies do not invest into because of their uncertain economic value. Second, they also ensure the researchers' involvement in the idea/technology development process, which is considered to be of crucial importance for successful commercialization.

Similar to Shane, Fontes (2005) highlights a crucial role that spin-offs play in transformation process of scientific and technological knowledge into viable products and services, particularly in the field of biotechnology. She argues that there are inherent barriers, which

hinder the industrial opportunity to directly put into use knowledge generated at public research institutions. The reason is that the nature of knowledge is tacit and context-related and it should be *translated* into usable products and services. The transformation process is complex and comprises different activities. For this purpose, spin-offs have been proved very suitable. Thus through translating knowledge- based ideas into viable products and processes spin-offs take on another role of reducing uncertainty, which is a very important barrier for the private companies to invest into academic inventions. In the development process of scientific concepts taking place at spin-offs uncertainty- aspect "is likely to diminish as control upon them increases through trial and error processes"(*ibid*: 340).

The important difficulty with respect to establishing spin-off companies is a lack of funding, especially in the early stages of its development. The reason is that private investors generally do not invest in spin-offs until they reach later stages of development. It has to be pointed out that this does not refer to biotechnology spin-offs, which, generally, do not encounter financing problems from private sector. Government funds become crucial for filling up this gap. As Shane (2004: 226) argues, "government grants and contracts are often the major source of revenue for university spin-offs during the initial period of technology development and allow those companies to develop their technology to the point where the spin-offs can achieve private sector financing".

2.4 Summary

Thus, a patent is a right to exploit an invention for a limited period; patents can be licensed which implies that a person, or a company that pays for a patent gets a permission to develop an invention further. Finally, a spin-off company is founded on a patent/patents in order to exploit an invention resulted from research.

Patenting, licensing and creation of spin-offs are considered the key mechanisms for "science-directed" commercialization. Universities and individual academics are encouraged

to get involved in these activities as they are regarded as efficient ways of communicating knowledge to society. This is especially the case with creation of spin-offs because of the following reasons: creation of a spin-off company by university fills a gap between university and industry, which is a consequence of uncertainty of the industry to invest in academic invention. Further, a spin-off ensures that a researcher continues to be involved in the development process of his/her invention through cooperating with the spin-off firm, which is of crucial importance especially in the first phases of product/technology development. Not least, spin-offs are viewed as an important source of new jobs.

Next, I will discuss government policies addressing commercialization of research outputs. They reveal governments' increasing expectations towards research institutions which are supposed to contribute more actively to the competitiveness of the nation states and social advance.

3. Research commercialization policies

Knowledge is increasingly viewed as a main source of economic development of the nation-states and their capacity to be competitive. That is why universities gain an important role of producing economically valued knowledge, or knowledge that can be turned into useful services and technologies. This explains the interest of governments worldwide to promote commercialization of research, as this is considered to be the most effective way for transferring new inventions to market and, not least, ensuring additional income for the institutions. Governments do encourage knowledge commercialization through legislative changes and a number of supportive programs. There is a tendency of implementing some "popular" policies and policy mechanisms by different governments. However, it has been doubted whether these policies can be regarded as efficient for all research university systems or they simply represent the "emulation" of specific policies that worked in some specific contexts. In the field of research commercialization, the US is regarded as a "leading" country taking into consideration commercialization results of its universities. Hence, it is the US policies that are often emulated in other countries in order to reach similar productivity in commercialization of academic knowledge (Geuna & Nesta, 2006; Sampat, 2006).

It should be noted that literature on government policies and instruments encouraging research commercialization is very much dominated by case studies on specific countries or universities. I will describe some important commercialization policy trends based on the policies of the three countries: the US, Sweden and Australia. I have chosen these particular countries for three reasons: first, their commercialization systems have raised interest among scientists in recent years; second, they are on the forefront of establishing commercialization policies as a separate field; and, finally, these countries are the examples of three different approaches to commercialization policies, which I will discuss further in the chapter. The analysis of the policy trends in these countries will provide a conceptual framework for my case study of Norwegian commercialization policies and the University of Oslo.

3.1 Global and local dimensions

I want to analyze commercialization policies within the globalization framework. Globalization is usually described as a force that eludes boundaries and distinctions between nation-states, global and local, international and national. My point here is that globalization also frames research policies and makes global and local dimensions to collaborate and coexist. According to Laredo and Mustar (2001), each country is characterized by a particular body of rules and routines and institutional organizations. However, increasing coexistence of the national and global dimensions in national research policies becomes apparent: ” the construction of favorable background is no longer only the business of national policies but of a whole set of public interventions, which, in Europe, mix regions, nations and the European Union in an increasingly manner” (*ibid:* 9).

The question with respect to national commercialization policies will be to what extent this coexistence of global and local is possible. I will use the terms “travelling” and “embedded” (Ozga & Jones, 2006) to describe the global and the local dimensions of commercialization policies. Travelling policies refer to those functioning on international level and promoted by globalized environment, while embedded policies are those shaped to respond more local demands (*ibid*.). Some critics argue that the global policy trends dominate in the national policies. Government officers worldwide elaborate a common set of policy themes. This is also the case when we think of national commercialization polices. The global trend that has identified in a number of studies is that the US policies on commercialization are recognized as most effective. These policies, as e.g. the Bayh-Dole legislation of 1980, have become an element of “travelling” commercialization policies. The Bayh-Dole act granted universities the rights to the patents that resulted from federally funded research. This was supposed to serve as motivation for universities and academics to commercialize their research outputs (Sampat, 2006). Policymakers worldwide emulate the same policy without much reconsideration and assessment of the eventual consequences of these policies. As Ozga and Jones (2006: 3) put it, policymakers “are steering research towards problem-solving and the consolidation of knowledge about ‘what works’”. However, what works at a first glance, cannot guarantee its efficiency in long-term perspective and not least, in other institutional

and economic contexts, as all policies are reshaped according to the national demands and adapted to the local institutional environments.

As Mowery and Sampat (2005) argue, nowadays policy initiatives in the US and elsewhere in Organization for Economic Cooperation and Development (OECD) are based on "a lack of attention to supporting institutions, a focus on the casual effects of the policies, and a narrow focus on commercialization of university technologies, rather than other more economically important outputs of university research" (p. 227). The emulation of the Bayh-Dole act within the OECD can be regarded as a good example of "one-sided research policies". According to the same authors, these policies overlook a number of other institutions and supportive mechanisms that together with government policies result in successful commercialization in the US. If we also take into account the fact that industrial R&D managers consider patenting and licensing to be relatively unimportant for technology commercialization in most fields, this will make the Bayh-Dole act less important and, probably, unnecessary for successful research commercialization at universities (*ibid*.). Therefore, what the authors believe is that some other aspects characterizing the US research system beyond the Bayh-Dole legislation have played decisive role that ended up in successful commercialization. Among them, they mention some institutions and supportive mechanisms that contribute considerably to commercialization culture at the US universities. Sampat (2006) argues elsewhere that American research universities have always been important economic institutions. Unlike to their European counterparts, they have never been pure "ivory towers" and have always fostered strategic and use-oriented research. Thus, he underlines the importance of learning the commercialization system as a whole consisting of different aspects and not just copying the policies that have turned out to be successful in a specific context.

Decter, Bennett & Leseure (2007), also emphasize the importance of the university culture and regulations with respect to commercialization activities. In their article dealing with technology transfer activities in the US and UK, they argue that consciousness on entrepreneurial role of the university tends to be stronger in the US than in the UK. Further, they state that while in the UK information is considered the most important outcome of publicly funded research, American universities focus more on invention. Finally, Decter and

colleagues (*ibid*.) believe that TT policies are more consistent in the US, which leads to greater degree of technology accessibility by companies.

A good example for how global and local dimensions of policy trends should be combined in a national policy can be seen in the study by Wong, Ho and Singh (2007) of Singapore policy. The authors maintain that transformation of traditional university into an entrepreneurial one is not simple and never follows fully some identified model. They address to the theory of entrepreneurial university by Etzkowitz and the shift of the National University of Singapore (NUS) from traditional to an entrepreneurial university model. The authors underline the great importance of taking into consideration the regional variations when structuring commercialization policies for universities. For instance, they believe that in case of Singapore which has a small population it is important to attract foreign talents who can participate in commercialization activities. Another characteristic that should be kept in mind is that universities in Newly Industrialized Economies (NIEs), which NUS represents, should become innovative by focusing on innovative research of its own instead of just absorbing the technological innovations from other countries. Finally, in order to reach the goal, universities have responsibility to foster "an entrepreneurial mindset" (p. 941) among students and thus prepare them to meet the challenge of turning science into business.

Therefore, the context in which commercialization policies are shaped and implemented is seen of crucial importance. A policy that is efficient in a specific institutional environment can turn out to be less productive or even inappropriate in other institutional milieu. Moreover, it is necessary to adjust a policy to local demands. Thus, each policy has to be a subject of detailed analysis and evaluation within the context it has been originally implemented and only then considered whether it is appropriate to the specific institutional system. In this evaluation, attention should be paid to other policies, government or institutional, and/or supportive mechanisms that together provided a basis for the implementation of the considered policy and, not less important, existed culture and regulations of the research system. After this deep reconsideration, it becomes possible to assess whether or not a specific policy or policy instrument can be "borrowed".

According to Sagasti (2004), policies and policy instruments are diverse in their character: they "have different information, organizational and administrative capacity requirements. Some of them work in clusters and reinforce each other while others work individually and may lead inconsistencies and contradictions" (p. 97). Some policy instruments have an immediate impact while others take a longer time before one can see results. Thus, it is a complex task to choose policies and policy instruments that are appropriate, efficient, congruent, and flexible and have a capacity to adapt to changing circumstances. This further implies that not all policies and policy instruments are equally important to all countries and "the choice of interventions has to be adapted to their historical evolution, present situation and development strategy" (*ibid*: 96-97).

It has been argued that policy language is filled with optimistic belief that with the help of "right" policies and incentives universities will become the cornerstone of innovation and economic development (Geuna & Nesta, 2006). The universities like Stanford and Massachusetts Institute of Technology (MIT) are regarded as examples of successful entrepreneurial universities and give policymakers worldwide the hope that implementing the like policies would ensure the shift of traditional universities toward an entrepreneurial one. However, the reality is that "building an entrepreneurial university… is an arduous task for which there is no blueprint" (Jacob *et al*., 2003:1556).

Geuna and Nesta (2006) also claim that existing policy literature on research commercialization is one-sided and does not cover all aspects of university technology transfer and Intellectual Property Right (IPR) ownership. They maintain that policy literature in Europe is very much influenced by the US experience during the 1980s and 1990s after the Bayh-Dole act. So once again we encounter the fact that global layers, here the US experience and the Bayh-Dole legislation, tend to become dominant in local policies as those of European countries.

3.2 Government policies and policy instruments to promote university research commercialization

Commercialization policies represent a specific area of innovation policies. Moreover, in literature reviews they are often referred to as initiatives to promote commercialization, policy instruments to encourage academic involvement in commercialization processes etc.

Spilling and Godø (2008) point to the complex nature of commercialization policies. They argue that there is no simple recipe to follow for designing efficient policies on the issue and policymakers should acknowledge the complexity of the emergent commercialization systems and realize their limited opportunities when it comes to designing successful policy mechanisms. According to Spilling and Godø (*ibid*: 120), the central drivers of entrepreneurial activities are the entrepreneurs and incumbent firms, while policymakers are supposed "to develop adequate framework conditions and stimulate the development in areas where important bottlenecks and barriers are identified". Thus, they claim that the most important goal of policies promoting research commercialization is to create favorable environment at universities by annulling barriers for academic entrepreneurs and firms that are the primary drivers of the activities.

In order to promote research commercialization at universities, government policies have to address several aspects of university life as commercialization processes involve a number of sides of university.

3.2.1 Academic motivation and incentives for academics to commercialize

First, researchers' attitude has to be directed towards the idea of knowledge commercialization. This becomes urgent taking into account the fact that academic involvement has been claimed to be crucial in development phase of a new idea. As Rasmussen, Moen and Gulbrandsen (2006: 520) put it, "commercialization of university

research is predominantly dependent on individuals and cannot be made a routine task". However, encouraging researchers to focus on the so-called "new mission" of intellectual property utilization is not simple, as it generates tensions with traditional academic values. It has also been argued that the shift of researcher generation could be the only solution to this barrier. Wessner (2003) mentions that entrepreneurial environment is a key to knowledge based growth. He maintains that this aspect makes a large difference between the US and the European university system, and argues that this issue has to be addressed already in a school as changing the mindset of people is a long and complex process and "may involve generational change" (p. 60). It will be wrong to argue that all the US universities are entrepreneurial-friendly and all the European ones are not. However, this is an obvious tendency, which should be taken into consideration when identifying the reason for the success of the US universities with respect to research commercialization.

Henrekson & Rosenberg (2001) note that three important factors can contribute to academic motivation: first is promotion of entrepreneurial behavior through special courses on entrepreneurship for academics and students; another is changing the legislative framework of universities with respect to its missions, recognizing commercialization as a valuable activity. The third factor would be provision of pecuniary incentives for academics, which implies sharing of revenues from commercialization activities (*ibid.*).

The importance of injecting an entrepreneurial mindset is argued by a number of authors to be of crucial importance. According to Klofsten and Jones-Evans (2000, cited in Rasmussen *et al*., 2006) three basic activities can contribute to stimulation of entrepreneurship at universities: the creation and maintenance of enterprising culture at the university, giving courses in entrepreneurship and specific programs for individuals who are going to start their own business. In their empirical study of National University of Singapore, Wong and colleagues (2007) maintain that universities are responsible for "fostering entrepreneurial mindset" among students and academics. Entrepreneurship programs and courses are specially arranged to raise awareness and interest in entrepreneurship among students and professors.

Rasmussen et al. (2006) also found entrepreneurship education programs very important in their empirical study conducted at four universities with traditionally strong links to industry: University of Chalmers in Sweden, University of Science and Technology in Norway (NTNU), university of Oulu in Finland and Trinity College Dublin (TCD) in Ireland. What the authors found very interesting is the awareness of the importance of learning entrepreneurial behavior and culture to the students. Three out of four universities have some kind of programs and arrangements that contribute to growing up "academic entrepreneurs". E.g., Chalmers' University runs one and a half year program in which students and teachers deal with innovation projects. As claimed by Rasmussen et al. (*ibid*: 524), "the idea is to educate persons to fill the gap between inventors and traditional managers". The University of Oulu offers a half-year course in entrepreneurship averaging thirty participants. Students that do not take the course but are interested in starting their own firms can also get advice. In addition, NTNU has a strong focus on raising interest in entrepreneurial activities among students by offering them a program where four students and an entrepreneur are involved. They make a business plan with the assistance of an experienced supervisor. In this way, students are learning the entrepreneurial skills, which they are encouraged to exploit in future.

