August, 2013

Master Thesis

Internal Migration of the U.S. inventors:
A long-term study.

Urszula Topolska

Student number: 372199

Supervised by: Ajay Bhaskarabhalta

Co-reader: Bas Karreman

Abstract

The steady decline in internal migration in the United States has recently been reported by several scholars (Molloy et al. 2011). These findings are potentially worrying, since the drop in internal migration may have a severe impact on the national economy through the disturbed flexibility of the labor market. This paper aims to contribute to the state of knowledge on declining mobility in the United States. It focuses on inventors that received at least one patent at the US Patent and Trademarks Office, as their mobility is regarded as a possible source of knowledge spillovers (Almeida, Kogut 1999) and therefore has a twofold effect on the economy, since it not only affects the flexibility of the labor market, but also indicates how knowledge spreads among firms. Hence, changes in the migration behavior of the inventors may have serious consequences for the economy's well-being, which makes this study particularly important. Currently, little is known about the internal mobility of highly skilled workers in the U.S. Thus, the objective of this study is to reveal the migration trend of the inventors and shed more light on the economic- and legal-related factors that may influence it in the long-term.

The main findings of this paper confirm that, indeed, the trend of internal migration of inventors in the U.S. is declining in consonance with the overall internal migration trends. The probability of inventors deciding to migrate has decreased consistently over time, for any type of migration (across states, regions, cities, and companies). This paper discusses the possible factor(s) which gradually affected the internal migration in the U.S. over time. Moreover, this study points out the additional hypotheses in relation to the cause of the downward trends in migration that ought to be tested in order to better understand what happens with mobility in the American society, particularly among inventors.

Contents

List of tables

List of figures

Introduction

There have been numerous studies on the subject of migration. Scholars examined questions such as the characteristics of people who move, as well as why, where, and when they move. Besides studies on the migration demographics, many studies were conducted to explain the consequences of migration flows, i.e. how migration affects the destination region and the source region (e.g., relating to changes in the labor markets).

The main focus of migration studies is directed at an international level, whereas little is known about internal movements of the labor force. Moreover, cross-country studies in the field of migration document results which are difficult to compare due to different national migration policies. The methodology of collecting migration data also differs considerably among countries, thus results can be difficult to compare across studies. Hence, it seems attractive to look at migration from a within-country level to more accurately answer questions about the characteristics and motives behind migration, free from between-country differences in policies.

Furthermore, a question on migration might be asked in regard to a specific group of the population, like the youth, or the refugees. In this paper, a case on the migration of inventors is examined. Inventors are a unique group of highly-skilled workers who are assumed to be one of the main sources of knowledge spillovers (Almeida, Kogut, 1999). When they migrate and change their employers, they transfer tacit know-how to a new firm. After a change of employer, inventors rely on formerly obtained experience, from which they may build upon while working on new inventions.

Very little is known about the specific migration behavior of inventors. The majority of papers on the topic of mobility have focused on management and organizational perspectives. These papers investigate to which extent migrating inventors are the sources of knowledge spillovers (Breschi, Lissoni 2009; Kim et al. 2006, Song et al. 2003; Moen 2000; Almeida, Kogut 1999), but they do not focus on the migration motives. On the other hand, there are rare examples of studies in the field of the labor economics that try to investigate the possible reasons for the migration behavior of inventors. Not many of these papers deal with the internal migration. A combination of two of the above perspectives, i.e. internal migration of inventors and its motives,

is rare to find in the academic literature[1]. Since previous studies have revealed very little about the internal migration of inventors, this research aims to shed more light on the intersection of within-country migration and determinants of inventors' migration, based on the United States example.

The United States are the mill-run example of a country where the mobility of the labor force and the immigration of highly skilled workers had a significant impact on the economy throughout decades. Furthermore, the American society is considered to be the most mobile country of the world. As a consequence of globalization processes, which took place throughout the 20th century, transportation and communication were significantly developed and it became more plausible for individuals to migrate. Also, new forms of migration have emerged, for instance *brain drain*[2]. These phenomena affected the labor force mobility in the U.S as well. All of the above facts are making this study of internal mobility in the U.S. particularly interesting, especially regarding the mobility of inventors.

Much has been said about migration in terms of its characteristics. However, little is known about its actual dynamics. Recent findings indicate that the internal migration in the U.S. is decreasing in the last few decades (Molloy et al., 2011). This research paper attempts to identify changes in the inventors' migration behavior in the U.S. There are a few preliminary questions that ought to be answered in order to correctly explain what happens with the migration of inventors. The first question is: what are the characteristics of the migrating individuals in this study? The answer for this question is already partly defined since it has been established that the focus group of this research consists of highly-skilled and educated researchers. The following questions that help to investigate the migration of inventors are: how do migration patterns change over time, from where to where do they move (i.e. origins and destinations) and what are the motives of migration flows? Also, is the inventors' internal migration rate declining along with the rate of internal migration in the U.S.?

This paper aims to answer all of the above questions using datasets of patent applications and patent grants, from the US Patent and Trademark Office, to track the migration behavior of U.S. inventors. In the empirical part, the probability of inventors moving across regions, states, cities, and employers is estimated within a period of 1975-2012. The main results indicate that the

[1] For example, Dahl, Sorenson (2011) examined the internal migration of technical workers in Denmark
[2] Brain drain – migration of highly-skilled labor force from developing to developed countries

migration rate of the U.S. inventors is consistently declining for any type of migration movements (i.e. inter-state, inter-region, inter-city, and inter-firm). Moreover, even though inventors are considered more mobile than an average U.S. citizen, their migration rate follows the general migration trend in the United States. The decline in migration happens gradually over time. Additionally, the migration patterns are not influenced by any specific regional characteristics, so at a national level the regional patterns seem to be alike. These statements lead to the conclusion that the cause of a decline in migration should be found at a national level.

The paper processes as following: in Section 1 prior accomplishments in literature are analyzed. Section 2 provides the insight in the methodology and the data characteristics that are applied in this paper. In Section 4 descriptive statistics and empirical results are presented and Section 5 presents conclusions and topics for further discussion. Finally, the paper is concluded with a list of references and a collection of relevant appendices.

Literature review

In this section prior literature from the field of migration is analyzed. Firstly, it is crucial to establish the terminology. In this paper the term migration is frequently used, although in the literature it is possible to encounter another term, mobility. Both terms refer to the movements of individuals and in general share the same meaning. Migration itself is a broader term than mobility and it does not apply exclusively to human movements. Mobility has a narrower definition and it refers to the human ability to move (Oxford Dictionary of English, 2010). Both terms may occur further in the paper and they are treated as synonyms, although in academic literature it is more common for management science to use mobility, and for economics science to use migration.

In the academic literature there are two main branches studying the movements of people. The first one is a branch stemming from the labor economics and demographics sciences. The term migration is mainly used while referring to moves of people within regions, or across them. This part of literature is, to great extent, focused on individuals' motives to migrate and economic consequences of the labor force allocation, for both source and destination regions. The second branch originates from management and organization science and refers mainly to the mobility of

workers and the diffusion of knowledge. The literature from this branch focuses on how the mobility of technical workers creates knowledge spillovers.

The literature from the migration branch is based on a few theoretical concepts, but none of them is commonly accepted by the academic society. For instance, many authors follow a concept of pursuing better economic opportunities as one of the migration stimulants (e.g. Molloy et al. 2011; Borjas 1989). Some papers mention pursuing social opportunities as a determinant of migration, next to the economic opportunities (Dahl, Sorenson, 2010; Chen, Rosenthal 2008). The above concept stems from neoclassical migration theory and suggests that individuals move between places to maximize their economic net benefits, e.g. wages (Harris, Todaro 1970). The additional social motives come from Stark and Bloom's theory (1985) and are known under the term of the new economics of labor. There are also newer theoretical approaches, Mayda (2010) for instance follows the dual labor market theory which views institutional factors, like migration policies, as a main factor of influence in regard to migration decisions (Castle, Miller 2009). A more rare approach is adopted by Saks and Wozniak (2010), who regard a model of migration as a sequential problem. This approach refers to the limited information that migrants have before moving, e.g. about wages.

Within the economic migration theory there are two relevant concepts, *positive sorting* and *positive selection.* These concepts are closely related to inventors, as they are highly-educated individuals (Grogger, Hansons, 2011; Egger, Radulescu, 2009; Hatton, Williamson, 2006; Chiquiar, Hanson, 2002; Borjas, 1989). . *The positive selection phenomenon* says that better educated individuals are more likely to emigrate compared to lesser educated individuals. *The positive sorting phenomenon* says that well educated migrants are more likely to settle in destinations with a high reward to skill[3]. It means that highly-skilled employees tend to move to a region where their skills are more financially appreciated, and they tend to remain there.

The literature from the management field is built around three different kind of concepts, all of them different than the concepts stated above. Management studies often follow discussions

[3] There are regions which differ by rewards to skill and this difference may stimulate migration, i.e. if there are significant discrepancies in the education level of individuals in a region and highly-skilled individuals will obtain relatively higher benefits than unskilled, it is less likely for the highly-skilled to migrate; on the other hand, if individuals live in a region with where returns to skills are alike among the society members, it is more likely for them to migrate; Borjas 1989

over diffusion of knowledge. Mobility of the highly skilled labor force is considered as one of the sources of knowledge spillovers (Breschi, Lissoni 2009; Kim et al. 2006; Song et al. 2003; Moen 2000; Almeida, Kogut 1999). Inventors are those who generate and master new knowledge and their mobility stimulates the mobility of knowledge that they own. Some articles from the mobility branch also follow agglomeration economies theories (e.g. Freedman 2008) and point that the inventors' flows are intensified between industry clusters. There are also authors who combine the agglomeration economy theories with human capital concepts, which suggest that people move between clusters to find both employment and a salary that are in line with their education and experience level (Fallick et al. 2006). Additionally, there are publications that are based on the push and pull theory (Thorn, Holm-Nielsen 2006). This theory refers to factors that differ between developing and developed countries. Some of these factors may *push* researchers from their origin country and some may *pull* them to developed country with higher benefits.

The academic literature differs not only by applied theoretical framework, but also by the research characteristics, i.e. applied time-perspective, data, focus group, and the cross- or within country level of analysis. The most common research characteristics of prior literature are described below.

Considering a time perspective, studies on migration and mobility comprise mainly of short-term analyses (e.g. Dahl, Sorenson 2010, Moen, Fallick et al. 2006). However, there are examples of articles which examine migration using the long-term perspective (Molloy et al. 2011; Saks, Wozniak 2011; Kim et al. 2006). Time perspective seems to be important since short-term factors do not always accurately explain trends in migration (Molloy et al. 2011).

The empirical results from the migration and mobility literature are calculated based upon information from a few commonly used datasets. Obtaining migration data is linked with some limitations. Firstly, long-term data (covering a few decades) at the national level is only possible to obtain from Census Bureaus. The Census Bureau conducts a national demographic survey directed to the whole population each 10 years. In the information collected by the Census Bureau there is information about the migration of citizens. Although the national census data is available for many decades, the data lacks information about in-between moves, thus little is known about what happens to the migrants between the many years of each survey. On the other hand, it is also possible to find data released at yearly bases (e.g. Current Population Survey, American

Community Survey), but the data is collected from a sample of the population (Molloy et al. 2011; Saks, Wozniak 2011; Fallick et al. 2006; Fallick, Fleichaman 2004).

Regarding the research focus, scientific papers focus on whole populations of certain countries, or they test migration based on the samples of populations (Saks, Wozniak 2011; Molloy et al. 2001; Mayda 2010; Chen, Rosenthal 2008; Fallick, Fleichman 2004). Although general groups are more commonly used by researchers, there are still some publications that focus on migration of specific individuals, like highly-skilled workers (Dahl, Sorenson 2010; Egger, Radulescu 2009; Breschi, Lissoni 2009; Kim et al. 2006, Moen 2000; Docquier, Marfouk 2004; Almeida, Kogut 1999). The literature on mobility deals mainly with the migration of skilled workers, whereas the literature on migration frequently investigates the migration of general populations, since it is a phenomenon that affects the economy as a whole.

As mentioned before, many studies have been conducted at the cross-country level (Mayda 2010; Kim et al. 2006; Thorn, Holm-Nielsen 2006). Although this perspective attracted more attention, there are also examples of internal migration studies (e.g. Molloy et al. 2011; Dahl, Sorenson 2010). There is a certain advantage of conducting a within-country analysis, since it is possible to compare results of the analysis between different regions without the bias of the migration policies, which might appear at the international level (Molloy et al. 2011).

Based on the above concepts, theories and approaches, researchers tried to answer varied questions about migration and mobility. One problem which is commonly studied by the literature on migration is the cyclicality of migration movements (Molloy et al. 2011; Saks, Wozniak 2011; Fallick, Fleischman 2004). This is also of great importance for this paper since this research focuses on a long-term trend in the migration of inventors. It is assumed that the long-term trend might be procyclical and follow economic business cycles which would mean that migration stagnates, or declines during recessions and increases around booms.

Molloy et al. (2011) questions the procyclicality of the migration trend and presents figures that depict a constant decline in internal migration in United States since 1980 to 2009 in his paper. Molloy et al. (2011) suggests that a factor behind the decline in migration has affected a large share of population. The factor might be linked with: an increase in the cost of moving, changes in wages, or changes in other benefits from allocation, like taxes. The author concludes that a business cycle is unlikely to be the main explanatory of a drop in migration, since recent recession

at the end of 2007 was preceded by earlier decline in migration rate. He also indicates in his research that differences in individuals' characteristics are not able to explain a long-term drop. Molloy et al. (2011) finds that a role of unemployment and housing cost, as determinants of migration, is marginal.

Similarly, Saks and Wozniak (2011) investigate the labor reallocation over the business cycle from the internal migration perspective. Based on migration theory, they assume that there are three motives of migration, i.e. spatial differences in economic opportunities, personal motives, and preferences towards local amenities. Although the authors find personal motives relevant, they are unrelated to the business cycle and they are therefore omitted in the analysis. Saks and Wozniak (2011) examine the net benefits of an individual as the forces that are driving the aggregate fluctuations in economy. More importantly, they presume that internal migration is correlated with fluctuations in the business cycle at a national level, and not a regional level. Their results indicate that internal migration in the U.S. is positively related to national business cycles. They also show that the net benefits from migration increase during economic booms. Although they find the migration trend to be procyclical, they point out that the Great Recession in 2007-2009 was characterized by a drop in migration before it took place. Additionally, they find that younger workers follow more procyclical migration patterns than older workers. They, likewise Molloy et al. (2011), find no role of housing costs and employment.

The third study concerning cyclicality is focused on the job-hopping phenomenon in the United States (Fallick, Fleischman 2004). The authors examine the procycliality of employer-to-employer flows and they find that employer-to-employer flows are only procyclical around periods of recession.

The second relevant problem regarding migration is the decline of migration in the United States. Molloy et al. (2011), as one of few, reports that the internal migration in the United States is falling since the 1980s. Apparently, the problem of declination does not obtain enough attention from the academic world. This study aims to contribute to the state of knowledge about the falling trend in mobility, examining the migration of inventors. The mobility of inventors is important for the national economics for two reasons. Firstly, mobility indicates how flexibly the supply of labor adjusts to the demand on the market (i.e. how flexible the economy is). Secondly, mobility of inventors, as one of the sources of knowledge spillover, reveals how knowledge spreads in the

economy. Hence, a decline in the mobility of inventors is of high importance for the economic world and policy makers.

