PhD THESIS DECLARATION

The undersigned

SURNAME *Zehtabchi*

FIRST NAME *Maryam*

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SURNAME *Zehtabchi*

FIRST NAME *Maryam*

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Abstract

This dissertation examines the role of the two most important intellectual properties, patents and trademarks on innovation, economic growth and markets. In the first essay, we study the impact of geographic distance on firm's external sources of knowledge spillover. We focus on customers and competitors as firms' two main private external sources of innovation. The second study investigates the regional economic growth and value chain structure. By using UD trademarks, I explore the dynamic interactions among generation of Intermediate products, Final products and economic growth in US metropolitan areas. Finally, the third essay looks at the notion of market for trademarks. And discusses how fluctuation in cost effect impacts location and mode of trademark transactions. Thus, the common denominator of these three essays is the geography perspective taken in to account.

Category: Strategy, Innovation, Economic Geography
Keywords: Patents, Trademarks, Spillover, Value Chain, Market for IP

Chapter 1

Introduction

The main focus of my dissertation is to study the role of Intellectual Property (IP) in knowledge spillover and innovative activity, regional economic growth and finally, market for IP. All these three topics are viewed through a geographic lens. My thesis strives to address following questions: What is the impact of geographic distance on firm's external sources of knowledge spillover? Why are the dynamics between innovations in different levels of value chain and regional economic growth? And finally, to what extent market for trademarks differ from patents'? How fluctuations in the maintenance costs affects trademark transactions?

Empirically, in the first section, I commence by incorporating patents, which are the most conventional form of IP in the field of innovation and spillover. However, in the second and third sections of the thesis, my focus predominantly shifts to trademarks, which are largely understudied in the existing literature. The three essays of my dissertation seek to build upon the extant patent studies and fill the gap in studying other forms of IP, particularly trademarks.

Chapter 2 --- *Impact of Geographical Distance on External Sources of Knowledge Spillover*

The first paper of my dissertation focuses on private sources of knowledge specifically customers and competitors as sources of innovative activity. Our main argument is that the two sources are correlated even after controlling for several factors at the level of technology, individual and organization. What is more, we show that the geographical distance of these sources modifies the intensity of this correlation, in a way that locally the two sources are more correlated. The underlying theoretical mechanism that explains the different roles is the *randomness* of local interactions as opposed to *planned-ness* of distant interactions.

We try to complement the line of studies on informal sources of knowledge by disentangling *jointly* the importance of two different sources of informal knowledge spillovers: customers (Von Hippel, 1988) and competitors (Markedis and Geroski, 2004). These two sources are the most important sources of private knowledge. The fact that these sources are near to the downstream market makes them crucial for firms.

Additionally, we add geographical distance as an important element in our picture, because it can play a decisive role on the level of importance of the competitors and customers as drivers of innovation.

There is a trade-off between local externalities and protective or imitation issues. Firms may decide to remain geographically far from competitors and customers have more protection, or locate close to them but be more prone to local spillover. In order to do so, we juxtapose local and distant customers and competitors- as main external sources of knowledge. We claim that geographical proximity augments the level of correlation between these two sources. The underlying theoretical mechanism that we propose explains this stylized fact with the *randomness* of local interactions as opposed to *planned-ness* of distant interactions. (Gittelman, 2007)

Empirically, we use 9017 patent-level observations from a survey on inventors (Giuri et al, 2007) for our analysis. The data includes the level of importance of various sources of knowledge that had lead to each patent. In particular, it includes the importance of customers and competitors, as main sources of knowledge.

Chapter 3 --- *Regional Economic Growth and Value Chain Structures: an Empirical Analysis of US Trademarks (2001-2012)*

This paper empirically explores the dynamic interactions among generation of Intermediate products, Final products and economic growth in 348 US metropolitan areas during the period 2001-2012. Using US trademark data I disentangle between the two types of ready-to-be-commercialized products based on their NICE product classifications. I test the demand-driven vertical relationship between Intermediate products, Final products and regional economic growth. The empirical results indicate that an idiosyncratic shock to metropolitan level GDP creates virtuous circle over time. Meaning, a shock to GDP triggers metropolitan areas' subsequent generation of final products, which in turn stimulates generation of intermediate products. And ultimately Intermediate products drive the GDP.

In this study I focus on late stages of product innovation process and the interactions between regional economic growth. In first step, I differentiate between invention and innovation. That is assuming, inventions per se will not affect economic growth and only successful implementation and commercialization of innovations emerging from inventions induces additional growth. Even so, there is heterogeneity among successfully commercialized innovations, in terms of their impact. The position of these innovations in the value chain and breadth of applicability in subsequent product innovation renders a criterion for discerning their impact level. As such, I disentangle between two types of product innovations: Intermediate goods and Final goods and services.

Intermediate goods are used as an input in production process of other goods and services, therefore mainly consumed by other business. On the other hand, Final goods and services are end products targeted for consumers.

Differentiating between Final and Intermediate products, based on the vertical relationship, allows us to break down the demand mechanisms (Geroski and Walters, 1995) that links innovation to economic growth.

Empirically, I test the research question using registered trademarks in US Patent and Trademark Office (USPTO) as a measure of ready to be commercialized product innovation. Based on the information about each trademark's owner address, NICE product classification and status, I constructed a dataset, which renders the stock of live trademarks per year, for 45 classifications, in each 348 metro area within the time-span of 2001-2012. Using trademark data in innovation and economic geography literature is embryonic but is gaining prominence (Graham et al2013, 2014; Mendonca et al 2004, Flikkema et al 2014, Graevenitz, 2007).

Chapter 4 --- *Market for Trademarks*

The third essay looks at the notion of "market for trademarks". I look at trademark market vis-à-vis patents to unveil their differences; trademarks have higher market *visibility*, less *complementarity*, less *value rivalry*, lack of repugnance, indefinite *renewability* and cover broader *range of products*. Second I posit a formal model to discusses how fluctuation in cost effect impacts location and mode of trademark transactions.

Firms intangible asset play crucial role for sustainable competitive advantage, are the main forms of these intangible assets. Over the past two decades intellectual properties (IP) - patents, copyrights and trademarks- have been recognized as the dominant factor in numerous significant commercial transactions. However, for the most part the existing literature on market for IP is focused on Market for Technology and Idea (MfTI) (Arora et al, 2001, 2010). Though extremely elegant, these studies by and large are concentrated on patents. Research and exploring market for other forms of IP, in particular "Market for Trademarks" remains scarce (Graham et al, 2014). The aim of this study is to explore this topic.

There are various reasons that make this topic worth investigating. First, this research allows us to complement our general understanding about potential unexplored features of market for IP. Secondly, making a comparison between patent and trademark unveils their market similarities or differences. Thus, the first goal of this study is to investigate whether market for the two IP's follows the same path or the differences in the nature of trademark, compared to patents, renders different market dynamic.

Next, I elaborate about formal models to posit three hypotheses: An increase in renewal cost, triggers higher number of trademark transaction. These transactions are more likely to be in form of security interest and finally among parties in different cities.

Empirically, I use the dataset of US registered trademark transactions obtained from USPTO (Graham et al, 2014). This data contains detailed information on 786,931 transactions recorded at the USPTO between (1952 – 2013). This information includes assignor (owner) and assignee's names, addresses, type of legal entity and the execution date of the transaction. In the second step, I combined this data with the case file dataset of these transacted trademarks also obtain from USPTO. This combined data allows me to have additional detailed information about each trademark. Particularly, the product classification and filing date of these transacted trademarks.

Chapter 2

"The Impact of the Geographical Distance on the External Sources of Knowledge Spillover"

Introduction

Innovative capability lies at the heart of firms' competitive advantage in several industries (Mowery et al 1998; Eisenhardt and Martin, 2000; Helfat and Raubitschek, 2000). However, innovation is subject to depreciation and competitive erosion (Tushman and Anderson 1986, Anderson and Tushman 1990; Christensen and Rosenbloom 1995; Christensen, 1997). Thus, firms should constantly seek to keep alive or renew innovative trajectories (Garud and Kumaraswamy, 1993). However, new ideas are rarely born in a vacuum. Recent stream of literature has focused on the importance of external sources of knowledge (Chesbrough, 2003, 2008; Giarratana, 2004; Christensen et al, 2005), based on the signals received especially from competitors and customers (Adner and Levinthal, 2001; Adner and Kapoor 2010).

Even largest innovation-active firms cannot rely solely on the internal R&D to keep their innovative engines up and running. Prior research has shown that external knowledge can enhance and complement firm-level innovation process. Cassiman and Veugelers (2006) found a complementarity effect between internal R&D and external knowledge acquisition. The previous studies in the literature have focused on the effects of formal external business activities on firms' innovation. Scholars have shown that corporate venture capital investments (Dushnitsky and Lenox, 2005), alliances (Ahuja, 2000), joint ventures (Oxley, 1996, Oxley and Wada 2009, Inkpen and Crossan, 1995), and acquisitions (Ahuja and Katila, 2001) are positively related to the innovative performance.

However, also informal external sources play a role in innovation. The informal perspective was mainly approached by geographical scholars. Despite all the early hype about digital era, geographical distance of these sources of ideas is still a relevant matter. Firms still locate in places to be close to customers, talent pool and likeminded firms, trying to maximize their benefit from the externalities that physical location can provide for them (Almeida and Kogut, 1999; Owen-Smith and Powell, 2004; Saxenian, 1994; Stuart and Sorenson, 2003; Gambardella and Giarratana, 2010). Hence, also the business press recognizes that hasty waves of excitement about “death of distance” and “end of geography”, that rose in the beginning of digital era, not only turned out to be much exaggerated, but the digital technologies have increased the returns to geographical agglomeration (*The Economist*, 2012).

Collocation of innovative activity is a complex strategic decision. At one hand, the literature on economic geography (Jaffe et al, 1993), knowledge spillover (Audretsch and Feldman 1996) and clusters (Porter, 2000), magnify the benefits and externalities that proximity of market players provides for firms (Krugman, 1991). On the other hand, other studies indicate that firms may intentionally decide to reside isolated and far, due to protective reasons and imitation threats (Liebeskind, 1996; Shaver and Flyer 2000, Chung and Alcácer 2002).

Following this literature, this article tries, first to complement the line of studies on informal sources of knowledge by disentangling *jointly* the importance of two different sources of informal knowledge spillovers, that have received the greatest attention so far: customers (Von Hippel, 1988) and competitors (Markedis and Geroski, 2004). These two sources are the most important sources of private knowledge. The role of customers as a driver of innovation is deepseated in the literature however when it comes to competitors existing literature mainly approaches them as (imitation) threats and focuses on protection perspective. Our study is an attempt to take a fresh look on competitors as sources of innovation.

Additionally, we add geographical distance as an important element in our picture, because it can play a decisive role on the level of importance of the competitors and customers as drivers of innovation.

There is a trade-off between local externalities and protective or imitation issues. Firms may decide to remain geographically far from competitors and customers but more protected or being close, but more prone to local spillover. In order to do so, we try to juxtapose local and distant customers and competitors- as main external sources of knowledge. Precisely, we explain how geographical distance can affect the correlation between these two sources of knowledge for firms' innovation process.

We claim that geographical proximity augments the level of correlation between these two sources. The underlying theoretical mechanism that we propose explains this stylized fact with the *randomness* of local interactions as opposed to *planned-ness* of distant interactions. (Gittelman, 2007)

Empirically, we use 9017 patent-level observations from a survey on inventors (Giuri et al, 2007) for our analysis. The data includes the level of importance of various sources of knowledge that had lead to each patent. In particular, it includes the importance of customers and competitors, as main sources of knowledge. The survey also provides us with information about importance of geographical distance of informal interactions.

In our study we assume that focal firm's location is already fixed and therefore exogenous from location decisions. However, our results can have implications for the decisions of such nature for entering a new market or opening new subsidiaries.

The front-end of this study is unveiling the underlying mechanisms of firms' informal external innovative sources at a finer-grained manner. Moreover, by framing firm's competitors as a source of innovation we strive to give a fresh look to competitors. This positive look is different from the conventional perspective in existing literature towards competitors as (imitation) threats.