The study on Nordic countries conducted by Nordic Innovation Centre (2005) also emphasizes the need for entrepreneurial learning in order to guarantee effective commercialization. The reason as stated further in the report is the huge difference between the two sectors: "the world of academia and business obey to different kinds of logic, and with a greater responsibility of the former to account also for the latter, the mind-set of commercialization needs to be incorporated into the universities" (*ibid*: 22).

Another way to encourage university research commercialization is legislative changes that recognize contribution to economic development as a "third mission" of the university. This becomes very important, as a traditional university has been isolated from politics and economy as the metaphor of "ivory tower" points to. Universities have had their long acknowledged roles, which they pursued without violating norms of "open science". However, recent changes associated with globalization and accelerated technological development brought a shift in what governments expect from universities. The university is

considered a central player in national economic development and an important source for increasing competitive capacities of the nation-states. This is particularly the case in biotechnology and Information and Communication Technology (ICT). Thus, governments at regional, national and international levels encourage universities to undertake responsibilities for economic development (Etzkowitz, Webster & Healey, 1998). The legislative changes made by governments in the US and Western Europe focus on revising the university missions and values forcing universities to take on the third role of economic development. To make this change smoother and painless for the faculty, governments start interpreting of the commercialization activities as another channel for research dissemination that has always been regarded as one of the missions of universities (Iversen, Gulbrandsen & Klitkou, 2007).

Based on the above presented discussion, one of the important areas that government policies should address is academic motivation to commercialize their research. It is worth mentioning that even though academics acknowledge the new external demands it does not mean that they can straightforwardly switch their attitudes and perception regarding the role of a university and an academic. Sampat (2006) maintains that the US universities have never been pure "ivory towers", but even they have long been reluctant to getting directly involved in patenting and licensing activities. That is why integrating commercial activities as a "third mission" of academe becomes necessary. Governments worldwide broaden the scope of university missions through amendments to laws on the roles of the universities and colleges legitimating their role as a contributor to economic development. This works as an important mechanism for strengthening university focus on research commercialization.

In their study of Chalmers' university, Jacob, Lundqvist and Hellsmark (2003) conclude that transformation of Chalmers' university into an entrepreneurial university is not simply a policy outcome. Rather, it can be seen as "an internally driven process that may be better explained by the culture of an engineering school rather than responses to top down steering" (p. 1567). However, they do not deny the significance of government policies in that they created a climate, which legitimized the efforts of the university to become entrepreneurial: "this legitimacy in turn made it possible for actors within Chalmers to make further and more radical moves that they would not have contemplated otherwise" (p.1567). Thus, the

legitimacy aspect of the government policies that gave academics rights and even obligations to commercialize their research seems to be of crucial importance. However, one thing should be mentioned. Based on the empirical study of four European universities, Rasmussen et al. (2006) note that policymakers should not exaggerate the aspect of "obligation" to commercialize university research. "Soft" emphasis on commercialization seems to be more acceptable for faculty: "commercialization should be a voluntary activity for faculty; it should be stimulated, not obligatory" (p. 524).

3.2.2 Commercialization infrastructure

Another important aspect of successful research commercialization is the infrastructure that supports academics in the processes of licensing, patenting and creation and running of spin-offs. The goal is to provide specialized expertise within the field of entrepreneurship or business, physical facilities, space and advice. In this way, these institutions are supposed to serve as a bridge between two different worlds of academe and business. The commercialization infrastructure comprises TTOs and/or Technology Licensing Offices (TLOs) (as in the US), research parks and technology incubators.

According to Guston (1999 cited in Gulbrandsen, 2008: 82), "a technology transfer office's core mission may be defined as moving research results and other ideas and technologies, most often originating at a certain higher education or public laboratory, into use". TTOs are intermediary institutions that are linked to the university, and they most often have a monopoly on commercializing ideas and technology from the institution it belongs to (Gulbrandsen, 2008). The drift of a TTO, as it is often claimed, is based on principal-agent theory. According to this theory, the principal hands over resources to the agent in order to reach goals that the principal cannot reach alone (*ibid*.). Jensen (2003 cited in Gulbrandsen, 2008) argues that a TTO can be viewed both as a principal with respect to its relationship with academics, and an agent of the university administration. It is a "boundary organization" that continuously tries to demarcate science from other activities and simultaneously acts as a bridge between public policies and the researchers (Guston, 1999 cited in Gulbransden, 2008).

Vohora et al. (2004 cited in O'Gorman *et al*. 2008) identify two main barriers that scientists face when appropriating the returns from new knowledge. These are a lack of resources and a lack of special capabilities that academics need for establishing firms. TTOs and incubators are regarded as effective instruments to overcome these difficulties by academics. According to Colombo and Delmastro (2002 cited in O'Gorman *et al*. 2008: 25), a key rationale for establishing university TTOs and incubators is that they "make it easier for academic personnel to exploit knowledge-based business ideas, thus lowering the barriers that inhibit direct commercial application of the results of university research".

According to Rasmussen and his colleagues (2006), incubator facility is a common mechanism to support new ventures on their early stages of development by providing office space and different physical and advisory support. Research parks can also serve as an incubation site of spin-off companies. However, it is not their only responsibility. Another important objective of a research park is to increase interaction between the faculty and private sector (Feller, 1997).

3.2.3 Finances

Finally, commercialization activities are demanding with respect to finances. It is costly to apply for patents, to run the supportive mechanisms and institutions placed at the universities as TTOs, Research parks and incubation facilities. As underlined in the report of Nordic Innovation Centre (2005:23), "commercialization is an avenue that is much more resource-intensive than the traditional channels of diffusion".

The need for money becomes even more urgent when it comes to spin-off formation, as the ideas resulted from university research should undergo different development phases until viable products and services are developed. Here public money becomes the necessity, as private companies are not willing to invest in academic inventions until they reach later stages when it becomes possible to forecast the profitability of these investments. The gap between the creation of intellectual property and its translation into useful products is called

"the valley of death" (Etzkowitz, 2002). Governments support the development processes of the ideas through different grants and loans. Seed- and venture capital gain vital importance for fostering successful spin-off companies. Seed capital is provided at a very early stage in order to develop the idea, while venture capital is provided at early stages of the firm development before it is capable for reaping its fruit (Rasmussen *et al*., 2006).

Thus, government policies designed to promote knowledge commercialization have to motivate academics to commercialize their research results, provide academic and economic incentives for researchers, legitimate research commercialization as a "third mission" of the university, and build and support the entrepreurial culture at universities.

3.3 Policy approaches to knowledge commercialization

There have been identified two different approaches to university knowledge commercialization (Goldfarb & Henrekson, 2003). The differences between these two seem to have crucial importance for how successfully government policies facilitate knowledge transfer from universities to the market. The authors compare the policy strategies in the US and Sweden and argue that the reason behind the US university success in knowledge commercialization and, on the contrary, failure of Swedish universities lies in the policies that either encourage (in the case of the US) or discourage (Sweden) the commercialization climate at universities.

The authors maintain that by academic outputs (publications) Sweden is "an academic powerhouse". What they argue for is that university recourses are not fully exploited in Swedish universities through transfer activities of academic ideas. They emphasize the weak performance of one specific mechanism of commercialization - start-up firms and claim that government commercialization policies should be revised in order to better the performance of Swedish universities on this plan. The important key to better understanding of the differences between the US and Swedish systems has been revealed by surveys of the US

TLOs which found that academic involvement in commercialization of their ideas is vital. Thus, enough incentives should be provided for academics to get involved in the process of translating their ideas into products and transferring them to the market. In this light, the role of government policy is to provide incentives for academics to overcome their reluctance to getting involved in business-kind activities. Based on this theoretical suggestion, Goldfarb and Henrekson (*ibid*.) believe that the competitive university environment in the US and the Bayh-Dole legislation which granted the rights on academic discoveries resulted from publicly funded research to the universities create the incentives for academics to commercialize their discoveries. On the contrary, in Sweden, academics face disincentives to get directly involved in the transfer process in spite of a number of policies launched by government to create more favorable environment. It should be noted that the financial aspect has nothing to do with the failure of the Swedish universities as government have allocated lavishly in university research sector, which, in fact, resulted in brilliant *academic* results.

There is an important note from the authors, which also refers to our discussion about how wrong it is to emulate international or generally recognized policy elements without consideration and detailed assessment of the original context. By confronting the US and Swedish policies as successful versus failed respectively, Goldfarb and Henrekson (2003) do not recommend to imitate the US policies as a role model, rather, they claim that institutional context where the US policies are efficient is of great importance. Nevertheless, they suppose that American experience can be helpful in finding a way that works best for Sweden.

The authors claim that two aspects should be taken into consideration when designing successful commercialization policies. First, no single mechanism is efficient for commercialization in all the settings; second, there is a lack of direct link between pursuing commercialization activities by academics and their professional reputation. The latter is considered an obstacle for getting researchers involved in transfer process of their ideas. The academic reward structure is rooted in the traditional view that researchers' prestige is closely tied with the contribution that academics do for their community. One most recognized way to do this is through publications that result from their research. Publishing the papers needs much efforts and time just like the involvement in commercialization

activities. Naturally, academics are not willing to undermine their traditional pursuits in order to create valuable knowledge. Goldfarb (2001 cited in *ibid*.) has observed that private sponsor with applied goals face difficulties in involving high-profile academics in their projects. Thus, the traditional incentive structure discourages commercialization activities. Based on this discussion the authors argue that the first step in enhancing commercialization capacities at universities is to create the right incentives for academics to participate in technology transfer. This should be done by tying results to compensation. Also in the report of Nordic Innovation Centre (2005:23), it is argued that changes in academic meriting system could be done "making an entrepreneurial path a credible career option". Publication turns to be the most valued academic output in Sweden. Hence, academics' strong focus on this particular channel of knowledge dissemination is natural. On the other hand, competition among universities in the US system has broadened the research agenda that resulted in more openness for experiments, more flexibility and more commercialization. Wessner (2003) argues that good goals and good objectives are not enough for designing good policy. He further maintains, "The reality of innovation is very complex and addressing it may challenge established beliefs and institutions" (p. 61).

Another aspect that makes a huge difference between the two countries is the relationship between the university sector and business. Sweden seems to lack the public-private collaboration, which has a negative impact on commercialization (Goldfarb & Henrekson, 2003).

Based on the detailed study of the policies implemented in the US and Sweden, Goldfarb and Henrekson (2003) suggest two different commercialization policy approaches. They argue that the US initiatives targeting research commercialization are introduced "bottom-up". Policies provide universities with incentives to respond to commercial opportunity in the way they find works best for them. This, in turn, excludes any dictations or even suggestions from the side of government. On the contrary, in Sweden all the policies are introduced from above, or "top-down" which do not provide any incentives for academics to be initiative in commercialization activities (*ibid*.). It is within this context of policy approaches I found Australia an interesting case with respect to its commercialization initiatives and instruments. According to Harman and Harman (2004), strategies employed here for

promoting research commercialization fall somewhere between the US and Sweden. Next, I will give a brief analysis of the commercialization policies in the three countries.

3.3.1 The American commercialization system and policies

The point of departure for describing the American system is the Bayh-Dole act that granted the property rights on inventions resulted from federally funded research to universities. According to Goldfarb and Henrekson (2003), this gave incentives to universities to set up TTOs that became instrumental in facilitating university technology transfer, and supporting academics in different activities associated with commercialization of their ideas. The policy is remarkable in the way that it gave universities freedom to adjust their policies and organizational structure to the opportunity of exploiting their research commercially. As the authors put it, the act fostered much experimentation in university policies encouraging knowledge transfer to private sector. This is why the American policy approach is called a "bottom-up". No doubt, the way universities attempted to respond to the opportunity of intellectual property exploitation is rooted in the flexible structure and traditional environment of the US universities. With respect to this debate, Goldfarb and Henrekson (*ibid*.) mention two important characteristics. The first is experimentation, to which American university system has always been more favorable and the second is environment in which the US universities have always been competing for finances. Viewed as an extra financial source and the activity encouraged by government, knowledge commercialization became gradually an important focus of the US universities. The authors argue that this involvement even violates academic norms in some cases. E.g., universities get grants from private firms for some goal-directed research activities results of which are fully in the hands of sponsors.

Another important university policy encouraging US academics to get involved in commercialization activities is the liberal environment where they can easily take leave of absence (Goldfarb & Henrekson, 2003). In addition, consulting privileges allow researchers to pursue commercialization activities and at the same time keep their positions as faculty members. Policies ensuring favorable environment for academics involved in technology

transfer are implemented to keep talented academics that different universities are competing for. Rosenberg (2000 cited in *ibid.*) argues that despite the benefits of this type of policies for universities, the costs are considerable. He further claims that eventually these policies will not be favorable for non-competitive systems. Thus, he underlines the importance of institutional settings in which policies are implemented.

Thus, awarding rights on inventions to universities resulted in establishing of Technology Licensing Offices at universities, which became instrumental in supporting academics. First, they facilitate academics with expertise in business kind activities that usually academics are not familiar with. Secondly, they cover expenses associated with commercialization activities, which usually works as another barrier to researcher involvement in technology transfer activities.

Entrepreneurial-friendly environment, strong links and cooperation between the public and private sector and labor flexibility together with low regulatory barriers to establish a firm, are considered as key factors of the US commercialization (Wessner, 2003). It is a fact that the US universities have long been resistant to direct involvement in business kind activities. As Greenberg (2007: 88) notes, "even if they weren't hushed oases of scholarly endeavor, proverbial ivory towers, universities once cultivated separation from their surrounding communities". In fact, some of them are still reluctant to commercialize their research, which they believe should not be privileged over the traditional academic values. Greenberg (*ibid.*) claims that in spite of the similar policy and regulatory framework and, not least, pressure "to deliver tangible economic benefits, the penetration of entrepreneurial goals and values… is markedly uneven across academe" (p. 95). However, this fact should not reduce the importance of the Bayh-Dole legislation which as Greenberg (*ibid*: 57) puts it, stimulated "academe's entrepreneurial spirit" by providing financial incentives.

The Bayh-Dole act (1980) is the most acknowledged, and, at the same time, most debated US policy targeting university research commercialization and contribution to economic growth. By granting the rights on federally funded research to universities, it provided financial incentives for the universities to commercialize research outputs and gain

additional revenues. Under the law, inventive professors are entitled to one-third of the licensing revenues. The university and the department to which the professor belongs get one-third of the total revenue. Scientists are thus encouraged financially to think of the marketplace as they pursue knowledge (Greenberg, 2007). This "one-third model" is nowadays a generally accepted model of income sharing at universities. The second important aspect of the legislation is that universities also became more responsible for commercializing the results generated from publicly funded research. As a respond to the Bayh-Dole act, universities started to establish offices of technology transfer and other institutions, which were supposed to support commercialization activities on campus.

