Mobility and Career Concerns of Patent Examiners: an Analysis of U.S. Data

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March 2009

Preliminary Draft

Abstract

This paper is a contribution to the growing empirical patent literature that studies patent examiners' behavior. An important issue for the U.S. Patent and Trademark Office is that examiners tend to leave the office. Our analysis is a first attempt at understanding whether the behavior of patent examiners during their tenure at the office might be driven by career concerns. We use U.S. patent data and follow each of 652 patent examiners who granted patents on December 19, 1995. We have data at both examiner and patent levels: for each examiner we identify all the patents that have been granted during her/his tenure, and we collect data on the characteristics of each patent.

Keywords: Patents, Examiners, Mobility

JEL classification: J60, O34

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We thank Lunyu Xie, Huan Zhao and Qiye Sun for research assistance, and participants of the 96th International Conference, Patent and Innovation: Econometrics Studies, in Strasbourg, France, for their comments. Financial support from the NBER grant 30-2213-07-0-18-003 is gratefully acknowledged.

1 Introduction

Examiners grant patents to innovators and, therefore, allow firms temporary monopoly power. The deliverance of too many questionable patents negatively impacts the economy and society. Poor examination quality lowers competition (imposes costs on society) and leads to high legal costs in cases of litigation (that may reduce innovation). Hence, patent examiners have a key role to play in society, and it is fundamental to have a better understanding of the mechanism by which patents are granted. There exists a growing number of empirical contributions that study the behavior of patent examiners and our paper is a contribution to this literature.[1]

According to several U.S. Government Accountability Office (GAO) reports (2005, 2007) on the progress of the implementation of modernization plans at the U.S. Patent and Trademark Office (USPTO), the office has a hard time to hire and retain a skilled workforce. It is not clear why examiners are leaving the USPTO, and the reasons given by the office management and the examiners are divergent. For the managers, examiners leave mainly for personal reasons, whereas examiners blame their production goals that, according to them, are set too high. It might also be the case that examiners have outside options, and once they have gained some expertise in a specific area, they leave the USPTO.

The objective of this paper is to understand and empirically analyze how the behavior of patent examiners affect the economy through innovation. More particularly, our goal is to assess whether examiner behavior can be strategic and might be driven by mobility and career concerns.

Holmstrom (1999) seminal paper analyzes how an agent career concern may influence her/his current incentives to make decision. He studies the effect of time on incentives, and shows that career motives can be both beneficial or detrimental to management depending on the context. It might be beneficial in the absence of risk-aversion as it was the case in Fama (1980)

[1] See for instance Cockburn, Kortum and Lerner, 2003; Sampat, 2005; Alcacer and Gittelman, 2006; and Alcacer, Gittelman and Sampat, 2009.

contribution where career concerns induce efficient managerial behavior. However, Holmstrom (1999) shows that by considering the implication of reputation on managerial risk-taking, it can be detrimental. Basic congruity in risk preferences between a manager and the firm arises from manager's career concerns.

In our setting, it is unclear whether career motives of patent examiners will negatively impact the patenting process. To the best of our knowledge there exist only a few theoretical contributions that analyze the strategic behavior of examiners, and the particular concern of career motives (Langinier and Marcoul 2008, 2009; Caillaud and Duchêne, 2005; Atal and Bar, 2008). The granting of questionable patents may be due to the poor knowledge of relevant prior art – the existing set of related inventions. Langinier and Marcoul (2008) propose a model of a bilateral search of information in which both innovator and examiner provide prior art information to prove the novel content of an innovation. The main focus is on the strategic behavior of patent applicants while searching and revealing information. Caillaud and Duchêne (2005) analyze also the determinant of patent quality but they are essentially concerned with the "overload" problem that the patent office faces. Incentives of innovators to search for prior art before undertaking any R&D investments, and after have been studied by Atal and Bar (2008), but with no strategic revelation of information. As in most of the patent literature, these contributions assume that the USPTO and examiners have identical objectives, and there is no strategic behavior on the part of patent examiners who have congruent incentives with the office. However, it seems realistic to consider that they are not congruent, as the USPTO is a federal institution for which many examiners are working, with most likely different objective functions. This non-congruence of incentives is accounted for in the contribution of Langinier and Marcoul (2009) that analyzes the reward scheme of examiners when they have career concerns. In a very simple setting it is shown that career concerns are not necessarily detrimental to the granting of patents of good quality. It is a first attempt at looking at the mobility of examiners and their

salary scheme. In the light of these few theoretical contributions, it became important to have a better understanding at patent examiner behavior, from an applied viewpoint. Our goal is to open the "black box" of the process by which patents are granted, and to provide an analysis at the examiner level.

There exists a growing number of empirical studies that have started to open the "black box" of the process of patent examination (Cockburn, Kortum and Stern, 2003; King, 2003; Sampat, 2005; Alcacer and Gittelman, 2006; Lampe, 2008; and Alcacer, Gittelman and Sampat, 2009). One of the first contribution is due to Cockburn, Kortum and Stern (2003) in which they provide empirical evidence that there exists heterogeneity among patent examiners and examination process. Their data set is based on patents that have been ruled on validity by the Court of Appeals for the Federal Circuit (CAFC) between 1997 and 2000. They have collected all the historical statistics of the 187 patent examiners associated with these patents that have been invalidated. Their sample is rather small due to the fact that only few patents end up in court, and many of patent litigations are settled out of court and, therefore, information is scarce for these patents. Concerned with the overload problem facing the USPTO, King (2003) provides an analysis of the effect of increasing application workloads on the recent performance of the USPTO. He shows that, despite an increase workload, patent examiners do spend, on average, the same amount of time on each application, but the pendency time (time elapsed between the filing and the granting of a patent) increased. These are among the few applied contributions that study the patenting process.