The remainder of this paper is structured as follows. First we formally elaborate on the mechanism and posit the hypothesis, and then we give a comprehensive description of the empirical setting for testing our hypotheses followed by the methodology used for our analysis. Finally, we conclude with discussing our results and implications

Theory and Hypotheses

Knowledge is arguably firms' most important asset for achieving an innovation output (Grant, 1996). Recent advances in the innovation literature have shown how external sources of knowledge are as important as internal ones (Howells et al, 2003, Cassiman and Veugelers, 2006). Firms tap external knowledge sources in addition to their internal research and development (R&D) through licensing (Teece, 1986, Teece et al, 1997), R&D outsourcing or offshoring (Arnold, 2000; Grimpe and Kaiser, 2010 Doh, 2005; Howells, 2006a; Jahns et al., 2006; Weigelt, 2009), alliances (Ahuja, 2000; Oxley, 2009), company acquisition (Zhao, 2009, Katila and Ahuja, 2001), or the hiring of qualified researchers with relevant knowledge (Almeida and Kogut, 1999; Gambardella and Giarratana, 2010).

However there are additional external sources of knowledge; in particular spillovers obtained through informal interactions with market players. We define informal interactions as all meetings, discussion or collaborations outside formal contractual format. So far literature has highlighted four types of main external knowledge sources: public knowledge (e.g. universities, literature, patents), suppliers, customers and competitors (Giuri et al, 2007). In this paper, we like to focus on the last two; we exclude public knowledge because while they tend to be informal they also tend to be too far away from market applications and therefore less strategic for firms. On the other hand, we exclude suppliers, because while are key for shaping downstream innovation, they are usually embedded in medium or long term contract relationships with firms, rendering this relationship less informal by default (Dawid and Kopel, 2003, Camuffo et al, 2007). Customers and competitors instead tend to be less structured inside contract relationships and also less bounded to firms decisions (more exogenous compared to who are the firm suppliers).

The customers' needs and ideas are important factors that can shape the direction of the innovation. Following the empirical studies, this appears to be particularly pertinent in sectors with rapidly changing user needs, such as high tech or extreme sports (Lüthje et al, 2005), although there is evidence in low-tech industries and services as well (e.g., Herstatt & von Hippel, 1992; Oliveira & von Hippel, 2011; Skiba & Herstatt, 2009).

Imitation from competitors has historically been crucial for firms to access unique, first-hand knowledge that provides competitive advantage. Competitors can act as a source of innovation primarily in terms of setting or raising industry standards. Firms tend to keep pretty close tabs on their competitors, and often copy and improve on competitors' products using their own applications. They strive to catch up with their competitors by tapping into each other knowledge and disrupting their cutting-edge technology. The literature indicates that firms that enter an industry at very early stages suffer from being "too fast to market" (Tellis and Golder, 1996) and often happen to be "first to market, first to fail" (Robinson and min, 2002) and face "first-mover disadvantage" (Lieberman and Montgomery, 1998; Dobrev and Gotsopolous, 2010). And in fact, it turns out that when it comes to new-to-the-world market pioneers almost always loose to their "fast seconds" competitors (Markedis and Geroski, 2004). Hence, the role of competitors as a trigger for consecutive innovations is very pronounced.

Geographical scholars have linked the importance of informal sources with geographical proximity, in particular in the case of innovative clusters (Jaffe, 1986; Jaffe et al., 1993, Saxenian, 1994, Alcacer, 2006). This line of research indicates that knowledge production has a spatial dimension and focuses on the role and significance of inherently informal spillovers among market players. Drawing upon this literature our study attempt to answer to the following questions: How does geographical proximity of customers and competitors affect the process of seeking, accessing, and accumulating external informal spillovers? Is the nature of interactions with *local* customers and competitors different from the geographically *distant* ones?

Geographically Distance of informal sources of knowledge

Distant interactions inherently lack spontaneity factor. Majority of distant interactions are planned, intentional and purposeful so that absorption of knowledge is not effortless, cheap and random. In studying inventive teams, Feldman and Bercovitz (2011) discuss the factors that might mitigate the disadvantages of distance. They show that those factors increase the likelihood that creative teams of academic scientists to include more geographically far-flung external members. They suggest three factors: prior experience of working together, strong social ties, and reputation. All these factors support the “planned-ness” of the distant interactions. In other words, while firms may interact with both distant customers or competitors these interaction are planned and determined in advance and are less likely to be based on spontaneity or chance meeting.

The complexity of firms’ search pattern (Rivkin and Siggelkow, 2007) increases when they seek geographically distant knowledge. The cost of such search can become unmanageable, especially if it involves face-to-face encounter. Therefore, firms need to screen distant sources, plan in advance and decide with whom they want to interact (Breschi and Malerba, 2006; Gittleman, 2007; Giuri and Mariani, 2013).

All this means that they need to ex-ante invest in time and resources when scouting for knowledge beyond the boundaries of their region. Since these distant informal interactions are costly they also tend to be less frequent than local ones. However, once firms make the effort to go distant they try to maximize the benefits from distant customers and competitors. Therefore, these interactions although are less often can still be correlated (scale economies). But, scarcity of this type of costly interactions makes the information received from a distant source (customer or competitor) more prone to be forgotten or losing its effectiveness in time (Holan and Phillips, 2004). And in contrast to the local case, since interactions with distant customers and competitors are not necessarily happening at the same time, firms may perceive the impact of the distant customer or competitor (as a source of knowledge) on one another less.

There are also forces that go against the correlation between customers and competitors as sources of knowledge. If the main reason to tap geographically distant knowledge is to access customer knowledge, protection reasons and imitation threats could make a firm reluctant about further interaction with distant competitors. On the other hand, when firms’ main intention is accessing their distant competitors’ knowledge it is more likely that the nature of this knowledge is more at technological level and technical know-how (Oxley, 1999). Therefore, inherently this type of knowledge is less likely to have sound link with the customer side. This situation makes their distant customers knowledge less desirable. These scenarios indicate that when firms are determined to access distant knowledge the correlation between importance of customers and competitors (as sources of knowledge) could even be negative. Thus we hypothesize two contrasting hypotheses: if cost reasons are greater than fear of imitation and basic science project bias we will observe a positive correlation, otherwise a negative. :

Hypothesis 1a: For firms that claim distant interactions are important for their innovative activities, there is a positive correlation between the degree of importance of customers and competitors as a source of innovation (cost reasons).

Hypothesis 1b: For firms that claim distant interactions are important for their innovative activities, there is a negative correlation between the degree of importance of customers and competitors as a source of innovation (fear of imitation and basic research reasons).

Geographically Closeness of informal sources of knowledge

One main characteristic of local interactions is their *randomness*. Geographical proximity provides a dynamic, unplanned contact system. Additionally, provides a low-cost channel for new ideas and talent to make their way into existing activities. The randomness notion can be central for innovative processes because it can make the relationships easier, cheaper and much more effective than they would be without proximity. (Gittleman, 2007; Giuri and Mariani, 2013). We claim that though not all the local interactions are random, but majority of the random interaction happen locally.

Vicinity facilitates random face-to-face contacts. Evidence from Psychology literature shows that that face-to-face contact can reveal the intentions of another actor (Husserl, 1968). Particularly, for complex context-dependent information, the medium *is* the message. The most powerful such medium for verifying the intention of another is direct face-to-face contact (Breschi and Malerba, 2006). Human's finely tuned ability to read people unconsciously places a premium on facial expressions and intonation. A disembodied voice can't inspire trust.

The other reason for face-to-face contact is for development of the ability to check the trustfulness of information. Humans are highly effective at sensing non-verbal messages, particularly about emotions, co-operation and trustworthiness (Putnam, 2000). Mehrabian (1981) states that our facial and vocal expressions, postures, movements and gestures, are crucial in the course of communication. Trust depends on reputation effect or the multilayered relation between parties to a transaction that can create low-cost enforcement opportunities (Gambetta, 1988; Lorenz, 1992); proximity reduces the transactions costs of these informal relationships. The trust literature (see Dirks and Ferrin 2001, Mayer et al. 1995 for reviews) provides considerable evidence that trusting relationships lead to greater knowledge exchange: When trust exists, people are more willing to give useful knowledge (Andrews and Delahay 2000, Penley and Hawkins 1985, Tsai and Ghoshal 1998, Zand 1972) and are also more willing to listen to and absorb others' knowledge (Carley 1991, Levin 1999, Mayer et al. 1995, Srinivas 2000). By reducing conflicts and the need to verify information, trust also makes knowledge transfer less costly (Currall and Judge 1995, Zaheer et al. 1998). These effects have been found at the individual and organizational levels of analysis in a variety of settings (Levin and Cross, 2004). The study by Bradner and Mark (2002) examines how geographic distance affects collaboration using computer-mediated communication technology. Their results indicate that cooperating members of a team are more like to deceive, be less persuaded, and initially cooperate less, with someone they believe is in distant city, as opposed to in the same city as them.

Therefore, geographical proximity by providing frequent, face-to-face interactions results in more trust-conducive, effective and improved knowledge transfer among subjects and consequently simplifies exchange of ideas. Random local interactions facilitates these factors, increase their frequency of occurrence while reducing the cost of their planned arrangement.

To recap, face-to-face interactions reduce the uncertainty and noise of information spilled among the market players. This appeal makes firms more open to receive knowledge from external informal sources locally. In particular information received from both customers and competitors, which indicates positive correlation.

To better instantiate our conceptualization of positive correlation between firm's local customers and competitors consider the following scenario. Firms make random encounters with customers and receive innovative ideas and signals from them. However, due to proximity local circulation of information is convenient and effortless therefore, their competitors are subject to the same signal, i.e. they should respond to the same stimulus and solve the same customer need. As a result the competition pressure is increased among the firms and triggers them to tap into each other's knowledge more.

A second explanation is that customers are the medium of knowledge circulations among the competitors. The probability that a customer will have interactions with several competitors increases with proximity (i.e. just to evaluate different offers). In this case customers, as knowledge brokers (Aldrich and von Glinow, 1992; Hargadon and Sutton, 1997; Howells, 2006b) receive the knowledge from competitors from one end and then carry it among local competitors.

Thus we hypothesize:

Hypothesis 2: For firms that claim geographically local, informal interactions are important for their innovative activities, there is a positive correlation between the degree of importance of customers and competitors as a source of innovation.

Methods

Sample

The empirical setting for this research is a survey based on 9,017 patents. These patents are granted by the European Patent Office (EPO) between 1993 and 1997, located in France, Germany, Italy, the Netherlands, Spain and the United Kingdom. This survey covers all technological fields, deals with both for-profit and non-profit applicants, and collects information on small, medium and large business companies. The respondents in the survey is (first) inventor(s) since the inventors are likely to have excellent information on their own biography and the invention process. The survey's patents are classified into five "macro"-technological classes: Electrical engineering, Instruments, Chemicals and Pharmaceuticals, Process engineering, and Mechanical engineering. The survey also provides information about inventors' employers: small firms, medium firms, large firms, universities, public or private research institutions, and others. The survey provides a unique opportunity to explore the characteristics of individual inventors, such as their sex, age, education, motivations to invent, and job mobility (Giuri et al, 2007).

The strength and advantage of our survey is that it provides us with direct measures for our variables. The data allows us to separately consider various sources of spillovers and knowledge flows without resorting to conventional patent citation measures, because the inventor assesses it directly. Other indicators from survey let us examines the importance of geographical proximity of interactions with different sources of knowledge in the invention process.

Variables

Dependent Variables

For our analysis we use two sources of innovation, customers and competitors (defined in Table 1) as our dependent variables. The respondent of survey has rated the importance (from 0 to 5) of the two types of sources of knowledge: customers and competitors (CUSTOMERS, COMPETITORS), for the innovative process that lead to a patent. The data also compares the extent to which geographical proximity encourages interactions. The survey asked inventors to rate from 0 to 5 the importance of two types of interactions in the development of the patented invention: (1) interactions with people not in the inventor's organization, and geographically close, meaning those located within-1-hour (W1R); (2) interactions with people not in the inventor's organization, and geographically distant, those beyond-1-hour (B1R) reach. We then define the local category as those firms that have assigned very high score (4, 5) to importance of geographically close interactions and at same time ranked distant interaction not so important (0, 1, 2). The reverse holds for the distant category. In so doing, we create to sub-samples from the original dataset: observations in which distant interactions are the only importance sources, and observations in which local interactions are the only important sources. We use CUSTOMERS and COMPETITORS as our dependent variables, once for the local case and then for the distant one.