A successful initiative aimed at fostering academic entrepreneurship nationwide in the US is launched by the Ewing Marion Kauffman Foundation of Cansas City, Missouri. In early 2003 the Foundation invited thirty universities to compete for financial awards up to $5 million each. As described in a press release the program was "the first such effort of its kind" (Greenberg, 2007: 88) and its goal was to make entrepreneurship an integral part of the university. From the original thirty universities fifteen were selected to receive $50 000 grants to deliver detailed proposals "for an innovative, comprehensive five-year plan to inject entrepreneurship into the fabric of the university" (*ibid*: 89). In the end of the 2003 eight universities were awarded grants ranging from $2 million to $4, 5 million. This program was built on the Foundation's 10-year history of promoting entrepreneurship by supporting entrepreneurship education at hundreds of US colleges and universities. The importance of the entrepreneurial attitude among academics is well acknowledged by the Foundation. As Carl Schramm, the president put it, their initiatives do not just focus on engineering and business students, rather they want "*all* students to have access to the skills, orientation and networks that lead to greater opportunities for them and result in more jobs, innovation and prosperity for America"(Greenberg, 2007: 89).

Funding is an important aspect of research commercialization that should be addressed by government policies. A lack of finances often becomes a problem for a newly established spin-off. Investors believe that the appropriate time to invest in university spin-off is at later stages when the company has already developed a prototype of the product and risk to fail on the market is reduced (Shane, 2004). Wessner (2003) argues that one of the anomalies of the

US system is the widespread belief that the US venture capital markets are the best in the world. He maintains that although the US venture capital markets are the "broadest and deepest" in the world, this does not mean that they are sufficient to commercialize all promising ideas. Wessner (*ibid*.) points to a recent trend which reveals that the US venture capitalists focus on the later stages of technology development. This becomes a real problem for newly started firms. According to Shane (2004), the funding problem does not concern the field of biotechnology. This is the sphere where private investors often are willing to invest already in early stages of firm development. However, other than biotechnology spin-offs, funding is a serious concern of new-established firms. A number of empirical studies in the US, the UK and Northern Ireland have revealed that funding from government agencies is the only way for a university spin-off to survive in its early phases and reach the point where private money is available (*ibid*.).

The main intention of "Small Business Innovation Program" (SBIR) is to provide financial support to small firms at an early stage (Wessner, 2003). The program is highly competitive. Nowadays budget of SBIR comprises $1.6 Billion per year. Another federal program, Advanced Technology Program (ATP), aims at providing funds to industry for development of promising high-risk technologies. According to Wessner (*ibid*: 52), it is a "world class program" which became the subject of interest of policymakers all over the world. Both programs aim at providing finances. The first one is mainly focusing on early stages of firm development. The other intends to facilitate the development of high-risk technologies.

3.3.2 The Swedish commercialization system and policies

The Swedish university system is in many ways the opposite to the US system. According to Goldfarb and Henrekson (2003), the Swedish policies on knowledge commercialization are directed from the government, giving no opportunity to the universities and academics to come with their own initiatives. A lack of financial incentives for universities is argued to be another reason.

According to the law of 1949, the ownership rights on inventions resulted from research lies entirely in the hands of faculty members. This is an exemption from a general regulation on patents developed by employees. Hence, there is no policy of "profit-sharing" with the faculty. This in turn, discourages the universities to get involved in technology transfer activities. As pointed out in the study conducted by Nordic Innovation Centre (2005), the issue has been debated since 1990s, as the policymakers were not sure whether to change the regulation by annulling the existed "teacher exemption clause". The issue was raised again in the government research bill in September 2000 where it was proposed that the exemption rule has to be annulled and the government should support the researchers who are interested in commercializing their research (*ibid.*).

Unlike the US university system where university policies ensure favorable environment for commercialization by making it easier to take temporary leave while pursuing transfer activities, the Swedish system is more rigid. Several constraints operating on university level discourage academics to get involved in commercialization activities but consulting. Otherwise, as Etzkowitz (2000 cited in Goldfarb and Henrekson, 2003) claims, academics might face the situation where they have to choose between the university and the new established firm. Therefore, the Swedish system does not provide university support as e.g. American TLOs, which means that academics are not supported by special expertise needed for pursuing commercialization activities, and have to cover expenses themselves. In addition, neither their researcher position is ensured at the faculty. Taking into consideration all aspects it is not surprising that Swedish university system fails with respect to the performance in research commercialization. Another important factor that Goldfarb and Henrekson (2003) consider as a barrier is a poor relationships between Swedish university and industry sectors. Swedish industry is dominated by large firms, which generally do not provide strong incentives to inventors. This, of course, discourages faculty to collaborate with them. In addition, when it comes to small high-tech firms, they do not realize fully the importance of cooperation with university sector. Several reports on Swedish firms have identified that cooperation with other firms are considered to be more important than with universities which discourages the fruitful relationships between the two sectors(*ibid.*). As Wessner (2003:61) puts it, a lack of collaboration between university and industry is generally recognized as "one of the debilitating things for innovation". He further argues that

universities and companies often have complementary objectives and it is very important that both sides recognize this fact and adopt an attitude of mutual respect (*ibid*.).

The Swedish government has implemented several policies to promote commercialization of university research. They mainly were directed towards creating supportive infrastructure for commercialization activities, more competitive funding system and some regulatory changes at institutional level.

In 1997, the amendment to the law was made which stated clearly that university was to include a third task apart from its two traditional missions of teaching and research. The amendment made universities responsible for wider dissemination of their knowledge. According to Jacob and his colleagues (2003), even though the "third mission" was not further specified in the amendment it is an obvious trend towards interpreting the new mission as being about commercialization of academic research.

As pointed out in the study by Nordic Innovation Centre (2005), Nordic countries generally are not regarded as entrepreneurial. This implies that in order to create favorable environment for commercialization, government policies should address all aspects of the commercialization system. Among them is the infrastructure that will support researchers in entrepreneurial activities.

The first university research parks were established in 1980s. Their aim was to provide researchers with physical facilities. However, later their role was increased including the advisory support, venture capital etc (Nordic Innovation Centre, 2005). Since 1994, seven intermediary institutions called Technology Bridging Foundations have been established. Their aim was to support academics in research commercialization and technology transfer from SMEs and individual inventors. In addition, university holding companies were set up to finance commercialization of patents. These institutions jointly established patents' and licensing offices to support academics (*ibid*.).

Funding has been another area targeted by policies addressing the innovative environment in Sweden. In 1994 strategic research foundations named as the "wage earner foundations" (Jakob *et al.*, 2003: 1557) were created. An interesting and controversial aspect of this reform was the fact that these foundations were not dependent on government budget and were financing strategic research, which was quite new for the Swedish academic environment. They provided an alternative financing channel apart from the public allocations, which was an attempt to make the funding system more flexible and adoptive to new external demands. Another important reform covered the establishment of the competitive funding system. Policymakers hoped that this would promote commercialization of university research through forcing universities to compete for a sizable portion of their research funding (Nordic Innovation Centre, 2005). The venture capital market supporting new-established spin-offs in Sweden is quite strong; both private and public. In 2002, it was the largest in the OECD in relation to Gross Domestic Product (GDP). However, like many other countries, Sweden also lacks the early-stage funding when the risk to invest is high (*ibid*.).

3.3.3 The Australian commercialization system and policies

Australian policies directed towards knowledge commercialization provide a mix of government and university initiatives. This, in turn, became one of the reasons why I selected it as the third country for providing conceptual framework for my case, which is Norwegian policies and the UO. Another reason is the fact that Australia is the country where recently the focus on the issue of university knowledge commercialization has been extremely strengthened from both government and university side.

As stated in the report of August 2004 by Business council of Australia[2], "Building effective systems for the commercialization of university research", since the mid 1990s government's focus on creating better environment for commercialization has been growing. It has long

[2] http://www.kca.asn.au/information/BCA-AVCCReport.pdf

been recognized that the excellent research provided by Australian universities was not enough on the evidence of their weak performance in translating this research into marketable products and services that could benefit the nation. One of the reasons for the weak performance identified was the lack of collaboration of the public and private sectors. Australian government launched a number of programs to better the situation. This started in 1985 with the measures to strengthen the researcher-industry links through the 150 % Taxation Concession Scheme and the Grants for Industry Research and Development program (Harman & Harman, 2004).

From the year of 2000, government policies and reforms began to directly address the commercialization environment. In 2000 in the recommendation of the Australian Research Council (ARC) to the government, the importance of integration of the research commercialization in the research process was emphasized. Federal government started to invest heavily in commercialization through different programs and initiatives.

- The commercializing Emerging Technologies (COMET) programme provides funding to businesses and individuals in commercialization of their inventions;
- R&D START programmes provide loans to smaller companies involved in commercialization;
- The R&D Taxation Schemes and the Premium Scheme provide tax deductions; the Innovation Access Programme encourages business firms to adopt the best innovations;
- Different venture capital programmes provide funds on early stage of commercialization;
- The Building on IT Strengths provide information and communication incubators across the country;

In addition to these activities, state governments established new innovation and commercialization councils; and business and seed capital funds (Harman & Harman, 2004). The fact that these programs are run by numerous different departments raises some concerns. This includes possible overlap between programs and arrangements, and some

ambiguity about their objectives and priorities. Besides, the evaluation results of several programs have revealed that they eventually provide more financial incentives for the industry than for researchers and university. This, in turn, can result in that universities and academics do not have incentives strong enough to commercialize their inventions. If it is the case, government programs targeting research commercialization might not be as fruitful as anticipated (*ibid*.).

When it comes to IPR in Australia, it is identical to the generally accepted model: according to the law, the employer is the owner of any kind of intellectual property created by employees in the course of their employment. It is worth mentioning that the University of Melbourne attempted to try an alternative approach to the intellectual property ownership by giving the rights on the inventions to their inventors. The aim was to give more incentives to academics to commercialize their research results. However, it has been argued that the policy was not successful as it turned out that bearing the full costs of commercialization discourages academics to commercialize (Harman & Harman, 2004).

The government pressure on universities to integrate commercialization as a core activity resulted in establishing different institutions to support academics in commercialization activities. Australian universities have found different ways to support technology transfer. Some of them established TTOs, others retained the old research offices which in addition to consultancy and contract management got the new function of technology transfer. As a result, four different models have emerged:

1. Specialist expertise located in university research offices;

2. Specialist university research commercialization offices;

3. University-owned companies providing research commercialisation support;

4. Research commercialization support provided by companies jointly owned by groups of universities, or through collaborative arrangements (*ibid.*).

This experiment of trying different approaches to technology transfer aimed to find the best alternative. However, it has been argued that there is no single alternative that works in all

university settings. Rather, universities have to organize their technology transfer activities in a way most suitable to them (Harman & Harman, 2004).

3.4 summary

Initiatives to promote direct commercialization at research institutions have become a strong focus of governments. Through legislative changes and different supportive programs and projects, governments worldwide facilitate knowledge commercialization activities. Rasmussen *et al*. (2006) argue that, generally, initiatives aim at providing support for individuals and projects in process while few attempts are made to stimulate new programs and projects at universities. This can be seen as a negative side of policies. However, we are not able to make much generalization across countries due to variations in policy applications. The way national higher education systems are framed has much to say with respect to their commercialization capacities. As a result of globalization, the convergence of global and local layers is obvious in commercialization policies. This fact should always be taken into consideration when designing and implementing new policies. On the one hand, external influence on research policies is inevitable whilst national characteristics remain important. No “big” policy is good enough for all education systems and research environments. The Bayh-Dole legislation in the US and the debate around the issue is a good example for how important it is to mould commercialization policies according to specific research environments.

There is no clear recipe for how to facilitate commercialization processes at universities. However, some aspects should be addressed by policies to strengthen commercialization. Academics are increasingly considered central players in research commercialization, which makes it vital to motivate them to get involved in commercialization activities. The possible incentives argued by scientists could be to tie commercialization results with academic career system, which implies that commercialization results would serve as an academic merit together with e.g. publication number for promotion of the researchers. Monetary incentives are also regarded as important to motivate academics. However, these incentives

alone might not be enough. The academic attitude towards commercialization activities traditionally considered as remote from academic world should be changed. On this way, academics should acknowledge that commercialization is another way of communicating their knowledge to society. The infrastructure with entrepreneurially educated staff is another important aspect for promoting commercialization at universities. Moreover, finances are vital for running commercialization infrastructure and supporting academics especially in the first phases of a product development.

I have discussed two different policy approaches advanced by Goldfarb and Henrekson (2003) and on this basis, I have presented the commercialization policies of three countries, which are the US, Sweden and Australia. According to the commercialization policy approach theory, policy initiatives are either introduced from government, i.e. "top-down" as in Sweden, or "bottom-up" as in the US. In the latter case, policies provide incentives for universities and individual academics and they respond to the challenge of commercialization in the way that fits them best. I found Australia interesting with respect to policy approaches as it represents the combination of both; initiatives introduced from government and the universities (Harman & Harman, 2004).

The discussion on global policy trends in commercialization policies and the policy approaches presented above together with commercialization systems of the three countries will provide a conceptual framework for the analysis of the Norwegian case. I will describe government policies on research commercialization and identify how global policy layers are presented in these policies; reflect on what is the Norwegian approach to commercialization policies; further I will describe government instruments that aim at encouraging commercialization processes at universities, and the supportive infrastructure. In other words, the following chapter will provide insight into Norwegian research environment with respect to commercialization activities. Moreover, the University of Oslo will be the focus of my observation in order to identify the university response on the new government policies.

4. Commercialization system in Norway

In this chapter, I will look at the Norwegian policy documents related to the university knowledge commercialization and observe the policy instruments implemented by the government to encourage commercialization activities.

This chapter addresses the following research questions:

1. What are the recent policies affecting the commercialization of university research in Norway?
2. What are the policy instruments initiated by Norwegian government in order to promote commercialization of research?

4.1 Review of Nowegian government policies promoting commercialization of university research

Norwegian policies on university research commercialization are quite recent. The first official document was the 1999 white paper on research policy (St. Meld. No. 39, 1998-1999) Forskning ved et tidsskille [*Reseach at the beginning of a new era*]. The paper maintains that Norway is greeting the new millennium with a stronger focus on Research and Development (R&D). The paper sets new goals and priorities for Norwegian research, which should be realized during the next five years.

