What do Scientists Want: Money or Fame?

Devrim Goktepe[1]
Max Planck Institute of Economics
goektepe@econ.mpg.de

Prashanth Mahagaonkar
Max Planck Institute of Economics
mahagaonkar@econ.mpg.de

Abstract

What makes scientists patent and disclose inventions to employers? Using a new dataset on Max Planck scientists, we explore their motivations to patent and/or disclose inventions. We propose that patenting need not be used for monetary benefits. Scientists value reputation as important use patenting and disclosures as a signal to gain it. We find that it is not monetary benefits that drive patenting and disclosures but expectation of reputation. We also find that experience with the employer matters for disclosure of inventions. This may imply that patents are indeed used as information transfer mechanisms with prime motivation being reputation.

Keywords: Incentives, motivations, individual inventors, patents

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[1] Corresponding author

1. Introduction

Scientists carry out the tasks of education, research and commercial activities (*the third task*) at universities. Despite their importance, the roles, motivations and perceptions of university inventors have been relatively neglected topics of study. Most studies on university-industry relations have hitherto focused on a few selected elite universities, technology transfer offices (TTOs), patent legislations, or technology transfer activities in specific sectors from the United States. In these studies, the focus of interest is primarily the importance of institutions (patent legislation, policy mechanisms) and organizations (TTOs, university administration) in the patenting activities of scientists (see recent reviews by Siegel and Phan 2005; Phan and Siegel 2006; Rothermael et al. 2007; Goktepe forthcoming). Some studies initiated the importance of individual oriented factors, but rather limited themselves only to entrepreneurial traits, experience, scientific background and demographic factors such as age in order to analyze commercialization motives of scientists.

A number of studies (see among others Bercovitz and Feldman 2004; Gulbrandsen 2005; Giuri et al. 2006; Meyer 2005; Azoulay et al. 2007; Baldini et al. 2007; Goktepe forthcoming) have recently paid attention to the roles of individual inventors in the university-industry technology transfer or academic entrepreneurship. In line with these recent developments, this research aims to focus on three factors of interest; namely scientists' internal factors (e.g. human and scientific capital), external factors (directors – research group leader behaviour, spin-offs at the institute.) and psychological factors (perceptions, motivations). Within the scope of this paper we specifically focus on the relationship between the likelihood of scientists' patenting and inventing behaviours and their perception and presumptions on the benefits (measured in terms of financial benefits and/or scientific reputation) of commercial activities. We control for different socio-demographic as well as institutional factors and scientific fields in our analysis. For this purpose we use a unique database developed recently at the Max Planck Institute of Economics on the commercialisation activities of over 2500 scientists spanning over 60 different institutes constituting the Max Planck Society for Advancement of Sciences (hereafter referred to as MPG).

Using discrete choice models on patenting and invention disclosure to the MPG, we find that it is not money that influences these decisions rather it is reputation/fame that drives scientists to both patent and disclose their inventions. Scientists' commercialization activities do not necessarily respond to monetary expectations. This confirms the assertions made by Long (2002) that patenting is basically an information transfer mechanism and patentees use patents not always for the expected financial benefits by excluding others but for the non-monetary benefits that accrue due to the information conveyed. Patenting activities could, to a certain extent, be independent from private economic incentives. This finding is important because it means that the *academic capitalism* is not essentially warranted. However this does not mean that the design of intellectual property rights, other forms of incentives, in academic organizations would not have real effects on economic growth and productivity.

The paper is organised as follows, the following section deals with the question of why scientists patent and disclose their inventions and takes the view of patents as signals that scientists use. In the third section, perceptions and motivations of scientists are shed light upon and propositions are put forward after which in the fourth section the new dataset is introduced along with the variables of interest and methodology. The fifth section puts forward the estimation results and analysis and sixth concludes.

2. Why do Scientists make Invention Disclosures and Patent?

By the nature of their work scientists constantly ask research questions and aim to show their research results in a timely fashion among their peers to achieve reputation and recognition (Merton 1957). On the other hand, research results of scientists sometimes lead to invention disclosures and patents which bring the economic incentives and pecuniary rewards into the picture. The standard expectation is that patenting is an essentially economic phenomenon. It is almost generally believed that any invention would barely come out of a human's brain if that human did not have the possibility to earn all or part of the stream of economic rents that results from the industrial exploitation of his or her invention, a preliminary condition for that being that he or she ought to own a propriety right (usually a patent) over that invention (Schmookler 1966).

Inventive activity –along with technological change and the production of scientific and technical knowledge– was later on argued as something that was independent of economic needs and motivations (Rosenberg 1974). More recent empirical findings also show that to some extent it is easier to accept that research and thus patenting is a matter of doing something professionally satisfying and rewarding (Gulbrandsen 2005; Giuiri et al. 2006; Baldini 2007; Goktepe forthcoming).