<Insert Table 1a here>

Control Variables

We use a list of control variables as our regressors. This list includes variables at individual, patent, firm, and regional levels. The goal is to remove the effect of these factors and obtain white noise residuals from our regressions. At the individual level we control for the educational level, age, gender and experience of the (first) inventor (EDUCATION, AGE, GENDER, TENURE). At the patent level in order to remove the impact of size of the innovative team we control for the number of inventors involved in the patent process, (# INVENTOR). Additionally we include the total cost of the research for the specific patent (TOTAL COST), also the IPC classification of the patent (IPC TECHNOLOGY DUMMY) and the number of claims mentioned in the patent application (CLAIMS). We also control for the number of patents that account for the overall patent family of this innovation (PATENT FAMILY SIZE). And finally, the year of application of the patent is included as different dummies. At the firm level, we also control for firm size with two dummies, LARGE FIRM and MEDIUM FIRM, leaving as a base line the small firm case. In addition to that total number of patents per firm is also taken into account (#FIRM PATENT STOCK). For regional controls, we include the area and population of the region (REGION AREA) where the parent firm was located at the NUTS3[1] level. Finally, we control for the country where the patenting firm is located (Country Dummy).

[1] NUTS3: Third subdivision (group of districts) of Nomenclature of Units for Territorial Statistics, that is a geocode standard for referencing the subdivisions of countries for

<Insert Table 1b here>

Data Analysis

Our objective in this section is to test how much the degree of importance of customers and competitors as sources of knowledge are correlated with each other depending on their geographical distance from a focal firm.

However, this correlation argument cannot be tested directly. The main reason is that, there are some unobservable factors at the geographical level that affect the importance that a firm attaches to its consumers and competitors as a source of knowledge, it is not possible to include a variable that directly measures the role of geography. Thus, we are constrained to testing an important implication of correlations by using the residuals of our regressions. In order to do so we use the same methodology explained in Gambardella and Arora (1990).

To instantiate the method, consider the following. For instance, suppose the two sources; customers and competitors are complements, but there is third exogenous and unobserved source that is a substitute for customers and a complement for competitors. It is then possible that correlation between customer and competitors move in opposite directions if both these sources are more strongly related to third source than to each other. Along the same lines, the reader may have noticed that we have ignored the importance of these knowledge sources to other characteristics of the firm, its environment and institutional setting. It is possible, for instance, out two focal sources are positively correlated because they are strongly correlated to a particular

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statistical purposes. The standard is developed and regulated by the European Union and Eurostat.
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characteristic of the firm, e.g. size. Similarly, institutional peculiarities of specific countries and regions may encourage or discourage external linkages of the kind that we are studying. In order to avoid these sorts of problems in our study we work with the residuals of the regressions rather than looking at the coefficients of regressors. And analyze the correlation between the residuals obtained from the regressions.

Meaning, if an increase in the importance of local interactions with customer raises the marginal effect of the interaction with local competitors, it seems intuitively compelling that we would expect to observe that firms, which have assigned high ranks to interactions with their local customers have also given high rates to importance of interactions with their local competitors. That is to say, one would expect them to be positively correlated. In contrast, if assigning high ranks to the importance of one of the two sources results in decrease of importance of the other source it means they have negative correlation.

Results

Table 2 provides descriptive statistics and correlations. The difference between the number of observations is due to missing variables. Moreover, some cells of Table 2 do not show any correlation because variables belong to different samples. The table shows that customers on average have higher importance (2.9) compared to competitors (2.2) as a source of innovative ideas. And seems that distant interaction seem to also have a slightly more importance on average (1.3) as oppose to close interaction (0.9).

<Insert Table 2 here>

As we mentioned earlier, our analysis is focused on the two sub-samples, local and distant. In order to have a better understanding of these sub-samples we provide an additional descriptive statistics of the main variables in the sub-samples in Table 3. The two sub-samples are defined in the way that include only the extreme cases, meaning that we only considered those who have simultaneously attached very high ranks to within-1hour-reach interactions and very low ranks to beyond-1hour-reach for the local case and vice versa for the distant case. Therefore the number of observations is reduced drastically to around 140 for the local and 450 for the distant case. In both sub-samples customers remain to be the more important source of innovation.

<Insert Table 3 here>

To operationalize the method explained in the previous section, we propose a Heckman selection model for our estimations to avoid any endogeniety or selection bias problem. First, we impose a first step estimation on local and distant categories, i.e. the firm first of all decides if using local or distance sources of knowledge. Then, given the chosen category, we estimate the importance of customers and competitors as sources of knowledge. The final dependent variables are then local customers, local competitors, distant customers and distant competitors. We once regress our list of controls on customers, conditioning they belong to local category. Then we run similar regression, this time regressing on competitors. We repeat the two regressions, but this time based on the condition the pair regressions belong to distant category.

The education level of the inventor is our selection variable for the Heckman model. We believe education level is a suitable selection variable since it indirectly differentiates between the distant and local categories without affecting the customers and competitors importance. We ground this assumption from a recent study (Giuri and Mariani, 2013) that found that inventors with higher level of education not only are less dependent on proximity to access external knowledge but also they might even prefer to go distant. In other words, highly educated people have less transaction costs in the ability to recognize the value of, assimilate, and exploit knowledge that is distant.

Reliance on local spillovers remains a better option for inventors who lack the capacity to move beyond their regional setting, therefore reducing the potential pool of knowledge spillovers to develop new ideas. Their study shows that less educated people need to remain in vicinity of each other to maintain the benefits of unplanned local interactions. The empirical results of the Heckman model are reported in the Tables 4a and 4b.

<Insert Table 4a here>

<Insert Table 4b here>

We are interested in the correlation coefficients between the residuals of customers and competitor regressions in the two cases of local and distant, after removing the effect of the firm characteristics and other controls. The results indicated in Table 5 shows that the off diagonal correlation between the residuals of customer and competitor regression is 0.87, strongly positive and significant, for the local case. Whereas, in the distant case, this correlation is still positive but of lower magnitude 0.37; the strength of correlation is almost half the local case.

Our results show support for Hypothesis 1a and 2. As mentioned earlier, the results indicates that in the distant case while the two sources are still positively correlated, due to the cost reasons this correlation is of lower magnitude. Whereas, in local case the two sources the positive correlation is very strong. Possible explanation is that proximity facilitates random interactions of a focal firm with its customers and competitors and as a result provides a strong correlation between the two local sources.

<Insert Table 5 here>

Furthermore, we try to test whether the two above correlations are statistically different from each other. In order to do so, we regress the residuals of local customers on local competitors and repeated the same for the distant residuals. Table 6 shows these two regressions. Statistically, the coefficient of the estimates in these two regressions is similar to the correlation between the regressor and dependent variable, in our case the correlation between the residuals of customers and competitors. We then made a T-test to test whether the coefficient of the local regressions is equal to the coefficient of the distant case. Table 7 shows the result of the t-tests. The equality of the coefficients is rejected.

<Insert Table 6 here>

<Insert Table 7 here>

CONCLUSION

In this study we explored the impact of geographical distance of two main knowledge sources (with respect to a focal firm) on firms' benefits from knowledge spillovers. The customers and competitors' knowledge were our main interest. We posited that for firms that claim local interactions are important for their innovative activities, there is a strong positive correlation between the degree of importance of customers and competitors (as a source of innovation). Whereas, for firms that claim distant interactions are important for their innovative activities, strength of this correlation diminishes.

Although existing literature provides us with a rich understanding of the spillovers but their generalist perspective and lack of differentiation between the sources of knowledge spillover called for a finer-level analysis.

Our study is an attempt to disentangle two main external sources, customers and competitors, analyze the nature of their correlation. We later juxtaposed the correlations in the two cases of local and geographically distant interactions and observed whether they play differently. Our results confirmed that for firms that claim local interaction is important for innovative activities there is positive correlation between the customers and competitors (as a source of knowledge). And the weaker correlation holds for distant customers and competitors. The underlying mechanism is the presence (absence) of randomness in local (distant) interactions. The randomness factor facilitates the cheap effortless and incidental contacts for market players.

By showing that geographical distance results in changes between correlation between customers and competitors- as firm's external sources of knowledge- we contribute to the growing literature highlighting the strategic value of geographic distance. Moreover, from managerial perspective, the results have implications for firms to actively and intelligently benefit from the local (distant) spillovers.

Moreover, a richer theoretical framework for the study of location-related innovative strategies emerges. Our findings extend the economic geography literature (Jaffe et al, 1993, Shaver and Flyer, 2000) by demonstrating that the strength of correlation among external sources depends on their distance from a focal firm. This study was an attempt to shed light on the micro-foundations of agglomeration by introducing finer-grained perspective to the external knowledge spillovers.

Several avenues for further inquiry arise. First, other sources of knowledge spillover might also play as complements or substitute of each other. Identifying which other sources and under what conditions can play such a role can give a better understanding about how to use them strategically. Identifying under what circumstances one mechanism is more appropriate than another calls for more future research.

Second, although our empirical approach confirms that strong correlation occurs in local interactions for customers and competitors and weaker one in distant case, but does not distinguish what factors might intensify or mitigate theses mechanisms. In other words, understanding what variables can have a modifying role in this process (e.g. competition level) would offer a better insight about when firms benefit or suffer from intentional or unintentional spillovers.

Finally, a growing body of research suggests that firms use spillover strategically in their location decisions to acquire capabilities (Alcácer and Zhao, 2012), taking the perspective discussed in our study for strategic use of spillovers in location choices can help this line of research put one step further. Specifically, results highlighted in this study can be beneficial for both classic and new multinationals strategic location choices when entering a new market.

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Tables

Table 1a. Definition of the variables

	a. **Definition of the Variables in the Empirical Analysis**
Customer	Importance of customers or product users as sources of knowledge for the research that led to the patented invention
Competitor	Importance of competitors as sources of knowledge for the research that led to the patented invention
Within 1hr-reach interaction	If interactions -discussions, meetings, sources of ideas, etc.- with people (apart from co-inventors) belonging to organizations other (unaffiliated) than the inventor's and located within a one hour reach, were important during the research that lead to this patent.
Beyond 1hr-reach interaction	If interactions -discussions, meetings, sources of ideas, etc.- with people (apart from co-inventors) belonging to organizations other (unaffiliated) than the inventor's and located beyond one hour reach, were important during the research that lead to this patent.
Local	Those who have assigned high ranks (4,5) to within 1-hr-reach interaction (W1R) and the at same time low ranks (0,1,2) to beyond 1-hr-reach
Distant	Those who have assigned high ranks (4,5) to beyond 1-hr-reach interaction (B1R) and at the same time low ranks (0,1,2) to within 1-hr-reach

Table 1b. Definition of Control Variables

	b. Control Variables
Age	(Logarithm) Inventor's age
Gender	Inventor's gender dummy
Tenure	(Logarithm) Number of years inventor has been in the firm till the application date of patent
Education	Inventor's highest academic degree when the research leading to this patent was conducted. The dummies are defined as below: 1: Secondary School or lower 2: High School Diploma 3: University BA or equivalent 4: University Master or equivalent 5: University PhD or equivalent
Year	Year of the patent application dummy
Total cost	Inventor's best estimate of the total cost (in Euro) of the research leading to this patent up to the date of application –excluding legal fees or any other fees related to the patent application
Claims	Number of claims in the application
# Patents per firm	Total stock of firm's patents till filing date
Patent Family Size	Number of the set of patents filed with different patenting authorities that refer to the same invention
Number of inventors	Number of inventors participating in the process that lead to the patent
IPC	4-digit Classification dummies
Size	Large firm (> 250 employees), Medium firm (100-250 employees)
# Patents per region	(Logarithm) Average # of patents by region (NUT3)
Parent Country	The country where the patent was issued
Geographical size of region	(Logarithm) The geographical size of the region (NUT3) in km.
Population	(Logarithm) Population of the geographical (NUT3)

Table 2. Descriptive statistics and correlations.