There are only a few studies that deal with the topic of long-term dynamics in the skilled labor force mobility. Studies of Docquier and Marfouk (2004) and Defoort (2008) focus on the migration trend of skilled employees in a long-time perspective. The first paper concentrates on increasing international *brain drain* and analyzes the phenomenon of the international migration of skilled workers in different regions of the world. The second paper is aimed at studying the long-term international migration trend. The author finds out that the emigration of highly-skilled individuals is characterized by an upward trend. Unfortunately, both studies do not explore the migration of skilled workers at an internal level.

On the other hand, the inventors' internal migration rate may possibly follow the internal migration trend presented by Molloy et al. (2011). Not only is the state of knowledge about internal migration of inventors limited, but its foregoing findings are also contradicting and inconclusive. The limited state of knowledge about the dynamics of skilled-labor force migration at the internal level demands further investigation.

The literature on the subject of migration mentions a few factors that may influence migration behavior, i.e. (1) differences in taxed income, (2) level of educational attainment, (3) non-compete laws. Egger, Radulescu (2009) suggest that net wages are a better indicator of the migration decisions for highly-skilled workers than gross wages, since the same income in two different regions may be taxed by dissimilar rates. The income tax rate is used further in empirical part as one of independent variables, since it is considered a more accurate explanatory variable than gross wages. Another factor that might influence migration is a level of educational attainment. It is frequently pointed that highly-educated (as inventors are assumed to be) have on average higher migration rate (Molloy et al. 2011; Grogger, Hanson 2011; Egger, Radulescu 2009; Hatton, Williamson 2006; Fallick et al. 2006; Borjas 1989). Fallick et al. (2006) examines the Silicon Valley case and refers to the state law about the non-compete agreements as a possible explanatory of the intensified job-hopping. In the state of California non-compete laws are unenforceable, and therefore employees can change companies without restrictions. In other words, non-compete agreements might be considered as a barrier to mobility of workers.

This paper aims to contribute to the current state of knowledge and shed a light on the internal migration of inventors in a long-term perspective (1975 - 2012). The stress in this paper is put on economic- and legal-related factors (e.g. income tax rate, mortgage deduction rate, unenforceability of non-compete laws) that might have influence the motivation of inventors to migrate. At the same time, state- and time-specific effects are controlled. Moreover, this paper is the within-country analysis and remains free of distortion in migration policies. This study follows a theoretical framework presented before in the prior literature on mobility, i.e. mobility of workers is considered a source of knowledge diffusion. Hence, investigating the mobility of U.S. inventors also contributes to the state of knowledge about tracking knowledge spillovers in United States, as well as verifying hypotheses about the effect of the unenforceability of non-compete laws on mobility.

Hypothesis

Based on the previously mentioned theories and findings, six hypotheses are constructed.

The first hypothesis stems from a theoretical *positive selection* concept which states that individuals with a higher level of educational attainment are more likely to move.

Hypothesis 1. Inventors have on average higher migration rate than the general population.

While an inventor is patenting and obtaining more working experience, he increases the level of his skills. This also means that he expects higher returns to his skills and he is more prone to seek for better economic opportunities in a new place with higher returns to his level of skills. Therefore, hypothesis 2 assumes:

Hypothesis 2. The more experienced in patenting an inventor is, the more likely it is for the inventor to move.

Assuming that an inventor has information about the same level of gross wages in two states (e.g. posted on-line salary indications) and there are two different income tax rates in those states, while the inventor considers moving, he chooses a state with lower taxation rate over a state with higher

taxation rate. His net wage is higher in a state with lower taxation. Therefore hypothesis 3 is constructed:

Hypothesis 3. A higher income tax rate has a negative effect on the inventors' probability of moving.

A decision about migration is also linked with migration costs, e.g. housing cost. It is more likely for an inventor to move to a place where the mortgage deduction rate is higher than in his origin location, assuming both housing estates have alike costs. Thereby hypothesis 4 says:

Hypothesis 4. Higher mortgage deduction rate has a positive effect on the inventors' probability of moving.

Theoretically non-compete laws may limit the possibilities of inventor to change a job since he is obliged not to work for competitors, as well as starting up an own company. Therefore it is assumed that in states like California, where non-compete laws are almost unenforceable, it is more likely for an inventor to move. Hypothesis 5 states that:

Hypothesis 5. The enforceability of non-compete laws has a negative effect on the inventors' probability of moving.

Finally, it may be assumed that the inventors' internal migration trend follows the internal migration trend in the U.S. (Molloy et al. 2011). Hence, it is expected that the probability of moving decreases over time. Hypothesis 6 depicts:

Hypothesis 6. The probability of an inventor to move, declines over time.

In further parts of this paper, above assumptions and hypothesis are tested.

Data and methodology

This part presents a methodology applied to this research and a description of the data used for empirical analysis. To answer questions about migration, it is necessary to track changes of employers with the greatest possible accuracy. This is often a main obstacle for researchers who undertake migration topics. The largest dataset that consist migration data at individual level come

from Census Bureaus. However, they are very detailed and reveal many individuals characteristics, the data is collected each 10 years. Such large ranges of time do not allow for an accurate estimation since little is known what happens within these period. The U.S. Census Bureau conveys also different surveys targeted to the sample of the population (e.g. Current Population Survey). The data is collected yearly, or each 5 years. Although, those surveys are able to more precisely capture movements of the population, they do have a certain disadvantage since the population is limited to a focus group.

The datasets applied to this research are limited only to a group of inventors (patent applicants). The data comes from the United States Patent and Trademark Office (USPTO). There are two datasets, one consists of patent grants data and the other one patent applications data. The datasets consists of detailed information about inventors, assignees (companies), application and grant dates. The first dataset comprises data about patent grants from 1975 to 1999. Using this dataset it is possible to track changes of employers (patent assignees) by a patent application year. For instance, if an inventor applied for a granted patent for assignee *x* in year *y* and next time he applies for a patent for assignee *z* in year *y+n*, it might be read from the patent grants data (i.e. knowing inventors name/ID number, assignee name, granted patent application year, location of assignee and inventor) that the inventor changes a company. Similarly, the second dataset consists of data from 2000 to 2012 about patent applications and it is possible to track inventors changing companies using alike information. The advantage of the second dataset is that it is possible to track any changes at a weekly basis. Although weekly tracking is possible, the patent grants dataset tracks migration moves at a yearly basis. The choice for yearly tracking is because it's advisable in order to conduct a comparable long-term analysis. The significant quality of both datasets is that they comprise of a whole population of inventors, in this research limited to United States. A sample is exceptionally large, i.e. from 1975 to 1999 it consists of 1,684,365 and from 2000-2012 1,834,433 observations (together 3,518,798). The sample consists of observations for all inventors who patented their inventions.

The empirical part of the research is calculated by the logit regressions with *the probability of an inventor moving across (1) regions, (2) states, (3) cities, and (4) companies* as a dependent variable. This way four similar models are constructed and it is possible to verify if a migration trend is alike for any types of migration movement. The logit equation is presented below.

The independent variables are *stock of patents3, state income tax rate, state mortgage deduction rate, patent class/100 (dInd), inventor's state,* and *application year.* Unfortunately, the choice of datasets limits the possibilities of investigating the characteristics of individuals (like age, marital status etc.). This kind of information is better captured by the U.S. Census Bureau datasets, which investigate in detail the individuals' characteristics. On the other hand, individuals' characteristics are pointed as not helpful to explain a long-term migration trend (Molloy et al. 2011).

The first independent variable, *Stock of patents3,* measures the number of patents that an inventor applied for within the last 3 years. *Stock of patents3* indirectly captures recent experience. *Stock of patents* is a numeric variable. *State income rate* and *state mortgage deduction rate* were obtained from the dataset of the National Bureau of Economic Research (NBER) for given years. *State income tax rate* helps to capture inter-state differences with wages. The actual income tax rate for an individual is endogenous, i.e. it depends on an individual's income. The income tax rate varies by state since taxation laws are different for different states and years. Therefore it is preferable to use income tax rate as an explanatory variable since gross wages in two regions might have alike salaries for the same type of position, but depending on taxation the net salaries might differ. *State income tax rate* is used in this empirical analysis since income disparities are frequently pointed as one of the motives of migration.

A *state mortgage deduction rate* is related to another determinant of migration, i.e. housing costs. It indicates a level of possible tax mortgage deduction which differ by state and by year. Both rates are numeric variables. *Patent class/100 (dInd)* indicates for which patent class patent applies for. The USPTO identifies 3 digit patent classes from 002 to 987. dInd is a variable created by dividing all 3 digit numbers by 100 and classifying them into one of 0-9 categories (for a period 1975-1999 numbers finished within 800-899 range therefore there are only 8 categories in this period). *Inventor's state* is a state which inventor indicated applying for a patent[4]. *Application year* is each year from the range 1975-2012[5].

The results of four models' regressions are obtained by logit estimation (Section 4). Due to the logit estimation properties, the magnitudes of effects on the probability of inventors' moving

[4]A list of states and their abbreviations is presented in Appendices p. 50
[5] A list of variables is presented in Appendices p. 52

across states, regions, cities, and companies are presented as marginal effects. Furthermore, all models capture industry, state, and year fixed effects for the robustness of the results. There may be some bias in the results of the regression regarding the probability of moving between firms, owing to the systematically bad coverage of companies' names in the patent application dataset before 2005. Hence, the additional regression is run with a dependent variable *the probability to move across companies* limited only to years 2005-2012.

1. The logit equation of the probability of an inventor to move across (1) states, (2) regions, (3) cities, and (4) companies.

$$\Pr(moved = 1|x) = \Pr(moved^* > 0|x) =$$

$$\Lambda(\beta + \beta 1 Stock\ of\ patents + \beta 2 Income\ tax\ rate + \beta 3 Mortgage\ deduction\ rate + \beta 4 Noncompetes\ unenforceable + \beta 5 Patent\ industry\ class + \beta 6 Inventor'state + \beta 7 Patent\ application\ year)$$

where Λ is equal $\frac{exp}{1+exp}$

Results

Descriptive statistics

In this subsection descriptive statistics are presented and further, in the next subsection, empirical results based on the logit model are described. In order to answer the question asked in the former part of this paper, Figure 1 was constructed to compare the internal migration trend of inventors with the internal migration trend for the general population in United States within a period of 1975 - 2010.

As it may be observed on the below figure, both inter-state migration rates have a declining trend[6]. Over years (1975-1995) the national migration rate is characterized by slight fluctuations in the number of individuals who moved (within a range of 2.45-2.95%). After 1995 a more drastic decline in migration takes place. Only between 1995 and 2000 the migration rate contracts by about half. The situation repeats within the next decade and the inter-state migration rate totals merely about 0.5% in 2010. Comparing the national migration rate to the inventors' migration rate, it is noticeable that values of the inventors' migration rate are more than tripled for the first 20 years and remain much higher for another 15 years. This significant difference suggests that highly-skilled inventors are indeed more prone to move than an average individual. Therefore, hypothesis 1 receives support.

The inventors' migration rate decreases from 1975 until 2010 by about 47%, which is only half of the decline in the national migration rate. Recent years are characterized by a severe decline, also in highly-skilled mobility. Summarizing figure 1, people in general, including inventors, are less eager to move between states. This finding indicates that there was a certain change that triggered the process of settling down in American society, which was considered as one of the most dynamic trends regarding internal migration (Molloy et al. 2011; Dahl, Sorneson 2010).

Although Figure 1 demonstrates the inter-state migration rates and their decreasing trends, it does not confirm a total decline in the inventors' mobility. Inter-state moving pattern may differ from the patterns across regions, cities, or firms. Inventors may migrate more frequently on shorter

[6] Trends where plotted on the figure with dashed lines.

distances. Therefore, in order to thoroughly examine what happens with the inventors' mobility, further analysis of migration across varied administrative levels is provided.

Figure 2 presents the trend in the mobility of inventors at four administration levels (i.e. inter-region, inter-state, inter-city, and inter-company). Inter-region moves are moves across four big regions in United States, i.e. West, Mid-West, South, and North-East. The migration rate at this level is similar to the inter-state migration rate, although values are lower at the inter-region level than at the inter-state level. Nonetheless, the trend in migration across region is declining. In 1975 6.2% of inventors moved across regions in the United States, whereas in 2010 only 3.11%. It may be observed that the inter-region migration rate also contracted by half within the examined period of time. The trend in inter-firm migration is also decreasing. Between 1975 and 1995 on average 17% of inventors changed employers every year, and after 2000 on average only 13.3% of the inventors changed their companies at yearly basis. The only upward trend depicted on the graph is the trend of inter-city migration of inventors. In the middle- 1970's and in the 1980's the rate of inter-city migration has the smallest values and since then the trend is on the increase, although from 1997 and on the values of the migration rate again start falling.

According to the migration theory people move more frequently with shorter distances and less frequently with longer distances. So that means that the frequency of flows are decreasing with each level, in the following order: inter-firm, inter-city, inter-state, and inter-region level. According to Figure 2 this theoretical assumption is supported by evidence only between 2005 and 2010. Interestingly, until late 1980's inter-city migration is characterized by the smallest values from all the levels. Speculatively, within this period the inventors may more frequently choose further destinations over nearby cities when they move. Additionally, the trend of inter-city migration is the one characterized by the most drastic fluctuations and further research could explore the inventors' migration across cities in more detail.