In line with these arguments, it is of particular interest to understand what matters for scientists to disclose their inventions to authorities and patent. Is it due to the perception of gaining reputation and free from pecuniary rewards? Yet, the question here becomes a little bit more complicated when we consider if the aim is to gain reputation and scientific visibility, why do scientists bother and patent instead of choosing the usual scientific publication route. We therefore alternatively pose, aligning with the classical economists may argue, scientists' patenting activities might be different from their research activities and they are also motivated by pecuniary rewards in their patenting activities. The underlying model can be formulated as follows:

Patenting/disclosure Activity=*f (motivations, age, gender, citizenship, career experience, research milieu*)

A further piece to this puzzle can be added by introducing if there is any significant difference regarding reputation and financial rewards between the scientists who patented and who had only disclosed their inventions to their employees. Inventing and patenting are two separable phenomena. It is accepted that not every invention can be patentable, even if scientists may have the expectations to patent. It is therefore accounting for the perceptions of scientists who actually applied for a patent with those who aimed but have not applied for a patent. Investigating and comparing what are the perceptions of scientists who patented and who invented would shed some light on the current debate on the role and ownership of intellectual property rights (IPR) at universities and public research organizations (PROs).

In what follows we develop the principal arguments of this paper. We revisit some of the recent studies on the role of patents and why scientists patent. However such findings merit further examination since they have been based on smaller samples or limited to a few selected universities or specific disciplines.

Patents as Signals

While many study why firms patent (for example- Horstmann et al. 1985), very few studies concentrate on why do ‘individuals’ patent. We tend to emphasize this due to the reason that benefits/costs that patents provide to firms might not be the same as for the individuals. Individual decision making is complex and one needs to first understand the specific functions that a patent provides to individuals. Common knowledge prevails that patenting is a mechanism to ‘privatise’ information by excluding others to the intellectual property. At the same time, through the channel of patenting documentation, an individual may actually reveal the invention process. This however does not happen.

Anton and Yao (2004) find that many of the patents do not actually reveal complete information on the invention process, therefore leading to “little patents-big secrets”. So with this finding it seems plausible that monetary benefits to patents can be still assured, without a danger to the knowledge underlying the invention process. But do all individuals patent just because they want money by excluding others? Fame and money have always been the ultimate passions of humans mainly due to their effectiveness, their power to lure others and their pervasive nature. The want for fame and money have always been omnipresent, in some cases omnipotent too. While we discussed about the monetary gains from patents, an equally intriguing gain is reputation. Since we are interested in individuals, reputation seems to be another interest that would drive them to act on different things.

In order to be reputable, in the first place, information has to be conveyed about the person in context. In this view, a scientist can be thought of conveying ‘his type’ (highly productive-low productive) to specifically two or more groups of people. One major group would be the compatriots in the research field concerned while another can be the employer. To the first group, scientists have three ways to convey information about their type – either publish, or patent, or do both. To the second group one specific channel would be to report their findings officially- meaning- disclose their invention to the employer on an official basis[2]. In this paper we focus on the channels of patenting and invention disclosure. Both of these can be viewed as information transfer mechanisms, not necessarily for monetary gains but for the non-monetary benefits (Long 2002) - in our case, reputation- that the individual foresees to be accrued. Individuals therefore would resort to actions that signal their type by conveying the right information to the concerned group.

Although Long (2002) as well as the earlier studies by Schmookler (1966) and Rosenberg (1974) have long been debated in the academic literature, their logic applies primarily in the patenting context *in general* or in the context of *industrial* research and development (R&D) (e.g., Cohen 2005; Eisenberg 1989; Merges and Nelson 1990, 1994; Thursby and Thursby 2007). We therefore questioned the role of financial rewards (by gaining monopoly powers /exclusivity) and/or the role of non-financial informational rewards (by reputation gain) as a driving force of inventing and patenting activities of scientists in public research organizations (similar to university context). By doing so, we move beyond the traditional argumentation of financial incentives are important for inventing activities for academic scientists. In the following section we dig deep into what factors (internal, external and motivational) are involved and how they get shaped and how they affect patenting/invention disclosure behaviour.

3. Perceptions & Motivations of Scientists

In this section we mainly focus on the question, what are the perceptions and motivations of scientists and their relation to commercial activities. To begin with we tip our hand with three basic assumptions that may motivate scientists to engage in research and commercial activities (Stephan and Levin 1992). (i) An interest in solving the puzzle; (ii) an interests for recognition and prestige among peers; (iii) an interest in achieving economic gains.