Related to the theoretical contributions mentioned above, Sampat (2005), and Alcacer and Gittelman (2006) provide empirical evidence of the role played by patent applicants and examiners in revealing information regarding prior art. In nanotechnology, Sampat (2005) finds strong evidence that examiners are less informed than patent applicants, and that they face particular challenges in searching for information. On the other hand, Alcacer and Gittelman (2006) show

that many citations (prior art information) are listed by examiners, and that firm-level effects (e.g., experience of applicants, nationality) seem to explain most of the variance of examiner citation shares (Alcacer, Gittelman and Sampat, 2009). These analyses suggest that patent applicants and examiners do not necessarily have the same information, nor the same incentives to search and reveal pertinent information. Lampe (2008) predicts that innovators would conceal information about prior art that is closely related to their innovation, which validates Langinier and Marcoul (2008) theoretical findings that applicants have an incentive not to reveal all of the prior art. However, none of these studies analyze the strategic behavior of examiners.

There exist very complete and concise patent databases (Hall *et al.,* 2001) that are freely available, but they do not contain information about examiners. Nevertheless, we use the very detailed and complete database of Hall *et al.* (2001) to construct our own data set.

Our contribution is also related to the labor economics literature, where many findings establish that long-term employment relationships are common, most of the new jobs end early and the probability of job change declines with tenure (see, for instance, Farber, 1999). There is a high probability of change job at low tenure levels. According to Topel and Ward (1992), over their career, individuals will change job 10 times, at very different path. There is a high turnover early on in their career, which is also associated to a rapid increase in wage. In the search literature it is also well-established that rational search implies that good pairings are more likely to survive, implying that the longer the tenure, the lower the mobility.

To the best of our knowledge, there is no contribution aimed at understanding the determinants of mobility of patent examiners, and to relate them to the behavior of examiners. This is the objective of our analysis that is concerned with empirically exploring problems linked to examiners' mobility. There are important factors that might impact mobility outcome such as, for instance, the field of technology in which the examiner is granting patents: is an examiner in biotechnology more likely to leave the USPTO or an examiner who grants patent in mechan-

ics? At the level of examiner, there are characteristics that might be correlated with mobility outcome such as experience (tenure at USPTO), performance both in terms of effort (number of granted patents) and in terms of talent (number of years in training). At the level of the patents that have been granted by an examiner, some (average) patent characteristics might also be correlated with mobility outcome such as pendency time, scope of patent protection (as defined by the number of claims in each patent). These are among the questions we would like to empirically address: does the technological field have an impact on the mobility of examiners? Is there a correlation between experience, performance, characteristics of granted patents and examiner's mobility? Ultimately, our goal is to answer the following ambitious question: if examiners send a signal to the job market, which signal is it?

Our contribution is twofold. On one hand, we collect data and construct an original database at the level of patent examiners. We rely on the existing database of Hall *et al.* (2001) for patents granted before 2002, and for the construction of some variables. On the other hand, we provide an econometric methodology (discrete choice model) to empirically address what the determinants of examiners' mobility are.

Data come mostly from the USPTO web site. We gather two kinds of information: information about patents that are not in the database of Hall *et al.* (2001), and information about examiners. Our sample contains 652 patent examiners who granted patents on December, 19 1995. We follow each of them until September 2006 and, thus, we are able to observe how many of them are still granting patents, and who has been stopping granting patents, and when this occurred. For each examiner we collect the statistical information about all of the patents that have been granted either as a primary examiner or an assistant examiner (which, in general, corresponds to the years spent as a trainee under the supervision of a primary examiner). We are thus able to determine the different variables explained above: experience (tenure), performance, technological field, whether the examiner is still working at the USPTO, and patent

characteristics.

The findings of our very preliminary empirical analysis based only on part of the dataset are the following. We find that the determinants of mobility have different effects on mobility outcome. The technological field seems to have a significant effect on the promotion within the institution as well as talent as defined by the tenure as assistant examiner, has a significant and strong effect on the promotion within the institution. However, talent as the number of patents per year as an assistant examiner has a significant but small effect of the mobility outcome left.

The paper is organized as follows. In section 2 we present an overview of the USPTO: the examination process, the career path of patent examiners and the major changes that have been taking places over the last decades. Section 3 is devoted to the description of data collection, and the construction of the dataset. In section 4 we present the empirical analysis. In section 5 we describe and interpret our first set of results.

2 USPTO: overview of the institution

The U.S. Patent Office was first established in 1836, and is located in a single campus of connected building in Alexendria, Virginia. It is one of the earliest and among the most visible agencies of the federal government. At the end of 2006, over 4,700 patent examiners, with a total of more than 8,000 full time equivalent employees, are working at the USPTO (USPTO annual report, 2006). About 183,000 patents have been approved in 2006, and the USPTO raises nearly $1.5 billion in revenue from fees.

Patent examiners, who are technological specialists employed by the office, review each patent application for compliance with the Patent Act that has been established by the Congress. Nowadays, they are organized into one of the eight broad "technological centers,"[2] each technological center is subdivided into dozens of "art units." In 2007, examiners are spread into 251 different

[2]Before 1998, instead of 8 technology centers there were 17 examiner groups.

art units. An art unit is a group of examiners who examine closely related technology and constitute an administrative unit. Approximately 10 to 20 examiners are assigned to each art unit. The office has established an elaborate classification system for all U.S. patents with classes and subclasses.

Examiner and applicant are engaged in an *ex parte* proceeding by mail, and the examiner ultimately decides whether the invention meets the "stringent" standards. If it meets all of the requirements, the examiner allows the patent to issue.

We first detail the examination process and the career path of patent examiners. Then, we discuss recent major changes that may impact the process of granting patents.