The point of departure for the white paper is the great importance of research for economic and social development of nation states. It maintains that the world is changing at an accelerated pace due to technological developments, the digital revolution and increasing global openness. Thus, science and research become a priority in national policies. The vital role of investment in research to create the favorable environment for knowledge commercialization is emphasized in the document, and the importance of substantial increase

in both public and private allocations is acknowledged. By the time the paper was written Norway with its R&D investments lagged behind the OECD average measured as a proportion of Gross Domestic Product (GDP). According to the paper, the reason for low R&D investments was that Norwegian industrial sector is comprised of Small and Medium-sized Industries (SMEs) which traditionally do not finance and conduct much R&D. Hence, the share of industrial R&D investments lags behind the OECD average, and not publicly financed research. The white paper sets the goal of reaching the OECD average during the next five years, and describes what should be done to fulfil this goal:

- Government allocations in research should be increased. This was to be fulfilled by establishment of a new research fund with a turnover of three billion Norwegian crones. The main priority of government allocations is strengthening of basic research. The paper claims that basic research is crucial for development, as it gives birth to the radical innovations, but can take long before these innovations can contribute to social advance. However, this does not undermine the importance and uniqueness of this type of research. On the other hand, applied research has its boundaries and limits when it comes to the topic and methods of the research. It is supposed to be conducted within the existed theoretical framework. The white paper states that basic research is more free and can "twist reality from a new point of view", thus contributing to radical innovations. Hence, the importance of increase in public allocations in basic research is emphasized.

- Due to the weaker share of private funding in research in Norway than in other OECD countries, another goal stated in the paper is to encourage industry to increase its investments in R&D.

The paper further states that Norwegian government wants a better commercial utilization of research results at universities and colleges. To reach this goal, the Ministry of education (then so-called Ministry of church, education and research) would propose several amendments to laws that would contribute to the increased involvement of the universities and colleges in commercialization of academic research. These changes are supposed to

ensure pecuniary benefits for the institutions resulted from commercial activities, which should generate strong incentive for the institutions and academics.

- The paper also reveals the intention of Norwegian government to increase its focus on innovation activities in research parks and other R&D institutions. Strengthening of FORNY program (commercialization of R&D- results) is considered one way of fulfilling the goal.

The paper analyzes the then existing environment for commercialization; identifies the barriers to the development of this environment and comes with suggestions about how to overcome them. The paper claims that it is mostly in the fields of technology, medicine and natural sciences where research generates new ideas that can be commercialized. It is very important that these ideas be further developed to the point when they can be transformed into viable products and processes. However, there are several barriers to this development. First, some environments discourage academics to patent and sell their inventions. Second, realization of inventions is associated with long time span, much money and specific knowledge related to entrepreneurship. The idea needs to be developed until the point when it is possible to consider whether it has a market value. However, even if the idea seems promising it is no guarantee that the efforts put in its development will give an anticipated result. The fact that academics generally have none or little experience in conducting commercial activities is another problem. They often need experienced personnel who can guide them through commercial activities.

The necessity of academic involvement in the process of commercialization is emphasized and further discussed in the document. The possible changes in incentive mechanisms for researchers and institutions are proposed. According to the paper, the most reasonable way to get academics and institutions directly involved in commercialization of research is to give them a share of the revenues resulting from the activities. The paper also identifies a legal barrier to commercialization at universities and colleges. According to the law on ownership of inventions from 17 April 1970, an employer has right on the inventions made by an employee during the course of employment. However, academics are privileged by same law

through the so called “teacher exemption clause” which guarantees them full ownership of their research results. As identified in the paper, “teacher exemption clause” or “professor’s privilege” is seen as an impediment in the commercialization of university knowledge, as many academics are not interested in these type activities. That is why policymakers suggest nullifying “teacher exemption clause”, which ensures that universities get right and responsibility to commercialize research.

These are the new rules proposed in the paper:

- Researchers should take on an obligation to inform their institutions when they think their research results have a potential of being patented and eventually commercialized;
- Institutions should take on greater responsibility to contribute to academic knowledge transfer to the industry.
- Both institutions and academics will get shares of the revenues generated from these activities;
- Researchers keep the right to publish their research results;
- Commercialization activities should not undermine the basic research at the research institutions; researchers should keep freedom to choose the research topics and methods.

The last criterion emphasizes that that academic freedom is seen as a positive ideal. However, it is also emphasized in the paper that there are several limits to it. The reason for restrictions is that public wants to know more about what is going on at research institutions. This has resulted in a stronger control on research agenda recently. Several institutions and special committees have been established in Norway responsible for keeping an eye on what kind of research is conducted. Even more, they come with more specific directives on which topics are worth further investigation and which topics are not. This is especially the case in the fields of bio- and gene-technology. The paper maintains that academic freedom should be combined with the social relevance of the research in order to get best results.

Thus, the focus of the Norwegian government on better utilization of academic research is the main issue of the paper. The important topics addressed by the paper were increasing public and private allocations in research, making research institutions responsible for commercial utilization, and creation of incentives for academics.

The next step in Norwegian government policies targeting university research commercialization was an official report submitted by the Bernt committee in 2001 (NOU 2001:11) *Fra innsikt til industri* [from insight to industry]. The central goal of the report was to evaluate the system of research commercialization in Norway, to observe the instruments for commercialization and suggest amendments to laws to create better environment for these commercial activities. The committee also was supposed to point to the possible administrative and economic consequences, resulting from suggested changes.

It is stated in the report that the everyday activities at universities and colleges have traditionally been steered by faculty priorities. The most part of the financial sources were government allocations. However, in the last years a number of institutions developed new private sources of finances, so called *external funds*. Whilst government allocations do not have any preconditions for the institutions, external funds are given for contract-based projects and set some framework for research conducted by these funds. The report states the importance of keeping the traditional and business-side in balance: growing business-side activities should not undermine the institutions' traditional activities as teaching and basic research.

The report raises the crucial issues as the ownership of the inventions resulted from research conducted at research institutions and the issue of university and college missions. Similar to the above-discussed white paper, the report emphasizes the need for annulling the "teacher exemption clause".

Another important focus of the Bernt committee is the law on universities and colleges (Law 12.05.1995 nr. 22), more specifically, the missions of the institutions claimed by the law.

According to the law, universities and colleges have two primary missions. They are supposed to generate knowledge and disseminate it to the society. According to the report, the concept of knowledge dissemination has been widened during the last decade making knowledge commercialization a new way of communication with society. In fact, it can be seen as a necessary mechanism for institutions to fulfil their mission of knowledge dissemination.

The report resulted in two amendments that aimed at increasing research exploitation at universities and colleges making them more responsive to societal needs. The first was the amendment to the law on universities and colleges (Ot. Prp. Nr. 40, 2001-2002). According to the amendment, commercial utilization of research results was regarded to be a new duty of the higher education institutions. The latter became obligated to "communicate knowledge about their work including artistic work and extend the understanding about and use of scientific and artistic methods and results to public administration, civil society, and business and industry" (Thune, 2006: 113). According to Iversen et al. (2007), the new responsibility of the higher education institutions refers only to patentable research results. However, Ministry of Research and Education has encouraged the institutions to deal also with commercializable results that cannot be patented.

The second was the amendment to the law on the ownership of inventions made by employees (Ot. Prp. Nr. 67 2001-2002), which revoked the "teacher exemption clause" granting the right on inventions made by academics to the institutions. Thus, universities and colleges became directly obligated to exploit promising research results commercially. Sharing of income generated by commercial activities was not specified in the law. However, according to Rasmussen et al. (2007), institutions established the different variations of three share rule according to which 1/3 goes to the inventor, 1/3 to the faculty and the last 1/3 goes to the university.

In 2003, the Norwegian parliament introduced an innovation plan Fra Ide til Verdi [*From idea to value*] where commercialization is regarded an important activity for science-based private sector (NHD 2003). The paper states that the fact that only a small number of

patentable ideas are developed into successfully commercialized products and services, does not reduce the vitality of commercialization activities. According to the paper, availability of special expertise in commercialization processes and market knowledge is crucial for successful transformation of research-based ideas into viable products. The goal-oriented collaboration between public and private actors is identified as a key to successful commercialization. The paper also suggests allocating funds for setting up TTOs at all universities in Norway and evaluation of the official instruments directed towards research commercialization.

Another important aspect emphasized in the paper is the need for "entrepreneurial learning". It is stated that the competence of putting products and services to market is an important part of entrepreneurship. Setting up new firms demands entrepreneurial knowledge and skills. This is why it is important to introduce entrepreneurial learning at different levels in the education system which, in turn, will contribute to creation of entrepreneurial culture and extended commercialization activities (*ibid*.).

Because of these policy papers, all four Norwegian universities established TTOs that became responsible for supporting academics through commercialization processes.

The next government policy document with focus on research commercialization is the white paper on research introduced in 2005 (*Vilje til Forskning* [Commitment to Research] St. Meld. No 20, 2004-2005), where the goal of reinforcing efforts for better commercialization is emphasized. Among the suggested efforts were to increase allocations to the Norwegian FORNY program and provide financial support to the academics who want to commercialize their research outcomes by setting up new firms.

Thus, the Norwegian government policy documents reveal the government attitude towards strengthening direct research commercialization at research institutions. The following important issues have been discussed in the papers: Incentive structure for academics, commercialization infrastructure at universities, legislative changes, and financial support to

commercial activities. Policy documents emphasize that direct involvement of academics and institutions is crucial for successful commercialization and efforts should be put to motivate them to get involved in these activities. The shares from the revenues resulted from commercialization activities have been supposed to be an important incentive for academics and institutions. Two major legislative changes have been identified in policy documents as essential for motivating academics to commercialize their research outputs. First, by annulling the "teacher exemption clause" universities became the owners of inventions made by their employees. Second, the amendment to the Law on Universities and Colleges made commercialization of research a direct responsibility of the institutions along with teaching and research. The policy documents have also emphasized the vitality of finances for developing of commercialization capacities. Increase in both public and, especially private allocations has been identified as urgent.

It is important to note that all policies promoting commercialization emphasize the importance of maintaining the traditional goals of academe. It is often mentioned that commercialization activities should not undermine the fundamental research and neither should it influence the research topics and methods that academics should be free to choose. Researchers also keep the right to publish their research results.

4.2 Policy instruments addressing commercialization

The Norwegian government have launched several programs that aimed at facilitating commercialization processes at research institutions. Here I will discuss two important initiatives targeting commercial utilization of academic research.

4.2.1 FORNY program (*Kommersialisering av FoU-resultater*)

The FORNY program is a key instrument through which Norwegian government supports commercialization activities. The initiative is a result of collaboration between the two

departments: Norwegian Research Council (NFR) and Innovation Norway. FORNY was launched in 1995. There were several other departments that also used to provide funds for the program at the beginning. The primary goal of the program was to increase value creation through commercialization of research results at public research institutions. As stated in the description of the program *(kort om programmet),*[3] FORNY supports the stimulation of the ideas in research milieus and provides funds for commercialization actors for evaluating and developing the ideas with market potential until they are ready developed to be licensed or set-up as new firms [the author's translation]. The target groups are universities, colleges, research institutions and university hospitals. It is worth noting that FORNY does not collaborate directly with individual researchers but through institutions and commercialization actors (Rasmussen et al., 2007).

The program addresses four levels of commercialization processes:

a) It provides funds for stimulation of new ideas and development of commercialization infrastructure (*infrastrukturmidler*). Research institutions can apply for this kind of financial support. The primary task is to make commercialization an integrated part of the institutions' strategy, increase awareness of IP and commercialization possibilities as well as patenting skills. These funds can cover up to 50% of total expenses. Through this funding channel, FORNY supports TTOs, their establishment and everyday drift, patenting expenses etc. In 2007, this type of allocations comprised 28, 7 millions in Norwegian crones (NOK).

b) Another type of FORNY allocations covers commercialization expenses itself. It implies that commercialization actors get the money to develop the ideas to the point they can be licensed or spin-offs are established on the basis of the technology resulted from research. Up to 50% of the whole amount can be covered through this channel. According to Rasmussen and his colleagues (2007), 47, 5 millions in NOK were allocated through this particular channel in 2007.

[3] http://www.forskningsradet.no/servlet/Satellite?c=Page&pagename=forny%2FPage%2FHovedSide&cid=1088789229221

c) In 2006, FORNY started a new arrangement called FORNY Verification Grant (*FORNY verifiseringsmidler)*. The goal was to increase allocations in promising technology projects and to cover all the costs in "proof of concept" phase of technology development. Similar programs in Scotland and Ireland that appeared to be success inspired the arrangement. Commercialization actors select nominee projects for this arrangement and FORNY evaluates the applications with the help of external panel. NOK 45, 7 millions were channelled through this arrangement in 2007.

d) FORNY also addresses the issue of researcher flexibility. As mentioned previously, one important barrier to commercialization is that academics often have to choose between either their traditional teaching and research activities or commercialization of research outputs, as both are time-consuming. The arrangement started by FORNY *(frikjøpsordning)* was an attempt to enhance the commercialization capacities of academics interested in commercializing their ideas through granting them commercialization scholarship that covers the employer's expenses during a year. It was started in 2006 with its total fund around NOK 8 million. In 2007, funding was decreased by NOK 1 million and constituted NOK 7 million (*ibid*.).

The program has been evaluated twice: first in 1997 and later in 2004. The evaluations revealed a number of positive results. During the time span of 1995-2004, 231 new firms have been established and 125 licensing projects developed in the Norwegian R&D institutions. In 2006, a special study of the similar programs in other countries has been conducted. The goal was to further develop the program remedies.

4.2.2 SkatteFUNN

SkatteFUNN is a tax deduction scheme driven by three Norwegian public institutions: Norwegian Research Council, Innovation Norway and Skatteetaten. The primary goal of the initiative is to increase industrial R&D investments and innovation. SkateFUNN funds the projects that "create new knowledge, information or the experience that is supposed to

benefit the industry through developing new or better products, services or methods" (Rasmussen *et al.*, 2007). It is run in a way that encourages private companies to collaborate with research institutions. The evaluation of FORNY program has revealed that about half of the FORNY- companies have support from SkatteFUNN program. The initiative seems to be a success. This assumption is based on the attitudes of different actors involved in this program who are quite content with the results (*ibid.*). This program aims at strengthening collaboration between industry and research institutions, which is crucial to knowledge transfer from the research sector to industry. In this way, the program is supposed to promote industrial research in collaboration with research institutions.

4.3 Higher education funding in Norway as another mechanism to enhance commercialization at universities

Funding is a critical steering mechanism for government as finances are central to Higher Education (HE). Government allocations become even urgent for centralized HE systems that enjoy relatively few external resources. In 2000-2001, government allocations comprised 91.23 % of the total university funding in Norway (CHINC, 2006).

Norway is an example of state steered education system and resembles the Swedish and, more generally, European university model with centralized HE system. Government is an important actor that sets regulation and provides the essential part of finances for them. The dependency of these institutions on government is also reflected in the way commercialization policies are implemented. As in Sweden, Norwegian government initiates supportive programs and mechanisms to promote commercialization at universities. In other words, they are introduced from above or "top-down" similar to the European policy approach discussed above.