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[2] Invention disclosure to the employer is a job requirement. Different from the former university patent legislation (university teachers' privilege (section 42 ArbNErfG – Law on Employees' Inventions), [organizational] ownership of intellectual property rights (IPR) regime has been valid since the 1970s.

Solving the Research Puzzle: Puzzle-solving involves a fascination for the research process itself (Stephan et al. 2005). The puzzle-solving nature of research is described by the historian of science, Robert Hull (1988 in Stephan et al. 2005). In addition to Mertonian norms[3] (see Merton 1973); there is considerable evidence that scientists have a desire for inventing (Stern 2004). Scientists at universities are intrinsically motivated to do research. Much of the incentive to invent comes from the joy of solving research questions (Levin and Stephan 1991; Stephan 1996). Thus they are intrinsically motivated to conduct research, quite apart from the ability to earn financial rents from their effort (Hellmann 2007).

Recent empirical studies have also confirmed that the innate curiosity of scientists make them research that can be publishable. Gulbrandsen (2005), Giuri et al. (2006), Goktepe (forthcoming) investigated the motives of inventors to patent. They asked whether monetary rewards or non-monetary rewards were important motivations for patenting. Consistently these studies although limited in scope found that personal satisfaction and doing something professionally enjoyable were important reasons for scientists to be involved in commercialization. They found that social and personal rewards (i.e. the fact that the innovation might increase the performance of the organization where the inventor works), personal satisfaction to show that something is technically possible, and prestige /reputation) were considered by the inventors to be more important than other types of compensation like monetary rewards and career advancement.

Social and Personal Rewards: In addition to curiosity-driven research, scientists are motivated to achieve reputation and recognition among their peers in a timely fashion (Merton 1957). Scientists are motivated by rewards of recognition and prestige among peers, and they have a strong interest in winning the game. Patenting can enhance the prestige and increase the scientific productivity of the scientists by reaffirming the novelty and usefulness of their research (Owen-Smith and Powell 2001, 2003). Although there is no explicit evidence that patents are used as a criterion to evaluate the academic

[3] Merton suggested four norms of science: universalism, communism (or communalism), disinterestedness, and organized skepticism.

merits of the scientists (e.g. in academic promotion), some scientists may consider patenting in order to increase their visibility and reputation. On the other hand, scientists who are concerned with more traditional academic values like *open (public) nature of science* might be less motivated to patent.

Source of Personal Income: Etzkowitz (1998) and Slaughter and Leslie (1997) underlined financial rewards, monetary compensation and profit motive in their analyses of the new entrepreneurial scientist. Universities that provide greater rewards for scientists' involvement in patenting (e.g. in the forms of equity shares, royalty distribution) are found to motivate scientists to commercialize (patent) more. Greater rewards are measured by the amount of royalty income received by the inventor. Owen-Smith and Powell (2001) argued that scientists' decisions to disclose are shaped by their perceptions of the benefits of patenting, licensing and start-up company formation. The incentives to be involved in technology transfer are magnified or minimized by the perceived costs and gains of interacting with industry and TTOs. Siegel et al. (2003) concluded that organizational factors, in particular scientists' reward systems and technology transfer office compensation, influence the productivity of the technology transfer activities and thus the motivations of scientists to disclose their inventions.

Bercovitz and Feldman (2004) assumed that faculty members would be responsive to financial incentives and that there would be a direct relationship between licensing royalty distribution rates and the amount of technology transfer across universities. Thursby et al. (2001) and Lach and Schankerman (2003) provided empirical evidence that milestone payments and share of license revenues from their inventions are positively related to the motivations of inventors to patent. Markman et al. (2004) investigated the relationship between entrepreneurial activities and payments to scientists, departments and TTO staff. They argued that scientists and their departments will be unlikely to disclose or participate in technology transfer activities unless they are given proper incentives to do so. They expect licensing revenues from technology transfer activities can motivate scientists and their departments towards entrepreneurial activities given the scarcity of resources on research. Based on the arguments posed until now, we frame the following propositions for empirical testing. Since we do not make a case for only reputation or only money drives patenting, we test several possibilities in terms of methodology. Apart from these specific propositions we also test several individual and external (institution specific) factors that affect patenting and invention disclosure decision.

Propositions

- *Scientists who expect high reputation are more likely to use both mechanisms (patenting and invention disclosure)*
- *Patenting and Invention disclosure need not be necessarily driven by monetary interests.*

Individual & External Factors

The group of studies that focuses on individuals is inspired partly by psychology and behavioural sciences. These studies have focused on the socio-demographic characteristics of inventors. Macdonald 1984, 1986; Sirili 1987; Amesse et al. 1990; Klofsten and Jones-Evans 2000; Giuri et al. 2006 investigated the characteristics, background and socio-demographic features of inventors. The socio-demographic findings of these different studies are fairly consistent (see also Azoulay et al.2007). Inventors were most often men; the average age being between 45 and 48. They were highly educated and had technical and commercial knowledge and had experience above the average.