Variables	1	2	3	4	5	6	7	8
1. Customer	1.000							
2. Competitor	0.394*	1.000						
3. Within 1-hr	0.125*	0.154*	1.000					
4. Beyond 1-hr	0.174*	0.125*	0.373*	1.000				
5. Customer if Local	1.000	0.4164	-	0.096	1.000			
6. Competitor if Local	0.416	1.000	-	0.143	0.416	1.000		
7. Customer if Distant	1.000*	0.317*	0.007	-	-	-	1.000	
8. Competitor if Distant	0.3174*	1.000*	0.026	-	-	-	0.317*	1.000
#Observations	9119	8959	8623	8708	153	151	516	515
Mean	2.935	2.207	0.882	1.313	2.816	2.317	3.358	2.260
Std. dev.	1.956	1.860	1.456	1.770	2.011	1.994	2.005	1.901
Min	0	0	0	0	0	0	0	0
Max	5	5	5	5	5	5	5	5

* P<0.01

Table 3. Descriptive statistics for the Local and Distant sub-samples

	Local					Distant				
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Competitor	132	2.42	2.02	0	5	444	2.38	1.89	0	5
Customer	134	2.89	2.00	0	5	444	3.50	1.95	0	5
Large Firm	141	0.71	0.46	0	1	452	0.75	0.43	0	1
Medium Firm	141	0.06	0.25	0	1	452	0.09	0.29	0	1
Age	138	44.87	9.94	23	75	445	45.53	9.082	27	67
Tenure	140	21.61	8.94	6	45	451	22.96	10.07	7	55
Sex	140	1.04	0.19	1	2	451	1.03	0.18	1	2
Inventors	141	2.31	1.53	1	9	452	2.38	1.51	1	14
Claims	133	11.18	7.28	1	44	428	11.07	6.81	1	45
Family size	133	7.18	4.17	2	29	428	7.24	3.91	2	26
Average patent	133	20.94	24.92	1	137.7	434	25.57	30.73	0	237.2
Population	134	795.81	680.87	105.2	3723.2	439	743.34	725.13	39.7	3723.2
Area	133	2766.33	2686.07	77.7	12028	438	2130.99	2357.52	43.8	17252

Table 4a. Heckman Regression

	Local		Distant	
	Customer	**Competitor**	**Customer**	**Competitor**
Tenure	1.974	1.181	0.027	0.001
	(38.643)	(30.742)	(0.021)	(0.024)
Gender	14.954	21.757	0.096	-0.647
	(481.205)	(396.595)	(0.679)	(0.847)
Age	-1.420	-0.523	-0.035	-0.024
	(22.152)	(16.661)	(0.023)	(0.027)
# Inventors	-0.864	-0.205	-0.043	-0.113
	(47.304)	(32.453)	(0.072)	(0.090)
Patent Family size	0.219	0.582	-0.002	-0.033
	(7.308)	(7.534)	(0.030)	(0.037)
# Claims	0.355	-0.048	-0.005	-0.007
	(7.527)	(3.753)	(0.016)	(0.020)
Total cost	-2.456	-1.333	0.011	-0.108
	(52.123)	(43.009)	(0.069)	(0.078)
# Patents per region	14.710	5.177	0.170	0.230
	(247.735)	(177.356)	(0.140)	(0.170)
Population of region	-26.774	-9.577	0.105	-0.377
(NUT3)	(385.158)	(289.514)	(0.166)	(0.206)
Area of region (NUT3)	7.608	0.542	-0.058	-0.118
	(99.115)	(45.788)	(0.146)	(0.172)
Large Firm	26.070	8.244	-0.461	-0.097
	(405.881)	(292.218)	(0.342)	(0.412)
Medium Firm	73.802	26.945	0.369	0.673
	(1,139.322)	(830.527)	(0.437)	(0.552)
IPC Technology dummy				
Country dummy	Yes		Yes	
Year of application dummy				

* p<0.05; ** p<0.01

Table 4b. Heckman Regression: Selection stage

	Local		Distant	
	Customer	**Competitor**	**Customer**	**Competitor**
Tenure	-0.017* (0.008)	-0.018* (0.008)	-0.008* (0.004)	-0.007 (0.004)
Gender	-0.287 (0.416)	-0.270 (0.418)	0.202 (0.194)	0.206 (0.194)
Age	0.005 (0.008)	0.006 (0.008)	0.010* (0.004)	0.009* (0.004)
Education	0.026 (0.086)	0.019 (0.087)	0.088 (0.047)	0.095* (0.047)
IPC Tech dummy	Yes		Yes	
Family Patent Size	-0.002 (0.014)	-0.003 (0.014)	0.011 (0.008)	0.011 (0.008)
# Claims	-0.002 (0.009)	-0.001 (0.009)	-0.003 (0.004)	-0.003 (0.004)
# Inventors	-0.009 (0.042)	-0.006 (0.042)	0.006 (0.021)	0.007 (0.021)
Total cost	0.027 (0.015)	0.030* (0.015)	0.038** (0.008)	0.036** (0.008)
# Patents per region	-0.104 (0.062)	-0.098 (0.063)	-0.037 (0.035)	-0.039 (0.035)
Population of the region	0.140 (0.087)	0.147 (0.088)	0.000 (0.049)	0.003 (0.049)
Area of the region	-0.027 (0.054)	-0.012 (0.055)	0.070* (0.030)	0.068* (0.030)
Large Firm	-0.211 (0.159)	-0.178 (0.162)	0.063 (0.099)	0.038 (0.098)
Medium Firm	-0.453 (0.245)	-0.422 (0.248)	0.001 (0.130)	-0.035 (0.130)

Constant	-2.635**	-2.857**	-2.777**	-2.738**
	(0.831)	(0.842)	(0.463)	(0.463)
Mills Lambda	-107.398	-64.497	0.715	-2.221
	(2,166.616)	(1,745.032)	(1.863)	(2.178)
# Observation	5524	5523	5523	5522
Censored Obs.	5450	5540	5219	5219
Uncensored	73	73	304	303
Wald chi2	0.09	0.27	325.37	136.16
	(1.00)	(1.00)	(0.00)	(0.0258)

* p<0.05; ** p<0.01

Table 5. Correlations between the residuals of Heckman regression for the two case of local and distant.

Local	**Customer**	**Competitor**	**Distant**	**Customer**	**Competitor**
Customer	1.00		**Customer**	1.00	
Competitor	**0.87*** 0.00	1.00	**Competitor**	**0.37*** 0.00	1.00

*Sig. (.01)

Table 6. Regressing Residuals of Heckman regressions

	Local Customer	**Distant Customer**
Local Competitor	0.536**	-
	(0.004)	
Distant Competitor	-	0.466*
		(0.021)
Constant	-17.612**	-4.982**
	(0.866)	(0.032)
# Observations	5601	5061
R-squared	0.76	0.14

* p<0.05; ** p<0.01

Table 7. T-test of the equality of table 6 coefficients

Test 1 **β(Distant Customer) = 0.536**	**Test 2** **β(Local Customer)= 0.466**
F(1, 5599) = 11.38	F(1, 5599) = 405.48
Prob > F = 0.007	Prob > F = 0.000

Chapter 3

"Regional Economic Growth and Value Chain Structures: an Empirical Analysis of US Trademarks (2001-2012)"

Introduction

Innovation and generation of new ideas are the prime motor force of competitiveness and regional economic growth (Acemuglu et al 2000; Gleaser, 2005; Jaffe et al, 1993; Saxenian, 1994; Stuart and Sorenson, 2003). Innovations with prospect of yielding increasing returns and high competitive advantage spread rapidly. In this study I focus on late stages of product innovation process and the interactions between regional economic growth. In first step, I differentiate between invention and innovation. That is assuming, inventions per se will not affect economic growth and only successful implementation and commercialization of innovations emerging from inventions induces additional growth. Even so, there is heterogeneity among successfully commercialized innovations, in terms of their impact. The position of these innovations in the value chain and breadth of applicability in subsequent product innovation renders a criterion for discerning their impact level. As such, I disentangle between two types of product innovations: Intermediate goods and Final goods and services. Intermediate goods are considered as what Greve and Seidal (2014) describe as production asset innovations and they are business facing. That is, they are used as an input in production process of other goods and services. On the other hand, Final goods and services are consumer facing therefore, affected by consumer market standards and preferences. I postulate that based on this vertical relationship the impact of adoption and diffusion of Intermediate and Final products on the subsequent regional growth differs. That is mainly because multiple downstream goods and services can descend from a single Intermediate good, whereas Final goods have very limited effect in triggering the subsequent production of other goods. This difference between the impact of Intermediate and Final goods is not only important for regional economic growth but also for understanding local business cycle fluctuations and drivers of entrepreneurship. So far the existing literature by studying patents and R&D suggests that innovations are procyclic and demand driven (Geroski and Walters, 1995). Differentiating between Final and Intermediate products, based on the vertical relationship, allows us to put this literature one step forward by breaking down the mechanisms that links innovation to economic growth.

This article attempts to test whether a demand driven dynamic runs between Intermediate goods, Final goods and the regional economic growth, as such; this dynamic is determined by stochastic factors. The focal regional level of analysis is metropolitan area, mainly due to the fact that economic players tend to circulate the knowledge and mimic the actions of the competitors in geographic proximity. In other words, proximity pronounces the adoption and diffusion new products. This is in line with spillover literature that shows every new product has an impact on other parts of local economy (Acemuglu et al 2000; Gleaser, 2005; Jaffe et al, 1993; Saxenian, 1994; Stuart and Sorenson, 2003).

Empirically, I test the research question using registered trademarks in US Patent and Trademark Office (USPTO) as a measure of ready to be commercialized product innovation. Based on the information about each trademark's owner address, NICE product classification and status, I constructed a dataset, which renders the stock of live trademarks per year, for 45 classifications, in each 348 metro area within the time-span of 2001-2012. Using trademark data in innovation and economic geography literature is embryonic but is emerging and gaining prominence (Graham et al 2013, 2014; Mendonca et al 2004, Flikkema et al 2014, Graevenitz, 2007). These studies provide evidence that trademarks can be used as indicators of innovation and industrial change. So far trademarks have been extensively studied in marketing (Aaker, 2012, 2009, 1997) and law literature (Landes ans Posner, 1987). Our study is an initial attempt to bridge between these three literatures and to complement our understanding about this multi-dimensional form of intellectual property. Another important aspect of trademark data compared to more conventional measures of innovation namely patents, is the wide range of products that incorporate this form of intellectual property (IP). Almost all types of goods: high-tech, low-tech and especially services use trademarks. While patent data has provided us with substantial information about innovation process and spillover, it mainly captures skill-intensive and high-tech innovations. There is little evidence of low-tech goods and services in patent data. Moreover, perpetual renewability and lower fees of trademark registration and maintenance, compared to patents may provide incentives for cash-strapped innovator to incorporate trademark as a mean for protecting their innovations. In order to study the dynamics and impact of innovations, particularly new product development on other parts of local economy trademark data provides us with complementary information about all types of goods and services and illustrates a more holistic picture before us.

The main novelty of my theoretical approach is distinguishing between the two types of new products in terms of the breadth of their applicability and their ultimate impact on local economic growth. Employing trademarks as my empirical measure fulfills the two aim of this study. First, to capture the impact of commercialized innovation. Secondly, breaking down the demand mechanism based on the value-chain structures of the innovations at the regional level.

The main findings of this study can be summarized succinctly. The results are consistent with the demand driven mechanism. That is, the causal relationships run from variation in economic growth to variation in Final goods and subsequently to variation in Intermediate goods. Results suggest that at metropolitan level, an idiosyncratic shock accounts for unidirectional interaction between GDP and subsequent Final products of that metropolitan that is: GDP Granger-causes Final products and not vice versa. Over time, this shock to Final product triggers generation of Intermediate products required for their production. The increase in Intermediate products is favorable for subsequent GDP of the metropolitan area. This results, unveil the underlying dynamics of regional growth and implications for place-based policies regarding innovative and entrepreneurial activities.

The remainder of this paper is structured as follows. First I formally elaborate on the mechanism and posit the hypothesis, and then I give a comprehensive description of the empirical setting for testing the hypotheses followed by the methodology used for our analysis. Finally, I conclude by discussing the results and implications.

Intermediate Goods and Local multiplier and Value Chain Structure

One of the main sources that characterizes the prospect of each new innovation is the breadth of their applicability in production of subsequent goods and services. The larger the applicability of a new intermediate product, the higher it's expected competitive advantage and returns. For example, the light-emitting polymers developed by Cambridge Display Technology (CDT), a nano-technology company, are used in numerous products ranging from semi-conductors, consumer electronics, toys and advertising (Gambardella and McGahan, 2010). This is true for several other nano-materials. The latest updated Nanotechnology Consumer Products Inventory[2] contains 1,628 consumer products that have been introduced to the market since 2005, representing a 24 percent increase since the last update in 2010. This first-of-its-kind inventory showcases the widespread usage of nanomaterials in several other products including but not limited to: kitchen appliances, automotive, electronics, food and beverage, goods for children, clothing, cosmetics, sporting goods, sunscreen, detergents, construction material, home furnishing and luggage. These multiuse intermediate products are analogous to General Purpose Technologies (GPT) defined by Bresnahan and Trajtenberg's (1995) as technologies with potential for pervasive use in a wide range of sectors. The technological dynamism of GPT's has a substantial impact on the process of economic growth over extended periods of time.