Norway is quite similar to European model also with respect to changes in HE funding system. A project conducted by European commission in 2006 (CHINC) identified the

changes in university income in a number of several European countries. It revealed that primary evolution of the university funding system from 1990s has been a shift from traditional model of government allocations to a new performance-based model. While traditional model was based on input-oriented criteria, in a new model greater attention has been paid to outputs and efficiency of each university.

In Norway, a new funding system was one of the results of the 2002 Norwegian "Quality Reform" in HE. In the new funding model, budgets are closely tied with the outputs of the institutions. This further implies that increased productivity results in increased government allocations. The new funding model has raised several concerns. First, it could lead to an increased focus on the external demands, which can undermine the traditional critical thinking at the university. Second, small and relatively unpopular disciplines can eventually suffer because of performance-based model tying productivity to the government funding. Third, increasing concentration on priority programs and projects can undermine the rest of the activities (*ibid.*).

Norway was among the countries covered by CHINC (2006). The project revealed some problematic issues associated with new funding model. As government funds become highly scarce and performance-based, academics are looking for external sources. High competition to win these funds seems to lead the institutions to adjust their priorities in order to increase chances for securing such funding. The study revealed a considerable growth in interdisciplinary and applied research as well as commercialized knowledge and in some countries, patenting. This trend raises the scientists' concern that the instability of funds will force academics to shift their attitude, abandoning their commitment to disinterested knowledge and focusing on research projects that "count more" in a new funding system. As stated in the project, HE institutions that have long enjoyed stable public financial support face a number of challenges in light of the new model. "This form of funding introduces considerable instability into institutions that have long functioned under more stable funding conditions and will likely have a substantial impact on how higher education institutions evaluate the costs and benefits of pursuing some types of research over others" (CHINC, 2006: 27).

So, in the new funding model institutions and academics no longer get funds for granted. It forces them to get engaged in projects and activities associated with external income. Through licensing research outputs and establishment of spin-off firms, academics as well as institutions become able to earn extra money. In this way, the new funding system becomes a strong government instrument for promoting knowledge commercialization at universities.

In the following section, I will describe the commercialization infrastructure in Norway.

4.4 Commercialization infrastructure in Norway

As an important step towards increasing competition of the nation state and substituting resource-based economy with more science-based one Norwegian government support universities in several ways encouraging direct commercialization of research. An important aspect characterizing Norwegian commercialization system is that commercialization activities take place outside the universities: at TTOs and research parks. According to Stankiewicz' classification (1986 cited in Gulbrandsen & Smeby, 2005a:122), this characteristic can be referred to as "externalism". The idea behind this system is the assumption that basic research and commercialization are complementary and interdependent, but too different activities to be organized at one place. As a result, networks of buffering institutions are established on university campuses to absorb knowledge produced at the universities, and transfer it to the outside world.

Bugge, Rasmussen and Holstad (2003) give important information regarding commercialization entities in Norway. They note that unlike the US system, where commercialization institutions are well integrated in the university system, their Norwegian counterparts are relatively free from the universities they serve. It should be mentioned that by the time this report was written, research parks were the only commercialization entities in Norway as TTOs were established little later, following the legislative changes. Therefore, the authors refer to the four research parks functioning at four university campuses. These are

Forskningsparken AS at the University of Oslo; Forinnova at the University of Bergen; Leiv Eriksson Nyfotek at the Norwegian University of Technology and Natural Sciences (NTNU), and Forskningsparken of Tromsø AS at the University of Tromsø. Bugge and his colleagues (*ibid.*) maintain that the advantage of these institutions is that they already exist and possess a number of useful facilities. However, the authors also point to the fact that research parks have some other interests beside the university generated intellectual property, which can lead to the conflict of interests. They also question the efficiency of the support provided by external organizations especially in the first phases of commercialization. This doubt is grounded in the increasingly recognized assumption that commercialization processes should be an integrated part of university in order to be success. That is why Bugge and his colleagues (*ibid.*) suggest that now that universities become responsible for commercializing research, they should decide to what degree they are willing to use existing commercialization entities and eventually consider building up their own supportive institutions[4].

As noted previously, creation of spin-offs is generally considered a more efficient and productive channel for knowledge commercialization than licensing to established firms. This is even more urgent in the case of Norway. According to Bugge et al. (2003), licensing of academic patents to established firms often results in that university based inventions move abroad because there is a limited private sector in Norway capable of absorbing the university knowledge. In this light establishing spin-off firms on university inventions rather than licensing to foreign firms seems to be more reasonable in order to keep new technologies in the country (*ibid.*). Licensing, on the other hand, is a traditional way in which technology has been transferred to the private sector. This system has its advantages. According to Lockett and Wright (2005), in case of licensing universities utilize technology without academics committing large amounts of time to commercial activities. However, recently policymakers started considering spin-off creation to be more promising than licensing. The most important reason to think so is that university generated ideas and technology in most cases need further involvement of academics to be developed, and

[4] The report by Bugge et al. was written in 2003 right after legislation changes addressing commercialization. TTOs were not established yet.

establishment of a spin-off company is the best way to keep academic participation in the development process of the idea/technology.

4.5 Summary

Based on the description above, we can assume that Norwegian approach to commercialization policies is "top-down" or initiated by government. The recent Norwegian government policies strongly focus on direct research commercialization at research institutions and reflect the global trends that dominate in commercialization policies worldwide. First was the legislative changes from the very beginning of 21st century, aiming to include research commercialization within the main missions of the universities. The second was the annulling of the "teacher exemption clause", which granted rights on inventions to the institutions. Both policy regulations can be viewed in light of global policy trends.

The Norwegian government supports and facilitates commercialization in different ways: the most important initiative launched by government is the FORNY program, which addresses different levels of commercialization. SkatteFunn is another mechanism promoting commercialization activities. It strengthens collaboration between research institutions and industry, which is an important precondition for successful commercialization at universities. Funding is yet another policy mechanism for government. By establishing a new funding model where basic funding has been tightened, institutions and academics got a signal to look for additional sources. Getting involved in direct commercialization processes is promising with this respect as well.

The next chapter aims at providing a picture of how the University of Oslo (UO) has responded to recent policy changes. The university attitude towards increasing government focus on commercialization will be discussed through the analysis of its strategic papers and commercialization infrastructure.

5. The University of Oslo and commercialization of research

As mentioned, the radical policy shift towards increased commercialization goes back to the end of 1990s. However some slight shifts have been identified even earlier. Already in the beginning of the 1990s the UO got a clear message from government to create its own strategic research plan with more defined and specified goals and take greater responsibility for finances (Tjeldvoll, 1998). This happened in light of the reduced public allocations and the increasing interest in producing more useful research. It seems that in respond to new government demands the UO acknowledged its new responsibility combining utility oriented research with the traditional goal of pursuing critical and disinterested knowledge. As stated in the strategic plan 1995-1999 (*ibid*: 108) "the desire to find better solutions to practical problems may be an important motivating factor for research and that research can contribute substantially to the accumulation of material wealth, as well as improving the quality of life". Thus, already from 1995 the UO is aware of new government expectation of putting research into use.

In the UO Strategic Plan for 2005-2009[5], contribution to innovation and problem solving through academic research is stated as one of the main goals. Further it is emphasized that putting knowledge into feasible products is one of the primary focuses of the institution. As stated in the document, in order to contribute to this purpose the UO will further develop its TTO- Birkeland Innovation (BIAS), which serves as a bridge between the UO and the external players in commercialization processes, such as technological firms, other knowledge intensive firms and investors. The need for further development of entrepreneurship courses offered on campus is also one of priorities for the time span 2005-2009.

[5] http://www.uio.no/om_uio/strategiskplan/2005-2009/strategiskplan2005-2009.pdf

It should be noted that adapting towards changing environmental needs through increased focus on commercial activities does not mean for UO to leave its old ideal of "a free intellectual institution", where curiosity is a legitimate and important principle for both research and teaching. When it comes to research, the strategic plan emphasizes the vitality of individual academic freedom to choose their research topics and methods as well as to publish their results (UO, 2005). This statement proves that the ideal of academic freedom is highly valued at the institution and this should not be undermined by new challenges as e.g. commercialization activities.

The annual UO report and plan series are another important source to keep track of the developments of commercialization, among them how the institution attempts to follow the directions defined by its administration in the strategic plan. In the annual report from 2006,[6] it is stated that the development of the collaboration with industry has been considerable. This is especially the case in the fields of medicine and other natural sciences. According to the report, UO is a strong actor with respect to the three technological spheres given priority by the government: Biotechnology/ biomedicine; ICT and new materials. The report also reveals that much should be done in order to promote the commercialization capacities of the university. The need for the central innovation policy document comes on the first place. The main goal of the document will be to look at and assess the existing instruments and to focus on the projects promoting entrepreneurial culture on campus; In addition, further development and more goal-oriented organization of its TTO Birkeland Innovation is emphasized as the main mechanism supporting innovation at the university.

In addition, the following annual report and plan (2007)[7] emphasizes the importance of knowledge transfer from the academic to private sector. Here it is stated that in 2008 the UO will prepare a policy document that will address the issues of knowledge transfer and collaboration with industry. However, the paper emphasizes the fact that knowledge transfer is not just about innovation and commercialization. University graduates contribute vitally to

[6] http://www.admin.uio.no/oepa/budsjett/Rapport_og_planer/index.html

[7] http://www.admin.uio.no/oepa/budsjett/Rapport_og_planer/index.html

the transfer of knowledge to both private and public sectors representing one of the key channels of knowledge dissemination.

5.1 Birkeland Innovation (BIAS)

Birkeland Innovation is the technology transfer office at the UO. It was established at the end of 2003 as a response to the law amendments made by Norwegian government. More specifically, the Law on Universities and Colleges made universities responsible for communicating their knowledge to the outside world and ensure the infrastructure supporting this process. As mentioned, all the four universities established TTOs as a response to the increasing government focus on knowledge commercialization reflected in the government policy documents of the time.

As stated on the website of Birkeland Innovation[8], the primary goal of the TTO is to encourage entrepreneurship at UO through building an innovative culture, raise awareness on and secure intellectual property rights, "facilitate the flow of [university generated] knowledge and competence into the society, industry and commercialization sector" through licensing and creation of spin-off companies. According to Gulbrandsen et al. (2006), the profile of Birkeland Innovation can be seen more oriented towards securing IPR than e.g. the profile of that of NTNU TTO. On the contrary, BIAS' focus on creation of new firms is relatively weaker than that of its counterpart in Trondheim.

Birkeland Innovation covers the following spheres: Biotechnology and Food, Medicine, Information and Communication Technology (ICT), Chemistry, Materials and Nanotechnology, Energy and Environment, and Culture and Science. This means that TTO covers mainly all disciplines represented at the UO. The focus, however, is concentrated within the Biomedicine and ICT.

[8] http://www.birkelandinnovasjon.no/Default.aspx?tabid=329

Birkeland Innovation's website gives important and helpful information on the office's activities and offers. As stated there[9], academics that have some novel idea which they think can have a market potential, are encouraged to contact the TTO or send a Disclosure of Invention (DOFI). Non-patentable ideas can also be sent. Next step is a meeting with the academic where she/he is supposed to provide detailed information on the invention. It will be followed by the evaluation phase, which identifies the patentability of the invention. Here the focus will be the novelty of the idea, the development phase and the issue of industrial applicability. After examining its patentability potential, the focus will shift towards its marketability and the problems associated with it. This phase covers the detailed analysis of the potential customers and competitors of the future product, anticipated time to market and the investments needed. Through the whole process, experienced project managers will guide academics. The latter are supposed to inform academics about their rights and support in a way that makes it possible for them to combine the commercialization activity with their academic careers.

BIAS activities can be classified along two axes. First, it targets fostering the entrepreneurial culture at university, which is of crucial importance. Second, it supports commercialization process by "providing project management, funding for patent protection, legal advice, commercialization scholarships and grants, business development and an extensive network within the international industry and venture capitals and investor" (Birkeland Innovation, *about us*).[10]

5.1.1 Initiatives to foster entrepreneurial culture at UO

According to Gulbrandsen et al. (2006), Birkeland Innovation's focus on the entrepreneurial culture at UO is strong. The initiatives towards changing the attitude and environment for more successful commercialization address three levels. The first is *individual level* where

[9] http://www.birkelandinnovasjon.no/Default.aspx?tabid=331&subtabid=348

[10] http://www.birkelandinnovasjon.no/Default.aspx?tabid=329

the targets are researchers and students. Initiatives on this level mainly comprise special courses and meetings. One important example of these activities is the obligatory course in innovation for Ph.D candidates. It covers the issues of IPR politics and provides the participants with the basic knowledge on innovation processes. Other arrangements are meetings with interested groups, individual academics and institutions. These meetings aim at providing information about what the institution can offer them. Forum on entrepreneurship and Birkeland "Innovation Day" arranged annually can also be placed in this category (*ibid.*). Another level addressed by Birkeland Innovation activities is the *idea level.* This refers to the quality of the ideas and innovations, which reach the TTO. Quality here also means that the idea is fully developed and explored i.e. ready to be commercialized. Finally, the *system level* is paid great attention by the TTO. As mentioned, the researchers need more flexible timetables to be able to get involved in commercialization processes. Birkeland Innovation wants the institutions and researcher groups to accept the fact that individual researchers use their time for commercializing their research results. Much effort is put to revise the system of time distribution for academics and establish more flexible one giving academics possibility to allocate time in commercialization activities without giving up teaching and research.

5.1.2 Financial support to commercialization processes

This category comprises a number of grants and scholarships provided either by Birkeland Innovation or other funding agencies cooperating with the TTO. *Birkeland Commercialization and Development Grant* is a first stage investment granted at the early stage of the idea evaluation. It intends to help researchers to examine the commercial potential of their idea or technology. Other grants are *FORNY Verification Grant* and *FORNY commercialization scholarship,* which I have described earlier.

As a bridging institution, Birkeland Innovation takes the responsibility of introducing the new established companies to the investors and government agencies that can provide further funding. Innovation Norway is another important commercialization actor after the Norwegian Research Council (NFR). Innovation Norway provides different entrepreneur and

innovation grants. The most important of them with respect to commercialization are as follows: *Etableringsstipend* is a scholarship provided to support the individuals, groups or companies with new idea to establish their own firm; another one is *Incubatorstipend.* This is an arrangement for newly established firms and companies that provide products or services with international market potential. *Opfinnerstipend* is aiming at supporting the inventor of new technology. The intention is to provide financial support covering living expenses while the inventor works with the project.