There is also one important weak point of the two figures below. All trends are plotted using information from two datasets, patent grants dataset (1975-1999) and patent applications dataset (2000-2012). Although the data incorporated in both of them is alike, there are small differences that might cause some discrepancies between 1999 and 2000 (see Figure 1. and Figure 2.). The patent grants dataset includes information about all patents that have been granted within 1975-1999, and the patent application dataset includes information about all patents that have been

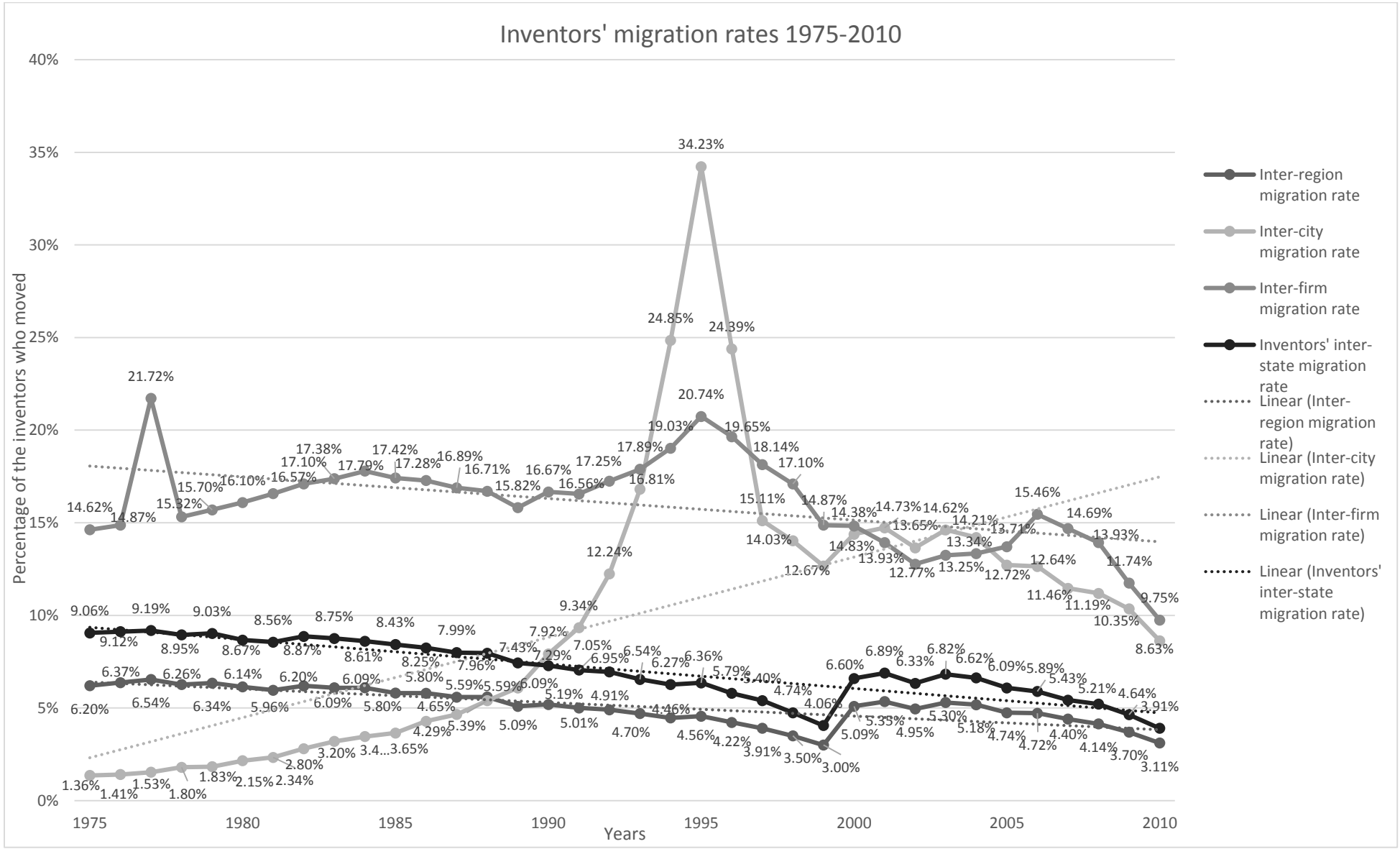
applied for within 2000-2012. Logically, not all patent applications are granted, therefore the patent grants dataset is slightly stricter in presenting patenting achievements. However, both datasets are useful for tracking inventors' mobility since the information on whether or not a patent becomes granted, is not crucial for checking the inventors' location.

Additionally, there is the question of procyclicality of the inventors' migration trend. Relating only to recessions which took place in United States since 1975 up to 2012 ((1)1980-81 OPEC recession, (2)1981-82 Iranian Revolution, (3)1990-91recession, (4)2001 dot.com bubble, (5) late 2007-2009 Great Recession) and based on plotted migration trends, it is inconclusive to state procyclicality of migration. Regarding the years 1975-1995, inter-city and inter-firm migration rates were constantly increasing and they seem unaffected by recessions which happened within this period of time. However, inter-region and inter-state migration trends are consistently declining within 1975-1995. Moreover, concerning the years 2000-2010, all trends, except the inter-city migration trend, are coherently decreasing without the apparent influence of economic recession. As mentioned before, inventors' mobility across cities is characterized by the most significant fluctuations and deserves more scientific attention.

Figure 1. Inter-state migration rates in the United States since 1975 to 2010.

Source: Own compilation based on USPTO patent grants and applications data and U.S. Census data 1975-2010.

Figure 2. Inventors' inter-region, inter-city, and inter-firm migration rates.



Source: Own compilation based on USPTO patent grants and applications data and the U.S. Census data 1975-2010.

Above figures demonstrate a significant fall in the migration of inventors in the United States. The fact is that at almost any considered level inventors tend to move less and less in recent decades. Only the inter-city migration trend is not coherent since up to 1995 it goes upwards, and later declines.

In a further part of this section more detailed information about regional differences in migration of inventors is presented. Assuming that there are certain regions in the U.S. characterized by a more severe decline in the mobility of inventors, there exist determinants of inventors' migration which negatively affect the probability of inventors to move in these regions. Therefore, investigating regional differences could allow us to uncover what these determinants are. The following statistics are presented in order to reveal whether there are any substantial regional differences in the internal migration of inventors. On the other hand, the overall decline in migration cannot be fully explain by the regional differences and it is probable that the cause of the decline is countrywide since all regions experience the fall in mobility of inventors. Perhaps, the determinant of the decline in migration may have even a worldwide scope, but in order to test this hypothesis internal migration in several countries should be examined.

Firstly, the mobility of inventors in four big regions in United States is examined. Table 1 presents the inter-state migration rate for three decades (1980-2010). It may be observed that West, Mid-West and South regions follow the trend of inter-state migration for a whole country and percentage values are consistently declining. Interestingly, the West region is characterized by the lowest percentage of inventors' inter-state migration and South region by the highest. Though, it cannot be concluded that in western states inventors move less than in the others. It is plausible that in these states the inventors move more often within states or within the region than across them.

Table 1. Inter-state migration rate of the U.S. inventors by regions.

Years	**Regions**			
	West	Mid-West	South	North-East
1980-1989	7.58%	8.48%	9.09%	8.40%
1990-1999	5.06%	5.78%	6.44%	6.08%
2000-2010	4.86%	5.73%	6.34%	6.49%

Source: Own compilation based on the USPTO data 1975-2012

Concerning the inter-city mobility of inventors in the four regions, the inter-city flows accelerate drastically between the 1980s and the 1990s (Table 2.). Subsequently, the inter-city migration rate decreased to the average level about 12.3%. This pattern is conclusive with inter-city migration trend at the national level. The values of the migration rate remain alike for all regions for all periods. West and North-East are characterized by slightly more frequent inter-city moves. This fact might be helpful explaining the assumption stated above that in the western states inventors move more often within states. For North-East regions all values, inter-state and inter-city migration, are relatively high. It should be noticed that North-East comprises mainly out of states with a small surface area, and therefore distances between cities, states, and even region borders are significantly smaller than for any other region.

Table 2. Inter-city migration rate of the U.S. inventors by regions

Years	**Regions**			
	West	Mid-West	South	North-East
1980-1989	4.09%	3.69%	3.45%	3.56%
1990-1999	18.43%	17.77%	15.97%	18.25%
2000-2012	13.04%	11.12%	11.71%	13.46%

Source: Own compilation based on the USPTO data 1975-2012

The inter-firm migration rate of inventors, depicted by region in Table 3, follows the same trend as the inter-firm migration rate at a national level. It rises between 1980 until 1989 and then in the last 10 years it declines. Interestingly enough, from 1980 until 1999 western states are characterized by the highest inter-firm mobility of inventors, while in a period between 2000 and 2010 the highest mobility between companies appears in North East (though in West the values are the second highest). In fact, there is a common pattern for the inter-firm and the inter-city migration of inventors, which differs from the trend of moving for the longer distances.

Table 3. Inter-firm migration rate of the U.S. inventors by regions

Years	Regions			
	West	Mid-West	South	North-East
1980-1989	19.40%	16.61%	15.98%	16.52%
1990-1999	18.83%	17.77%	16.80%	17.65%
2000-2010	13.83%	12.68%	12.52%	14.06%

Source: Own compilation based on the USPTO data 1975-2012

It is noticeable that there are differences in the mobility of researchers per region. Even though values of migration rates do not differ greatly, it is still discernible that western states have a lower inter-state migration rate than elsewhere, and almost the highest at inter-city and inter-firm regions levels. In order to examine regional differences in more detail, it is worthwhile to take a look on the state migration rates.

Table 4 demonstrates the inter-state migration rate of inventors by state[7]. There are two groups of states that might be distinguished by the pattern in migration behavior of inventors. Some states happen to have the decreasing inter-state migration rate over the period 1980-2010 (e.g. California, Minnesota, Texas, Washington, Wisconsin), but the majority of states follow the pattern of a decrease between 1980 and 1999, and then the rate increases between 2000 and 2010 (e.g. Alabama, Arkansas, Georgia, Hawaii, Idaho, etc.). Hence, the question about a factor that divides American states in these two groups ought to be asked. Though, the answer requires further analysis. Regarding the lowest values of the inter-state migration rate of inventors throughout the analyzed period, the smallest percentage of movements appear among states from the group with the declining trend (i.e. California, Texas, Washington, etc.). A group of states with the inversed trend has respectively the highest values of the inventors' inter-state mobility. Summarizing, it is distinguishable that there is a group of U.S. states where inventors tend to migrate less and less across states over years, contrary to their colleagues from states where the inter-state migration is recently accelerating.

Table 5 presents the inter-city migration rates of inventors by state over a period 1980-2010. Similarly to the analysis of the inter-state migration of inventors by state, two groups of

[7] For abbreviation of states see Appendices p. 50

states may be distinguish regarding the inter-city migration patterns. Slightly more than half of the states (e.g. Alabama, Georgia, Massachusetts, etc.) are characterized by the inversed trend, which means that mobility of inventors falls down in the 1990s and then it starts increasing again. The second group of states (e.g. California, Colorado, Minnesota, etc.) follows a constantly declining trend. The magnitudes of mobility of inventors are more diversified for the inter-city moves than for the inter-state moves. The highest values of the inter-city migration appear at the beginning of the analyzed period in New Mexico, Minnesota, Colorado, Wisconsin, and Massachusetts, whereas recently the highest percentage of inventors move between cities in Montana, New Jersey, Massachusetts, California, and Maryland[8]. It seems challenging to explain the differences in the inter-city moves at the state level since there are many discrepancies and different patterns.

The analysis of migration rates at different regional levels reveals that there are no substantial differences between regions. The mobility of inventors is declining in any location, although some states are characterized by a more consistent decreasing trend in inter-state and inter-city migration than others.

[8] The values of five states with the highest inter-city migration rates are listed for 1980-1989 and 2000-2010.

Table 4. Inter-state migration rate of the U.S. inventors by state 1980-2010

Years	States											
	AK	AL	AR	AZ	CA	CO	CT	DE	FL	GA	HI	IA
1980-1989	13.28%	9.56%	14.18%	10.19%	6.40%	9.93%	8.64%	9.28%	8.96%	9.01%	7.51%	10.63%
1990-1999	9.39%	7.30%	7.91%	6.46%	4.39%	6.59%	6.39%	7.17%	9.16%	6.14%	7.29%	6.79%
2000-2010	15.03%	8.50%	10.91%	6.40%	4.31%	6.51%	6.78%	7.08%	6.87%	7.22%	8.06%	6.93%
	ID	IL	IN	KS	KY	LA	MA	MD	ME	MI	MN	MO
1980-1989	9.90%	8.08%	9.73%	11.07%	11.11%	8.58%	9.07%	8.92%	9.55%	7.25%	7.87%	9.21%
1990-1999	5.37%	5.77%	6.88%	7.21%	7.59%	6.69%	6.20%	6.95%	6.59%	5.13%	5.08%	7.12%
2000-2010	5.81%	5.93%	7.12%	6.69%	6.33%	8.41%	6.71%	6.98%	8.04%	5.35%	4.79%	7.83%
	MS	MT	NC	ND	NE	NH	NJ	NM	NV	NY	OH	OK
1980-1989	13.17%	8.84%	9.55%	9.04%	9.77%	9.31%	8.08%	10.15%	11.26%	8.01%	8.37%	9.90%
1990-1999	8.82%	7.60%	6.09%	6.39%	5.67%	6.69%	5.94%	7.96%	7.54%	5.79%	6.03%	7.37%
2000-2010	9.40%	7.71%	6.20%	5.70%	7.00%	7.95%	7.13%	8.36%	6.78%	5.63%	5.54%	6.59%
	OR	PA	RI	SC	SD	TN	TX	UT	VA	VT	WA	WI
1980-1989	9.19%	8.04%	9.03%	10.45%	8.38%	9.47%	7.73%	10.05%	9.52%	1.48%	8.11%	8.27%
1990-1999	6.65%	6.18%	7.30%	6.93%	6.07%	6.72%	5.70%	6.42%	7.11%	6.92%	5.57%	5.47%
2000-2010	5.64%	6.72%	8.11%	7.83%	6.06%	7.50%	5.43%	6.26%	7.99%	4.90%	5.28%	5.36%
	WV	WY										
1980-1989	10.84%	11.44%										
1990-1999	7.53%	10.12%										
2000-2010	9.73%	8.98%										

Source: Own compilation based on the USPTO data 1975-2012

Table 5. Inter-city migration rate of the U.S. inventors by state 1980-2010

Years	States											
	AK	AL	AR	AZ	CA	CO	CT	DE	FL	GA	HI	IA
1980-1989	2.49%	3.54%	3.47%	4.52%	4.40%	4.98%	4.32%	3.35%	3.24%	4.35%	1.79%	4.40%
1990-1999	6.73%	14.63%	12.82%	16.51%	19.18%	18.39%	17.83%	17.82%	14.29%	16.51%	7.68%	17.50%
2000-2010	12.88%	12.51%	11.61%	10.36%	13.83%	12.23%	12.62%	10.87%	12.57%	12.35%	13.22%	10.75%
	ID	IL	IN	KS	KY	LA	MA	MD	ME	MI	MN	MO
1980-1989	4.67%	3.77%	4.28%	3.63%	4.67%	2.77%	4.76%	4.20%	4.39%	3.67%	4.96%	3.98%
1990-1999	16.35%	16.86%	18.98%	15.03%	15.64%	13.39%	20.18%	17.00%	15.50%	0.35%	10.73%	1.01%
2000-2010	9.33%	11.39%	11.62%	10.10%	9.71%	11.70%	14.07%	13.82%	11.38%	10.21%	11.16%	14.90%
	MS	MT	NC	ND	NE	NH	NJ	NM	NV	NY	OH	OK
1980-1989	3.22%	1.87%	4.18%	2.95%	3.59%	4.66%	3.64%	5.32%	2.95%	3.66%	4.04%	2.81%
1990-1999	12.53%	12.34%	16.50%	11.79%	13.16%	19.61%	19.30%	17.67%	11.45%	16.68%	18.84%	14.44%
2000-2010	11.73%	11.20%	11.68%	9.21%	9.02%	11.48%	14.66%	10.89%	10.25%	12.98%	11.63%	10.09%
	OR	PA	RI	SC	SD	TN	TX	UT	VA	VT	WA	WI
1980-1989	4.41%	3.73%	3.14%	3.75%	4.32%	3.74%	3.87%	3.81%	3.75%	0.92%	4.11%	4.80%
1990-1999	16.42%	18.17%	18.29%	15.83%	14.38%	16.78%	16.68%	17.31%	15.54%	15.22%	15.97%	18.89%
2000-2010	10.40%	13.20%	13.10%	13.06%	8.00%	11.61%	10.56%	11.83%	12.06%	12.64%	12.02%	9.89%
	WV	WY										
1980-1989	3.36%	3.54%										
1990-1999	15.81%	11.29%										
2000-2010	11.35%	10.88%										

Source: Own compilation based on the USPTO data 1975-2012

After investigating migration in detail at a regional and state level, the example of California is used to explore the within-state moves of inventors. Table 6 presents information about the inter-city migration in California. The choice of this particular state is not coincidental. California is a state characterized by the highest number of inventors in the United States. Furthermore, state law regarding non-compete agreements in California, as one of few states, is unenforceable. Inventors are not limited while choosing a new employer, or starting up own company in the same field. The opposite situation when non-compete agreements are enforceable may be considered as a type of a barrier for inventor to move. In last decade in California, serious court trails took place against companies who agreed to 'secretly enforce' non-compete agreements (e.g. Microsoft and Google case in 2005, IBM vs. Papermaster case in 2008). These cases were highly controversial also because one of the biggest technological clusters in the United States, Silicon Valley, was a mill-run example of a region with unenforceability of non-compete agreements. Hence, the economic discussion began in the academic world about the impact of such actions on the free labor market, and limiting the appropriability of R&D investments.