Stephan and Levin (2005) investigated whether personal characteristics, age (life-cycle), citizenship status, gender and receipt of federal funding were related to patenting behaviours. They found little evidence of age effects, yet they found that tenured scientists are more likely to patent than non-tenured ones (Levin and Stephan 1991; Stephan 1996). Women patent less than men, although the effect is smaller since the number of women employed in universities relative to men is low. In addition to the individual (socio-demographic) factors, one should also account for the perceptions of scientists on the use of knowledge (whether research should be open) and role of organizational factors, like the need for technology transfer office (TTO).

"A scientist, by choice of vocation, would heretofore have been assumed to have put aside all thoughts of business-like activity to live a monk-like existence as a searcher for truths about nature" (Etzkowitz 1998). Etzkowitz continues – "attired in a white lab coat to protect their street clothing from chemical spills, the uniform of the scientist also signified a certain purity of motives, an abstraction from material concerns and a bemused tendency toward absentmindedness in daily life". Further, "they were believed to find rewards for their discoveries not in pecuniary advantage but in recognition from their scientific peers through citation in the literature, election to a national academy and the ultimate accolade of the Nobel Prize". Thursby et al. (2001) argued that scientists who specialize in basic research may not disclose because they are unwilling to spend time on the applied R&D required to interest business in licensing invention. They also stated scientists may not disclose because they believe that commercial activity is not appropriate for an academic scientists. Having this kind of perception or believing in the Mertonian norms of 'disinterestedness'- scientists would perceive that their research results should be freely accessible to any other scientists and businesses. Such scientists are also expected to be less interested in patenting or other commercial activities.

Scientists' incentives to be involved in technology transfer are magnified or minimized by the perceived costs of interacting with industry, TTOs, (Owen-Smith & Powell 2001, 2003) or dealing with patenting, licensing and company formation individually. Scientists who think the costs of commercialization, e.g. patent applications, fees associated with starting a business, are very high will be less likely to get involved in entrepreneurial activities or patenting. Faculty decisions towards technology transfer are shaped by the institutional and organizational environments which are supportive or oppositional for university-industry technology transfer. It is therefore necessary to control for scientists' perception on the role of agents such as technology transfer offices.

4. Data Characteristics, Variables of Interest and Methodology

This paper is based on a large-scale survey of over 2500 scientists in Germany aimed at obtaining information about the commercialization activities.[4] The scientists pooled for this research are from the independent non-profit research organization –the Max Planck Society for the Advancement of Science (MPG hereafter). MPG was founded in the late 1940s in Germany. The survey was conducted in the last part of 2007 at around 80 institutes specialized in different scientific disciplines and located different cities in Germany. The MPG is funded to large extent by both the federal and state governments. Although the aim is to conduct basic research in the interest of general public in natural sciences, life sciences, social sciences and the humanities; the institutes takes up new and innovative ideas that the German universities are not in a position to conduct adequately. By providing equipments, facilities the research at the MPG complements the work done at the universities. Currently the MPG has 4,300 scientists and substantial amount of graduate students, post-docs, research scholars and guests scientists. 51% come from abroad. In 2006, the budget was around 1,379.1 million euros. 82% is from federal and state governments, while 13% is from projects supported by government, federal states and the EU. Donations, evaluation royalties etc. amount to 5%.

Different from the former university patent legislation (university teachers' privilege (*section 42 ArbNErfG – Law on Employees' Inventions*), [organizational] ownership of intellectual property rights (IPR) regime has been valid since the 1970s. This regime has recently become a model of organizing property in university inventions as well (Buenstorf 2006). The MPG has thus a well-established tradition of organized technology transfer, having established a dedicated technology transfer subsidiary in 1971 to promote technology transfer, and provide guidance e.g. patenting, licensing and venture creation (Buenstorf 2006). Regarding technology transfer MPG has a 100% subsidiary named 'Max Planck Innovation', whose functions are mentioned as "within the Max Planck Society, the company provides the research institutes with advice regarding patent

[4] Survey tool can be available upon request.

matters and organises patent applications" and further "Its primary business is the transfer of patented and non-patented technologies developed by Max Planck Institutes to industry and to negotiate and close license agreements"[5] .