Apart from breadth and applicability, position of an innovation in the value chain is also an important factor. In this regard, Intermediate product innovations are located in upper part of value chain compared to Final ones. It is important to understand the mechanisms under which these two types of innovations affect the economic growth in a metropolitan area. Two possible stories can occur: supply driven or demand driven.

In the supply driven case, a macroeconomic shock to generation of intermediate products in a metropolitan area in time t drives generation of subsequent Final products in time t+1 in the same

2 http://www.nanotechproject.org/news/archive/9242/

metropolitan. This increase in generation of the final products in turn, affects the economic growth of that area. In other words, there is a top down direction with respect to value chain structure. This explanation is in line with the "supply push' model of innovation.

However, I argue that the interplay between Intermediate Innovation, Final Innovation and Economic Growth does not follow this model and has rather a "demand pull" model. That is variation in demand boost variation in economic activity. This is consistent with the existing literature that states both R&D and patents are demand driven and pro-cyclical (Geroski and Walters 1995, Griliches 1990, Comin and Gertler 2006). Geroski and Walters indicate that innovations are driven by consumers' behavior and more likely to be produced in boom period. In this interpretation periods of high and growing demand provide favorable conditions, which allow market expansion. Therefore, any idiosyncratic shock that results in increase of economic growth can stimulate absorption of Final products in the market. Generation of these final products command for increase in generation of Intermediate products required as one of their components. In other words, the increase in GDP of a metropolitan in time t drives generation of final products in time t+1. This increase in demand for Final products drives generation of intermediate products used for production of the final ones. Which ultimately boost the economic activity (GDP) at the metropolitan level.

Having the above specification in mind, these three variables: Final products, Intermediate products and economic growth within the boundaries of a metropolitan area, are affected by two sets of factors. First a common factor that affects all the variables. Second an idiosyncratic factor that affects only one of the variables. This stochastic factor makes the interaction between the above variable unidirectional. Hence we hypothesize that:

H1a: Ceteris paribus, at the metropolitan level, stochastic shock to GDP triggers generation of Final products

H1c: Ceteris paribus, at the metropolitan level, stochastic shock to Final products triggers generation of Intermediate products.

H1c: Ceteris paribus, at the metropolitan level, a stochastic shock to generation of Intermediate products triggers GDP.

Intermediate Goods and Proximity

If cities and metro areas are going to flourish and survive, then they need to continue to innovate. These concentrated economic areas provide channels for easy circulation of knowledge between the market players. Proximity facilitates interaction and exchange of ideas, which fosters innovation (Almeida and Kogut, 1999; Owen-Smith and Powell, 2004; Saxenian, 1994; Stuart and Sorenson, 2003; Gambardella and Giarratana, 2010). The future of cities is then more and more dependent on innovations, particularly ones that yield large returns. These innovations are important both for resurgent economic hubs and laggard regions. The former needs them to maintain their productive edge and remain vibrant, whereas the latter, to catch up with the prosperous regions.

This specification indicates that an important aspect of Intermediate good innovations is their geographic scope of consumption. From geographic perspective the impact of Intermediate good innovations is two-fold. At one hand, economic geography studies shows that local spillovers in dense geographic areas such as cities result in widespread and quicker adoption of new innovations in same area. Therefore Intermediate good innovations are more likely to be first adopted and employed locally. For instance, a new software security system is more likely to be first adopted in local banks, resulting in generation of new services and facilities that these banks can offer.

At the other hand, in time, they are also likely to be disseminated in regions other than their home cities due to their high applicability. Therefore, we can conclude at earlier stage, Intermediate good innovations' multiplier effect on downstream final products and services is more pronounced locally. In other words, this effect is by and large bounded to dense geographic areas like metropolitans and as we expand the geographic scope the effect is mitigated. Thus we hypothesize:

H2: Ceteris paribus, expanding the geographical scope from city to state-level, weakens the intensity of multiplier effect between Intermediate goods and final products.

Method

Sample

In order to test the hypotheses above I use US trademarks. Trademark can be a very relevant measure of commercialized product innovation. Mainly, since for registration of a good or service in US Patent and Trademark Office (USPTO) it is necessary to provide evidence of use (or intent to use within 6 months). This condition makes trademark a suitable measure for late stage product innovation especially those, which are ready to be launched to the market. However, since novelty is not a necessary condition for registration one might argue that it may not capture real innovations. Nonetheless, there is an emerging body of research providing the positive evidence between innovative activity and trademark. The study by Mendonca et al

(2004) shows that trademarks can be used as an indicator of innovation and industrial change. They show that there is a positive correlation between patenting (where novelty is a necessity) and trademark activity. Moreover, latest report by World Intellectual Property Organization (WIPO, 2013) on brands also argues that companies, which invest heavily in trademark activities, are also often highly innovative.[3] Trademark activity can be an important complement to product innovation. By generating demand and willingness to pay, trademark activity enables firms to profit from investing in technology and design. Trademark data contains valuable information on innovative activity not well captured by other traditional measures, namely patents. Trademarks are closer to market and cover large amount of commercial activity. That is the point where firms can secure their return in investment the innovative process.

Compared to patents, which are limited to technological inventions, trademarks cover a broader set of participants in the economy because almost every firm, regardless of size, market, or business strategy, has goodwill to protect. Accordingly, trademark data may capture innovations that are not patented or not R&D intensive, either because they are not patentable or because their inventors have chosen not to seek patent protection. For instances, innovation in low-tech industries.

Having mentioned the advantages, I also acknowledge limitation of this data. First, as mentioned earlier lack of direct evidence of novelty. Secondly, trademarks are mainly categorized by NICE

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3 http://www.wipo.int/export/sites/www/freepublications/en/intproperty/944/wipo_pub_944_2013.pdf

production classification. These classifications are at very aggregated level. Therefore, unlike industry and technology classifications (e.g. NAICS or SIC codes) some of the NICE classifications may consist of products from various technological levels.

For this article I use a new dataset of trademark applications and registrations derived from USPTO publically available for download at: www.google.com/googlebooks/uspto-trademarks-recent-applications.html. These files contain detailed information on around 6 million trademark applications filed with, or registrations issued by, the USPTO between January 1884 up to 2013, including prosecution history, ownership, mark text, classification, related marks, and renewal history. However the files are in XML format that are not well suited to large-scale, comprehensive analysis. I converted these file to a comprehensive database in a format compatible with statistical software, in particular STATA. In the next step, I merged this dataset with US zip code data obtained from 2010 US Census data. For the particular use of this article I used a sub-sample of these two datasets, based on the extensive and detailed information provided in the case-file of each trademark. NICE *Classification* and *Owner Address* and *Status code* are the three main variables of interest selected from the case-file dataset. I used the zip code in Owner Address to associate each trademark to a US metropolitan area and the *status code* allowed us to consider only live trademarks and exclude the expired, abandoned or canceled ones. These variables are defined in detail in Table 1. The result is a sample, with information about the stock of live trademarks per year, for 45 Nice classifications, in each 348 metro area within the time-span of 2001-2012. For instance, I know that 7,368 goods in Chemical class were registered in Chicago metropolitan area in 2004. These 348 metro areas represent almost 90% of all US metropolitan areas. I also collected GDP per metropolitan area for the period of analysis.

This data is obtained from U.S. Department of Commerce, Bureau of Economic Analysis (BEA), the Regional Analysis Division. Similar type of data was collected at the state level. Meaning the stock of existing trademarks, in 50 US states, in 45 Nice classification for the time-span of 2001-2012. And accordingly, similar analysis is performed at the state-level.

<Insert Table 1 here>

Variables

Main Variables

My main variables of analysis are the Intermediate and Final goods trademarks and GDP of each metro area. Empirically, I start by count of *Total* number of the stock of trademarks in each metropolitan area per year. Next, I split the Total variable into two categories based on their Nice product classifications. These 45 classifications include 34 goods and 16 services. I assign a dummy to each of the 45 Nice classifications associating them to either Intermediate product or Final product and services. Dummy 1 refers to Intermediate and dummy 2 refers to Final category. The two categories were decided based on the information in each of the 45 "Class Headings" and "Explanatory Notes" provided in the USPTO website. The full list of class headings is included in the appendix. The class headings provide information about the range of products covered by each class. The explanatory notes render additional information about the nature products in each each class. Additionally, I used World Intellectual Property Organization (WIPO) detailed definition and examples for each of the Nice classes.

For instance, Nice code 1 refers to chemicals. The corresponding USPTO class heading for this code indicates that products, which belong to this class includes "Chemicals used in industry, science and photography, as well as in agriculture, horticulture and forestry; unprocessed artificial resins, unprocessed plastics; manures; fire extinguishing compositions; tempering and soldering preparations; chemical substances for preserving foodstuffs; tanning substances; adhesives used in industry." Moreover, the explanatory notes for Nice class "1", explicitly indicates that " …products belong to this class are mainly used for generation of products in other classes…". Based on the information above, I assigned Nice code 1 to an Intermediate category.

In order to double-check my categorization I asked three independent raters to repeat the procedure of assigning the Intermediate and Final dummies based on the aforementioned sources. The final result indicates that out of 45 classes, 11 classes refer to Intermediate category and 34 classes refer to Final dummy. The Intermediate variable is then the total count of Intermediate trademarks in all 11 classes in each metropolitan area per year. In the similar vein, I construct the Final variable as the count of Final trademarks in all 34 classes in each metro area in each year in each metro area. Following similar pattern, we replicate similar variables, this time at the state-level. I acknowledge this specification has its limitations. This limitation stems from various reasons. First, Nice classes are highly aggregated. Second, unlike sector and industry classification there is no standardized input-output, supply-use or concordance table at product level. Hence, the author and the raters assigned the dummies based on definitions and details about class headings and examples provided in USPTO and WIPO. While, some USPTO explanatory notes mentions that products of certain classes are used in generation of "other" classes they do not explicitly indicate *other* refers to which classes.

And finally, our third variable of interest is the GDP data at the metropolitan for the period between 2001-2013. And as mentioned earlier, this data is obtained from U.S. Department of Commerce, Bureau of Economic Analysis (BEA).

Data Analysis

For the empirical part of our analysis, given the structure of our data, I test for predictability or Granger-causality in the technical sense formalized by Granger (1969) and Sims (1980) and also used in other studies (Gandal et. al, 1999, Gerosky and Walters 1995). In this interpretation, a variable x causes y if lagged values of x are significant in explaining y in a regression in which lagged values of y are also explanatory variables. It is, of course, possible that causality exists in both ways. This test can be performed using Vector Auto-Regressions (VARs).

The existing literature that addresses the impact of innovation on economic growth has mainly used patent or R&D. The same goes for the body of literature on business cycle and economic fluctuations. Thus, it is important to test whether incorporating trademark as an alternative indicator of innovation renders consistent results compared to the previous studies. In particular, I am interested to examine whether the demand driven story holds for trademarks, as a close to the market measure of innovation. Therefore, I start by running the regressions using total number of trademarks, regardless of categorization. I use two-equation VAR model to investigate the relationship between the variables of interest: Total trademark and GDP at the metropolitan level. I control for the metro area fixed effect and Year is assigned as our time variable. The objective is to examine whether an idiosyncratic shock to generation of Total trademarks in a given metro area drives the subsequent GDP in that same metro area (or vice versa) that is controlling for the lagged values of our dependent variables (indicated below). The VAR models for Total and GDP are given by the following equations:

$$P_{c,t}^{Total} = \beta_0 + \sum_{i=1}^{s} \gamma_i P_{c,t-i}^{Total} + \sum_{i=1}^{s} \delta_2 GDP_{c,t-i}^{Metro} + \varepsilon \qquad (1)$$

$$GDP_{c,t} = \beta''_0 + \sum_{i=1}^{s} \gamma_i' P_{c,t-i}^{Total} + \sum_{i=1}^{s} \delta_2' GDP_{c,t-i}^{Metro} + \varepsilon'' \quad (2)$$

$$\varepsilon = \mu + \theta, \quad \varepsilon' = \mu + \theta'$$

Where $P_{c,t}^{Total}$ refers to total number of live trademarks in all 45 Nice products classifications, in each metropolitan area c in year t and $GDP_{c,t}$, refers to GDP of each metropolitan area c in year t. The error term ε and ε' are assumed to consist of, a common factor represented by μ and a truly random component θ and θ'. For our analysis we include 1 lag time difference. Later on, regressions (1) and (2) are replicated at the state level.