Table 6 demonstrates two types of information about the inter-city migration in California. The data is presented for selected cities. The selection of cities is based on a number of Californian inventors who migrated between cities within 2000-2012. 15 cities with the highest value are listed in a descending order. For instance, the highest percentage of inventors who moved across cities in California is from San Jose (7.93%). Remarkably, the 15 cities with the highest rate of inter-city migration of inventors cover almost half (46.69%) of all inventors in California who move across cities. Moreover, 10 out of 15 cities belong to the region of the Silicon Valley and nearby cities like Fremont or Southern San Francisco are also considered as a part of the cluster[9].

The third column in Table 6 depicts inter-city migration rate per selected city in California. The average state migration rate totals 12.89% which means that almost 13% of all inventors in the state moved across cities within the examined period. Curiously enough, in almost all cities that belong to the region of the Silicon Valley, inter-city migration rate is higher than the state average[10]. The presence of industry cluster and unenforceability of non-compete laws have a certain effect on inventors mobility in this region. Apparently, there are meaningful differences

[9] All shaded rows distinguish cities that belong to the region of the Silicon Valley.
[10] Higher values than California inter-city migration rate are bolded

between Californian cities regarding the mobility of inventors, which suggests that there exist some undiscovered determinants of the migration of inventors that operate at a local level and depend on the specificity of the location.

Table 6. Inter-city migration of inventors based on the case of California (2000-2012)

Inter-city moves		
California		
Selected CA cities	The number of CA inventors who moved across cities (in %; per selected city)	Inter-city migration rate for selected cities (in %)
San Jose	7.93	10.9
San Diego	5.89	9.18
Sunnyvale	4.83	**15.02**
Palo Alto	3.78	**13.07**
San Francisco	3.73	9.94
Mountain View	3.55	**15.76**
Fremont	3.07	**12.92**
Santa Clara	3.06	**17.11**
Cupertino	2.64	**13.26**
Los Angeles	1.85	**12.93**
Los Altos	1.58	12.52
Menlo Park	1.54	**13.46**
Irvine	1.49	10.64
Los Gatos	1.06	11.46
Campbell	0.69	**14.25**
Total	46.69	x
California	100	12.89

Source: Own compilation based on the USPTO 2000-2012

After examining dynamics of inventors' migration in different regions and states, it is worthwhile to also investigate directions of mobility flows (see Table 4.) Table 4 presents four time periods, although a period of the mid-late seventies do not have comparable values, since it covers only four years, not a whole decade. Information is still presented to show differences between regions at that time. As might be observed in the North-East region, a significant percentage of inventors change their job without crossing region boarder, which also means that a very small percentage of inventors who moved comes from different regions. On the other hand, migration to the South is characterized by the largest number of inventors from the other regions.

Concerning three next decades (the 1980s, the 1990s, and the 2000s), in first two decades the highest percentage of mobile inventors (except within-region mobility) flows from the North-East to the West, the Mid-West, and the South. The North-East region itself is not characterized by any pattern regarding flows of inventors from the other regions. In the 2000s the highest percentage of immigrating inventors comes from the South and the West (except within-region mobility). The group from the South directs to western and mid-western states, and the group from the West directs to the South and the North-East.

Presenting more detailed analysis of direction of inventors' movements per state seems to be somewhat troublesome because of the size of matrixes that would need to be created, therefore only main findings are described below.

Concerning inventors who moved across states from a perspective of a destination place[11], the highest percentage of researchers often comes from the same group of states. The group of the top states where inventors move from (i.e. the source states) consists of California, New York, Illinois, Pennsylvania, Ohio, Texas, New Jersey, Michigan, Massachusetts in the 1980s and California, New York, Texas, Massachusetts, Washington, and Michigan in the 2000s. In most of the states the biggest percentage of immigrating inventors comes from California and New York. Interestingly, the composition of states where inventors migrate from changes over the years, and recently it becomes less diverse than it used to be in the 1980s. Moreover, many of the listed states are also the most common destinations for the migrating inventors. Hence, it suggests that these locations have certain qualities which enhance the inventors' migration flows.

Although the analysis of the destination of inventors' migration flows reveal which regions or states are attractive for inventors to move into, they do not indicate which regional characteristics influence the location choice. On the other hand, there are some common features that may be identified for certain regions, for example many highly regarded universities are located in states which experience the most significant flows of inventors.

[11] The highest percentage of inventors who moved across states (except within-state migration) is obtained for each state in 2 periods ((1) 1980-1989 and (2) 2000-2010). Then top 3 results are counted for each state. The sum of top 3 results is calculated for each source state where inventors moved from within given period.

Table 7. Destinations of inventors' migration by region

	Destination region				Destination region			
Origin region	1975-1979				1980-1989			
	West	Mid-West	South	North-East	West	Mid-West	South	North-East
West	96.97%	0.56%	0.81%	0.48%	95.29%	0.87%	1.27%	0.80%
Mid-West	1.05%	97.88%	1.41%	0.76%	1.61%	96.56%	2.10%	1.17%
South	0.86%	0.66%	96.25%	0.60%	1.42%	1.20%	94.55%	1.11%
North-East	1.11%	0.90%	1.53%	98.16%	1.67%	1.37%	2.08%	96.92%

	Destination region				Destination region			
Origin region	1990-1999				2000-2010			
	West	Mid-West	South	North-East	West	Mid-West	South	North-East
West	94.83%	1.31%	1.84%	1.21%	96.12%	1.45%	1.96%	1.70%
Mid-West	1.58%	95.58%	2.08%	1.34%	0.98%	95.96%	1.25%	0.98%
South	1.74%	1.56%	93.84%	1.40%	1.53%	1.41%	95.29%	1.40%
North-East	1.84%	1.55%	2.23%	96.05%	1.37%	1.18%	1.51%	95.92%

Source: Own compilation based on the USPTO data 1975-2012

Empirical results

In this section the results of logit regressions are described. Table 5 presents coefficients and marginal effects on the probability of an inventor to move across states, regions, cities, and companies between 1975 and 1999.

It may be observed in Table 8 that experience in patenting, denoted here as a *stock of patents*, has a positive and significant effect on the probability of an inventor to move across states, regions, cities, and companies. Regarding the magnitude of this effect calculated for different distances, the strongest effect appears at the inter-company level (each additional obtained patent in the inventor's portfolio increases the probability of moving across firms by 2.9%). Hence, hypothesis 2, which says that the more experienced in patenting is an inventor, the more possible is that he will move, is supported.

The income tax rate has a positive and significant effect on the probability of inventors' to move. However the effect is positive, it is very insubstantial, or there is almost no effect (0.0006-0.3 %). It also does not support hypothesis 3 since it was expected that the higher income tax rate is, the lower is the possibility of inventors to move.

Similarly the effect of the mortgage deduction rate on the probability of an inventor to move across cities, or companies, is significant and positive, but very weak. There is no significant effect of the mortgage deduction rate on the probability of an inventor to move across states, or regions. Even though it means that hypothesis 4 finds some support, this support is notably insubstantial. This finding is alike to the previous ones (Molloy et al. 2011; Saks, Wozniak 2011), which indicated that there is no effect of housing costs on the probability of an individual to move.

The effect of unenforceability of the non-compete laws is significant, but inconclusive. It is negative for the inter-state and the inter-region migration movements and positive for the inter-city and the inter-company moves. This finding does not support hypothesis 5 and requires further explanations.

Observing magnitudes of the time effects on the probability of an inventor to move across states, regions, cities, and companies, as is plotted on the Figure 3, it is noticeable that the probability decreases with time. These effects are significant and coherent for all types of moves.

This is in support of hypothesis 6, which says the probability of an inventor to move declines over time, receives support.

.

Table 8. Logit regression results with the probability of an inventor to move across (1) states, (2) regions, (3) cities, and (4) companies as a dependent variable (1975-1999)[12]

	Model 1		Model 2		Model 3		Model 4	
VARIABLES	Moved across states		Moved across regions		Moved across cities		Moved across companies	
	Coeff moved	Mfx moved	Coeff moved_regio	Mfx moved_regio	Coeff moved_city	Mfx moved_city	Coeff moved_company	Mfx moved_company
Stock of patents3	0.186**	0.011**	0.197**	0.009**	0.170**	0.014**	0.205**	0.029**
	[0.003]	[0.000]	[0.003]	[0.000]	[0.002]	[0.000]	[0.002]	[0.000]
Income tax rate	0.010**	0.001**[13]	0.007	0.000	0.018**	0.001**	0.021**	0.003**
	[0.003]	[0.000]	[0.004]	[0.074]	[0.004]	[0.000]	[0.002]	[0.000]
Mortgage deduction rate	0.005	0.000	0.003	0.000	0.026**	0.002**	0.015**	0.002**
	[0.004]	[0.223]	[0.005]	[0.454]	[0.005]	[0.000]	[0.003]	[0.000]
Noncompetes_unenforc=1	-0.928**	-0.043**	-0.719**	-0.026**	1.040**	0.113**	0.973**	0.165**
	[0.115]	[0.004]	[0.134]	[0.004]	[0.155]	[0.022]	[0.129]	[0.026]
Observations	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
Application Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Log-likelihood	-411295	-411295	-321831	-321831	-555773	-555773	-761194	-761194
Chi Sqared	440024	440024	420038	420038	563215	563215	451303	451303
p value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in brackets

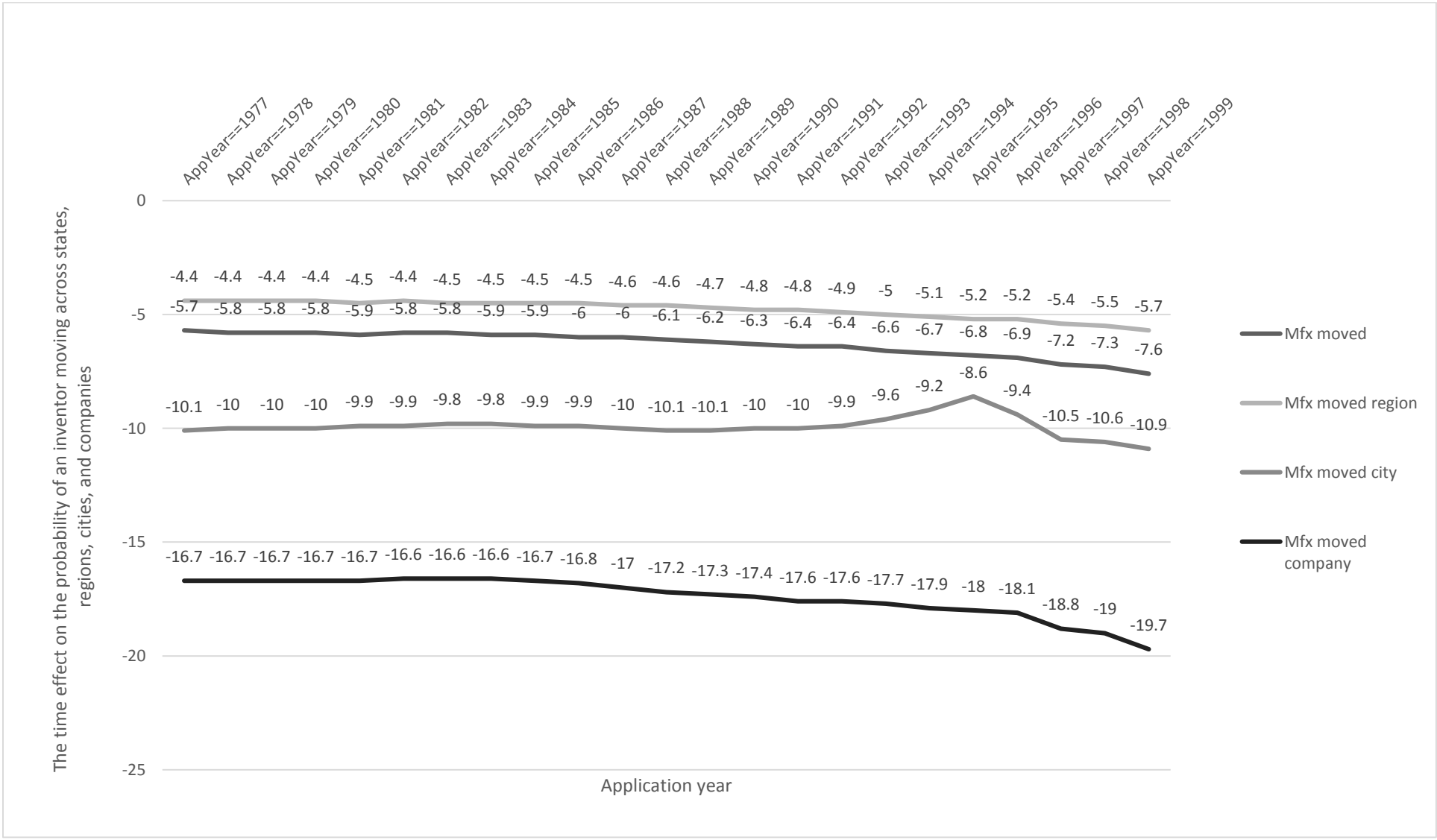
** p<0.01, * p<0.05, + p<0.1

TABLE 8 NOTES: The method of estimation is Logit with state and years fixed-effects. The dependent variable in following 4 models is the probability of an inventor to move across (1) states, (2) regions, (3) cities, and (4) companies. State, year, and industry-specific fixed-effects are included and standard errors are clustered at the inventor level

[12] A full version of the table is presented in Appendices, p. 53-58

[13] .0005821

Figure 3. Time effects on the probability of an inventor to move across states, regions, cities, and companies in 1975-1999



Source: Own compilation based on the USPTO data 1975-2012

Table 9 presents results of logit estimation of four models within a period of 2000-2012. The stock of patents, for all types of moves, has a significant, positive, but considerably small effect on the probability of an inventor to move. Though more experience in patenting increases a chance of an inventor to migrate, its effect is so weak that hypothesis 2 obtains little support. Comparing this results with the results from the previous period, the effect de-escalates over time.

The outcomes indicate that there is no effect of the income tax rate on the probability of an inventor to move. Relating this finding with the results from 1975 to 1999 which are very weak, the income tax rate has almost no effect on the probability of an inventor to move across states, regions, cities, and companies. Thereby, hypothesis 3 is not supported. Similarly, there is no effect of the mortgage deduction rate on the probability of an inventor to move. Once again, comparing the results from 1975-1999 and 2000-2012, there is almost no effect of the mortgage deduction rate, and therefore hypothesis 4 does not find support.

Inconclusive outcomes on the effect of unenforceability of the non-compete laws in regressions from a period of 1975-1999 do not find a clarification in findings presented in Table 9. The effect of the unenforceability is significant and negative for all types of the migration movements. Regarding values, the effect is notable (e.g. for an inventor living in a state with unenforceable non-compete laws, comparing to an inventor living in a state with enforceable non-compete, the probability of moving across companies is 13.9 % lower). These inconclusive finding are also counterintuitive and do not give any support to hypothesis 5.