The survey was conducted by a professional consultancy company from October till December 2007. It was a telephone-based survey. Names of the participants were kept confidential and are not to be revealed. Previous studies on technology transfer, academic entrepreneurship and available interview guides and questionnaires were consulted before constructing the survey. To check for possible interpretation errors and mistakes, pilot surveys were conducted with randomly contacted scientists from other public research organizations in Germany. In addition the survey was proof-read. The survey has four parts. The first part is about invention, patenting and research cooperation activities. Second part focuses on entrepreneurial activities. The third part is about the perceptions of scientists on commercial activities in general. The final part deals with individual and professional demographic information (age, gender, academic title and education, citizenship).

Empirical Strategy

In order to construct the variables we first concentrate on the variable of interest – patenting and invention disclosure. We use three groups of scientists to measure the relationship between likelihood of scientists' patenting activities and their perceptions and motivations to do so. Scientists who have only applied for a patent; scientists who have only disclosed inventions to the MPG and not have a patent and scientists who have both disclosed inventions to the MPG and also have applied for a patent. The set up for the econometric model therefore is of a multinomial discrete choice model; specifically we use the multinomial logit estimation method. Measuring perceptions is a tricky issue. Since our main propositions are on reputation and money there are many ways that we could measure it. The questionnaire proved helpful at this stage since scientists were

[5] source: Max Planck Innovation Website

asked whether they expect commercialisation (patenting results, research collaboration with private sector, consulting services etc.) to increase their reputation basing on a 5 point scale. In the same vein, the question on whether they expect commercialisation to make money was asked. Using these two measures we constructed variables – high money, high reputation if the respondents strongly agree with the prospects of getting money, or getting reputation.

Since our interest was also to cover the demographic nature of the respondents, we have used age, gender (female or not), foreign-born scientist variables. These cover the aspects ‘internal’ to the scientists. We further utilize data on their industry experience, MPG experience, the position (whether a director, a group leader, a post doctoral fellow), and which field of science do they belong. In order to clearly track the patenting and invention disclosure behaviour one has to also account for the personal opinions of the scientists with respect to the nature and mode of commercialisation. Scientists were therefore asked if they want their research to be open (free from exclusion) and if they think a technology transfer office (TTO) is indeed needed to take their research to industry or commercialise it in any other fashion. We utilise this information in order to account for the personal opinion of scientists about commercialisation in general that may affect their actual commercialisation behaviour. The following section puts forward some statistics indicating on the nature of data, the variables considered and the estimation results from the multinomial logit model.

5. Estimation Results & Analysis

After the necessary inclusions and exclusions for the paper we had almost 1100 usable responses. Out of this sample, 110 scientists reported only patenting, 99 reported only disclosure and 187 reported both patenting and disclosure. Table 1 provides the descriptive statistics on the variables we consider. It can be clearly seen that most of the scientists take both paths of patenting and invention disclosure, but only few of them do it for money. It’s also interesting to see that scientists who consider their research to be freely available for everyone also patent and disclose inventions to MPG. The mean ages for every mechanism is around 40 while less than a quarter of scientists patenting, disclosing or doing both, is female. Almost half of the foreign-born scientists patent and the number is almost the same for disclosure, but lesser for both.

Directors certainly seem to show a very high patenting and disclosing behaviour, if not for each of them individually. There is almost an equal share of scientists patenting in the broad fields of biology and medicine compared to chemistry, physics and other technical subjects. Post-docs and group leaders seems to show very high patenting and disclosure behaviour. This may be due to their young age that they are needed to show performance mainly after PhD and therefore they might be more active in inventing and patenting.

Given this scenario, we tested a multinomial logit model where all the three categories (only patent, only disclose, both patent and disclose) are considered. Table 2 provides the estimation results.[6] Based on our estimation results we can observe that the scientists who expect high reputation from commercialisation activities are more likely to perform both patenting as well as invention disclosure. This confirms our first hypothesis that *scientists who expect high reputation are more likely to use both mechanisms.* It can be interpreted as the scientists who would expect to have high reputation would signal it through patenting and disclosing their invention to reach the relevant audience who receive the signal. Secondly, we can see the effect is so strong that if scientists want reputation they do not necessarily take any one of the paths, but are very highly likely to take both.

Is money driving the patenting and invention disclosure behaviour then? The answer seems to be no. As can be seen in Table 2 scientists in fact are less likely to take any of the three paths if their motivation is to gain money. The alternative path may be viewed as starting up for firms, consultancy, or just keeping it as secret for future monetary gains. This however, we did not explicitly test, but we can confirm our second hypothesis that *patenting and invention disclosure need not be necessarily driven by monetary interests.* It is indeed reputation that drives these two and scientists may view reputation as more

[6] A basic assumption of the Multinomial logit model is the Independence from Irrelevant Alternatives (IIA)-assumption. Therefore, we tested for the validity of this assumption. We performed a Hausman-test and the test results suggest that the null hypothesis of IIA cannot be rejected.

important than money. Academic interests might be of more value to the scientists than monetary interests and this might be driven by the inner philosophy of science and want of basic research in order to solve the puzzle, answer the questions that are left unanswered and other motivations.