2.1 The patent examination process

The brief description of the examination process that follows is mainly based on Cockburn, Kortum and Stern (2003) that provide a very detailed exposition of it. They have been interviewing about 20 current and former patent examiners and patent attorneys.

Patent applications arrive at a central receiving office and must pass basic checks to qualify for a filing date. They are sorted by a specialized classification branch that allocates them to one of the art units. Within each art unit a supervisory patent examiner (SPE), who is a senior examiner with administrative responsibilities, looks at the claims and assigns the patent application to a specific examiner. The examiner who has been assigned is responsible for the patent application until it is disposed of (rejected, allowed or discontinued). He then interacts with attorneys and/or assignee. Even though the process is fairly standard and is documented in the Manual of Patent Examining and Procedure,[3] it is highly dependent on the examiner's skill.

The examination of an application begins with a review of legal formalities, and an analysis

[3]See website http://www.uspto.gov/web/offices/pac/mpep/

of the claims. The examiner must judge the application against the relevant technical, legal and commercial information. Therefore, she/he searches for prior art to determine whether the degree of novelty of the innovation deserves to be granted a patent. There is heterogeneity in the prior art search procedure. It begins with a review of existing U.S. patents in relevant technology classes either through computerized tools or by hand examination. The examiner then reviews the material given by the applicant. After reviewing the prior art information, the examiner decides to grant a patent or not. She/he writes a first action letter to the applicant who accepts or rejects the claims. In general, some claims are rejected. The applicant has a certain amount of time to respond. The examiner analyzes the answer and then writes a second action letter. Most applications are allowed or not on the second or third action letter.

Examiners are allocated fixed amount of time for completing the initial examination and for disposal of the application, but they are free to average these time allotments over their caseload.

2.2 Production quotas and career path of patent examiners

Patent examiners are evaluated on their production. Each technology center is expected to review a certain number of patent applications and examiners have a bi-weekly (two weeks) production quotas. They receive "counts" for each action and disposal. The are two possible counts per patent application: a count is the completion of an office action referred to as a new case or a disposal, allowance or rejection. The office actions are written correspondence with the patent applicant. Once the action is approved by a SPE, the examiner receives credit for it. As his career progresses, an examiner is expected to examine more patent applications.[4] Production

[4]The production quotas system is measured by two different equations depending on the experience. The balance disposal (BD) of experience examiners is $BD = (N + D)/2$ and a new hire $BD = (2N + D)/3$ where N is a new case and the first office action taken has with the case, and D is disposal (allowance, rejection or abandonment of the case).

goals depend on the technological field in which the examiner is working and also on her/his position in the general schedule (GS) pay scale. The GS factor determines the experience level of individual examiners.[5] Production goals make the career ladder attractive. In the first year, examiners are evaluated semi-annually and can potentially be promoted twice. To advance to the next GS, an examiner needs to complete more that 100% her/his production quotas. To get to the next step she/he needs to work at a production level of 107%. Each work period is two weeks, but the measure of production comes quarterly for all patent examiners. When an examiner meets all the deadlines on time and with few errors, she/he advances to the next GS level. The highest level on the GS chart corresponds to the level of a SPE who manages an art unit and is the direct supervisor to approximately 15 patent examiners (assistant or primary examiners). The ideal career path of a junior patent examiner is to get promoted twice the first year and then every year, such that after only a few years a junior (assistant) examiner becomes a primary examiner. To gain the title of primary examiner, a junior employee needs to get the signatory authority to sign off her/his own patent application.[6] Once the examiner gains the full signatory authority, she/he can apply for a SPE position.

On top of the promotion to the next step, examiners get bonus if they exceed their production goals by at least 10%.[7] According to GAO (2007), 60% of eligible examiners get bonuses.

Since January 2006, new employees have to participate in a eight month training at the Patent Training Academy (PTA). During the first two months of examinations, new examiners do not have production quotas. Then, they start to have to meet quotas, and these are increasing. At the end of the training each examiner is required to take a proficient test. New examiners

[5] New hires are in general at level $GS-7$ or inferior, whereas experienced examiners are $GS-9$ or above.

[6] After reaching a certain level in the GS scale, an assistant examiner can be tested for partial signatory authority. The test consists in the scrutiny at least 17 patent applications in 6 months. To gain full signatory authority, the examiner needs to spend six more months to process applications and then be evaluated.

[7] If their production goals is above 110%, they get a bonus of 5% of current salary, over 120 it is a 7% and over 130% it is a 9% bonus.

have a two-year probation period during which they must demonstrate their ability to work as an examiner for the USPTO. However, before January 2006, new examiners had only two weeks of training (during which they were introduced to software, and they did acquire a better knowledge about patents). After two weeks, SPEs were responsible to train the new examiners. Therefore, it should be the case that a junior examiner is listed as an assistant examiner for a few years (years in training) before being able to be the primary examiner for her/his own patent applications. After becoming a primary examiner, the experienced examiner should be able to supervise junior examiners. The number of years a junior examiner spends as a trainee is a good measure of her/his performance.

There are many different levels of promotion, as every year an examiner might be promoted. Nevertheless, the ultimate promotion is to become a SPE (or a director of unit), and that is why we do not consider all the ladders as promotion, but only the last one to become a PSE.

2.3 Major changes in the examination process

In their analysis of patent examiners, Cockburn et al. (2002) draw attention to the possible limitations of any empirical analysis concerned with USPTO. Indeed, they emphasized on the fact that examination practices, resources, and management processes have changed over time. According to Gallini (2002), three major changes have affected the U.S. patent system: first, extending patent protection to new subject matter. Second, giving greater power to patentholder in infringement lawsuits. And finally, lengthening the term of patents.