The marginal time effect values, plotted on the Figure 4, support hypothesis 6. The probability of an inventor to move declines with time for inter-state, inter-region, inter-city, and inter-company moves. Unfortunately, the lack of support for hypotheses 3, 4, 5 does not improve the understanding of why the decrease in the inventors' mobility takes place. In the next section, a summary of main findings and plausible explanations and conclusions are presented.

Table 9. Logit regression results with the probability of an inventor to move across (1) states, (2) regions, (3) cities, and (4) companies as a dependent variable (2000-2012[14])

	Model 1		Model 2		Model 3		Model 4	
VARIABLES	Moved across states		Moved across regions		Moved across cities		Moved across companies	
	Coeff	Mfx	Coeff	Mfx	Coeff	Mfx	Coeff	Mfx
VARIABLES	moved	moved	moved_regio	moved_regio	moved_city	moved_city	moved_company	moved_company
Stock of patents3	0.011**	0.001**	0.012**	0.000**	0.013**	0.001**	0.011**	0.001**
	[0.002]	[0.000]	[0.002]	[0.000]	[0.002]	[0.000]	[0.002]	[0.000]
Income tax rate	0.001	0.000	0.000	0.000	0.001	0.000	-0.003**	-0.000**[15]
	[0.001]	[0.263]	[0.001]	[0.708]	[0.000]	[0.122]	[0.001]	[0.000]
Mortgage deduction rate	0.000	0.000	0.001	0.000	-0.001	0.000	0.003**	0.000**[16]
	[0.000]	[0.408]	[0.001]	[0.460]	[0.000]	[0.139]	[0.001]	[0.000]
Noncompetes_unenforc=1	-2.877**	-0.092**	-2.956**	-0.076**	-1.692**	-0.128**	-1.723**	-0.139**
	[0.034]	[0.001]	[0.038]	[0.001]	[0.026]	[0.002]	[0.027]	[0.002]
Observations	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
Application Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Log-likelihood	-387139	-387139	-326070	-326070	-661029	-661029	-693681	-693681
Chi Sqared	176916	176916	171437	171437	201641	201641	486819	486819
p value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in brackets

** p<0.01, * p<0.05, + p<0.1

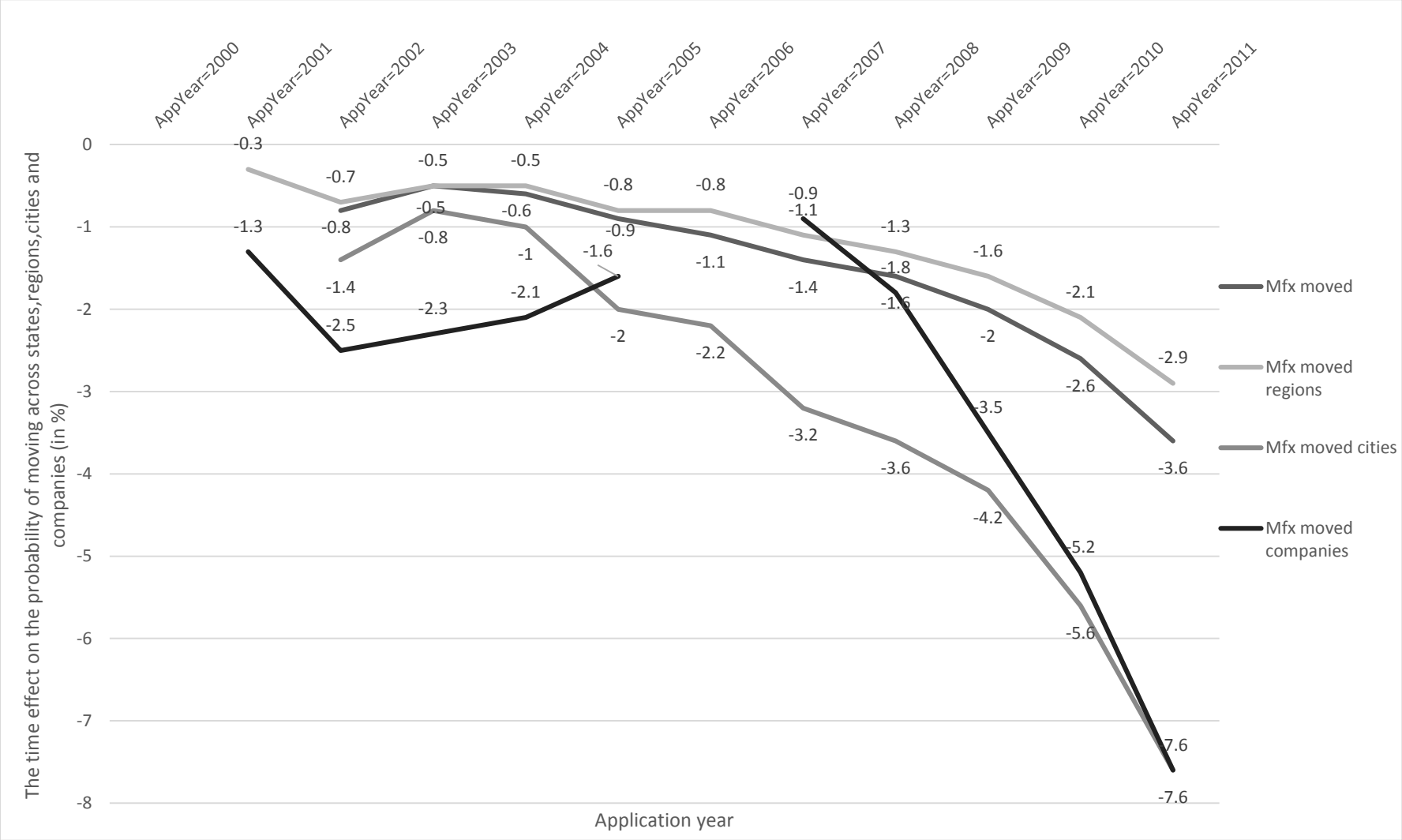
See: Table 8 Notes

[14] A full table is presented in Appendices, p. 59-63

[15] -.0003691

[16] .0003333

Figure 4. Time effects on the probability of an inventor to move across states, regions, cities, and companies in 2000-2012.



Source: Own compilation based on the USPTO data 1975-2012. The value of the effect on the probability of an inventor to move across firms in 2006 is omitted since it is insignificant.

Table 10 presents a comparison of the results of the Model 4 (i.e. with the probability of an inventor to move across companies) and the restricted Model 4. This robustness check is conducted due to the systematically bad coverage of companies' names in the patent application dataset before 2005 which may generate a possible bias in the data. Marginal effects values in Table 10 show that effects remain significant and alike in the magnitudes, although the restricted model has slightly stronger values regarding time effects.

Table 10. Robustness check of the Model 4

Robustness		
	Model 4	Restricted Model 4
VARIABLES	Mfx moved_company	Mfx moved_company
Stock of patents3	0.002**	0.001**
	[0.000]	[0.000]
Income tax rate	-0.002*	-0.000**
	[0.001]	[0.000]
Mortgage deduction rate	-0.002*	0.000**
	[0.001]	[0.000]
Noncompetes_unenforc=1	-0.144**	-0.139**
	[0.003]	[0.002]
AppYear==2006	0.012**	-0.003
	[0.001]	[0.002]
AppYear==2007	0.006**	-0.009**
	[0.001]	[0.002]
AppYear==2008	-0.003**	-0.018**
	[0.001]	[0.002]
AppYear==2009	-0.022**	-0.035**
	[0.001]	[0.002]
AppYear==2010	-0.040**	-0.052**
	[0.001]	[0.002]
AppYear==2011	-0.067**	-0.076**
	[0.001]	[0.001]
Observations	1,834,433	1,153,085
Industry FE	YES	YES
State FE	YES	YES
Application Year FE	YES	YES
Log-likelihood	-426357	-693681
Chi Sqared	296901	486819
p value	0.000	0.000

Robust standard errors in brackets

** p<0.01, * p<0.05, + p<0.1

See: Table 8 Notes restricted only to the Model 4

Conclusion and discussion

In this section the main findings are summarized and the possible conclusions are derived. Subsequently, the limitations of this study and further research recommendations, the contribution of this paper, and the implications of its results are presented.

Main findings

The above findings give support to hypotheses 1, 2, and 6. Most importantly, the empirical analysis confirms that the probability of an inventor to move decreases over time. Together with the internal inter-state migration rate in the U.S., the inventors' inter-state, inter-region, inter-city, and inter-firm migration rates decline throughout the recent decades. This discovery is contradictory to the findings of the prior studies on the mobility of inventors that was conducted at an international level, which indicated that inventors tend to migrate more and more (Docquier, Marfouk 2004; Defoort 2008). On the other hand, this paper confirms that the internal migration trend of inventors is in consonance with the overall internal migration trend in the U.S. Furthermore, the examination of the trends in migration reveals that they are not procyclical since they do not change along with the business cycle trend. The findings of the procyclicality of the migration trend was inconclusive in the prior literature, since Saks, Wozniak (2011) finds that the migration trend is procyclical only around economic booms, Fallick, Fleichman (2004) finds that it is procyclical only around recession, and Molloy et al. (2011) does not find that it is procyclical at all.

Moreover, the positive effect of prior experience in patenting is found and additionally, alike to the previous studies (Molloy et al. 2011; Grogger, Hanson 2011; Egger, Radulescu 2009; Hatton, Williamson 2006; Fallick et al. 2006; Borjas 1989), this paper shows that inventors have a higher probability of moving than an average citizen.

On the contrary however, hypotheses 3, 4, 5 do not find support. The assumed effect of the economic- and legal-related determinants of the migration behavior of inventors is not found. Similarly to this study, other papers do not find the effect of housing on mobility (Molloy et al.

2011; Saks, Wozniak 2011). The lack of confirmation of the above hypotheses, partly supported by the findings of the previous studies will continue the ongoing discussion about the reasons behind the fall in the inventors' migration.

Since the trend in the internal mobility of inventors is in consonance with the overall internal migration trend in the U.S. and since the internal mobility of inventors declines in all regions at alike level, it is possible that the factor that affects the migration behaviors of inventors (as well as a whole American society) has a countrywide scope. Furthermore, the inventors' internal migration trend seems not to be linked with economic, time-specific, nor regional characteristics, nor with the business cycle.

Although findings of this paper do not give an answer to the question why the mobility of inventors is decreasing, they do indicate that the factor behind the decrease is common for the whole U.S. population. This factor causes the mobility of inventors to be gradually declining over years. Possible assumptions about the cause of decline in the mobility of inventors are presented below.

There are a few possible suggestions to determine the factor which causes the fall in the migration of inventors. Firstly, due to significant concentration of firms within clusters, inventors may change jobs living in the same area. It would explain why inter-region and inter-state migration rates are very low. Although it is a plausible cause, it does not explain why inter-firm migration rates are declining. Secondly, alike reasoning may suggest that thanks to the improved commuting conditions (in terms of comfort and time duration), inventors may change companies but still remain in the same living location. Once again, the presumption does not fully explain the fall in the inventors' migration at all levels since there is also a drop in the inter-firm migration.

Presumably, inventors decide about moving based on other kind of information. One possible explanation may be that inventors, thanks to drastically developed communication tools have an access to unknown before, or limited information. It is easier for them to stay in touch (e.g. using social media) with their fellow university friends who work in different locations. Inventors can exchange information with their colleagues about working or living standards in their current areas. They can also obtain a subjective assessment of the local labor market. Furthermore, over the course of the examined decades, the Internet was significantly developed, which allowed inventors to obtain access to a lot of information about job opportunities.

Additionally, again thanks to technological advancements, it became possible for some of the inventors to work from home. This phenomenon indicates that the work itself becomes more alike between locations and perhaps therefore it is less attractive for inventors to move.

The other findings of this paper implicate that the mobility of inventors is also directed to a few specific destinations. It seems that certain regions are more attractive for inventors to work. These regions happen to be states where the most regarded American universities and the most regarded American technical universities are located (e.g. California, Massachusetts, New York, Illinois, New Jersey, Pennsylvania, Texas etc.). It might be assumed that a certain percentage of observed inventors are the alumni of mentioned educational institutions. Possibly, a part of the inventors joined the academic community after graduation. These inventors may also look for jobs at other universities, and therefore there would be migration between these states. Although this scenario is possible, there might also be another explanation why inventors move between certain locations. Due to the fact that companies are more aware of the advantages of location strategies, they are often located close to the source of highly skilled labor force, i.e. universities. Hence, inventors who obtained their education in a certain state may simply remain there since they have appropriate opportunities to work and change companies during their lifetime. On the other hand, the agglomeration of the companies in certain regions (clusters) may stimulate the flows of inventors between these kinds of locations. Inventors specialized in a certain field may look for a job within a cluster they already work, or within alike cluster elsewhere. They may compare the advantages and disadvantages of both locations and migrate to the location they prefer.

Limitations and further research

The limitation of this paper stems from the specific data properties that in some cases are advantageous, but may also narrow the focus of this research. Firstly, there is little known about the inventors' characteristics, since the data does not consists of information on the age of inventors, their race, marital status, and the exact level of education attainment. Furthermore, the data lacks information about social connections of inventors, which as suggested by Dahl, Sorenson (2010) may have significant influence on a decision whether or not to migrate. Another disadvantage of the data is that it is combined from two datasets and movements are observed

yearly (since the older dataset is constructed from observations obtained at yearly bases), whereas a newer dataset allows for tracking weekly changes in inventors' migration. Furthermore, the industry control variable *dInd* allows for capturing fixed effects between different patent classes, although it does not explore in detail which industries are characterized by the more heavily decreasing inventors' migration rate. A more detailed study of industry effect on mobility could possibly explain which sectors may have been more severely experienced by a fall in the inventors' mobility.

Due to the many unanswered questions about the motives and factors that affect the migration of inventors in the U.S. there are a few recommendations for further research. First of all, the long-term internal migration trends should be examined for different countries. This kind of information could explain if the determinants of the decline in the internal migration in the United States have countrywide, or worldwide scope. Moreover, a study regarding the effect of the development in communication and information technology on inventors' mobility could test the hypothesis about the possible impact of new technologies on the migration behaviors. Furthermore, the investigation of the mobility of university graduates could shed more light on the process of migration of highly skilled labor force, and perhaps also on the destination of moving graduates. Finally, more studies are required that would explore the inventors' characteristics, as well as reveal more information on the inventors' mobility within, for example the most innovative industries.

Contribution and implications

This paper aimed to investigate the problem of internal migration of U.S. inventors. This narrower perspective (compared to global research approaches, or general population studies) was applied to reveal more about the dynamics in the internal migration trends of the inventors. Thanks to the unique data it was possible to explore migration behaviors of the whole population of U.S. inventors in the long-term perspective with significant level of accuracy. This study examined the internal migration trend for the U.S. inventors and showed that it goes along with the overall internal migration trend. The empirical results confirmed the assumption that inventors, likewise average individuals, move less and less within the United States over years, although they do not

reveal why this process takes place. Furthermore, other findings suggest that the factor, or factors, that cause the decline in migration are arguably common for a whole population and affects the mobility of inventors gradually over time. It seems that the determinant of migration may be alike for any individual, since even a group of highly skilled inventors, which is assumed to be more likely to move, experience a constant decrease in mobility. Although the paper does not give the accurate answer to the question what might be the factor (factors) responsible for the falling inventors' migration rate, it presents a couple of suggestions that might be helpful for further research.