This leads to the result on the opinion of scientists on research as being ‘open’. Even though descriptive statistics show that there are a number of scientists who patent and disclose while having the view of open research, the estimation findings confirm their opinion. Scientists who consider research to be open are less likely to take any of the three paths to commercialisation. Scientists who consider costs of commercialisation to be high are less likely to disclose their inventions but are more likely to patent and disclose. If a scientist considers costs as high, she would not be willing to approach the MPG to disclose the invention in the first place whereas if the research has high potential (may be through reputation), it might be possible that the scientist is willing to both patent and disclose.

Another interesting result is on the position variable. As a sequential process- the post-doc seem to be more likely to patent, the group leader is more likely to only disclose or take both paths, and the director would be more likely to only choose both paths. This might be possible due to the experience that each of these persons have by understanding the rules, regulations and institutional culture of the MPG (i.e. existence of organizational ownership of patents and an active TTO since 1970s). It is as well as due to the fact that the personal responsibilities towards disclosing inventions may grow over time. This is confirmed by the MPG experience variable, that scientists having higher number of years with the MPG are more likely to disclose their inventions to the MPG.

On the demographics- it is interesting to notice that foreign born scientists are more likely to choose both paths rather than only one of them, older scientists are more likely to patent and choose both paths rather than only disclose their inventions. Scientists with higher industry experience are more likely to disclose their inventions.

Scientists in the field of biology and medicine, seemingly a very vibrant field with respect to inventions and patenting, are more likely to choose both patenting and invention disclosure. Being female is insignificant, which was expected since patenting and invention disclosure are indeed norms and practices of scientists in general and may not be particularly gender specific.

6. Discussion & Concluding Remarks

In this paper we are inspired by the tension whether the traditional assumption that financial rewards (gaining monopoly powers /exclusivity) are the main driving forces of inventing and patenting decisions of scientists. Or scientists' inventing and patenting activities are related to their traditional academic concerns, i.e. gaining reputation and visibility. As we introduced in earlier, this tension has been long debated in the literature especially in the context of industrial knowledge creation, protection, research and development (see Schmookler 1966; Rosenberg 1974; Eisenberg 1989; Merges and Nelson 1990, 1994; Long 2002; Cohen 2005; Thursby and Thursby 2007). We discussed this tension (money or fame) within the context of academic knowledge creation and research from the perceptions of scientists and their decisions to make inventions disclosures and patenting. Instead of making a case for or against one factor, we investigated both aspects. By doing so, we move beyond the traditional argumentation of financial incentives matter for inventing activities for academic scientists. This paper thus also contributed to the debate on the role of IPR and commercial activities at the universities and public research organizations.

Empirically we show that scientists who have more expectations to gain scientific reputation and visibility will more likely to patent. On the other hand scientists' commercialization activities do not necessarily respond to monetary expectations. By the same token, scientists' inventing activities are also related to their expectations of recognition and reputation while financial benefits are less important. Specifically, the scientists who expect high reputation from commercialisation activities are more likely to perform both patenting as well as invention disclosure. This confirms our first hypothesis that *scientists who expect high reputation are more likely to use both mechanisms.* It can be interpreted as the scientists who would expect to have high reputation would signal it through patenting and disclosing their invention to reach the relevant audience who receive the signal.

On the other hand, scientists in fact are less likely to take any of the three paths if their motivation is to gain money. Invention disclosure and patenting activities *could to a certain extent be independent from private economic incentives.* It can be clearly seen that most of the scientists take both paths of patenting and invention disclosure, but only few of them do it for money. It's also interesting to see that scientists who consider their research to be freely available for everyone patent and disclose inventions to a lesser extent.

These findings are also important because it means that the academic capitalism is not warranted and traditional academic values seemed intact. However this does not mean that the design of intellectual property rights, other forms of incentives (e.g. accepting patenting activities as an academic merit, qualification for promotion or providing research funds to patenting scientists), in academic organizations would not have effects on economic growth and productivity. Controlling for a variety of other determinants, including age, gender, citizenship, scientific discipline, industrial and academic experience, scientists with high reputation perception from commercial activities will more likely to patent. We acknowledge that, these factors (reputation and financial rewards) are not mutually exclusive meaning that under certain conditions (in the long term) reputation and visibility of scientists may bring financial rewards maybe in the forms of research funds, if not personal gains.

Understanding of scientists' patenting decisions and behaviour is still a recent phenomenon. Although only recently have some systematic studies started to appear (see Meyer 2003 and similar studies) only few of them have examined the incentives and motivations of scientists' invention disclosure and patenting behaviours. This paper aims to open this discussion and interest further.