The first change was initiated by the decision Diamond v. Chakrabarty (1980) when the U.S. supreme court extended patentability to genetically engineered bacteria. In 1981, the decision Diamond v. Diehr extended patentability of software, and in 1998, Street Bank and Trust v. Signature Financed Group extended patentability to business methods.

The second change was due to the creation of a specialized court, the Court of Appeals of the

Federal Circuit (CAFC) in 1982, to handle appeals on cases involving patent infringement and validity. It was intended to bring uniformity expertise and predictability to patent decisions.

And, finally, the third major change allows for longer patent lives for some inventions. In 1994, in compliance with the TRIPs agreements, 20 year patent term were adopted by U.S. starting from the date at which the patent application was filed (prior to that change it was 17 years form the issued date).

3 Data and Descriptive Statistics

In this section we present the methodology used to collect data, and to construct the variables of interest. We also present some descriptive statistics.

For our analysis, the data were collected mostly from the USPTO web site. To select a random sample of examiners, we started by gathering information about all of the USPTO examiners who granted U.S. patents on a randomly chosen day, December 19, 1995. A total of 1663 utility patents were granted by 660 different examiners on that day.[8] For each of these examiners we searched for all patents granted in the period 1976-2006, for which the examiner was either the primary or assistant examiner. One important problem we encountered, that is also mentioned in several studies (Cockburn *et al.* 2002; Sampat, 2005), is that the same examiner may appear under several combinations of last, first and middle names. For instance, the middle name may sometimes be omitted, the last name may be misspelled, Jr. or Sr. terms

[8] Although this method creates randomness in the process for gathering information, it is not a perfect sampling method as there may be seasonality effects in the organization's hiring or retirement which may increase or reduce the population of examiners around that particular date more than at other periods of the year. This mainly affects the size of the sample which is not a major issue provided that the size of the collected sample is reasonable. A more problematic issue affecting the randomness of the sample is the fact that there may be greater absenteeism during that particular time of the year but we believe that the effect is likely to be small as it is far enough from the big holiday period.

may sometimes be omitted and women may also change names as they get married.[9] One rule of decision we decided to adopt was, for non-common names, to omit the middle and first names and search for patents that correspond to the last name. Then, we compared the number of patents obtained under that search to the number of patents granted by the examiner if we searched for patents with the complete name (first, middle and last name). Whenever the difference between the two numbers was small, we just assumed it was the same person and decided to count all of the patents. Otherwise, we would refine our search by including first name as well. To define whether a last name is common or not, we looked at how many examiners with a particular name are currently working at the USPTO. It gives an idea of the scarcity of a name. For instance, Smith is a very common name whereas Bartuska is not. All those data have been checked by hand, and every time there were a discrepancy between the number of patents for apparently the same examiner, we checked carefully by hand whether different examiners had identical names. After ruling out name problems, we obtain a sample of 652 examiners.

For this sample of examiners, we retrieved information about the number of patents they have granted as primary and assistant examiner and we gathered specific information for each examiner's patent. Therefore, we have collected two kinds of data: data at the examiners' level, and for each examiner, patents data. At the examiners' level, we are concerned with knowing for how long each examiner has been working at the USPTO, if she/he is still working there, when she/he stopped granting patents, how many patents have been granted as primary or assistant examiner. At the patent's level, as a starting point we are using Hall *et al.* (2001) data until 2002 and we complete our own data set for the period 2002-2006. We thus restrict our analysis to variables similar to Hall's variables. We are planning to add more variables that are not currently including in Hall dataset.

[9] The name problem is actually an important one that is carefully treated in Trajtenberg, Shiff and Melamed (2006) concerning inventors' names.

On September 19th, 2006, the end date of our sample, we checked whether each examiner was still working at the USPTO. We accomplished this task by looking at the USPTO roster on September 2006, and checking whether and which examiners were still working for the office. This piece of information is very useful as it allows us to define if an examiner who had stopped granting patents, let say, in January 2001, is still working at the USPTO but is doing another task, or left the USPTO sometimes between 2001 and 2006. Therefore, we are able to identify "leavers" – those who stopped to grant patents between 1995 and 2006 and are no longer working for the USPTO, and "stayers" – those who were still working for the USPTO on September 2006.

The information we currently have for the leavers is the date at which they stopped granting patents, and the fact that they are not working at the USPTO in the end date of our data, which is 2006. However, we do not know whether they stayed employed at the USPTO and changed of duty during the time they have stopped granting patents and 2006. For the time being, we are only aware of the fact they were gone in 2006, we do not know exactly when they left. In the future, we are planning to obtain USPTO Employee directories for several years and then check when they left to have a better idea of their career path.

For the stayers, we checked whether they were still granting patents in 2006 and if not, when they stopped, by using the year of the last granted patent. We call "job changers" within the organization, the examiners who stopped granting patents at some point in time between 1995 and 2006 and identify the year at which it occurred, but who were still working for the organization in 2006. The job change is likely to be a promotion to a managerial position. For instance, an examiner might have been promoted and is now a SPE (supervisory patent examiner) or a director and, therefore, is responsible for an entire team of examiners. However, it may also be the case that an examiner changed of job within the institution (e.g., office of petition, board of appeal) and we are not sure whether it was a promotion or, on the contrary, a demotion. For the stayers we also collected information about the art unit where they worked

in 2006, which is correlated to the technological field in which they were granting patents if they were still granting patents.

For all the examiners we collected additional information about whether they have been assistant, for how long and how many patents they have granted as assistant. This information is essential to accurately determine the entire tenure at the USPTO. Examiners start as assistant which is equivalent to being in training under the supervision of a senior primary examiner. They are assistant until they obtain signatory authority, date at which they become primary examiners. This is used as a proxy for a measure of performance, more particularly the talent of an examiner. Talented examiners should climb the ladder quickly and should not stay assistant more than a few years. However, because our data are left-censored at 1976, we do not have the information about training for the most experienced examiners (who have been at the USPTO in 1976, which is the beginning date of our dataset). In our preliminary empirical analysis we remove all the examiners that have been granting patent in 1976 and have not been assistant at all. In the future, we are planning on breaking the experience into different levels.