Nonetheless, the findings of this paper are of unique value to the United States labor market. It is confirmed that the United States faces a decrease in the internal migration of inventors. Besides the labor allocation problem, which is relevant for the flexibility of the economy, the decline in the inventors' mobility is also linked with limiting knowledge spillovers. Therefore, it is required to enhance the state of knowledge about the inventors' migration behavior in order to explain the consequences of this phenomenon for both the national economy and an average American firm.

References

1. Almeida, P., & Kogut, B. (1999). Localization of knowledge and the mobility of engineers in regional networks. *Management science*, *45*(7), 905
2. Borjas J. G., (1989). Economic Theory and International Migration, *International Migration Review*, 23, p. 547
3. Breschi, S., & Lissoni, F. (2009). Mobility of skilled workers and co-invention networks: an anatomy of localized knowledge flows. *Journal of Economic Geography*, *9*(4), 439
4. Castles S., & Miller M., (2005). The Age of Migration: International Population Movements in the Modern World, *American Foreign Policy: The Journal of the National Committee on American Foreign Policy*, 27, p.338
5. Chen, Y., & Rosenthal, S. S. (2008). Local amenities and life-cycle migration: Do people move for jobs or fun? *Journal of Urban Economics*, *64*(3), 519
6. Chiquiar, D., & Hanson, G. H. (2002). International migration, self-selection, and the distribution of wages: Evidence from Mexico and the United States (No. w9242). *National Bureau of Economic Research.*
7. Dahl M. S., Sorenson O., (2010.) The Migration of Technical Workers, *Journal of Urban Economics*, 67, p.33
8. Docquier F., & Marfouk A., (2004). Measuring the International Mobility of Skilled Workers (1990-2000)- Release 1.0, *World Bank*
9. Egger, P., & Radulescu, D. M. (2009). The influence of labour taxes on the migration of skilled workers. *The World Economy*, *32*(9), 1365
10. Fallick B., & Fleischman C. A., 2004, *Employer-to-employer flows in the US labor market: The complete picture of gross worker flows.* Vol. 4. *Division of Research & Statistics and Monetary Affairs, Federal Reserve Board*
11. Fallick, B., Fleischman, C. A., & Rebitzer, J. B. (2006). Job-hopping in Silicon Valley: some evidence concerning the microfoundations of a high-technology cluster. *The Review of Economics and Statistics*, *88*(3), 472
12. Freedman, M. L. (2008). Job hopping, earnings dynamics, and industrial agglomeration in the software publishing industry. *Journal of Urban Economics*,*64*(3), 590

13. Greenwood, M. J. (1997). Internal migration in developed countries. *Handbook of population and family economics*, *1*, 647
14. Grogger, J., & Hanson, G. H. (2011). Income maximization and the selection and sorting of international migrants. *Journal of Development Economics*, *95*(1), 42
15. Harris J. R., & Todaro M. P, (1970). Migration, Unemployment and Development: a two-sector analysis, *The American Economic Review*, 60, p. 126
16. Hatton, T. J., & Williamson, J. G. (2006). International migration in the long run: Positive selection, negative selection, and policy (pp. 1-31). *Springer Berlin Heidelberg*.
17. Iredale R., (2002). The Migration of Professionals: Theories and Typologies, *International Migration*, 39, p.7
18. Kim, J., Lee, S. J., & Marschke, G. (2009). International knowledge flows: evidence from an inventor-firm matched data set. In *Science and Engineering Careers in the United States: An Analysis of Markets and Employment* (p. 321). University of Chicago Press.
19. Mayda, A. M. (2010). International migration: A panel data analysis of the determinants of bilateral flows. *Journal of Population Economics*, *23*(4), 1249
20. Møen, J. (2000). Is mobility of technical personnel a source of R&D spillovers?(No. w7834). *National Bureau of Economic Research.*
21. Molloy, R., Smith, C. L., & Wozniak, A. K. (2011). Internal migration in the United States (No. w17307). *National Bureau of Economic Research.*
22. Oxford Dictionary of English, (2010). *Oxford University Press*; 3rd Revised edition, UK
23. Saks, R. E., & Wozniak, A. (2011). Labor reallocation over the business cycle: new evidence from internal migration. *Journal of Labor Economics*, *29*(4), 697
24. Song, J., Almeida, P., & Wu, G. (2003). Learning–by–Hiring: When Is Mobility More Likely to Facilitate Interfirm Knowledge Transfer? *Management Science,49*(4), 351
25. Stark O., Bloom D. E., 1985, The New Economics of Labour Migration, *The American Economics Review*, 75, p. 173
26. Thorn, K., & Holm-Nielsen, L. (2008). International mobility of researchers and scientists: Policy options for turning a drain into a gain. *The international mobility of talent. Oxford University Press, Oxford*, 145

Appendices

List of states and their abbreviations

Alaska	AK
Alabama	AL
Arkansas	AR
Arizona	AZ
California	CA
Colorado	CO
Connecticut	CT
Delaware	DE
Florida	FL
Georgia	GA
Hawaii	HI
Iowa	IA
Idaho	ID
Illinois	IL
Indiana	IN
Kansas	KS
Kentucky	KY
Louisiana	LA
Massachusets	MA
Maryland	MD
Maine	ME
Michigan	MI
Minnesota	MN
Mississippi	MS
Montana	MT
Missouri	MO
North Carolina	NC
North Dakota	ND
Nebraska	NE
New Hampshire	NH
New Jersey	NJ
New Mexico	NM
Nevada	NV
New York	NY
Ohio	OH
Oklahoma	OK
Oregon	OR
Pennsylvania	PA
Rhode Island	RI
South Carolina	SC
South Dakota	SD
Tennessee	TN
Texas	TX
Utah	UT
Virginia	VA

Vermont	VT
Washington	WA
Wisconsin	WI
West Virginia	WV
Wyoming	WY

List of variables

Dependent variable	
moved	Moved denotes the probability of an inventor to move across states
moved_regio	Moved regio denotes the probability of an inventor to move across four big United States regions (West, Mid-West, South, North-East)
moved_city	Moved city denotes the probability of an inventor to move across cities
moved_company	Moved company denotes the probability of an inventor to move across the U.S. firms
Independent variables	
Stock_of_patents3	Stock of patents denotes how many patents an inventor obtained in last 3 years
State_wagerate	State wagerate stands for state income tax rate
State_mortgdedrate	State mortgdedrate stand for state mortgage deduction rate
Noncompetes_unenforc==1	Noncompetes_unenforc is a dummy for pointing unenforceability of non competes laws (for California=1, for the rest of states=0)
dInd (categories from 0 to 8)	dInd categorizes observations to 0-8 patent industry classes according to USPTO patent classification
InvState	InvState dentoes a state in which an inventor obtained a patent
AppYear (1977-1999)	AppYear denotes a year in which an inventor applied for a patent

Table 11. Results of the logit regression. The probability of inventors moving across states, regions, cities, and companies within a period of 1975-1999

	Model 1		Model 2		Model 3		Model 4	
VARIABLES	Moved across states		Moved across regions		Moved across cities		Moved across companies	
	Coeff	Mfx	Coeff	Mfx	Coeff	Mfx	Coeff	Mfx
	moved	moved	moved_regio	moved_regio	moved_city	moved_city	moved_company	moved_company
Stock of patents3	0.186**	0.011**	0.197**	0.009**	0.170**	0.014**	0.205**	0.029**
	[0.003]	[0.000]	[0.003]	[0.000]	[0.002]	[0.000]	[0.002]	[0.000]
Income tax rate	0.010**	0.001**	0.007	0.000	0.018**	0.001**	0.021**	0.003**
	[0.003]	[0.000]	[0.004]	[0.000]	[0.004]	[0.000]	[0.002]	[0.000]
Mortgage deduction rate	0.005	0.000	0.003	0.000	0.026**	0.002**	0.015**	0.002**
	[0.004]	[0.000]	[0.005]	[0.000]	[0.005]	[0.000]	[0.003]	[0.000]
Noncompetes_unenforc=1	-0.928**	-0.043**	-0.719**	-0.026**	1.040**	0.113**	0.973**	0.165**
	[0.115]	[0.004]	[0.134]	[0.004]	[0.155]	[0.022]	[0.129]	[0.026]
dInd==1	0.022	0.001	0.007	0.000	0.075**	0.006**	0.074**	0.011**
	[0.013]	[0.001]	[0.016]	[0.001]	[0.011]	[0.001]	[0.009]	[0.001]
dInd==2	0.034**	0.002**	0.029*	0.001*	0.101**	0.008**	0.104**	0.015**
	[0.012]	[0.001]	[0.014]	[0.001]	[0.010]	[0.001]	[0.008]	[0.001]
dInd==3	0.127**	0.008**	0.116**	0.005**	0.357**	0.032**	0.253**	0.037**
	[0.012]	[0.001]	[0.014]	[0.001]	[0.010]	[0.001]	[0.008]	[0.001]
dInd==4	0.080**	0.005**	0.069**	0.003**	0.185**	0.016**	0.193**	0.028**
	[0.012]	[0.001]	[0.014]	[0.001]	[0.010]	[0.001]	[0.008]	[0.001]
dInd==5	0.031*	0.002*	-0.018	-0.001	0.259**	0.023**	0.210**	0.031**
	[0.015]	[0.001]	[0.017]	[0.001]	[0.011]	[0.001]	[0.010]	[0.002]
dInd==6	0.092**	0.006**	0.090**	0.004**	0.326**	0.030**	0.430**	0.068**
	[0.019]	[0.001]	[0.022]	[0.001]	[0.013]	[0.001]	[0.012]	[0.002]
dInd==7	0.212**	0.014**	0.217**	0.010**	0.261**	0.023**	0.070**	0.010**
	[0.016]	[0.001]	[0.019]	[0.001]	[0.012]	[0.001]	[0.011]	[0.002]
dInd==8	0.469**	0.034**	0.408**	0.022**	0.363**	0.034**	0.451**	0.072**
	[0.065]	[0.006]	[0.079]	[0.005]	[0.041]	[0.004]	[0.042]	[0.008]
InvState==AL	-0.342**	-0.018**	-0.389**	-0.014**	0.753**	0.082**	0.862**	0.155**
	[0.119]	[0.005]	[0.138]	[0.004]	[0.156]	[0.022]	[0.131]	[0.029]
InvState==AR	-0.090	-0.005	-0.183	-0.007	0.740**	0.081**	0.765**	0.134**

	[0.127]	[0.007]	[0.149]	[0.006]	[0.164]	[0.023]	[0.138]	[0.029]
InvState==AZ	-0.448**	-0.022**	-0.508**	-0.018**	0.860**	0.097**	0.712**	0.122**
	[0.115]	[0.005]	[0.134]	[0.004]	[0.154]	[0.023]	[0.129]	[0.026]
InvState==CO	-0.435**	-0.022**	-0.468**	-0.017**	0.977**	0.115**	1.083**	0.203**
	[0.114]	[0.005]	[0.133]	[0.004]	[0.153]	[0.025]	[0.129]	[0.030]
InvState==CT	-0.588**	-0.028**	-0.633**	-0.021**	0.846**	0.095**	0.811**	0.142**
	[0.113]	[0.004]	[0.131]	[0.003]	[0.153]	[0.022]	[0.128]	[0.027]
InvState==DE	-0.520**	-0.025**	-0.475**	-0.017**	0.884**	0.102**	0.661**	0.113**
	[0.121]	[0.005]	[0.141]	[0.004]	[0.156]	[0.024]	[0.133]	[0.027]
InvState==FL	-0.408**	-0.021**	-0.458**	-0.017**	0.657**	0.068**	0.696**	0.119**
	[0.112]	[0.005]	[0.131]	[0.004]	[0.152]	[0.020]	[0.128]	[0.026]
InvState==GA	-0.513**	-0.025**	-0.595**	-0.020**	0.879**	0.100**	0.836**	0.149**
	[0.116]	[0.004]	[0.135]	[0.003]	[0.154]	[0.023]	[0.129]	[0.028]
InvState==HI	-0.428**	-0.021**	-0.652**	-0.021**	0.121	0.010	0.253	0.038
	[0.151]	[0.006]	[0.185]	[0.004]	[0.189]	[0.017]	[0.158]	[0.026]
InvState==IA	-0.372**	-0.019**	-0.495**	-0.017**	0.979**	0.117**	0.760**	0.133**
	[0.117]	[0.005]	[0.137]	[0.004]	[0.155]	[0.025]	[0.131]	[0.027]
InvState==ID	-0.564**	-0.027**	-0.663**	-0.022**	0.895**	0.103**	0.675**	0.115**
	[0.124]	[0.004]	[0.146]	[0.003]	[0.156]	[0.024]	[0.133]	[0.027]
InvState==IL	-0.639**	-0.030**	-0.563**	-0.020**	0.789**	0.085**	0.713**	0.121**
	[0.112]	[0.004]	[0.130]	[0.004]	[0.152]	[0.021]	[0.128]	[0.025]
InvState==IN	-0.442**	-0.022**	-0.461**	-0.017**	0.918**	0.106**	0.804**	0.141**
	[0.113]	[0.005]	[0.132]	[0.004]	[0.153]	[0.024]	[0.128]	[0.027]
InvState==KS	-0.288*	-0.015**	-0.283*	-0.011*	0.845**	0.096**	0.865**	0.155**
	[0.119]	[0.006]	[0.139]	[0.005]	[0.157]	[0.024]	[0.131]	[0.029]
InvState==KY	-0.305**	-0.016**	-0.367**	-0.014**	0.858**	0.098**	0.744**	0.129**
	[0.118]	[0.005]	[0.138]	[0.004]	[0.156]	[0.024]	[0.131]	[0.027]
InvState==LA	-0.472**	-0.023**	-0.703**	-0.023**	0.659**	0.070**	0.754**	0.131**
	[0.117]	[0.005]	[0.138]	[0.003]	[0.155]	[0.021]	[0.131]	[0.027]
InvState==MA	-0.589**	-0.028**	-0.554**	-0.019**	0.929**	0.106**	1.004**	0.183**
	[0.113]	[0.004]	[0.131]	[0.004]	[0.154]	[0.023]	[0.128]	[0.028]
InvState==MD	-0.467**	-0.023**	-0.462**	-0.017**	0.882**	0.101**	1.042**	0.194**
	[0.114]	[0.005]	[0.133]	[0.004]	[0.153]	[0.023]	[0.129]	[0.029]
InvState==ME	-0.434**	-0.022**	-0.515**	-0.018**	0.800**	0.089**	0.804**	0.142**