Appendix

Table 1. Descriptive Statistics on Scientist patenting and invention disclosures

Variable	**Only Patent(110)**	**Only Invention Disclosure (99)**	**Patent and Disclosure (187)**
High financial benefits	28	24	37
High reputation	52	45	85
Open Research	66	69	106
Commercialisation costs are high	78	69	153
TTOs are needed	94	75	148
Age (Mean)	41	40	44
Female	27	28	22
Foreign-Born	42	40	49
Post-Doc	38	22	32
Group Leader	26	24	78
Director	5	8	26
MPG Experience(Mean Years)	8.3	8.9	12.2
Industry Experience(Mean Years)	1.1	1.2	0.7
Biology & Medicine	50	46	105
Chemistry/Physics and other Technical subjects	58	49	80

The opinion based questions report numbers that respond to "highly agree and strongly agree" in the 5 point scale. All others are particular numbers that pertain to the column category. *Source:* Own Compilation.

Table 2.Multinominal Logit Estimates of Reputation & Financial Benefits on Inventing & Patenting Behaviours of Scientists

	ONLY PATENT	ONLY MPI DISCLOSURE	PATENT+MPI DISCLOSURE
IND VARS			
High financial benefits	-0.790** (0.31)	-0.559* (0.33)	-0.796*** (0.29)
High reputation & recognition	0.208 (0.33)	0.00544 (0.32)	0.534* (0.28)
Research results should be open to public	-0.312** (0.13)	-0.253* (0.13)	-0.355*** (0.12)
The cost of commercialization is very high	-0.168 (0.17)	-0.328** (0.16)	0.412* (0.23)
TTOs are needed	0.269 (0.19)	0.00887 (0.16)	0.0106 (0.16)
Post-doctoral fellow	0.558* (0.34)	-0.0307 (0.39)	-0.501 (0.40)
Group leader	0.479 (0.49)	1.159** (0.49)	1.651*** (0.39)
Director	0.685 (0.76)	1.117 (0.89)	2.115*** (0.60)
Years MPG	-0.0372 (0.030)	0.0541* (0.031)	0.0367 (0.024)
Foreigner-born scientists	-0.145 (0.31)	0.155 (0.36)	0.620** (0.29)
Age	4.451*** (0.97)	-0.218 (1.23)	2.093** (0.92)
Female	0.141 (0.36)	0.160 (0.36)	-0.572 (0.42)
Years work in industry	0.201 (0.20)	0.469** (0.20)	0.125 (0.19)
Biology & Medicine	1.690 (1.11)	0.441 (0.72)	2.230* (1.17)
Chemistry /Physics/Technical subjects	1.565 (1.10)	0.412 (0.71)	1.784 (1.17)
Constant	-19.46*** (3.58)	-1.043 (4.48)	-13.13*** (3.57)
Observations	1074	1074	1074
R-squared	0.1892		
P>chi2	0.000		

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

References

Amesse, F., Desranleau, C., Etemad, H. Fortier, Y. & Seguin-Dulude, L. "The Individual Inventor and the Role of Entrepreneurship: A Survey of the Canadian Evidence", *Research Policy*, Vol. 20 (1991), pp.13-27.

Azoulay, P., Ding, W., & Stuart, T. "The Determinants of Faculty Patenting Behavior: Demographics or Opportunities?" *Journal of Economic Behavior and Organization*, Vol. 63 (2007), pp.599-623.

Baldini, N., Grimaldi, R., & Sobrero, M. "To patent or not to patent? A survey of Italian Inventors on Motivations, Incentives, and Obstacles to University Patenting". *Scientometrics,* Vol. 70 (2007), pp.333-354.

Bercovitz, J. & Feldman, M. "Academic Entrepreneurs: Social Learning and Participation in University Technology Transfer", Mimeo, University of Toronto, 2004

Buenstorf, G. "Is Academic Entrepreneurship Good or Bad for Science? Empirical Evidence from the Max Planck Society" Discussion Paper No.2006-17, Max Planck Institute of Economics, 2006

Cohen, W. "Patents and Appropriation: Concerns and Evidence". *Journal of Technology Transfer*, Vol. 30 (2005), pp.57-71.

Eisenberg, R. "Proprietary Rights and the Norms of Science in Biotechnology Research". *Yale Law Journal*, Vol. 97 (1987) pp.177-231.

Etzkowitz, H. "The norms of entrepreneurial science: Cognitive Effects of the New University-Industry Linkages". *Research Policy,* Vol. 27 (1998), pp. 823-833.