Concerning the information about the characteristics of patents, we use some of the variables defined in the dataset of Hall *et al.* (2001). For each patent, we obtained the filing date and granting date (the difference between filing and granting dates allows to determine how long it takes to grant the patent, or pendency time), the current U.S. classification (using the 6 categorizations and 35 sub-categorizations of Hall *et al.* 2001), the number of claims, the references cited (U.S. patents, non U.S. patents and others), which we use to construct a backward citations index, the citations received that we use to construct a forward citation index, the names of innovators, country of innovators, assignee, assistant examiner, attorney that files the patent application. For the moment, we do not use all of the gathered information, in particular we do not use the variables that contain names. The names information will be coded and cross-checked across patents to identify correlations between examiners and innovators and

innovators and attorneys due to possible non random assignment of patents to examiners. We believe that if such correlations exist, it may have an effect on mobility outcomes. As a starting point we use similar data (as for instance filing year instead of the entire date that gives a more precise pendency time of we calculated it in months), and we do not account for some variables such as assistant examiner, and attorney.

Table 1 summarizes the variables at both examiners and patents levels.

The current sample contains 652 examiners and 1,485,006 granted patents as primary and assistant examiner (the majority of the patents were granted by primary examiners, 1,339,245). On average, each examiner in our sample has granted about 2054 patents as a primary examiner (with a standard deviation of 1553), with a minimum of 8 patents and a maximum of 15,466 patents. On average each examiner granted 223 patents as an assistant, with a minimum of 0 and a maximum of 1,283. Because our data are left-censored, the minimum of 0 patent is most likely attributed to examiners who were already working in 1976, and had probably been assistant before that date. In the empirical analysis we do not consider these examiners. On average an junior examiner stays assistant for about 4 years, with a minimum of 0 and a maximum of 20 years. The minimum of 0 year is again due to our left-censored data, but the maximum of 20 years is a bit more puzzling as examiners are supposed to become primary examiners before 20 years.

In 2006, in our sample of 652 examiners, 244 were not working at the USPTO anymore, 265 were still granting patents as primary assistant, 102 had been promoted (they may still grant patents or not, and they became director or SPE), and 41 changed of duty. We account for a total of 92 supervisory patent examiners (SPE), some of them are still granting patents as primary examiner (and they probably supervise junior assistants), and others do not grant patents anymore. For those who had been promoted and do not grant patents anymore, we calculated when she/he became a SPE, and after how many years of working for the USPTO.

On average, an examiner changes of job within the institution only after a few years (average of 3.02 and a standard deviation of 2.67). Again we do not have information about examiners who became SPE and are still granting patents, when did they became SPE. We exclude SPE who are still granting patents.

We know that the examiners in our sample were working at the USPTO on December 1995, some may have just started whereas other may have been granting patents for years. In 2006, all the examiners that were still granting patents had been there for at least 11 years. We can represent the distribution of performance (as the number of patents granted as primary and assistant examiner) of the examiners in Figure 1. We find a similar distribution of patent examined per examiner as in Cockburn et al. (2002) suggesting our sample and theirs are equivalent. We also represent the number of patents granted as assistant examiner in Figure 2. Only a few assistant examiners have been granted more than 500 patents as an assistant.

For the leavers, we determined after how many years they left the USPTO, or in other words their tenure. On average, examiners leave after 20.02 years (standard deviation of 6.65), with a minimum stay of 1 year and maximum of 30 years. Our database starts only in 1976 and, therefore, those who stayed 30 years may have stayed even longer, and probably got retired (or died). Thus, the maximum of 30 years corresponds to the maximum number of years available in the data set of the USPTO. Overall, examiners tend to stay a long period. Only 9 of them left before 10 years at the USPTO. We should be able to determine after how many years at the USPTO an examiner is efficient, and then calculate how many of them left when they were supposed to be the most efficient (corrected by their productivity in term of how many patents per year they grant).

In summary, in September 2006, about 37.5% of the examiners in the sample had left the USPTO, 40.5% were still examiners and 15.5% had been promoted (they became SPE or directors and some of them are still granting patents). The remaining 6.5% have changed of

duty. The distribution of examiners who are still working for the USPTO and those who left in function of the number of granted patents per year is represented in Figure 3.

We cross our data with the data of Hall *et al.* (2001) to use the six technological fields they have identified, and the corresponding subcategories. Technology category 1 corresponds to chemical, category 2 to computers and communication, category 3 to drugs and medical, category 4 to electrical and electronic, category 5 to mechanical and category 6 to others. For the examiners who were still working at the USPTO in 2006 we can determine in which field they were working by looking at the art unit in which they were employed. For examiners who are gone, we need to perform a careful analysis of their patents to be able to determine their field of expertise. To start our analysis, we consider the 15 last patents granted by each of the examiners that are gone, and then we link these fields to the technological fields determined by Hall *et al.* (2001). We represent in figure 4 the distribution of examiners per technological category, where we use the six digit classification of Hall *et al.* (2001). Examiners are spread over the technology categories, and even though category 5 (mechanical) seems predominant, examiners are granting patents in all of those categories (see figure 5).

4 Methodology, Variables and Empirical Framework

We describe the empirical framework for our analysis of the determinants of mobility.