	[0.135]	[0.006]	[0.159]	[0.004]	[0.167]	[0.024]	[0.139]	[0.030]
InvState==MI	-0.756**	-0.034**	-0.690**	-0.023**	0.779**	0.084**	0.781**	0.135**
	[0.113]	[0.004]	[0.131]	[0.003]	[0.153]	[0.021]	[0.128]	[0.026]
InvState==MN	-0.738**	-0.033**	-0.686**	-0.023**	1.053**	0.127**	0.837**	0.148**
	[0.115]	[0.004]	[0.134]	[0.003]	[0.154]	[0.025]	[0.129]	[0.027]
InvState==MO	-0.426**	-0.021**	-0.403**	-0.015**	0.891**	0.102**	0.908**	0.164**
	[0.115]	[0.005]	[0.134]	[0.004]	[0.154]	[0.024]	[0.129]	[0.028]
InvState==MS	-0.058	-0.003	-0.240	-0.009+	0.599**	0.062**	0.831**	0.148**
	[0.127]	[0.007]	[0.150]	[0.005]	[0.163]	[0.021]	[0.137]	[0.030]
InvState==MT	-0.316*	-0.017**	-0.411*	-0.015**	0.613**	0.064**	0.618**	0.104**
	[0.141]	[0.006]	[0.167]	[0.005]	[0.173]	[0.022]	[0.146]	[0.029]
InvState==NC	-0.494**	-0.024**	-0.535**	-0.019**	0.883**	0.101**	0.787**	0.138**
	[0.115]	[0.005]	[0.134]	[0.004]	[0.154]	[0.023]	[0.129]	[0.027]
InvState==ND	-0.465**	-0.023**	-0.588**	-0.020**	0.607**	0.063**	0.651**	0.111**
	[0.153]	[0.006]	[0.184]	[0.005]	[0.176]	[0.023]	[0.150]	[0.030]
InvState==NE	-0.476**	-0.023**	-0.537**	-0.019**	0.573**	0.058**	0.726**	0.126**
	[0.128]	[0.005]	[0.151]	[0.004]	[0.162]	[0.020]	[0.137]	[0.028]
InvState==NH	-0.449**	-0.022**	-0.598**	-0.020**	1.018**	0.123**	1.050**	0.197**
	[0.118]	[0.005]	[0.138]	[0.003]	[0.154]	[0.026]	[0.130]	[0.030]
InvState==NJ	-0.695**	-0.032**	-0.699**	-0.023**	0.814**	0.088**	0.844**	0.147**
	[0.112]	[0.004]	[0.131]	[0.003]	[0.154]	[0.021]	[0.128]	[0.027]
InvState==NM	-0.294*	-0.016**	-0.369**	-0.014**	1.018**	0.123**	1.088**	0.206**
	[0.122]	[0.006]	[0.142]	[0.004]	[0.158]	[0.026]	[0.132]	[0.031]
InvState==NV	-0.253*	-0.014*	-0.527**	-0.018**	0.477**	0.047*	0.634**	0.107**
	[0.126]	[0.006]	[0.152]	[0.004]	[0.162]	[0.019]	[0.137]	[0.027]
InvState==NY	-0.715**	-0.033**	-0.683**	-0.023**	0.739**	0.077**	0.404**	0.063**
	[0.113]	[0.004]	[0.132]	[0.003]	[0.153]	[0.020]	[0.128]	[0.022]
InvState==OH	-0.640**	-0.030**	-0.526**	-0.019**	0.847**	0.094**	0.829**	0.145**
	[0.113]	[0.004]	[0.132]	[0.004]	[0.155]	[0.022]	[0.129]	[0.027]
InvState==OK	-0.441**	-0.022**	-0.627**	-0.021**	0.705**	0.076**	0.657**	0.112**
	[0.116]	[0.005]	[0.136]	[0.003]	[0.155]	[0.021]	[0.131]	[0.026]
InvState==OR	-0.478**	-0.023**	-0.521**	-0.018**	0.855**	0.097**	0.715**	0.123**
	[0.118]	[0.005]	[0.137]	[0.004]	[0.155]	[0.023]	[0.131]	[0.027]
InvState==PA	-0.631**	-0.030**	-0.539**	-0.019**	0.861**	0.095**	0.824**	0.143**

	[0.112]	[0.004]	[0.130]	[0.004]	[0.152]	[0.022]	[0.128]	[0.027]
InvState==RI	-0.433**	-0.022**	-0.586**	-0.020**	0.992**	0.119**	0.967**	0.178**
	[0.126]	[0.005]	[0.149]	[0.004]	[0.160]	[0.026]	[0.134]	[0.030]
InvState==SC	-0.368**	-0.019**	-0.496**	-0.017**	0.860**	0.098**	0.883**	0.159**
	[0.118]	[0.005]	[0.138]	[0.004]	[0.156]	[0.024]	[0.131]	[0.029]
InvState==SD	-0.414*	-0.021**	-0.457*	-0.016**	0.792**	0.088**	0.614**	0.103**
	[0.161]	[0.007]	[0.190]	-0.005	[0.179]	[0.026]	[0.158]	[0.031]
InvState==TN	-0.398**	-0.020**	-0.506**	-0.018**	0.847**	0.096**	1.009**	0.187**
	[0.115]	[0.005]	[0.135]	[0.004]	[0.153]	[0.023]	[0.129]	[0.029]
InvState==TX	-0.631**	-0.030**	-0.553**	-0.020**	0.814**	0.088**	0.863**	0.151**
	[0.112]	[0.004]	[0.130]	[0.004]	[0.152]	[0.021]	[0.128]	[0.027]
InvState==UT	-0.449**	-0.022**	-0.518**	-0.018**	0.917**	0.107**	1.073**	0.202**
	[0.118]	[0.005]	[0.138]	[0.004]	[0.155]	[0.024]	[0.130]	[0.030]
InvState==VA	-0.408**	-0.021**	-0.496**	-0.018**	0.826**	0.092**	0.846**	0.151**
	[0.115]	[0.005]	[0.134]	[0.004]	[0.154]	[0.023]	[0.129]	[0.028]
InvState==VT	-0.524**	-0.025**	-0.647**	-0.021**	0.773**	0.085**	0.301*	0.046*
	[0.128]	[0.005]	[0.152]	[0.004]	[0.159]	[0.023]	[0.138]	[0.023]
InvState==WA	-0.616**	-0.029**	-0.481**	-0.017**	0.827**	0.092**	0.770**	0.134**
	[0.115]	[0.004]	[0.133]	[0.004]	[0.154]	[0.022]	[0.129]	[0.027]
InvState==WI	-0.652**	-0.030**	-0.684**	-0.022**	1.026**	0.123**	0.912**	0.164**
	[0.114]	[0.004]	[0.133]	[0.003]	[0.153]	[0.025]	[0.129]	[0.028]
InvState==WV	-0.321*	-0.017**	-0.401**	-0.015**	0.670**	0.071**	0.902**	0.164**
	[0.126]	[0.006]	[0.147]	[0.004]	[0.161]	[0.022]	[0.134]	[0.030]
InvState==WY	-0.007	0.000	-0.032	-0.001	0.546**	0.055*	0.757**	0.133**
	[0.149]	[0.009]	[0.174]	[0.007]	[0.191]	[0.024]	[0.159]	[0.033]
AppYear==1977	-1.930**	-0.057**	-2.326**	-0.044**	-5.362**	-0.101**	-2.941**	-0.167**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.156]	[0.001]	[0.128]	[0.002]
AppYear==1978	-2.001**	-0.058**	-2.415**	-0.044**	-5.239**	-0.100**	-2.971**	-0.167**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.156]	[0.001]	[0.128]	[0.002]
AppYear==1979	-2.015**	-0.058**	-2.425**	-0.044**	-5.243**	-0.100**	-2.965**	-0.167**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.156]	[0.001]	[0.128]	[0.002]
AppYear==1980	-2.074**	-0.058**	-2.476**	-0.044**	-5.095**	-0.100**	-2.953**	-0.167**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.155]	[0.001]	[0.128]	[0.002]
AppYear==1981	-2.103**	-0.059**	-2.523**	-0.045**	-5.026**	-0.099**	-2.933**	-0.167**

	[0.113]	[0.001]	[0.131]	[0.001]	[0.155]	[0.001]	[0.128]	[0.002]
AppYear==1982	-2.072**	-0.058**	-2.488**	-0.044**	-4.850**	-0.099**	-2.905**	-0.166**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.154]	[0.001]	[0.128]	[0.002]
AppYear==1983	-2.092**	-0.058**	-2.512**	-0.045**	-4.721**	-0.098**	-2.898**	-0.166**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.154]	[0.001]	[0.128]	[0.002]
AppYear==1984	-2.112**	-0.059**	-2.517**	-0.045**	-4.646**	-0.098**	-2.890**	-0.166**
	[0.113]	[0.001]	[0.131]	[0.001]	[0.154]	[0.001]	[0.128]	[0.002]
AppYear==1985	-2.137**	-0.059**	-2.569**	-0.045**	-4.590**	-0.099**	-2.906**	-0.167**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.153]	[0.001]	[0.128]	[0.002]
AppYear==1986	-2.160**	-0.060**	-2.571**	-0.045**	-4.418**	-0.099**	-2.911**	-0.168**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.153]	[0.001]	[0.128]	[0.002]
AppYear==1987	-2.189**	-0.060**	-2.606**	-0.046**	-4.332**	-0.100**	-2.934**	-0.170**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.153]	[0.001]	[0.128]	[0.002]
AppYear==1988	-2.200**	-0.061**	-2.610**	-0.046**	-4.183**	-0.101**	-2.952**	-0.172**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.153]	[0.001]	[0.128]	[0.002]
AppYear==1989	-2.285**	-0.062**	-2.689**	-0.047**	-4.033**	-0.101**	-2.993**	-0.173**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.152]	[0.001]	[0.128]	[0.002]
AppYear==1990	-2.308**	-0.063**	-2.710**	-0.048**	-3.790**	-0.100**	-2.977**	-0.174**
	[0.112]	[0.001]	[0.131]	[0.001]	[0.152]	[0.001]	[0.128]	[0.002]
AppYear==1991	-2.352**	-0.064**	-2.747**	-0.048**	-3.609**	-0.100**	-2.993**	-0.176**
	[0.112]	[0.001]	[0.130]	[0.001]	[0.152]	[0.001]	[0.128]	[0.002]
AppYear==1992	-2.376**	-0.064**	-2.777**	-0.049**	-3.315**	-0.099**	-2.953**	-0.176**
	[0.112]	[0.001]	[0.130]	[0.001]	[0.152]	[0.001]	[0.128]	[0.002]
AppYear==1993	-2.446**	-0.066**	-2.828**	-0.050**	-2.945**	-0.096**	-2.919**	-0.177**
	[0.112]	[0.001]	[0.130]	[0.001]	[0.152]	[0.002]	[0.128]	[0.003]
AppYear==1994	-2.496**	-0.067**	-2.889**	-0.051**	-2.452**	-0.092**	-2.847**	-0.179**
	[0.112]	[0.001]	[0.130]	[0.001]	[0.152]	[0.002]	[0.128]	[0.003]
AppYear==1995	-2.495**	-0.068**	-2.884**	-0.052**	-2.010**	-0.086**	-2.756**	-0.180**
	[0.112]	[0.001]	[0.130]	[0.001]	[0.152]	[0.003]	[0.128]	[0.003]
AppYear==1996	-2.590**	-0.069**	-2.961**	-0.052**	-2.495**	-0.094**	-2.815**	-0.181**
	[0.112]	[0.001]	[0.130]	-0.001	[0.152]	[0.002]	[0.128]	[0.003]
AppYear==1997	-2.670**	-0.072**	-3.050**	-0.054**	-3.108**	-0.105**	-2.926**	-0.188**
	[0.112]	[0.001]	[0.130]	[0.001]	[0.152]	[0.002]	[0.128]	[0.003]
AppYear==1998	-2.809**	-0.073**	-3.170**	-0.055**	-3.199**	-0.106**	-3.002**	-0.190**

	[0.112]	[0.001]	[0.131]	[0.001]	[0.152]	[0.002]	[0.128]	[0.003]
AppYear==1999	-2.983**	-0.076**	-3.338**	-0.057**	-3.330**	-0.109**	-3.182**	-0.197**
	[0.112]	[0.001]	[0.130]	[0.001]	[0.152]	[0.002]	[0.128]	[0.003]
Observations	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365	1,684,365
Industry FE	YES		YES		YES		YES	
State FE	YES		YES		YES		YES	
Application Year FE	YES		YES		YES		YES	
Log-likelihood	-411295		-321831		-555773		-761194	
Chi Sqared	440024		420038		563215		451303	
p value	0.000		0.000		0.000		0.000	

Robust standard errors in brackets
** p<0.01, * p<0.05, + p<0.1

TABLE 11 NOTES: The method of estimation is Logit with state and years fixed-effects. The dependent variable in following 4 models is the probability of an inventor to move across (1) states, (2) regions, (3) cities, and (4) companies. State, year, and industry-specific fixed-effects are included and standard errors are clustered at the inventor level

Table 12. Results of the logit regression. The probability of inventors moving across states, regions, cities, and companies within a period of 2000-2012

	Model 1		Model 2		Model 3		Model 4	
VARIABLES	Moved across states		Moved across regions		Moved across cities		Moved across companies	
	Coeff	Mfx	Coeff	Mfx	Coeff	Mfx	Coeff	Mfx
VARIABLES	moved	moved	moved_regio	moved_regio	moved_city	moved_city	moved_company	moved_company
Stock of patents3	0.011**	0.001**	0.012**	0.000**	0.013**	0.001**	0.011**	0.001**
	[0.002]	[0.000]	[0.002]	[0.000]	[0.002]	[0.000]	[0.002]	[0.000]
Income tax rate	0.001	0.000	0.000	0.000	0.001	0.000	-0.003**	-0.000**
	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]
Mortgage deduction rate	0.000	0.000	0.001	0.000	-0.001	0.000	0.003**	0.000**
	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]
Noncompetes_unenforc=1	-2.877**	-0.092**	-2.956**	-0.076**	-1.692**	-0.128**	-1.723**	-0.139**
	[0.034]	[0.001]	[0.038]	[0.001]	[0.026]	[0.002]	[0.027]	[0.002]
dInd==1	-0.090**	-0.004**	-0.095**	-0.004**	-0.003	0.000	0.090**	0.010**
	[0.023]	[0.001]	[0.026]	[0.001]	[0.019]	[0.002]	[0.017]	[0.002]
dInd==2	-0.045*	-0.002*	-0.034	-0.001	0.037*	0.004*	0.098**	0.011**
	[0.022]	[0.001]	[0.025]	[0.001]	[0.018]	[0.002]	[0.016]	[0.002]
dInd==3	-0.023	-0.001	0.002	0.000	0.055**	0.006**	0.174**	0.020**
	[0.022]	[0.001]	[0.024]	[0.001]	[0.018]	[0.002]	[0.016]	[0.002]
dInd==4	0.007	0.000	0.018	0.001	0.089**	0.009**	0.250**	0.029**
	[0.021]	[0.001]	[0.024]	[0.001]	[0.018]	[0.002]	[0.016]	[0.002]
dInd==5	0.094**	0.005**	0.087**	0.004**	0.202**	0.022**	0.363**	0.044**
	[0.024]	[0.001]	[0.027]	[0.001]	[0.019]	[0.002]	[0.017]	[0.002]
dInd==6	-0.003	0.000	-0.013	-0.001	0.199**	0.022**	0.443**	0.055**
	[0.027]	[0.001]	[0.030]	[0.001]	[0.021]	[0.002]	[0.018]	[0.003]
dInd==7	-0.069**	-0.003**	-0.014	-0.001	-0.002	0.000	0.081**	0.009**
	[0.022]	[0.001]	[0.024]	[0.001]	[0.018]	[0.002]	[0.016]	[0.002]
dInd==8	0.242**	0.013**	0.304**	0.014**	0.239**	0.027**	0.243**	0.029**
	[0.047]	[0.003]	[0.054]	[0.003]	[0.038]	[0.005]	[0.031]	[0.004]
dInd==9	0.018	0.001	0.092	0.004	0.058	0.006	0.033	0.004
	[0.108]	[0.005]	[0.116]	[0.005]	[0.079]	[0.008]	[0.075]	[0.008]
InvState==AL	-2.148**	-0.046**	-2.514**	-0.039**	-1.813**	-0.095**	-1.971**	-0.106**