5.2 Research park of Oslo (Forskningsparken AS)

The research park is one of the infrastructural institutions in the innovation system aimed at supporting commercialization activities at research institutions. Bugge and colleagues (2003) note that Norway is a leading country with respect to the number of research parks functioning near the universities. An external independent institution aims at commercializing ideas and results from the research milieus. Research parks in Norway were established as buffering organizations that were supposed to take on the role of commercializing the research conducted at the institutions, which by that time had neither the responsibility nor the right to commercialization *(ibid.).* Thus, these institutions are older than TTOs. It has been argued that commercialization activities are more successful when they are integrated within the universities together with the other missions. In this case, research parks lose their function of intermediary institutions. This model has been practiced also in the US. However, they have long abandoned this tradition moving commercialization activities from the periphery to the core of the institution. A good and old example of this shift is the Massachusetts Institute of Technology (MIT) that as early as in 1960 decided to handle its patenting activities itself (Bugge *et al*., 2003).

The Research Park of Oslo has a 20-year history. As stated on its home page[11], the main goal of the research park is to contribute to innovation, particularly from research and

[11] http://www.forskningsparken.no/

development institutions in Oslo. The institution offers different supportive mechanisms to firms through the Oslo Innovation Center (OIC). It gives for rent space to firms and incubator facilities for especially promising companies. In this case, the research park also invests in the firm. The main fields covered by the OIC are biotechnology, ICT, media and electronics. Nowadays it houses 130 firms, research groups and institutions with 1600 employees.

The Research park of Oslo arranges several programs annually. "Gründerdagen" is one of the most important arrangements taking place every fall. It is arranged in collaboration with the UO and other partners. The primary goal of this initiative is to promote innovation within the research- and knowledge- intensive sector. Another initiative is the meetings with the firms established at the research park, called "Smartlunch", where important issues are discussed during the lunchtime. The institution also contributes to several external arrangements initiated by other institutions. A good example of the latter is a VentureLab Investment Forum 2007[12] that brought together the new established firms and the investors. As stated on the homepage of the research park (Såkorninvestorer[13]), VentureLab offers net-based presentation of business projects to possible investors and helps new companies to find new investors and get in touch with them. In this way, the program helps new firms to get seed-corn funding from the investors collaborating with VentureLab. In addition to the support provided for new established firms in the form of guidelines and financing, Oslo Research Park also offers professional licensing and sales activity for the research-based ideas. The process of licensing includes the evaluation of the project, exploring patentability options, finding possible licensees and negotiating licensing agreements with them, and, at last, collecting revenue.

According to Gulbrandsen et al. (2006), the Research Park of Oslo had to abandon some of its functions because of the law amendments, more specifically the establishment of the Birkeland Innovation. E.g., it no longer gets the ideas from the UO as this function is taken

[12] http://www.venturelab.no/

[13] http://www.forskningsparken.no/Sakorninvestorer/

over by the Birkeland Innovation. The latter is located on the territory of the research park although the extent to which the two institutions collaborate is not very clear (*ibid.*).

Thus, I have described how the UO responded to the new demand on increased research commercialization reflected in Norwegian government policy papers since the end of 1990s. This comprises infrastructural changes (establishment of TTO) and awareness of the new responsibility of directly contributing to economic development by commercializing research results. The latter was clearly reflected in the university documents and reports.

5.3 Measuring commercialization at UO

In this section, I will look at the empirical data provided by Birkeland Innovation on licensing and spin-off activities from 2004 (from the very beginning of the TTO activities) until October 2007. As mentioned elsewhere, licenses and spin-offs are considered important indicators of science-directed commercialization (Gulbrandsen & Slipersæter, 2007).

In addition to this data, I will use an article by Gulbrandsen and Smeby (2005a) in order to give the impression of academic involvement and attitude towards commercialization activities in Norway before the policy changes occurred. It is an article based on an empirical study of university academics conducted every 10 years by Nifu Step. The paper I will look at covers the time span of 1991-2001. It should be noted that the goal of my thesis is to analyze the results that followed policy changes, which took place around the year of 2000. However, I found it interesting to gain insight in the commercialization atmosphere at Norwegian universities before the changes.

The 2001 study encompassed all academic staff from the four Norwegian universities and was based on the questionnaire answers. Academics were asked whether their research has ever resulted in patents, licenses, academic spin-offs or consulting activities. The latter is not

my focus. The results were following: 7 % of the participants reported that their research had resulted in patents; 10 % identified that their research had led to commercial products and 7 % said that their research had resulted in creation of a spin-off firm.

The study revealed that technological disciplines have the highest numbers of commercial results. Further, it showed that industrial funding was closely tied with patents, licenses and spin-off creation. In other words, it happened rarely that academics without industrial funding commercialized their research outputs. Collaboration with industrial colleagues also was related to more patents and spin-offs. This proved that stronger and closer ties between the university and industry could lead to more successful commercialization at universities (*ibid.*).

Another important conclusion was related to the research funding issue. The study explores the assumption of Benner and Sandström (2000 cited in Gulbrandsen and Smeby, 2005b) that "research funding and research funding organizations create 'organizational fields' … which over time affect the fundamental routines, norms and organizational structures of the researchers and their institutions". This implies that external funding, which universities are increasingly dependent on, is not "neutral" and forces the research institutions to become more responsive to the external demands and expectations (*ibid.*). Commercial outputs of the universities can also be seen as part of these expectations. The authors conclude that external funding, and especially, industrial funding is significantly correlated with different kinds of commercial results as e.g. patents and creation of spin-offs.

The study also revealed that industrial funding was related to more collaborative and applied research. According to the authors (*ibid.*), this can undermine long-term and critical research, which has always been main responsibility of the university.

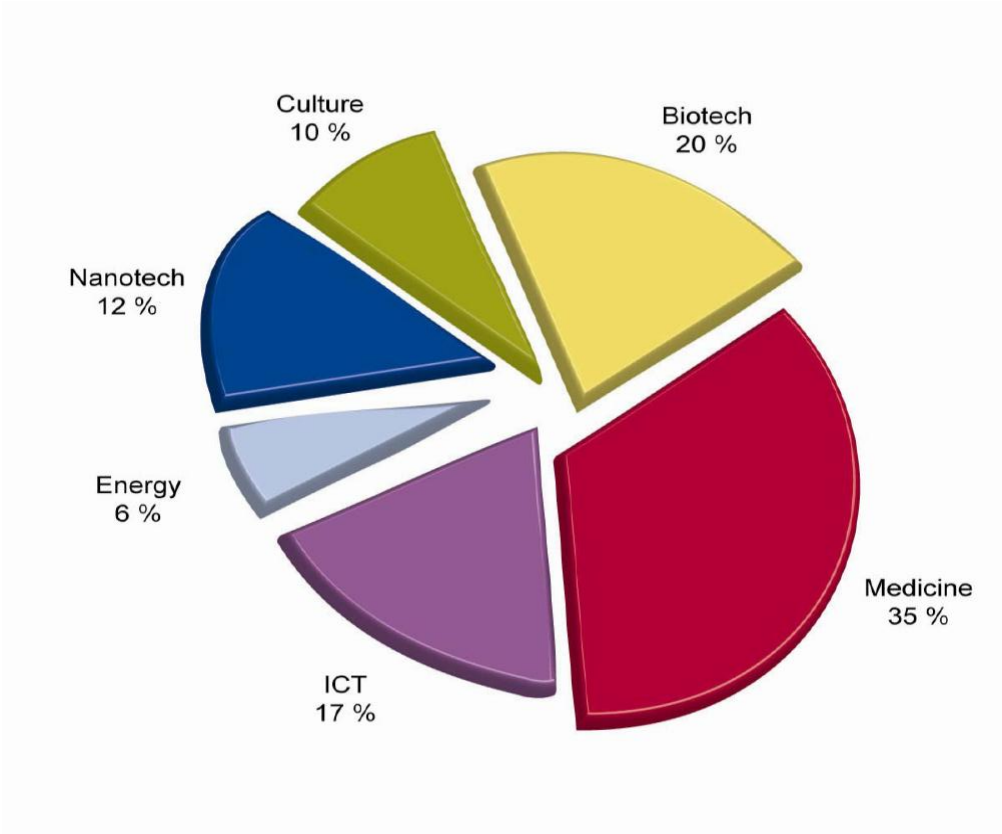
The results provided by Gulbrandsen and Smeby (2005a; 2005b) covered all the four Norwegian universities. Next, I will describe the commercialization results of the UO based on BIAS data 2004-2007 (October)[14].

The empirical data from Birkeland Innovation are the following: from the very establishment of the TTO within the October 2007, 254 Disclosure of Invention (DOFI) have been delivered. This scheme is the first step in the commercialization process of research output through Birkeland Innovation. The inventor should fill in the DOFI and send it to the TTO administration. It encompasses the following information: the name and the date of invention, the personal information of the inventor and possible contributors to the invention. The inventor should note whether he/she is going to publicly disclose the invention in the form of publication, oral presentation, and if he/she intends to do it before patent is secured. In addition to this, a brief description of the invention should be written covering the expectations of the inventor with respect to problem solving.

The following diagram reveals distribution of DOFI across disciplines identifying the leading position of the faculty of medicine.

[14] The data has been collected by mail through BIAS employees.

Figure 1: Distribution of DOFIs across faculties (Source: BIAS)



All received DOFIs are evaluated and only promising ones are sent to early-project phase. However, this does not guarantee for a DOFI to become ongoing (current) projects. The DOFIs are carefully evaluated and only those with a market potential are sent to the last phase, which is the project commercialization phase.

Table 2: Share of projects sent to project- and commercialization-phase (Source: BIAS)

The year	Number of DOFIs	Number/share of projects furthered to early-project/project phase	Number of ongoing (current) projects	Commercialized projects	Share of commercialized projects
2003/2004	81	13 (16 %)	5	6	46 %
2005	70	30 (42,8 %)	9	6	20 %
2006	65	31 (47,7 %)	27	2	6,5 %
2007 Pr. 10.10.07	54	25 (46,3 %)	25		

As showed in the table above, idea and project supply, and the quality of the project suggestions (DOFIs) are steadily increasing from 2003/2004 to October 2007. This becomes obvious if we take into consideration that the share of DOFIs that became projects has increased in the period 2003-2006, followed by more stable period with the share around 46-47%. From 2005, the share of commercialized projects seems to be stable comprising about 25-30%. With this number, Birkeland Innovation is among the other international TTOs that have the same strategy and model as BIAS. The providers of the data point to the empirical study by Clarysse et al. (2004 cited in the Resultater for Birkeland Innovasjon 01.2004-10.2007) which revealed that the average of commercialized projects by TTOs is generally around 25% out of the whole projects.

During the time-span of 2004-2007 (October) BIAS reports twelve spin-offs and nine licenses. Following spin-offs have been established:

1. SoniTrack AS
2. Promon AS
3. Birkeland Publications AS
4. Cgene AS
5. BioIndex AS
6. Omegatri AS
7. ChemLex AS
8. TOD AS- as a result of collaboration with MediNova where Birkeland had a leading position.
9. Symhonical AS- as a result of collaboration with Simula where the latter had a leading position.
10. World Beside AS- as a result of collaboration with Simula where Birkeland had a leading position.
11. Baldur AS (to be established in November 2007).
12. UniGEO AS (to be established in November 2007 in collaboration with the University of Bergen, where Birkeland Innovation has a leading position).

By October 2007, Birkeland Innovation reported 21 patents that were supposed to be kept in 2008.

Thus, we see that Birkeland Innovation activities (until October 2007) have resulted in a considerable number of established spin-offs and license agreements with already established companies.

5.4 Summary

As we have seen from the official papers, the UO acknowledged the signal from the Norwegian government of combining applied research with the traditional disinterested research already in the mid. 1990s. Since then putting science in feasible products and services is one of the main goals of the university. As a response to legislative changes, the UO established its TTO Birkeland Innovation, which became officially responsible for commercialization of research at the university. Birkeland Innovation initiates several programs aiming at raising awareness on intellectual property among academics and, more generally, fostering entrepreneurial culture at the UO. Besides, it provides financial support to academics involved in commercialization activities and guides them through the processes of patenting, licensing and spin-off establishment.

The Research Park of Oslo is also a part of commercialization infrastructure at UO. However, the UO is not the only target of the research park. It launches a number of arrangements and projects aiming at promotion of innovation within research- and knowledge- sector. It also provides incubator facilities and space to new-established firms.

The UO has implemented its own IPR policy according to an internationally acknowledged revenue distribution model where 1/3 goes to the inventor; 1/3 goes to the BIAS; and the last 1/3 - to the UO.

It is difficult to make any conclusion on how and to what degree the commercialization atmosphere has been changed because of the short time-span (2004-2007). However, according to the statistical data (2007) from Birkeland Innovation, the share of the commercialized projects is 25-30%, which places the TTO among the international TTOs with the same strategy and model. Besides, the quality of the ideas reaching the Birkeland Innovation seems to be increasing, which again is a sign of the positive development (Gulbrandsen *et al*., 2006).

6. Academics' commercialization experience

The aim of this section is to provide the picture of commercialization system at the university level from researchers' perspective and reflect on their attitudes toward new government policy. The main intention of the small interview study was to describe how researchers experience the changing commercialization environment at the university, what main barriers and challenges they encounter in the course of involvement in these activities, and what they perceive as the main goal of commercialization at universities. Accordingly, the analysis would be divided into sub-sections each of which them covering a specific focus area already mentioned in the introduction.

6.1 Commercialization processes at UO

All respondents were asked questions about how they experience commercialization system and processes with government policy shift at the beginning of 2000 as a starting point. Several sub-topics were developed from the interview material which will be analyzed further.

Table 3: Analysis: commercialization environment at the UO

The main topic of discussion	**Sub-topics**	**The focus of sub-topics**
Commercialization environment at the UO	Government policies	Interviewees' perceptions of the consequences of Norwegian government policy shifts
	Commercialization infrastructure	Informants' accounts of how commercialization infrastructure at the UO works
	Academic motivation	Respondents' perceptions of motivation for commercialization among younger and older generations.
	Challenges for academics to commercialize	Interviewees' accounts of compatibility of entrepreneurship and academic work; and a lack of industry interest in academic research.
	The main goals of commercialization	Informants' perceptions of the main goals of research commercialization.