The net benefits of mobility are not fully observable and measurable, instead we observe the outcome of mobility. We define mobility outcome by a discrete variable that can take five different values. It takes the value 0 if the individual remained an examiner who was still granting patents at the USPTO on September 2006. It is equal to 1 if the examiner was no longer working at the USPTO by that same date because he had left the organization some time between 1995 and 2006 (we do not have information about the year at which he left, we just know that the person was gone by 2006). It is equal to 2 if the individual was still at the USPTO

on September 2006 but had stopped granting patents and moved to a job with administrative duties. We call this outcome a "change of task" as we cannot tell from the title of the new position whether it is a lateral move, a promotion or a demotion.[10] The mobility outcome is equal to 3 if the individual had become a SPE but was still granting patent on September 2006. Because some SPEs were not granting patents, we have decided to separate these two kinds of individuals even though they all have been promoted. Therefore, we denote by 4 the outcome mobility if the individual was a SPE in September 2006 and was no longer granting patents.

We are interested in analyzing the effect of examiners and patent characteristics on mobility outcomes. Given the five possible outcomes (no changes, left the organization, change of duties, promotion but still granting patents, promotion to management), we use a multinomial estimation framework. In the future, after completing the longitudinal part of the data in terms of the patent characteristics per year (from 1975 to 2006) and mobility outcomes per year (from 1995 to 2006), we will be able to analyze the dynamics of mobility using a hazard model framework.

The patent characteristics provide information that is specific to the year the patent was granted and goes back to 1976 when the data were first made available. We are currently still working on the collection of patent characteristics. Once this is done, we will be able to construct a longitudinal sample with information on examiner mobility, experience, number of patents granted and average characteristics of granted patents on a yearly basis from 1995 to 2006.

For now, as a preliminary analysis of mobility, we exploit the cross-sectional information about examiners mobility, experience in terms of the number of patents granted and in terms of tenure at the USPTO as assistant examiner and primary examiner, and the technological

[10] Some of the new titles involve the board of patent appeals and interferences, search and information resources and administration, international liaison staff, office of patent quality and training, office of patent legal administration, or simply indicates the name of the technology center in which the individual has been newly assigned.

field. We obtain the technological field information from the art unit in which the examiner works if she/he is still at the USPTO in September 2006. Otherwise, we use the current U.S. classification that is the most common among the last 15 patents examined by the individual prior to his stopping granting patents and leaving by 2006. We refer to Hall *et al.* (2001) to constructs dummies for the six one digit technological fields they identified.[11]

We use the following specification for the likelihood of mobility outcomes:

$$P(Mobility = k) = f[\beta_{0k} + \sum_{j=1}^{2}(\beta_{1jk} Tenure_j) + \sum_{m=1}^{6} \beta_{mk} TechCategory_m * P_2 + \beta_{7k} P_1] \quad (1)$$

where f is the multinomial distribution, $j = 1$ for assistant examiner and 2 for primary examiner and P_j is the number of patents granted per year of tenure at the USPTO as an assistant ($j = 1$) and as a primary examiner ($j = 2$). We use STATA to perform the estimations. We also plan to add quadratic functions of tenure as we suspect that tenure effects may have differential effects at the beginning and toward the end of an examiner's career.

5 Preliminary Results

The basic question addressed in our preliminary analysis is whether the determinants of the mobility have different effects on mobility outcomes. Our findings provide support for that perspective. The effects depend on the characterization of the skills of the examiner and are different depending on whether the examiners have been promoted within the organization, or have left the USPTO by 2006.

We define the skills of examiners by using measures of experience and performance. The number of years an examiner has spend as a primary examiner (tenure as an experienced examiner) is a measure of her/his experience. We characterize the number of granted patents per

[11] Note that the categorization was established in 2001 and by 2006 new fields have emerged. We have a few examiners associated with new classifications but it is too small to be considered a separate category so we dropped them for now.

year as a primary examiner as a measure of performance and, in particular, a measure of effort for an experienced examiner.[12] We also provide other measures of performance, in particular the talent, as the number of years as an assistant examiner (which corresponds to the tenure in training), and the number of patents per year as an assistant examiner. This last measure of talent is also a measure of the first promotion. Indeed, going from assistant examiner to primary examiner corresponds to the very first promotion of a patent examiner as she/he is becoming independent, and has the authority to sign on her/his own patent applications.

Our findings indicate that, whenever significant, tenure always decreases the likelihood of promotion or change of task. The longer an experienced examiner has stayed at the USPTO as a primary examiner, the less likely she/he is going to change of task (e.g., administrators, or work at the board of appeal). The change of task might be seen as a lateral change, but we do not have enough information to judge.

Effort and talent each influence differently the mobility outcomes. Talent, as being the tenure as assistant examiner, has a significant and strong effect on promotion within the organization. The shorter time an examiner spends as an assistant examiner, the more likely she/he is promoted. This is consistent with the literature on fast-tracking where individuals who get their first promotion more quickly typically spend less time before getting their next promotion.[13] Talent measured by the number of granted patents per year as an assistant examiner has a significant but small effect on the outcome *left*. The more patents are granted as an assistant examiner, the more likely the examiner leaves. In other words, the more talented a junior examiner is, the more likely she/he will leave the institution at some point.

Our findings also suggest that the technological field has a significant effect on promotion

[12] We have to be cautious here, as experienced examiners might be responsible to supervise several junior examiners. Therefore, they can get the benefits of many patents even though most of the work has been done by the assistant examiner.

[13] See, for instance, Gibbons and Waldman (1999).

within the institution. This is the case for the following fields: drugs and medical, electrical and electronic and mechanical.

We also consider the marginal effects. We re-scale appropriately our data to have more pronounced effect. If we increase by 100 the number of patents as assistant, we increase by 5% the probability of leaving.

Overall, our preliminary results suggest that the effects associated to being a primary examiner tend to influence internal promotion, whereas the effects of assistant examiners tend to have an impact on exterior promotion.