I continue the analysis by breaking down the *Total* variable in two aforementioned categories; trademarks referring to *final* and *Intermediate* products. The idea is to break down the underlying demand driven mechanisms based on the vertical relationship between the two categories of product innovation. The empirical regression equation used to estimate the dynamic between the three variables: Final, Intermediate products and GDP in each metro is given by the equations below:

$$P_{c,t}^{F} = \beta_0 + \sum_{i=1}^{s} \beta_i P_{c,t-i}^{Int} + \sum_{i=1}^{s} \gamma_i P_{c,t-i}^{F} + \sum_{i=1}^{s} \delta_i GDP_{c,t-i}^{Metro} + \varepsilon \qquad (3)$$

$$P_{c,t}^{Int} = \beta'_0 + \sum_{i=1}^{s} \beta'_i P_{c,t-i}^{Int} + \sum_{i=1}^{s} \gamma'_i P_{c,t-i}^{F} + \sum_{i=1}^{s} \delta_i' GDP_{c,t-i}^{Metro} + \varepsilon' \qquad (4)$$

$$GDP_{c,t} = \beta''_0 + \sum_{i=1}^{s} \beta''_i P_{c,t-i}^{Int} + \sum_{i=1}^{s} \gamma''_i P_{c,t-i}^{f} + \sum_{i=1}^{s} \delta_i'' GDP_{c,t-i}^{Metro} + \varepsilon'' \quad (5)$$

$$\varepsilon = \mu + \theta, \quad \varepsilon' = \mu + \theta', \quad \varepsilon'' = \mu + \theta''$$

Where, P^{f} and P^{GPP}, respectively, denote trademarks in final products and Intermediate products at region c at time t. And similar to earlier $GDP_{c,t}$, refers to GDP of each metropolitan area c in year t. The error term ε, ε' and ε'' are assumed to consist of a common factor, represented by μ, and a truly random component θ, $\theta'$and θ''. This time our VAR model is a three-equation one.

Our models allow us to include different time lags. We include one-year lag in our equations. In the same vein, equations (3), (4) and (5) are again replicated at the state-level.

Results

Table 2 presents the descriptive statistics and correlations of the main variables at the metropolitan and state levels. Figure 1 illustrates the average value of the our three main variable during the period of study years (2001-2012).

<Insert table 2 here>

<Insert Figure 1 here>

Next, I look at the cross tabulation of our variables to compare the cases one there are above or below average of a certain variable. Table 3a indicates that areas with above average GDP also have higher average Final products. Table 3b, suggest that areas with above average Final also have higher average Intermediate products. And finally, table 3c

Suggests that areas with above average Intermediate have higher GDP. These tables are consistent with our hypotheses.

<Insert Table 3a, 3b, 3C here>

The empirical results of Granger Causality regressions for the Total trademarks at the metropolitan and state-level are given in Table 4 and 5, respectively. By comparing the two tables, results of equation (1) are similar for both geographical levels. The lagged values of Total trademark are positive and highly significant with almost same magnitude for metropolitan (1.120) and state (1.139) level. However, regarding equation (2) the most striking results is that while at the metro level Total is positive and significant at 5 percent (0.458), this effect disappears at the state level and loses its significance. We can interpret this as total trademark derives the GDP in subsequent years in metropolitan level but not at the state level.

<Insert table 4 here>

<Insert table 5 here>

We continue our analysis by focusing on GDP and our Intermediate and Final categories. The result of the three regressions for metro and state level are presented in tables 6 and 7.

<Insert table 6 here>

<Insert table 7 here>

In first glance, by looking at equation (3) in both tables, we notice that while GDP is positive and significant on at the metropolitan level (0.003), its significance is lost at the state level. When it comes to equation (4) the results seem to be similar with only difference of Final losing its magnitude of significance from 1 percent to 5 percent. And finally, with respect to equation (5) it is evident that Intermediate is only positive and significant (1.267) at the metro level and when we move to the state level not only the it is no longer significant but also it has a negative sign.

Overall we can conclude that, at metro level, it is Intermediate that has an effect on GDP. And in fact, the significance of Total trademark is captured by Intermediate trademark part of the variable and not the Final trademarks. Moreover, our results indicate that the effect of GDP on Total trademarks at the metropolitan is the result of Final trademarks and not Intermediate ones. That is, the increase of local demand of Final goods and services in metropolitans drives the GDP.

The results above are consistent with all three hypotheses. The effect of the externalities and forward spillover is more pronounced at the metropolitan level. That is, smaller geographical level of analysis benefit from externalities of spillover and results in local multiplier. As we expand the level of analysis these effects tend to disappear and diminish.

The result above is based on the analysis with 1 lag included. The tables included in the appendix include the replication of above analysis with 2 lags both at metropolitan and state levels.

Conclusion

Our study was an attempt to illuminate the underlying mechanisms, which influence the regional economic growth. Discerning which types of product innovations can trigger regional growth is crucial. I posit that disentangling innovations based on their position in the value chain can explain the underlying demand-driven mechanisms that link innovation to economic growth. The findings suggest that demand mechanisms convey through two sets of vertically differentiated products innovations over time. Our results indicate that, a unidirectional relationship runs from metropolitan area's GDP to subsequent generation of Final goods and services in that same area. This increase in generation of Final goods calls for increase in the Intermediate products that are used as an input for generation of the Final goods. Which in turn, triggers the GDP over time. By doing so, my study contributes to the literature on innovation and industrial change.

From empirical point of view innovation and economic growth literature have largely focused on the effect of innovations, spillover and economic growth mainly by focusing on conventional measures namely R&D and patents. While the existing studies have elegantly expanded our understanding about the nature of innovation, they tend to be focused on the patent-producer industries. Hence our knowledge about characteristics of innovation and their impact on growth in non-patenting industries and services has so far remained scarce and limited. The emergence of attention toward trademarks as an alternative IP for measuring innovation helps us to complement our previous knowledge and shed light on nature of product innovation in larger range of products and services.

The recent ease of access to trademark data (Graham et al, 2013) has opened a new window for scholarly research. My objective in this study was merely an initial attempt to bring more attention to trademarks and their underlying potentials to enlighten innovation and spillover. I tried to give a fresh look to the new product innovation, drivers of regional economic growth and business cycle. The results of this study can have managerial and policy implications for regional economies.

Currently we face an ever-widening disparity across urban areas. Some regions are thriving with paramount success while others remain stagnant and the divergence between the two seems to be increasing. Our results can provide insights for place-based policies and help policymakers to come up with solutions to alleviate the gap between prosperous and laggard regions and mitigate the polarization between these regions.

Moreover, this study opens avenues for future research. It would be interesting to examine whether similar vertical relationship between Intermediate and Final products exits in other units of analysis, particularly at the firm level. In other words whether innovating Intermediate goods affects the subsequent Final goods innovations in the same firm. And if that is the case how this within-firm vertical relationship affects firms' diversification decisions.

It is also worth to further investigate the impact of the Intermediate and Final product innovation on regional entrepreneurship. Identifying which one on the two types triggers regional entrepreneurship and start-ups it is important for firms, policy makers and society as a whole.

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Tables and Figures

Table 1. Variable definitions

Classification	WIPO 45 Nice classifications: 34 goods and 16 services.
Owner Address	The 5-digit postcode indicated in the owner address.
Status code	The three-digit code signifying the last recorded status event for the application or registration. There are 121 unique values for the *status code* in our **case_file** data obtain from USPTO. Generally, this code will indicate whether, at the time I created my dataset, an application was abandoned or pending or a registration was live, cancelled, or expired.
GDP	Total GDP per year at two levels: metropolitan area and state.

Table 2. Descriptive statistics for main variables at Metropolitan level.

Variables	1	2	3	4	5	6
1. GDP_metro	1.000					
2. Intermediate_metro	0.9449*	1.000				
3. Final_metro	0.9431*	0.9638*	1.000			
4. GDP_state				1.000		
5. Intermediate_state				0.9449*	1.000	
6. Final_state				0.9431*	0.9638*	1.000
#Observations(12 years)	3996	3996	3996	600	600	600
Mean	32710.29	1049.925	3097.869	40727.98	7267.457	20931.91
Std. dev.	86039.94	3482.036	12157.17	7534.685	10765.27	34392.16
Min	1440	0	0	1440	29	326
Max	1400000	58055	262637	64900	107055	349523

* Sig at 0.01

Table 3a. Cross tabulation of means for areas with above and blew Avg. GDP

	GDP	
	Above mean	***Below mean***
Final	12175.25	607.61
Intermediate	4032.53	231.69

Table 3b. Cross tabulation of means for areas with above and blew Avg. Final products

	Final	
	Above mean	***Below mean***
GDP	152814.1	11031.29
Intermediate	5599.861	247.598

Table 3c. Cross tabulation of means for areas with above and blew Avg. Intermediate

	Intermediate	
	Above mean	***Below mean***
GDP	152814.1	11031.29
Final	16929.09	658.90

Figure 1. Avg. number of trademarks associated with Intermediate products, Final products and GDP per year

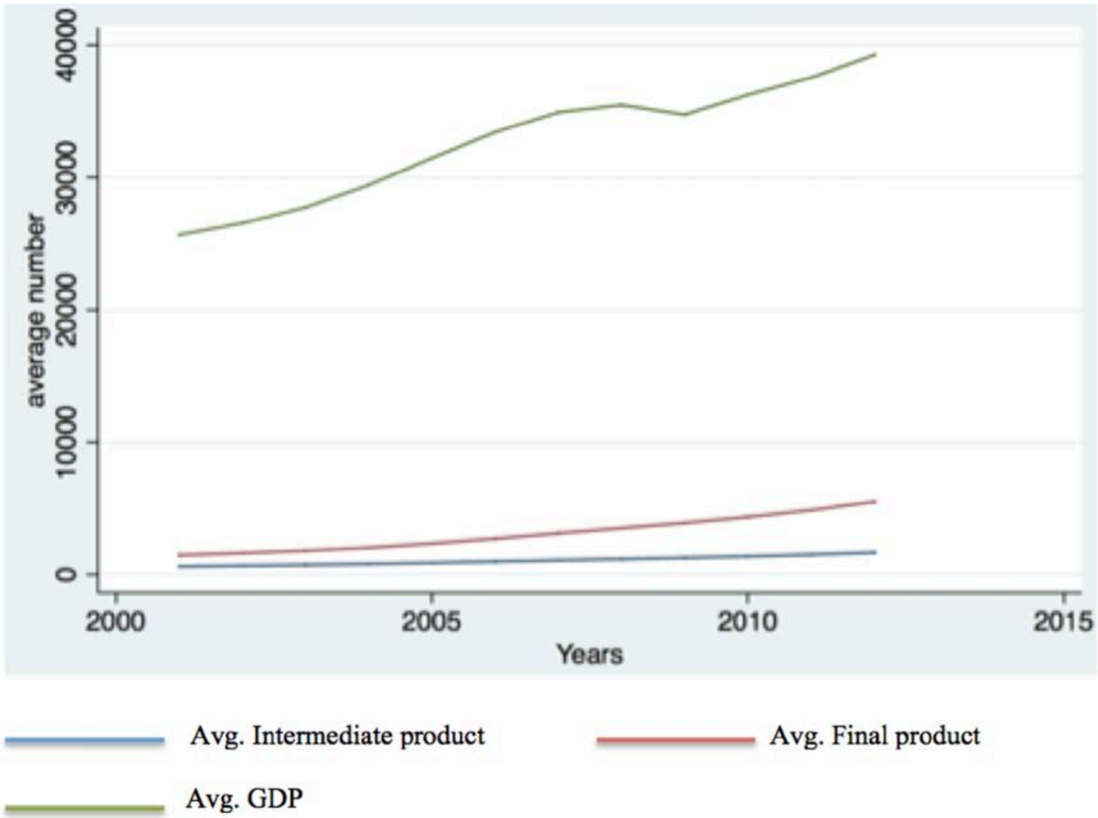

Table 3. Granger Causality Test Statistics at Metropolitan level with 1 lag

	Equation (1) ***Total Trademark***	***Equation (2)*** ***GDP***
$\boldsymbol{Total\,Trademark_{t-1}}$	1.120**	0.458 *
	(134.50)	(2.57)
$\boldsymbol{GDP_{t-1}}$	0.001	0.814 **
	(0.73)	(11.23)
Constant	-40.216	5,542.906**
	(1.33)	(3.29)
# observations	3,663	3,663
Overall R^2	1.00	0.93
	F(2,332) = 18232.39	F(2,332) = 4061.55
	Prob > F = 0.0000	Prob > F = 0.0000