6.1.1 Norwegian government policies from academics' perspective

All the respondents are mainly positive towards new government regulations that came at the millennium shift. However some were doubtful towards the changes associated with new intellectual property regulations in the beginning. Professor c mentioned that he was skeptical towards new regulation which annulled the "teacher exemption clause". He reflected on the issue in a following manner:

I was very skeptical when new regulations came. Before we were free, we owned our inventions and could do what we wanted more or less… I knew what it was to work with patents and I was very skeptical if it would work at all. But I have to say the experience has been very positive…

As a result of the changes the UO established Birkeland Innovation, which was supposed to support academics during the course of their commercial activities at the university. This was truly the reason for that professor b was positive and hopeful towards new government regulations from the very beginning. He argues that it is of course better to do the commercialization projects together with Birkeland Innovation and then share the results than do it alone and have a total ownership. He claims some particular reasons for why the new system works better: in the sphere of biomedicine which professor b belongs to, it is difficult to attract investors in early phases of a project development. This fact makes it necessary to develop projects within a university as long as possible. In this light the interest and motivation of the university becomes vital for successful collaboration and project development:

I was happy to share ownership with the university, because if you have institutional interest you can push projects much further inside the institution while commercializing them. I have experienced that if it's only me who has an economic interest in developing the project and the institution has none, it externalizes the project… I tried to do this earlier when I owned 100%. And I say that it is better to own 33% of something that actually gets worth something than 100% of something that is worth nothing.

Yet another respondent believes that university interest in commercialization project is very important in order to create a favorable environment at the university. According to professor d, *it is very important for the university to have control over ideas with commercial potential*. He is aware of the fact that the attitudes of the academics towards these changes differ and maintains that the situation will change with the time: *it will take time because we are going from one regime to another*.

Quite a neutral view on regulation changes has also been encountered in the interview with professor a. She mentioned that before the new regulations she collaborated with Oslo Research Park and she had to share 50% of income with this institution. After the new IPR rules the inventor owns 1/3 which, according to professor a, does not make a big difference.

So the attitudes of the respondents toward new regulations at the UO are in general quite positive. The fact that university became officially responsible for commercialization processes at the institution and owns 1/3 share of the invention seems to result in higher probability of successful commercialization.

6.1.2 Commercialization infrastructure at UO

In this sub-section informants' experiences on commercialization infrastructure will be presented. The main focus will be how the respondents experience changes associated with the establishment of the university TTO and what supportive mechanisms they used before Birkeland Innovation was set up.

At the time of the interviews, researchers view Birkeland Innovation as their main TTO with an exception of professor c who mentioned that he mainly collaborates with Medinnova, because all his new projects at this point are within the field of medicine. The professor c emphasizes that the help he gets from this institution is very significant. He maintains that Birkeland Innovation and Medinnova are collaborating and they can decide which of them can take best care of a new project presented by him or his inventor group. Professor c also

has experienced collaboration with the Research Park of Oslo. He reflects on the past experiences with the institution in the following way:

I think it has changed over the years. They became more and more professional. They were not so experienced by the time we had first contracts. However, we got more and more help over the years from them. We have really benefited from the relationships with the research park.

Professor a has also experienced collaboration with several agencies which have been gone through reorganizations and policy changes during their development process. However she argues that it really has not affected her work in a negative way: *Whenever we had something and we wanted to patent, we always knew more or less where to go*. Among these agencies have been Medinnova, Biomedical Innovation (Biomedisinsk Inovasjon) and Oslo Research Park. She underlines that when she has a new idea she has to figure out whether it really is something new or just an extension of former project. Because if it is an extension of some previous project, then it is better to go to Biomedical Innovation which is familiar with the project; but if it is a new idea she would rather collaborate with Birkeland Innovation. All in all, she thinks that these institutions are in contact with each other and they work out which of them is best for some specific project presented by the researcher. Informant also mentions that for her as an academic a distance with Birkeland Innovation is somewhat larger than with Biomedical Innovation. Nevertheless, she does not find it a barrier. She describes the collaboration with the university TTO as following:

I am absolutely comfortable with the way Birkeland is operating. I think their DOFI is clear, I fill it in, I am quite happy. They answer right away: "Yes, we received it"…

However, professor a thinks that Birkeland Innovation should be *much more aggressive when it comes to establishing companies*; as she puts it, *just waiting for the patent to be licensed is very naïve*. And as the company is established, it is very important to formalize the relationship between a researcher and a company:

The relationship between the company and the researcher should be formalized… one should be really aware of who is working where, and what for, and for which goal. Otherwise academics will be eaten by the commercialization procedure.

For professor d, Birkeland Innovation is a preferred partner in commercialization activities. He has also experienced collaboration with Oslo Research Park and claims that he can still choose between the two, but does not see any reason for this. He expresses his attitude toward Birkeland Innovation as following:

Birkeland is our TTO. Of course they can be better, but so far they have done a fairly good job. There are always challenges with respect to competence and profile. However, the largest problem they have is that they don't have enough money. That affects us eventually. They don't have enough resources to properly take care of all the ideas that we produce.

A solution to this problem could be increased financial support from Norwegian government which will make the TTO more efficient in buying *Innovation services* from professionals. He mentioned two specific examples for *Innovation services*: first was the ability to get professional help in writing proposals and business plans toward Innovation Norway; another important service could, according to the informant, be capacity of the TTO to investigate a potential of certain market segments which eventually would be the possible consumers of products/services:

If you are going to sell a product to a school, you need to understand the whole structure: who pays for what? Is it government, is it parents, is it a teacher or an owner of the school?! We know how it works in Norway, but it's different in Denmark, Sweden… You should be able to buy services from e.g. consultancies in order to gather knowledge, information on possible consumers.

The interviewees claim that Birkeland Innovation should learn much and improve its approaches as it is in the development process. They agree that it takes time to be professional. Professor b describes the TTO in the following manner:

They are still developing; they are still improving. From my point of view, it is good thing to know that there is an organization where I can go. I could see some examples when Birkeland is handling projects better than the hospital TTO… It's important at all times to have a good motivated staff.

Thus, out of the informants discussions on commercialization infrastructure at the UO, several conclusions can be drawn: they are willing to collaborate with Birkeland Innovation which is responsible for commercializing research outputs at the UO. They are aware of the fact that it is not that long the TTO was established and it is learning and improving through the experiences.

6.1.3 Academic motivation to commercialize

The respondents' attitudes regarding academic motivation for commercializing their research are very much the same. They think that interest for commercialization activities is stronger among young researchers and it is difficult to say whether it is possible to motivate the older researcher generation who are not interested in these processes.

As professor a puts it: *trying to change old people is a waist of time*. On the other hand, she believes that the most important is to direct all the attitude towards younger generation who really want to work on commercialization. The informant further maintains that among the young people around her there are not two kinds of people who either want to commercialize, or not:

I think that all are ok when it comes to commercialization. If they can see that there is a commercial potential in research, even if it will require more work, they will still do it.

Also professor b can confirms increasing interest for commercialization among young researchers around him. He emphasizes the fact that they are much more flexible when it comes to the future career as an academic and/or an entrepreneur. According to him, just some 5-10 years ago there were two separate parts among researchers who either wanted to work in academia, or in industry: *today many of them are much more open to go back and forth between commercial sector and academia*.

Professor d believes that there are several reasons behind the growing interest in commercialization among young researchers. The most important, according to him, is probably the fact that *younger generation is generally more open for new possibilities than older people; we could have said the same 30 years ago, and we will probably say the same in 30 years*.

According to the informants, the interest for commercialization is growing among the young generation which they view as very positive. The fact that young people are more open to new things could be the driving force behind this development. They also seem to be more flexible when it comes to combine working within the sectors of academia and industry.

6.1.4 Challenges for academics involved in commercialization activities

Informants have reflected on two main aspects of challenges associated with academic involvement in commercial activities: first is the compatibility of academic and entrepreneurial activities; the other is associated with the industry interest and capacity to exploit academic inventions in Norway. As to the first, one of the informants argues that entrepreneurship is as important as their academic career. Therefore, from their perspective,

both can be regarded as two equally vital missions of a researcher. This attitude is clearly expressed by professor a:

I don't work within the field where academic work is the only focus and commercialization is a threat; it's rather the way around. I work in the field where commercialization is a norm.

Another respondent (professor d) also emphasizes that in his field, *innovation is all over the place.* According to him, in his discipline problem-solving is considered the main goal:

We are here basically because innovation is important, would it be either knowledge transfer to existing industry or creating new industry… Although we do basic research, we are in applying setting where we are trying to solve problems and challenges for society.

So, for the respondents, general skepticism towards compatibility of entrepreneurship and academic career is not a case. However, they mention that commercial activities *are* really time-consuming and they have to work hard to make it work. For a professor b, combining academic work with commercial activities has meant working up to 70-80 hours a week which entails putting a lot extra effort in what he did. Also professor c argues that it is a lot of work to do both teaching, supervising the students on the one hand, and commercializing research outputs on the other. For him, this eventually results in that *everything goes very slowly.* In his opinion, the solution to this problem can be to get more funds to employ people that can do some work under the professor's supervision. However, he claims that it is difficult at this point to get such funds. Lack of people and money in commercial activities is also underlined by professor a. She maintains that there is a lot of work to do, but because of the fact that they do not have enough people and money, they have to do some adjustments to the real picture and do what their resources let them do.

According to professor d, time is the main challenge for researchers at his department. He furthers that the capacity of the department at this point is not enough to take care of huge numbers of students and, consequently, it is difficult for an academic to find time for

commercial activities. Another challenge for him is associated with the necessity of building an innovation culture at the UO in order to involve more people in these activities and in this way, *get out a full commercial potential*.

As discussed in a theoretical chapter of the thesis, "absorptive capacity" of the industry is often argued to be an important barrier to successful knowledge transfer from research sector to industry (Decter *et al*., 2007). It has also been mentioned that in case of Norway where industrial sector is comprised of SMEs, a lack of industrial interest in academic inventions can be a crucial hindrance to successful commercialization of academic research. In fact, this often results in licensing of Norwegian inventions abroad (Bugge *et al*., 2003). Professor c shares similar experience from his past.

When we licensed our patent abroad, it was already 10-12 years old and no Norwegian company had been interested in it. We had a couple of other companies interested in the same patent, also international…

However, the professor hopes that this situation can change in future and he points to some positive signs, as the project his research group is working on now has already attracted a Norwegian company which might become the future licensee of the patent.

The same positive development regarding the growing interest from the industry sector towards academic research at his department is claimed by professor d. He puts it in the following way: *I think we have doubled revenues or turn-over on industry projects for the last 3-4 years.* On the other hand, professor a can not confirm the same tendency out of her experience. Rather, she claims that it is very hard to find a company that would pay for a patent. According to her, *small companies have their own patents and they do not look around for other people's patents*. That's why she does not think it is a good strategy to patent and wait for a licensee.

Thus, commercial activities are perceived as very natural within the fields where informants work. They all agree that it is much work to combine entrepreneurship activities with an academic career and that they need to work much to reach their goals. Therefore, one of the main challenges is a lack of time; another barrier is associated with a lack of finances for hiring some people who could assist in the activities, and, not least, covering the expenses associated with commercial activities.

6.1.5 The goals of research commercialization

The increasing focus from policymakers on commercialization of academic research is supported by the vitality of its contribution to economic development and social advance of nation states. It is argued that increasing academic involvement in commercialization processes at universities would benefit society through providing knowledge based products/services and jobs, and also benefit the university itself, as these activities are supposed to provide additional source of income. However, the real picture up to now has revealed that economic benefit for the universities has been a seldom case taking into consideration the costs of running supportive institutions. Thus, the main outcome of commercialization activities remains the academic contribution to social and economic development. The respondents' experiences and attitudes towards the goal formulation are pretty much consistent with this assumption.

For professor d, to create *meaningful workplaces of tomorrow* is the main goal of commercial activities. Income comes on the second place. He claims that they have not earned substantial amounts of money though they have gained some. Professor d believes that it is just a matter of time:

We have worked with commercial projects now for 4-5 years and it's too early to speak about large amounts of money yet. There is a potential for us in 5 to 10 years.

Professor b also believes that commercialization process is a long way to success. According to him, it is unrealistic to expect that Birkeland Innovation would earn something on commercial activities during first 10-15 years *just because it takes that long to develop projects*. Rather, it would more probably cost money which will be the first step; another step would be to get enough revenues to become a self-sufficient institution and not cost anything the government and the university. In professor's opinion, *big hits* are not that usual and one should not expect that it would happen. And it is not the most important thing. Here is what professor b believes is more realistic to expect:

If the TTO covers its costs of patenting and operating and does not cost a university a thing, then the overall benefit is very positive. Because then the TTO can help the university to make its research relevant to society, generate spin-out companies which provide jobs for people, other people invest in projects and benefit from it economically, developing companies can pick up things from university research which helps them to develop their industrial activity. If that happens, I think the TTO has done its mission for the whole society.

Professor a also mentions that she has not earned anything from patenting activities. Nevertheless, she is sure that it is worth to commercialize simply for the reason that *work that you do will amount to something and will mean something to people.*

No *success stories* in his commercial practice have been the case yet for professor c either. However, he tells us for sure that he and his research group have been able to get money to cover their patent expenses, and earn a little bit extra. As to the main goal of commercialization, he talks on two aspects: the first thing is to bring new techniques to market to help people; and, second, to be visible by making the research known. The latter seems an important motivation for the professor.

6.2 Summary

The aim of the interview analysis was to explore the commercialization environment at UO through researchers' commercialization experiences. The focus of the exploration was government policy shifts and its consequences for commercialization activities at the university. The analysis was unfolded around the following topics: government policies, commercialization infrastructure, academic motivation, challenges to commercialize, and main goals of commercialization activities. In terms of government policies, three of the respondents are positive. They maintain that university support in commercialization activities, which was a direct result of new government regulations, is considerable and hope that it could possibly increase over the time. On the other hand, one informant seems to keep quite neutral position with respect to the impacts of government policy shift. When it comes to commercialization infrastructure, the informants' experiences are somewhat different. Two of them are optimistic. Although they are aware of the fact that it takes time to build sufficient commercialization infrastructure, they argue that Birkeland Innovation has done a good job. They also acknowledge the fact that the TTO has yet much to learn through the development process. One of the informants thinks that Birkeland Innovation should change its strategy and become more aggressive when it comes to establishment of spin-offs. In terms of academic motivation to commercialize, the informants' views are pretty much the same. They agree that there is an increasing interest in commercialization processes among younger generation, whilst it seems difficult to motivate older generation not familiar with commercialization processes. As the main challenges the respondents mention a lack of time to commercialize research, a lack of people involved in these activities and not least, a lack of money to cover the expenses. Combining academic and entrepreneurial careers does not seem to be an option for informants. Rather, it is perceived as natural. This tendency is not surprising taking into consideration the fields informants belong to. However, they all emphasize that combining the two spheres is time-consuming. In terms of the main goals of commercialization, respondents agree that it is, first of all, contribution to social advance by providing new products and services; and second, generating additional revenues. One respondent also emphasizes the ambition of an academic to make his/her research known internationally.