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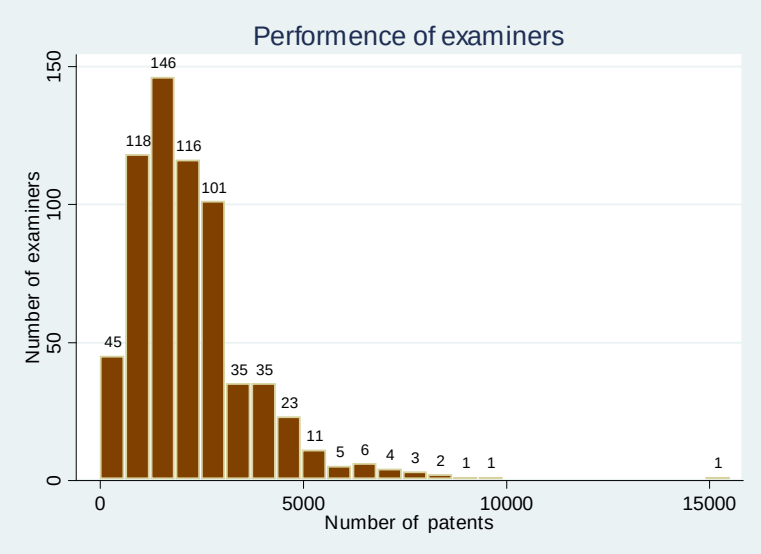