Giuri P. et al. Inventors and Invention Processes. Results from the PatVal Survey, Working Paper No. 5752, CEPR, 2006

Goktepe, D. Inside the Ivory Tower: Inventors and Patents at Lund University (forthcoming)

Gulbrandsen, M. "But Peter's in it for the money: The Liminality of Entrepreneurial Scientists." *Vest*, Vol.18 (2005), 44-75.

Hellmann, T. "The Role of Patents for Bridging the Science to Market Gap." J*ournal of Economic Behavior and Organization*, Vol. 63 (2007), pp. 624-647.

Horstmann, I., MacDonald, G. M., & Slivinski, A. "Patents as Information Transfer Mechanisms: To Patent or (Maybe) Not to Patent." *The Journal of Political Economy*, Vol. 93 (1985), pp. 837-858.

James J. A. & Dennis A.Y. "Little Patents and Big Secrets: Managing Intellectual Property." *RAND Journal of Economics, The RAND Corporation*, Vol. 35 (2004), pp. 1-22

Klofsten, M. & Jones-Evans, D. "Comparing Academic Entrepreneurship in Europe: The Case of Sweden and Ireland." Small Business Economics, Vol. 14 (2000), pp.299-309.

Levin, S. & Stephan, P. "Research Productivity over the Life Cycle: Evidence for Academic Scientists." American Economic Review, Vol. 81 (1991), pp.114-32.

Long, C. "Patent Signals." *The University of Chicago Law Review*, Vol. 69 (2002), pp. 625-679.

Macdonald, S. “The Patent System and the Individual Inventor.” *The Inventor* Vol. 24 (1984), pp. 25-29.

Macdonald, S. “The Distinctive Research of the Individual Inventor.” *Research Policy*, Vol. 15 (1986), pp.199-210

Markman, G. D., Gianiodis, P. T., Phan, P. H., & Balkin, D. B. “Entrepreneurship from the Ivory Tower: Do Incentive Systems Matter?” *The Journal of Technology Transfer*, Vol. 29 (2004), pp. 353-364.

Max Planck Innovation Website http://www.mpg.de/english/institutesProjectsFacilities/subsidiaries/garching_innovation/index.html (accessed on 28/02/2008)

Merges, R. and Nelson, R.R. “On Limiting or Encouraging Rivalry in Technical Progress: The Effect of Patent Scope Decisions.” *Journal of Economic Behavior and Organization*, Vol. 25 (1994) pp. 1-24.

Merges, R. and Nelson, R.R. “On the Complex Economics of Patent Scope.” *Columbia Law Review*, Vol. 90 (1990), pp 839-916.

Merton, R.C. “The Normative Structure of Science.” in Robert C. Merton eds., the Sociology of Science, Chicago: University of Chicago Press.

Meyer, M. “Independent Inventors and Public Support Measures: Insights from 33 Case Studies in Finland.” *World Patent Information*, Vol. 27 (2005), pp.113-123.

Owen-Smith, J. & Powell, W. “Careers and Contradictions: Faculty Responses to the Transformation of Knowledge and its Uses in the Life Sciences Research.” *Sociology of Work*, Vol. 10 (2001), pp. 109-40.

Owen-Smith, J. & Powell, W. “The Expanding Role of University Patenting in the Life Sciences: Assessing the Importance of Experience and Connectivity.” *Research Policy*, Vol. 32 (2003), pp. 1695-1711.

Rosenberg, N. “Science, Invention and Economic Growth.” *Economic Journal*, Vol. 84 (2003), pp. 90-108.

Rothermael, F. T., S. D. Agung & L. Jian, “University entrepreneurship: A taxonomy of the literature.” *Industrial and Corporate Change*, Vol. 16 (2007) pp. 691–792.

Schmookler, J. *Invention and economic growth* Cambridge: Harvard University Press, 1966

Sirilli, G. “Patents and inventors: an empirical study.” *Research Policy*, Vol.16 (1987), pp. 157-174.

Slaughter, S., & Leslie, L. L. *Academic capitalism,* Johns Hopkins Univ. Press, 1997

Stephan, P. “The Economics of Science.” *Journal of Economic Literature*, Vol. 34 (1996), pp. 1199-1235.

Stephan, P.E. and Levin, S.G. “Leaving Careers in IT: Gender Difference in Retention.” *Journal of Technology Transfer*, Vol. 30 (2005), pp. 383-396.

Thursby J.G., Jensen, R., & Thursby, M.C. “Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities.” *Journal of Technology Transfer*, Vol. 26 (2001), pp. 59-72.

Thursby, J. & Thursby, M. “Knowledge Creation and Diffusion of Public Science with Intellectual Property Rights in “Intellectual Property Rights and Technical Change,” Frontiers in Economics Series, Vol. 2, Elsevier Ltd. (Forthcoming)