* p<0.05; ** p<0.01

Table 4. Granger Causality Test Statistics at State level with 1 lag

	Equation (1) ***Total Trademark***	***Equation (2)*** ***GDP***
$\boldsymbol{Total\,Trademark_{t-1}}$	1.139**	-0.003
	(268.26)	(1.50)
$\boldsymbol{GDP_{t-1}}$	0.032	0.829**
	(1.86)	(12.92)
Constant	-1,630.820*	7,338.025**
	(2.20)	(2.84)
# observations	550	550
Overall R^2	1.00	0.70
	F(2,49) = 40031.82	F(2,49) = 98.78
	Prob > F= 0.0000	Prob > F = 0.0000

* p<0.05; ** p<0.01

Table 5. Granger Causality Test Statistics at Metropolitan level for Intermediate, Final and GDP

	Equation (3) ***Final***	***Equation (4)*** ***Intermediate***	***Equation (5)*** ***GDP***
$Final_{t-1}$	1.124** (109.32)	0.016** (5.05)	0.296 (1.52)
$Intermediate_{t-1}$	-0.036 (0.60)	1.052** (57.94)	1.267* (1.98)
GDP_{t-1}	0.003* (2.02)	-0.001 (1.54)	0.810** (11.00)
# observations	3,663	3,663	3,663
Overall R^2	1.00	1.00	0.7
	F(3,332) = 17298.35 Prob > F = 0.0000	F(3,332) = 48808.26 Prob > F = 0.0000	F(3,332) = 8468.23 Prob > F = 0.0000

* p<0.05; ** p<0.01

Table 6. Granger Causality Test Statistics at State level for Intermediate, Final and GDP

	Equation (3) ***Final***	***Equation (4)*** ***Intermediate***	***Equation (5)*** ***GDP***
$Final_{t-1}$	1.126 ** (36.77)	0.011* (2.08)	-0.000 (0.01)
$Intermediate_{t-1}$	0.064 (0.50)	1.085 ** (41.63)	-0.014 (0.29)
GDP_{t-1}	0.038 (1.94)	-0.006 (1.44)	0.829** (12.88)
# observations	550	550	550
Overall R^2	1.00	1.00	0.7
	F(3,49) = 50746.52 Prob > F = 0.0000	F(3,49) = 51551.04 Prob > F = 0.0000	F(3,49) = 67.41 Prob > F = 0.0000

* p<0.05; ** p<0.01

Appendix

Table I. Nice Classifications, Headings and Dummy

Classification code	Class heading	Dummy*
1	Chemicals used in industry, science and photography, as well as in agriculture, horticulture and forestry; unprocessed artificial resins, unprocessed plastics; manures; fire extinguishing compositions; tempering and soldering preparations; chemical substances for preserving foodstuffs; tanning substances; adhesives used in industry.	1
2	Paints, varnishes, lacquers; preservatives against rust and against deterioration of wood; colorants; mordants; raw natural resins; metals in foil and powder form for painters, decorators, printers and artists.	1
3	Bleaching preparations and other substances for laundry use; cleaning, polishing, scouring and abrasive preparations; soaps; perfumery, essential oils, cosmetics, hair lotions; dentifrices.	2
4	Industrial oils and greases; lubricants; dust absorbing, wetting and binding compositions; fuels (including motor spirit) and illuminants; candles and wicks for lighting.	1
5	Pharmaceutical and veterinary preparations; sanitary preparations for medical purposes; dietetic food and substances adapted for medical or veterinary use, food for babies; dietary supplements for humans and animals; plasters, materials for dressings; material for stopping teeth, dental wax; disinfectants; preparations for destroying vermin; fungicides, herbicides	1
6	Common metals and their alloys; metal building materials; transportable buildings of metal; materials of metal for railway tracks; non-electric cables and wires of common metal; ironmongery, small items of metal hardware; pipes and tubes of metal; safes; goods of common metal not included in other classes; ores.	1
7	Machines and machine tools; motors and engines (except for land vehicles); machine coupling and transmission components (except for land vehicles); agricultural implements other than hand-operated; incubators for eggs; automatic vending machines.	1
8	Hand tools and implements (hand-operated); cutlery; side arms; razors	2
9	Scientific, nautical, surveying, photographic, cinematographic, optical, weighing, measuring, signalling, checking (supervision), life-saving and teaching apparatus and instruments; apparatus and instruments for conducting, switching, transforming, accumulating, regulating or controlling electricity; apparatus for recording, transmission or reproduction of sound or images; magnetic data carriers, recording discs; compact discs, DVDs and other digital recording media; mechanisms for coin-operated apparatus; cash registers, calculating machines, data processing equipment, computers; computer software; fire-extinguishing apparatus.	1
10	Surgical, medical, dental and veterinary apparatus and instruments, artificial limbs, eyes and teeth; orthopedic articles; suture materials	1
11	Apparatus for lighting, heating, steam generating, cooking, refrigerating, drying, ventilating, water supply and sanitary purposes.	2
12	Vehicles; apparatus for locomotion by land, air or water	1
13	Firearms; ammunition and projectiles; explosives; fireworks	1
14	Precious metals and their alloys and goods in precious metals or coated therewith, not included in other classes; jewellery, precious stones; horological and chronometric instruments.	2

15	Musical instruments	**2**
16	Paper, cardboard and goods made from these materials, not included in other classes; printed matter; bookbinding material; photographs; stationery; adhesives for stationery or household purposes; artists' materials; paint brushes; typewriters and office requisites (except furniture); instructional and teaching material (except apparatus); plastic materials for packaging (not included in other classes); printers' type; printing blocks	**2**
17	Rubber, gutta-percha, gum, asbestos, mica and goods made from these materials and not included in other classes; plastics in extruded form for use in manufacture; packing, stopping and insulating materials; flexible pipes, not of metal.	**1**
18	Leather and imitations of leather, and goods made of these materials and not included in other classes; animal skins, hides; trunks and travelling bags; umbrellas and parasols; walking sticks; whips, harness and saddlery.	**2**
19	Building materials (non-metallic); non-metallic rigid pipes for building; asphalt, pitch and bitumen; non-metallic transportable buildings; monuments, not of metal.	**2**
20	Furniture, mirrors, picture frames; goods (not included in other classes) of wood, cork, reed, cane, wicker, horn, bone, ivory, whalebone, shell, amber, mother-of-pearl, meerschaum and substitutes for all these materials, or of plastics.	**2**
21	Household or kitchen utensils and containers; combs and sponges; brushes (except paint brushes); brush-making materials; articles for cleaning purposes; steelwool; unworked or semi-worked glass (except glass used in building); glassware, porcelain and earthenware not included in other classes.	**2**
22	Ropes, string, nets, tents, awnings, tarpaulins, sails, sacks and bags (not included in other classes); padding and stuffing materials (except of rubber or plastics); raw fibrous textile materials.	**2**
23	Yarns and threads, for textile use	**2**
24	Textiles and textile goods, not included in other classes; bed covers; table covers.	**2**
25	Clothing, footwear, headgear	**2**
26	Lace and embroidery, ribbons and braid; buttons, hooks and eyes, pins and needles; artificial flowers.	**2**
27	Carpets, rugs, mats and matting, linoleum and other materials for covering existing floors; wall hangings (non-textile).	**2**
28	Games and playthings; gymnastic and sporting articles not included in other classes; decorations for Christmas trees	**2**
29	Meat, fish, poultry and game; meat extracts; preserved, frozen, dried and cooked fruits and vegetables; jellies, jams, compotes; eggs; milk and milk products; edible oils and fats	**2**
30	Coffee, tea, cocoa and artificial coffee; rice; tapioca and sago; flour and preparations made from cereals; bread, pastry and confectionery; ices; sugar, honey, treacle; yeast, baking-powder; salt; mustard; vinegar, sauces (condiments); spices; ice	**2**
31	Grains and agricultural, horticultural and forestry products not included in other classes; live animals; fresh fruits and vegetables; seeds; natural plants and flowers; foodstuffs for animals; malt	**2**
32	Beers; mineral and aerated waters and other non-alcoholic beverages; fruit beverages and fruit juices; syrups and other preparations for making beverages.	**2**
33	Alcoholic beverages (except beers)	**2**

34	Tobacco; smokers' articles; matches.	**2**
35	Advertising; business management; business administration; office functions.	**2**
36	Insurance; financial affairs; monetary affairs; real estate affairs	**2**
37	Building construction; repair; installation services	**2**
38	Telecommunications	**2**
39	Transport; packaging and storage of goods; travel arrangement.	**2**
40	Treatment of materials	**2**
41	Education; providing of training; entertainment; sporting and cultural activities.	**2**
42	Scientific and technological services and research and design relating thereto; industrial analysis and research services; design and development of computer hardware and software.	**2**
43	Services for providing food and drink; temporary accommodation.	**2**
44	Medical services; veterinary services; hygienic and beauty care for human beings or animals; agriculture, horticulture and forestry services.	**2**
45	Legal services; security services for the protection of property and individuals; personal and social services rendered by others to meet the needs of individuals.	**2**

*** Dummy 1 refers to Intermediate goods and 2 Final goods and services trademarks**

Table II. Granger Causality Test Statistics at Metropolitan level with 2 lags

	Equation (1) ***Total Trademark***	***Equation (2)*** ***GDP***
$\boldsymbol{Total\,Trademark_{t-1}}$	1.893** (17.83)	4.287 (1.61)
$\boldsymbol{Total\,Trademark_{t-2}}$	-0.818** (8.24)	-3.930 (1.48)
$\boldsymbol{GDP_{t-1}}$	0.002 (0.28)	0.807** (4.54)
$\boldsymbol{GDP_{t-2}}$	-0.018** (6.33)	-0.152* (2.33)
Constant	348.284 (1.84)	9,467.583** (2.84)
# observations	3,330	3,330
Overall R^2	1.00	0.92
	F(4,332) = 207413.04 Prob > F = 0.0000	F(4,332) = 2148.25 Prob > F = 0.0000

* p<0.05; ** p<0.01

Table III. Granger Causality Test Statistics at State level with 2 lags

	Equation (1) ***Total Trademark***	***Equation (2)*** ***GDP***
$\boldsymbol{Total\,Trademark_{t-1}}$	1.800** (67.15)	-0.008 (0.11)
$\boldsymbol{Total\,Trademark_{t-2}}$	-0.743** (23.56)	0.006 (0.07)
$\boldsymbol{GDP_{t-1}}$	0.118* (2.66)	0.944** (8.53)
$\boldsymbol{GDP_{t-2}}$	-0.212** (2.82)	-0.187* (2.32)
Constant	3,475.129* (2.40)	10,220.650** (2.81)
# observations	500	500
Overall R^2	1.00	0.65
	F(4,49) = 206680.19 Prob > F = 0.0000	F(4,49) = 99.77 Prob > F = 0.0000

* p<0.05; ** p<0.01

Table IV. Granger Causality Test Statistics at Metropolitan level for Intermediate, Final and GDP with 2 lags

	Equation (3) ***Final***	***Equation (4)*** ***Intermediate***	***Equation (5)*** ***GDP***
$\boldsymbol{Final_{t-1}}$	1.477**	-0.045*	1.536
	(22.46)	(2.01)	(0.46)
$\boldsymbol{Final_{t-2}}$	-0.396**	0.062**	-1.269
	(6.31)	(2.87)	(0.37)
$\boldsymbol{Intermdeiate_{t-1}}$	2.559**	2.008**	21.403**
	(3.09)	(11.92)	(2.73)
$\boldsymbol{Intermediate_{t-2}}$	-2.670**	-0.997**	-21.054**
	(3.19)	(5.87)	(2.76)
$\boldsymbol{GDP_{t-1}}$	0.002	-0.001	0.792**
	(0.34)	(0.35)	(4.23)
$\boldsymbol{GDP_{t-2}}$	-0.011**	-0.002	-0.116
	(3.26)	(1.38)	(1.41)
Constatnt	178.178	49.750	8,507.999**
	(1.86)	(1.78)	(2.76)
# observations	3,330	3,330	3,330
Overall $\boldsymbol{R^2}$	1.00	1.00	0.92
	F(6,332) = 739492.59	F(6,332) = 145753.37	F(6,332) = 1681.49
	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000

* p<0.05; ** p<0.01

Table V. Granger Causality Test Statistics at State level for Intermediate, Final and GDP with 2 lags

	Equation (3) ***Final***	***Equation (4)*** ***Intermediate***	***Equation (5)*** ***GDP***
$\boldsymbol{Final_{t-1}}$	0.915** (4.93)	-0.230** (3.78)	-0.389* (2.45)
$\boldsymbol{Final_{t-2}}$	0.227 (1.14)	0.263** (3.97)	0.426* (2.61)
$\boldsymbol{Intermediate_{t-1}}$	4.819** (5.18)	2.763** (11.31)	1.965** (3.72)
$\boldsymbol{Intermediate_{t-2}}$	-5.223** (5.20)	-1.822** (7.02)	-2.140 ** (3.93)
$\boldsymbol{GDP_{t-1}}$	0.074** (2.78)	0.018* (2.30)	0.936** (8.50)
$\boldsymbol{GDP_{t-2}}$	-0.099** (3.69)	-0.025** (3.37)	-0.156 (1.86)
Constatnt	981.61 (1.69)	204.136 (1.44)	9,427.713* (2.53)
# observations	500	500	500
Overall R^2	1.00 F(6,49) = 359681.63 Prob > F = 0.0000	1.00 F(6,49) = 303190.18 Prob > F = 0.0000	0.66 F(6,49) = 54.60 Prob > F = 0.0000

- p<0.05; ** p<0.01

Table VI. Mean values of

	Avg. GDP		***Avg. Intermediate***		***Avg. Final***	
	Above	***Below***	***Above***	***Below***	***Above***	***Below***
GDP	137074.1	9812.05	152814.1	11031.29	137694.4	11028.8
Intermediate	4032.53	231.69	5599.86	247.6	5141.39	217.49
Final	12175.25	607.61	16929.09	658.90	15204.34	634.71

Chapter 4

"Market for Trademarks"

Introduction

Google worth almost $159 billion, Apple $148 billion and McDonald's $86 billion[4]. These numbers reflect the value of trademarks of the above companies. "Trademarks are the most valuable thing that companies as diverse as Apple and McDonald's own, often worth much more than property and machinery. Brands account for more than 30% of the stock market value of companies in the S&P 500 index, reckons Millward Brown, a market-research company" (The Economist, 2014).