	[0.066]	[0.001]	[0.075]	[0.000]	[0.056]	[0.001]	[0.055]	[0.001]
InvState==AR	-1.897**	-0.044**	-2.132**	-0.037**	-1.912**	-0.097**	-2.080**	-0.107**
	[0.082]	[0.001]	[0.089]	[0.001]	[0.081]	[0.002]	[0.072]	[0.001]
InvState==AZ	-2.449**	-0.050**	-2.868**	-0.041**	-2.005**	-0.101**	-1.885**	-0.106**
	[0.044]	[0.000]	[0.049]	[0.000]	[0.036]	[0.001]	[0.031]	[0.001]
InvState==CO	-2.439**	-0.050**	-2.877**	-0.042**	-1.832**	-0.098**	-1.916**	-0.107**
	[0.042]	[0.000]	[0.047]	[0.000]	[0.034]	[0.001]	[0.031]	[0.001]
InvState==CT	-2.439**	-0.050**	-2.854**	-0.042**	-1.842**	-0.098**	-1.880**	-0.107**
	[0.045]	[0.000]	[0.051]	[0.000]	[0.038]	[0.001]	[0.032]	[0.001]
InvState==DE	-2.412**	-0.048**	-2.583**	-0.039**	-2.038**	-0.099**	-1.880**	-0.104**
	[0.071]	[0.000]	[0.078]	[0.000]	[0.058]	[0.001]	[0.042]	[0.001]
InvState==FL	-2.366**	-0.050**	-2.663**	-0.041**	-1.783**	-0.097**	-2.069**	-0.111**
	[0.039]	[0.000]	[0.043]	[0.000]	[0.031]	[0.001]	[0.029]	[0.001]
InvState==GA	-2.315**	-0.049**	-2.644**	-0.041**	-1.807**	-0.097**	-1.869**	-0.106**
	[0.042]	[0.000]	[0.047]	[0.000]	[0.035]	[0.001]	[0.030]	[0.001]
InvState==HI	-2.179**	-0.046**	-2.696**	-0.039**	-1.742**	-0.093**	-2.293**	-0.110**
	[0.121]	[0.001]	[0.154]	[0.001]	[0.103]	[0.002]	[0.115]	[0.002]
InvState==IA	-2.387**	-0.048**	-2.703**	-0.040**	-1.976**	-0.098**	-1.821**	-0.103**
	[0.059]	[0.000]	[0.068]	[0.000]	[0.050]	[0.001]	[0.041]	[0.001]
InvState==ID	-2.679**	-0.050**	-3.161**	-0.041**	-2.277**	-0.104**	-2.064**	-0.109**
	[0.086]	[0.000]	[0.097]	[0.000]	[0.080]	[0.001]	[0.047]	[0.001]
InvState==IL	-2.548**	-0.053**	-2.730**	-0.043**	-1.917**	-0.103**	-1.995**	-0.113**
	[0.045]	[0.000]	[0.049]	[0.000]	[0.039]	[0.001]	[0.034]	[0.001]
InvState==IN	-2.351**	-0.049**	-2.616**	-0.040**	-1.909**	-0.099**	-1.963**	-0.108**
	[0.043]	[0.000]	[0.049]	[0.000]	[0.036]	[0.001]	[0.031]	[0.001]
InvState==KS	-2.384**	-0.048**	-2.682**	-0.039**	-2.007**	-0.099**	-1.967**	-0.106**
	[0.066]	[0.000]	[0.075]	[0.000]	[0.056]	[0.001]	[0.048]	[0.001]
InvState==KY	-2.466**	-0.048**	-2.772**	-0.040**	-2.087**	-0.100**	-2.255**	-0.111**
	[0.063]	[0.000]	[0.070]	[0.000]	[0.054]	[0.001]	[0.047]	[0.001]
InvState==LA	-2.204**	-0.047**	-2.721**	-0.039**	-1.901**	-0.097**	-2.269**	-0.111**
	[0.069]	[0.001]	[0.088]	[0.000]	[0.060]	[0.001]	[0.060]	[0.001]
InvState==MA	-2.425**	-0.054**	-2.686**	-0.045**	-1.698**	-0.099**	-1.677**	-0.106**
	[0.037]	[0.000]	[0.041]	[0.000]	[0.029]	[0.001]	[0.026]	[0.001]
InvState==MD	-2.438**	-0.050**	-2.717**	-0.041**	-1.774**	-0.096**	-1.823**	-0.105**

	[0.054]	[0.000]	[0.059]	[0.000]	[0.042]	[0.001]	[0.034]	[0.001]
InvState==ME	-2.185**	-0.047**	-2.651**	-0.039**	-1.884**	-0.096**	-1.911**	-0.104**
	[0.098]	[0.001]	[0.121]	[0.000]	[0.084]	[0.002]	[0.065]	[0.001]
InvState==MI	-2.641**	-0.054**	-2.855**	-0.044**	-2.023**	-0.105**	-1.943**	-0.112**
	[0.037]	[0.000]	[0.041]	[0.000]	[0.030]	[0.001]	[0.026]	[0.001]
InvState==MN	-2.754**	-0.054**	-2.953**	-0.044**	-1.952**	-0.103**	-1.884**	-0.109**
	[0.041]	[0.000]	[0.045]	[0.000]	[0.032]	[0.001]	[0.026]	[0.001]
InvState==MO	-2.266**	-0.048**	-2.535**	-0.039**	-1.637**	-0.092**	-1.873**	-0.105**
	[0.052]	[0.000]	[0.059]	[0.000]	[0.042]	[0.001]	[0.040]	[0.001]
InvState==MS	-2.035**	-0.046**	-2.473**	-0.038**	-1.877**	-0.096**	-2.248**	-0.110**
	[0.088]	[0.001]	[0.104]	[0.000]	[0.081]	[0.002]	[0.075]	[0.001]
InvState==MT	-2.296**	-0.047**	-2.633**	-0.039**	-1.980**	-0.098**	-2.046**	-0.107**
	[0.117]	[0.001]	[0.121]	[0.000]	[0.110]	[0.002]	[0.088]	[0.002]
InvState==NC	-2.492**	-0.051**	-2.825**	-0.042**	-1.874**	-0.100**	-1.853**	-0.107**
	[0.041]	[0.000]	[0.046]	[0.000]	[0.033]	[0.001]	[0.031]	[0.001]
InvState==ND	-2.563**	-0.048**	-3.029**	-0.040**	-2.123**	-0.100**	-1.966**	-0.105**
	[0.142]	[0.001]	[0.179]	[0.001]	[0.118]	[0.002]	[0.089]	[0.002]
InvState==NE	-2.335**	-0.047**	-2.551**	-0.039**	-2.132**	-0.100**	-1.996**	-0.106**
	[0.091]	[0.001]	[0.099]	[0.000]	[0.082]	[0.001]	[0.065]	[0.001]
InvState==NH	-2.207**	-0.047**	-2.667**	-0.040**	-1.890**	-0.097**	-1.776**	-0.102**
	[0.052]	[0.000]	[0.061]	[0.000]	[0.045]	[0.001]	[0.038]	[0.001]
InvState==NJ	-2.354**	-0.052**	-2.713**	-0.043**	-1.645**	-0.096**	-1.878**	-0.110**
	[0.037]	[0.000]	[0.042]	[0.000]	[0.029]	[0.001]	[0.027]	[0.001]
InvState==NM	-2.162**	-0.047**	-2.576**	-0.039**	-1.961**	-0.098**	-2.041**	-0.107**
	[0.068]	[0.001]	[0.078]	[0.000]	[0.060]	[0.001]	[0.053]	[0.001]
InvState==NV	-2.402**	-0.048**	-2.889**	-0.040**	-2.027**	-0.099**	-2.092**	-0.108**
	[0.075]	[0.001]	[0.084]	[0.000]	[0.070]	[0.001]	[0.059]	[0.001]
InvState==NY	-2.596**	-0.057**	-2.895**	-0.048**	-1.761**	-0.103**	-1.868**	-0.115**
	[0.036]	[0.000]	[0.040]	[0.000]	[0.028]	[0.001]	[0.026]	[0.001]
InvState==OH	-2.627**	-0.053**	-2.777**	-0.043**	-1.903**	-0.101**	-1.972**	-0.111**
	[0.039]	[0.000]	[0.042]	[0.000]	[0.030]	[0.001]	[0.027]	[0.001]
InvState==OK	-2.440**	-0.048**	-2.900**	-0.040**	-2.064**	-0.100**	-1.945**	-0.105**
	[0.067]	[0.000]	[0.078]	[0.000]	[0.059]	[0.001]	[0.048]	[0.001]
InvState==OR	-2.625**	-0.051**	-3.057**	-0.042**	-2.047**	-0.102**	-2.302**	-0.115**

	[0.052]	[0.000]	[0.060]	[0.000]	[0.043]	[0.001]	[0.036]	[0.001]
InvState==PA	-2.418**	-0.052**	-2.677**	-0.043**	-1.766**	-0.099**	-1.965**	-0.111**
	[0.037]	[0.000]	[0.041]	[0.000]	[0.029]	[0.001]	[0.027]	[0.001]
InvState==RI	-2.245**	-0.047**	-2.801**	-0.040**	-1.800**	-0.095**	-1.963**	-0.105**
	[0.071]	[0.001]	[0.099]	[0.000]	[0.069]	[0.001]	[0.066]	[0.001]
InvState==SC	-2.230**	-0.047**	-2.598**	-0.039**	-1.735**	-0.094**	-2.013**	-0.107**
	[0.054]	[0.000]	[0.065]	[0.000]	[0.045]	[0.001]	[0.040]	[0.001]
InvState==SD	-2.502**	-0.048**	-3.035**	-0.040**	-2.297**	-0.102**	-2.162**	-0.108**
	[0.149]	[0.001]	[0.186]	[0.001]	[0.132]	[0.002]	[0.110]	[0.002]
InvState==TN	-2.278**	-0.048**	-2.732**	-0.040**	-1.895**	-0.097**	-1.989**	-0.107**
	[0.051]	[0.000]	[0.058]	[0.000]	[0.043]	[0.001]	[0.034]	[0.001]
InvState==TX	-2.609**	-0.057**	-2.832**	-0.047**	-1.973**	-0.109**	-1.885**	-0.115**
	[0.035]	[0.000]	[0.038]	[0.000]	[0.028]	[0.001]	[0.025]	[0.001]
InvState==UT	-2.454**	-0.049**	-2.850**	-0.040**	-1.860**	-0.097**	-1.993**	-0.107**
	[0.053]	[0.000]	[0.060]	[0.000]	[0.043]	[0.001]	[0.041]	[0.001]
InvState==VA	-2.213**	-0.048**	-2.567**	-0.040**	-1.838**	-0.097**	-1.916**	-0.106**
	[0.045]	[0.000]	[0.051]	[0.000]	[0.036]	[0.001]	[0.033]	[0.001]
InvState==VT	-2.785**	-0.050**	-3.277**	-0.041**	-1.842**	-0.096**	-1.654**	-0.099**
	[0.096]	[0.001]	[0.116]	[0.000]	[0.080]	[0.002]	[0.041]	[0.001]
InvState==WA	-2.659**	-0.054**	-2.825**	-0.044**	-1.847**	-0.102**	-2.055**	-0.115**
	[0.043]	[0.000]	[0.046]	[0.000]	[0.035]	[0.001]	[0.030]	[0.001]
InvState==WI	-2.662**	-0.051**	-2.923**	-0.042**	-2.093**	-0.103**	-1.997**	-0.109**
	[0.044]	[0.000]	[0.049]	[0.000]	[0.036]	[0.001]	[0.030]	[0.001]
InvState==WV	-2.021**	-0.045**	-2.513**	-0.039**	-1.945**	-0.097**	-1.971**	-0.105**
	[0.091]	[0.001]	[0.117]	[0.001]	[0.088]	[0.002]	[0.082]	[0.002]
InvState==WY	-2.038**	-0.045**	-2.642**	-0.039**	-1.903**	-0.096**	-1.924**	-0.104**
	[0.139]	[0.001]	[0.159]	[0.001]	[0.120]	[0.002]	[0.107]	[0.002]
AppYear==2001	-0.042	-0.002	-0.066*	-0.003*	-0.026	-0.003	-0.122**	-0.013**
	[0.027]	[0.001]	[0.030]	[0.001]	[0.020]	[0.002]	[0.020]	[0.002]
AppYear==2002	-0.160**	-0.008**	-0.179**	-0.007**	-0.142**	-0.014**	-0.249**	-0.025**
	[0.028]	[0.001]	[0.030]	[0.001]	[0.021]	[0.002]	[0.020]	[0.002]
AppYear==2003	-0.094**	-0.005**	-0.119**	-0.005**	-0.076**	-0.008**	-0.223**	-0.023**
	[0.028]	[0.001]	[0.031]	[0.001]	[0.021]	[0.002]	[0.020]	[0.002]
AppYear==2004	-0.118**	-0.006**	-0.136**	-0.005**	-0.104**	-0.010**	-0.207**	-0.021**

	[0.029]	[0.001]	[0.031]	[0.001]	[0.022]	[0.002]	[0.021]	[0.002]
AppYear==2005	-0.191**	-0.009**	-0.213**	-0.008**	-0.214**	-0.020**	-0.150**	-0.016**
	[0.029]	[0.001]	[0.031]	[0.001]	[0.022]	[0.002]	[0.020]	[0.002]
AppYear==2006	-0.233**	-0.011**	-0.228**	-0.008**	-0.237**	-0.022**	-0.027	-0.003
	[0.028]	[0.001]	[0.031]	[0.001]	[0.021]	[0.002]	[0.020]	[0.002]
AppYear==2007	-0.316**	-0.014**	-0.300**	-0.011**	-0.347**	-0.032**	-0.089**	-0.009**
	[0.028]	[0.001]	[0.031]	[0.001]	[0.022]	[0.002]	[0.020]	[0.002]
AppYear==2008	-0.374**	-0.016**	-0.379**	-0.013**	-0.394**	-0.036**	-0.170**	-0.018**
	[0.029]	[0.001]	[0.032]	[0.001]	[0.022]	[0.002]	[0.020]	[0.002]
AppYear==2009	-0.490**	-0.020**	-0.493**	-0.016**	-0.478**	-0.042**	-0.365**	-0.035**
	[0.030]	[0.001]	[0.033]	[0.001]	[0.023]	[0.002]	[0.021]	[0.002]
AppYear==2010	-0.658**	-0.026**	-0.661**	-0.021**	-0.673**	-0.056**	-0.566**	-0.052**
	[0.030]	[0.001]	[0.033]	[0.001]	[0.023]	[0.002]	[0.021]	[0.002]
AppYear==2011	-1.034**	-0.036**	-1.022**	-0.029**	-1.032**	-0.076**	-0.937**	-0.076**
	[0.033]	[0.001]	[0.036]	[0.001]	[0.025]	[0.001]	[0.023]	[0.001]
Observations	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433	1,834,433
Industry FE	YES		YES		YES		YES	
State FE	YES		YES		YES		YES	
Application Year FE	YES		YES		YES		YES	
Log-likelihood	-387139		-326070		-661029		-693681	
Chi Sqared	176916		171437		201641		486819	
p value	0.000		0.000		0.000		0.000	

Robust standard errors in brackets

** p<0.01, * p<0.05, + p<0.1

See: Table 11 Notes