Figure 1

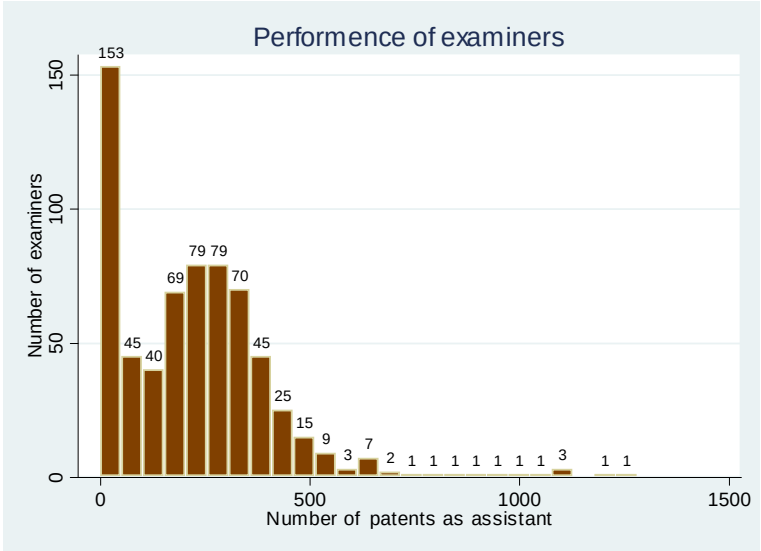

Figure 2

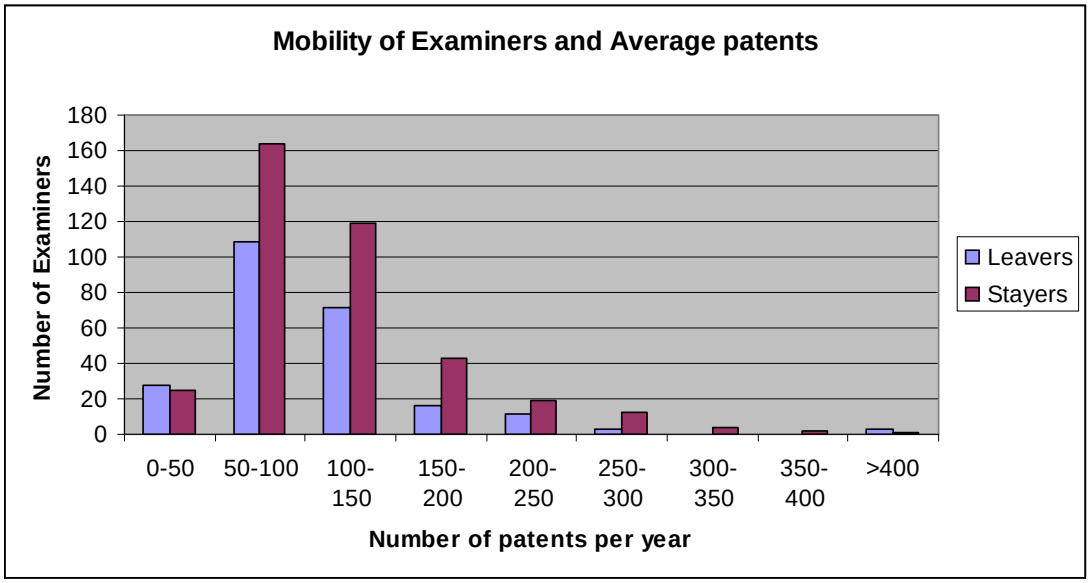

Figure 3

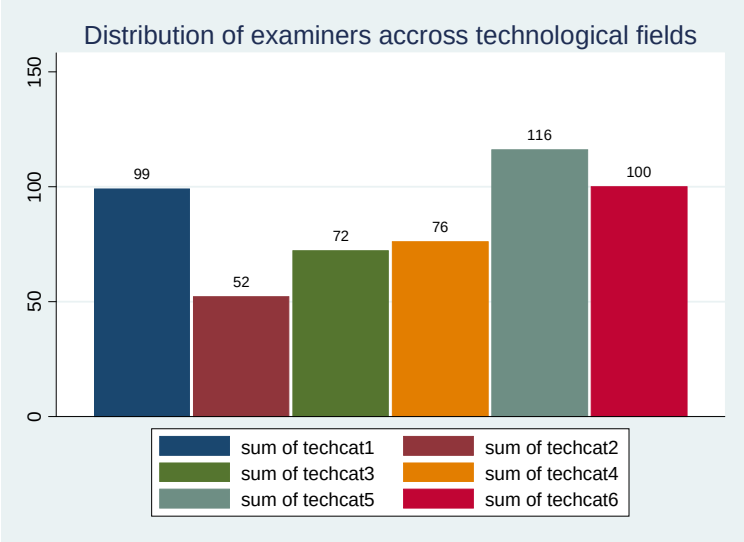

Figure 4

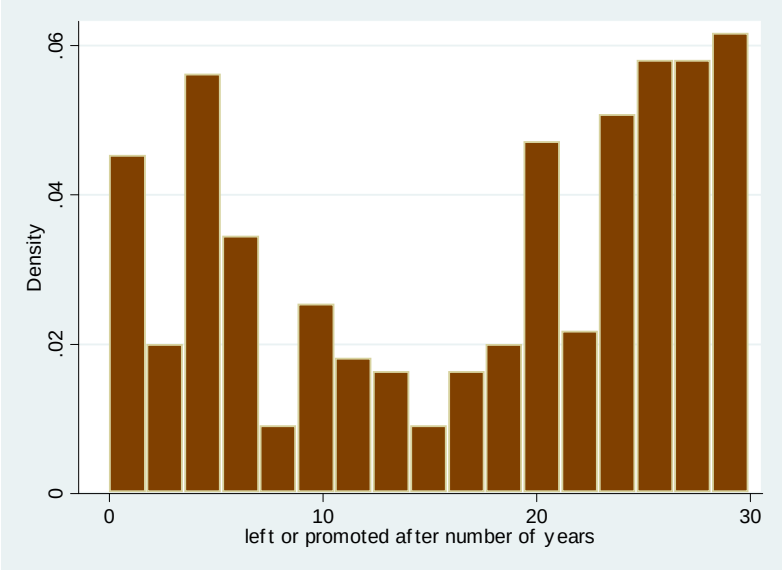
Density
0
.02
.04
.06
0
10
20
30
left or promoted after number of years

Table 1: Variables and Definitions

Variables	Definitions
Examiners	
Mobility=k	$k = 0$ Stayer and still grant patents
	$k = 1$ Leaver
	$k = 2$ Stayer and job changer
	$k = 3$ Stayer, promotion and grant
	$k = 4$ Stayer, promotion, does not grant
Patentprim	Number of granted patents as primary examiner
Patentassist	Number of granted patents as assistant examiner
Tenureprim	Tenure at the USPTO as primary examiner
Tenuretot	Total Tenure (assistant + primary)
Artunit	Art Unit where the examiner works in 2006
CurrentOccup	Current Occupation in the organization (SPE, Administration...)
Class	Hall Classification of Technological field
Patents	
ID	Patent ID
IDEXAM	Examiner ID
Gdate	Granting date
Filingdate	Filing date
Claims	Number of claims
NClass	Hall classification
Subclass	Subclass
BackwardCitation	Citations made
ForwardCitation	Citations received

Table 2. Sample Statistics

Variable	Mean	Std Dev.	Min	Max
Mobility				
No Mobility	0.46		0	1
Left	0.29		0	1
Change Duties	0.07		0	1
Promotion Still Granting Patents	0.13		0	1
Promotion No More Granting Patents	0.05		0	1
Experience				
Tenure (Years) as Primary Examiner	16.07	6.52	0.5	30.33
Tenure (Years) as Assistant	4.73	2.36	0	19.58
Patents Granted per Year As Primary Examiner(/100)	1.11	0.66	0.06	6.57
Patents Granted per Year As Assistant(/100)	0.708	0.066	0	46.32
Technological Fields				
Category 1	0.20		0	1
Category 2	0.09		0	1
Category 3	0.13		0	1
Category 4	0.15		0	1
Category 5	0.22		0	1
Category 6	0.19		0	1
Number of Examiners		512		

Table 3. Effect of Examiner Characteristics on Mobility Within and Out of the Organization

Multinomial Logit Marginal Effects

	Left	Change Duties	Promotion Still Granting	Promotion No Granting
Tenure as Primary Examiner	-0.003	-0.007***	-0.003	0.000
	(0.004)	(0.002)	(0.002)	(0.001)
Tenure as Assistant	-0.019	-0.008*	-0.009	-0.002
	(0.014)	(0.005)	(0.007)	(0.003)
Patent/Year as Primary*Tech Cat 1	-0.097	0.014	0.161***	0.034
	(0.084)	(0.030)	(0.035)	(0.027)
Patent/Year as Primary*Tech Cat 2	-0.111	-0.076	0.209***	0.018
	(0.089)	(0.051)	(0.041)	(0.035)
Patent/Year as Primary*Tech Cat 3	-0.065	0.033	0.200***	0.078***
	(0.106)	(0.031)	(0.046)	(0.024)
Patent/Year as Primary*Tech Cat 4	-0.116*	0.027	0.159***	0.059***
	(0.073)	(0.025)	(0.029)	(0.017)
Patent/Year as Primary*Tech Cat 5	-0.091	0.015	0.137***	0.053***
	(0.068)	(0.025)	(0.032)	(0.018)
Patent/Year as Primary*Tech Cat 6	-0.010	0.029	0.119**	0.025
	(0.102)	(0.020)	(0.053)	(0.021)
Patent/Year as Assistant	0.043**	-0.012	-0.042	-0.021
	(0.021)	(0.021)	(0.040)	(0.029)
Log Likelihood	-602.81			
N	512			

Notes-***: significant at the 1% level, **: at the 5% level, *: at the 10 % level.