7. Conclusions

The intention of my study was to contribute to better understanding of the phenomenon of research commercialization. The main research questions were the following:

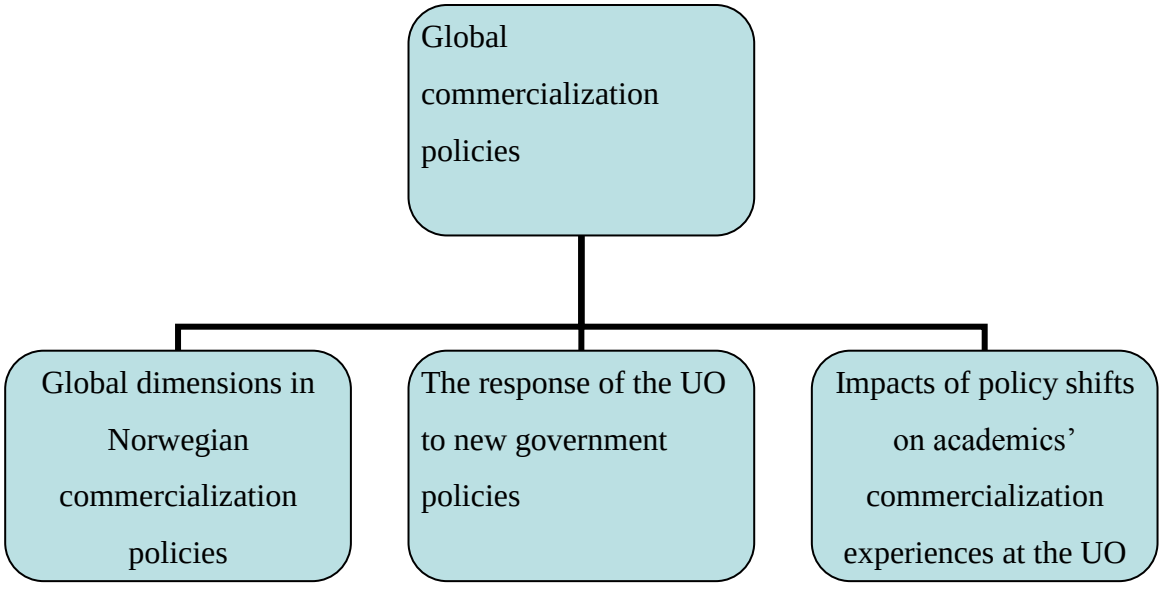
- What global trends can be identified in government policies addressing research commercialization?
- How do these trends influence the Norwegian government policies on commercialization?
- What are the responses from the University of Oslo on policy shifts?
- How academics at the University of Oslo experience the results of policy shifts?

Although the focus was on commercialization policies, the description of the commercialization phenomenon was given at the beginning. Research commercialization is generally defined as "the process of turning scientific discoveries and inventions into marketable products and services" (Harman & Harman, 2004:154). There are different channels for research commercialization. These activities encompass contract research, consulting activities, licensing, patenting, creation of spin-off firms etc. These activities are grouped in two modes of commercialization: "user-directed" -, and "science-directed" commercialization modes (Gulbrandsen and Slipersæter, 2007). Patenting, licensing and creation of spin-offs are considered the main channels of "science-directed" commercialization, which is the focus of my thesis.

Here I will summarize the main findings of the study. As already mentioned, the description of the concept of commercialization, including commercialization modes, channels and processes, was the first step of the thesis, which aimed at providing the basis for further discussion on commercialization policies and its impacts on the academic practices. Another step was to observe the global trends that dominate in commercialization policies, which

highlighted the centrality of the US policies (the Bayh-Dole legislation) and tendency of copying them in different country contexts[15]. Next was the case of Norwegian government policies addressing research commercialization, which was followed by the analysis of the UO strategies identified in the official documents of the university. The final step was the reflections of the academics at the UO on government policy changes and impacts on their commercialization experiences. These focus areas are related as depicted in figure 2. The figure shows how global policy trends reach the commercialization environment of the nation-state, here Norway. The Norwegian government has implemented the successful policies in order to promote research commercialization; these new regulations influence the university strategies, which, in turn, affect commercialization activities at academic level.

Figure 2: The main categories of the study



[15] The cases presented in the study are the US, Sweden and Australia.

At the top of the hierarchy comes global commercialization policy category, which has constituted the conceptual framework for the analysis throughout the work. Thus, it is the first category I will summarize.

7.1 Global commercialization policies

Commercialization of academic research has become an issue of debates as it is considered an important way through which the universities can contribute to economic and social development. In the era of accelerated technological development, university research becomes important source for knowledge-based innovations. That is why governments' expectations towards universities are growing. They are supposed to provide new knowledge and make new products and services out of this knowledge in order to benefit society. "In a knowledge-based economy, the university becomes a key element of the innovation system both as human capital provider and seed-bed of new firms" (Etzkowitz et al., 2000:3). In order to encourage universities and academics to commercialize their research outputs, policymakers implement different policy mechanisms and revise legislative frameworks for the universities. All these efforts aim at increasing commercialization of academic research.

Commercialization policies have been analyzed within globalization framework. As I have underlined, globalization is a very broad concept. The phenomenon is associated with "complex connectivity" which is the consequence of accelerated technological development (Tomlinson, 1999 cited in Singh, Kenway & Apple, 2005:4). Knowledge-intensive innovation is one of the two main bases of globalization (Carnoy, 1999). This fact once again highlights the centrality of academic knowledge as the key source for innovation. Globalization has profound impacts on higher education systems. My focus is the tendency of homogenization across national research policies, which is the case with commercialization policies as well.

The recent discussions around commercialization systems have revealed that the way policies are formulated has an important impact on commercialization systems of nation states. The issue becomes even urgent taking into consideration strongly uneven

performances in commercialization across countries. The US universities are regarded to be the most successful when it comes to commercialization results. This fact makes policymakers believe that the US policies addressing the issue are most efficient. The analysis of the commercialization systems of the US and Sweden (Goldfarb & Henrekson, 2003) has revealed that there are two different approaches to commercialization policies in these countries. It is argued that in the US, policies are implemented in a way that allows universities to commercialize research as it is most suitable for them ("bottom-up" approach), whilst in Sweden, policies are implemented from above giving less flexibility to universities ("top-down" approach).

The leading role of American universities with regard to commercialization results has probably contributes to the tendency of imitating the US policies in a number of OECD countries. The Bayh-Dole legislation has been recognized to be the key to successful performance of the US universities in commercialization; hence, it became the most imitated policy. The Bayh-Dole act (1980) granted the ownership on inventions resulted from federally funded research to the institutions, as it was supposed that this would motivate the institutions to commercialize. The Bayh-Dole legislation can be regarded as the global dimension of contemporary commercialization policies especially popular in OECD countries.

7.2 Global dimensions in Norwegian commercialization policies

In Norway, as in other Scandinavian countries, academics had traditionally been entitled the full ownership of their research results ("the teacher exemption clause"), which later was considered to be an obstacle to commercialization processes at the universities. As a result of legislative changes initiated by Norwegian government at the beginning of 21st century, the "teacher exemption clause" was revoked which means that the research institutions got the ownership of the inventions made by their employees; in addition to this, the missions of universities have been revised as a result of which research commercialization became the

"third mission" of the university. These layers of Norwegian commercialization policies can be identified as a reflection of the Bayh-Dole legislation of the US.

What the long-term results of these policies will be is difficult to say at this point. One cannot be sure that the policy that works in one context (here the US) will be sufficient in the other (here Norway). There are several reasons for this concern. First, the success of the US universities can not be regarded as the mere result of efficient policies (Mowery & Sampat, 2005). There are several other factors that together with the policies contribute to the US' excellent performance in commercialization of academicresearch. Hence, policies are just a part of the system that creates favorable environment for commercialization. However, this fact is often overlooked by policymakers (*ibid.*). Second, the importance of the culture and traditions of higher education system comes into the picture. The US universities have never been the "ivory towers". On the contrary, they have always been strategic economic institutions where unlike the European universities use-oriented research has always been valuable (Sampat, 2006). All these factors comprise the system that encourages research commercialization at the US universities. Thus, we can argue that a policy should be studied in its original context in order to provide deep insight in how it works and what are the supportive mechanisms that facilitate its efficiency. Only after the in-depth assessment of a policy within a whole system it can be *adjusted* to another context if considered suitable. I used the word *adjusted***,** not copied or implemented, by which I want to underline the crucial importance of the new context as well. Here, it is important to reconsider how the research system works in Norway, how productive the policy will be taking into consideration the academic values and supportive institutions of the Norwegian system.

7.3 The response of the University of Oslo to new government policies

As a result of legislative changes that took place in 2003-2004, the UO established its TTO Birkeland Innovation which became officially responsible for commercializing research results generated at theuniversity. It serves as a bridge between the UO and external

commercialization actors. Before the establishment of the TTO, the Research Park of Oslo has been the only institution that supported knowledge commercialization at the university. As already discussed, this type of commercialization system is referred to as “external” which is increasingly considered as less sufficient for research commercialization at universities (Stankiewicz 1986 cited in Gulbrandsen & Smeby, 2005a). One of the concerns regarding research parks is associated with the fact that they have other interests beside the university generated intellectual property, which can lead to the conflict of interests (Bugge *et al*., 2003).

The main activities of the Birkeland Innovation aim at building entrepreneurial culture at the UO, raise awareness on intellectual property among academics and support them through commercialization processes with advice and funds. Birkeland Innovation provides several scholarships, and ensures to bring academics involved in commercialization to industrial representatives that can result in successful knowledge transfer from the UO to industry.

Another response to the policy changes is associated with implementing of new intellectual property regulations which has established the 1/3 revenue distribution model.

The increasing need for knowledge commercialization and strengthening of university-industry collaboration is often underlined in the UO policy papers. This especially is the case with strategic plans and annual reports dating after 2005. However, the official papers also state that new external demands should not undermine the individual academic freedom to choose research topics and methods as well as their right to publish research results (UO, 2005).

7.4 Impacts of policy shifts on academics' commercialization experiences at UO

The policy changes are quite recent, which makes it difficult to draw any conclusion on their real effects on commercialization system at the UO. On the other hand, the interviews with the academics provided a picture of how they experienced the impacts of policy shifts.

A general impression is that the respondents seem to be positive to the new policies. One of them underlined that he was quite sceptical to new IPR regulations at the beginning. Yet another respondent turned to be quite neutral to these changes. The main outcome of new policies, Birkeland Innovation, was identified as a positive consequence of new regulations. The respondents acknowledge that the institution probably is not perfect, but it is developing and learning through the experiences. However, one of the respondents mentioned that the TTO should probably change its focus and show stronger initiatives towards establishing the spin-off firms. This comment is consistent with what we have encountered in literature review on Birkeland Innovation. It was stated that the TTO's profile can be seen more oriented towards securing IPR than on creation of new firms (Gulbrandsen *et al*., 2006). Other wishes have also been expressed. One informant stated that the increased financial support to the TTO was necessary in order to make it possible for Birkeland Innovation to buy "innovation services" as e.g., investigation of market segments that eventually would become the consumers of the academic inventions generated at the university. All the respondents mentioned eagerly that younger generation is generally more interested in commercialization of their research. They are also more flexible when it comes to collaborating with industry. Informants' perceptions were quite consistent with regard to the main goal of commercialization activities- contribution to social advance through providing new products and services, and generating new jobs, came on the first place whilst financial interest appeared to be a good incentive too. Three of the respondents expressed the positive development with regard to industrial interest in academic research, which is an important precondition for successful commercialization of university research. Respondents have also identified challenges for academics involved in commercialization. These are a lack of time to commercialize research results, a lack of personnel involved in these activities, and a lack of money in some cases.

7.5 Weaknesses and limitations of the thesis

As discussed in the methodology chapter, the qualitative research approach was used in the study. Interpretation is an inherent part of this approach. This implies that a researcher should interpret the findings observed and obtained during the study. In other words, a researcher should tell a story to reader (Janesick, 1994). Consequently, findings of interpretive research are not merely descriptions of the existed phenomenon, but also represent knowledge or "construction" which is developed by a researcher through the processes of developing themes, categories, coding etc. (Kelly, 2002: 422). This makes a qualitative researcher an important instrument of the research, which, in turn, implies that the results of the study are very much dependent on his/her intelligence, skills and experience (Durrheim, 2002; Patton, 2002). Interpretive nature of qualitative inquiry undermines the positivist understanding of reliability, generalizability and validity of the research. Unlike the validity in quantitative research where it has clear definitions, standards of validity in qualitative research are still in the process of developing. There are several assumptions on validity in qualitative study. According to Janesick (1994:216), "validity in qualitative research has to do with description and explanation, and whether or not a given explanation fits a given description. In other words, is the explanation credible?" Others argue that validity does not fit within qualitative research, as there is no single "correct" interpretation (Wolcott, 1990 cited in *ibid.).* Concerns about validity of qualitative research raise the question: how valid are the interpretations made in the study and what are the possible shortcomings? The process of data reduction and selecting theoretical framework for analysis involves possible biases that work as a threat to validity of the findings in the thesis.

The study has several limitations. Due to the time constraints, the interview analysis is based on a small sample; it covers the interviews with four academics. In literature of social sciences, a small sample size usually used in qualitative study often raises the concern on generalizability. Even more, the question of impossibility of generalizing in qualitative research is often posed (Patton, 2002). As Cronbach (1975 cited in Patton, 2002:582) puts it, "social phenomena are too variable and context-bound to permit very significant empirical generalizations". The small empirical exploration conducted in the thesis aimed at providing an insight into academics' experiences of commercialization activities at the UO without

generalizing on a broader group. Consciousness about the importance of selecting information-rich samples has been central though. However, this can also be associated with the weakness of the empirical exploration. Because commercialization of research results is more usual in natural sciences, all the respondents were purposely selected from this field. On the other hand, this limited the perspective of the study, as the researchers belonging to other disciplines are not presented in the thesis.

7.6 Suggestions for further research

As mentioned, the interview sample was selected purposely from the fields where research commercialization is more natural. This decision was made taking into consideration the criterion of "information-richness" of the samples in qualitative study. However, other fields where commercialization is considered a secondary mission, will also be interesting to observe, which could be the topic of further investigation in the field.

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Secondary data

Birkeland Innovasjon. Resultater for Birkeland Innovasjon 01.2004-10.2007. (Statistics with comments).

Attachment A

Interview guide

- Academics' experiences of new government regulations. The way new policies have been reflected in their commercialization practices.
- Informants' experiences of commercialization infrastructure at the UO. Attitudes to Birkeland Innovation which was the main infrastructural change following the new regulations.
- Motivation for academics to commercialize research. Their attitude to courses in entrepreneurship. Motivation in younger and older generations of academics.
- The main challenges for an academic to get involved in commercialization activities.
- Academics' perceptions of the main goals of commercialization activities.
- Informants' wishes for creating better commercialization environment at the UO.