Firms intangible asset play crucial role for sustainable competitive advantage, are the main forms of these intangible assets. Over the past two decades intellectual properties (IP) - patents, copyrights and trademarks- have been recognized as the dominant factor in numerous significant commercial transactions. However, for the most part the existing literature on market for IP is focused on Market for Technology and Idea (MfTI) (Arora et al, 2001, 2010). Though extremely elegant, these studies by and large are concentrated on patents. Research and exploring market for other forms of IP, in particular "Market for Trademarks[5]" remains scarce (Graham et al, 2014). The aim of this study is to explore this topic.

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[4] According to the 2014 report of BrandZ top 100 most valuable brands in the world. (http://www.brandz100.com/#/tabbed/global-100/149?tab_id=150&tab_url=%2Ftop-table%2Ftop-100-48673d91-a201-4477-aefd-86db2db2b656%2F150)

[5] It is worth mentioning the two terms brand and trademark can be used interchangeably if one has in mind that trademarks are legal incarnation of brands. Brand refers to firm's marketing activities while trademark is the legal protection of these marketing activities.

There are various reasons that make this topic worth investigating. First, this research allows us to complement our general understanding about potential unexplored features of market for IP. Secondly, making a comparison between patent and trademark unveils their market similarities or differences. Thus, the first goal of this study is to investigate whether market for the two IP's follows the same path or the differences in the nature of trademark, compared to patents, renders different market dynamic.

I start by looking at trademarks from market efficiency perspective. A body of studies has addressed the efficiency of the market for IP; in particular MfTI's and patents (Roth 2007, Arora and Gambardella 2010, Gambardella et al 2010, Gambardella 2002, Gans and Stern, 2010, Giarratana and Fosfuri 2010, Hagiu and Yoffie 2013). These studies, on one hand emphasize on the importance of the technology transaction and patent market. And on the other hand, they note that patent market is marked by high level of uncertainty, transaction costs and asymmetric information that can lead to potential opportunistic behavior among economic actors. All of these elements can be a source of market inefficiency. Building upon these elements, I juxtapose trademark with patent to investigate whether and how the "Market for Trademark" (MfT) differs from patents. The main elements of interest are market *visibility*, *complementarity*, *value rivalry*, *renewability* and *range of product* coverage.

The result of this comparison is: Trademarks have more visibility and their market is not as blind as patents (Lemley and Myhrvold, 2008). Hence, it is easier to assess and evaluate trademarks among the goods and services in the same product market. This higher comparability allows their price to be shaped by outside options in the market. While trademarks can range from umbrella brands and bundles to singletons, often times are not as interdependent as patents. Therefore, their value is not drastically affected whether they are transferred as a portfolio or singleton.

Some studies suggest that individual trademarks can be even more attractive for buyers (Graham et al, 2014). Yet, there is a weak point in trademarks and that is their low value rivalry. Replicating a mere ‘sign’ is not that difficult, thus the abundance of counterfeit products in markets where the IP rights are not strongly enforced. Trademarks are one of the most commonly used forms of IP (WIPO 2013, Graham et al 2013). They are employed in all range of product categories, from high-tech to low-tech and services. Finally, registered trademarks in US are indefinitely renewable, so long as they are used in commerce.

The aforementioned elements provide evidence that trademark market differs from patents and opens a very interesting realm that requires further investigation at various levels. Clearly, this is beyond the scope of a single study. Hence, I limit my study on investigating this market from specific perspective. The second part of this study then focuses on how increase in the maintenance cost affects trademark transactions. I look at this effect from two dimensions: geographical proximity and mode of transaction. From geography perspective, I am interested to explore how fluctuations in cost effect impacts the *local* transactions compared to *distant* ones. That is when both economic actors, assignor and assignee, are located in the same city and conversely, when the transaction is conducted among parties in different cities.

Second dimension is the mode of transaction. The two most common modes of transaction in this market are *assignment* and *security interest*. Fluctuations in maintenance costs can affect these two modes of trademark transactions.

Next, I elaborate about formal models to posit three hypotheses: An increase in renewal cost, triggers higher number of trademark transaction. These transactions are more likely to be in form of security interest and finally among parties in different cities.

Empirically, I use the dataset of US registered trademark transactions obtained from USPTO (Graham et al, 2014). This data contains detailed information on 786,931 transactions recorded at the USPTO between (1952 – 2013). This information includes assignor (owner) and assignee's names, addresses, type of legal entity and the execution date of the transaction. In the second step, I combined this data with the case file dataset of these transacted trademarks also obtain from USPTO. This combined data allows me to have additional detailed information about each trademark. Particularly, the product classification and filing date of these transacted trademarks.

The remainder of this paper is structured as follow. In the first section, I make a comparison between patents and trademarks from market efficiency perspective. Second, I explain the mechanisms of local versus distant transactions based on product classifications and posit my hypotheses. Next, I elaborate on different modes of trademark transaction focusing on assignment and security interests. I continue by giving a comprehensive description of the empirical setting for testing the hypotheses followed by the methodology used for our analysis. Finally, I conclude by discussing the results and implications.

Market for Patents vs. Market for Trademark

Patents

Over the past two decades numerous studies have raised awareness of importance of IP in valuing companies and financial deals. The seminal study by Arora et al (2001) discusses the notion of "Market for Technology and Idea" (MfTI). The body of literature following this topic mainly revolves around patents. Hence, in the existing literature market for other forms of IP in particular trademarks remains understudied. A stream of studies in this area has addressed the efficiency of market for IP and in particular MfTI. I recognize that it is important to understand the main sources of market failures in MfTI to explore market for other forms of IP. Below, I provide an overview of this literature.

The study by Gambardella (2002) discusses transaction cost mechanisms to improve three market failures: (i) R&D duplication;(ii) externalities in potentially public R&D outcomes; (iii) deviations from marginal cost pricing in the down stream market. Using European patents, Gambardella et al (2010) note that weak protection; limited breadth and low economic value make patents less appealing and therefore decreases the propensity of occurrence of licensing activity. They also find that the most important determinant of occurrence of licensing in patent is firm size. Arora and Gambardella (2010) highlight the different factors that explain supply and demand for technology. Giarratana and Fosfuri (2010) elegantly summarized various papers included in the *Industrial and Corporate Change* special section, which predominantly addresses IP.

Hagiu and Yoffie (2013) build upon the patent market failure to explore the role of intermediaries in this market. Gans and Stern (2010) take a rather different view. They focus on market failures in market for ideas by looking at the main market design principals mentioned by Roth (2007): thickness, lack of congestion, safety and repugnance. And provide additional dimensions: complementarity, User-reproducibility and value rivalry.

Many of patent market inefficiencies stem from the high level of uncertainty associated with patents. Patents capture very early stages of innovative process therefore they come with a promise, which may or may not be realized. Literature is full of examples of unsuccessful or “sleeping” patents (Rivette and Kline, 2000; Palomeras, 2003) that never see the face of marketplace. Patents, compared to other assets, are extremely difficult to value. The main reason is that by definition they are unique and for the most part incomparable. So much so that, Lemley and Myryhld (2008) consider patent market to be *blind*. That is, finding a suitable 'match' between buyer and sellers is extremely hard. This issue negatively affects the thickness of market and creates congestion. Interdependence of patents or complementarity often time makes them valuable only when sold in terms of patent portfolios. Singular patents are often less appealing and face problem being sold. The other source of inefficiency of patent market rises from the asymmetric information and opportunistic behavior. This in turn leads to high risk of user reproducibility and value rivalry. More over, repugnance can be an important issue when is comes to patent. Finally, patents are subject to expiration and hence have limited period of protection. Many firms use this exclusivity period in building strong trademarks and brand loyalty so that they can secure their sale and curb the loss once the patent has expired. In other word, strong trademarks can create high barriers to market entry, as new competitors may not be able to bear the high advertising costs of inducing consumers to switch to their products. Many pharmaceutical companies employ this strategy for their patented drugs (Appelt, 2009).

In the next section I draw upon insights from patent market to highlight the characteristics of market for trademark. Table 1 summarizes this comparison.

<Insert Table 1 here>

Trademarks

While patents and trademarks are intangible assets -which makes many features of illiquid IP market apply to both them- there are distinct differences between the natures of the two IP's that can affect their market. Moreover, high cost of introducing new brands into the marketplace and the high failure rate of new brands enhanced perceptions about the value of already established trademarks (Simensky, Melvin, 1997). Recent studies (WIPO, 2013; Graham et al, 2014) suggest that more and more firms strive to monetize on their trademarks. According to Graham et al (2014) mergers involving trademarks represent roughly 19 to 28 percent of M&A activity during the 1997 to 2003 period. Juxtaposing trademark features with patent features can shed light on whether and how market for trademark differs.

First, trademark market is not as *blind* as patents and they have much more *visibility*. This higher visibility facilitates finding a match between interested buyers and sellers. Brand (trademark) equities (Aaker, 1996, 2009) are routinely valued. Several institutes, namely BrandZ, Interbrand, Brand Finance, Milward Brwon, periodically publish their reports with the estimates of brand values. Second, unlike patents were majority of the investments are undertaken before they are granted; large share of investments on marketing activities are undertaken only after the trademark is granted (Sander and Block 2011), which is close to the point when a product is set to be launched in the market. That is mainly because according to US trademark law an actual good or service, ready to be used in commerce, is necessary for registration in USPTO. This necessary condition implies that a good or services is ready to be launched and commercialized in the market. This aspect can mitigate a lot of uncertainties. A trademark can be a signal for discerning whether a potential innovation (patent) has been realized in terms of a commercializable good or service. However, novelty is not a criterion for trademarks registration. Now, whether trademark is a perfect measure of innovation is subject to discussion and is not the interest of this study. However, several emerging studies corroborate for a positive correlation between firms' patenting and trademarking activities (WIPO, 2013; Graham et al, 2013; Flikkema et al, 2014; Gra, Sandner and Block, 2011, Graevenitz, 2007, 2008). That is basically the point were firms strive to secure returns of their earlier investment in R&D or patenting. The function of trademark is to help customers to reliably identify and differentiate the goods of different producers in the market place. On the other hand, this lack of novelty condition provides a *comparability-ground* between trademarks for similar goods and services. As a result, the trademark evaluation is easier and its price can be shaped by outside options.

Trademarks have low to medium complementarity. In a sense that while they can range from “umbrella brands” to singletons, often times are not as interdependent as patents. Consequently, their value is not drastically affected whether they are transferred as a portfolio or singleton. Some evidence suggests that individual trademarks can be even more attractive for buyers. Graham et al (2014) indicates that 64 percent of US trademark assignments are single property transactions, suggesting that trademarks may often be transferred individually rather than as part of a large portfolio deal. The underlying reason might be the easier post-transaction maintenance of brand identity of individual trademarks. However, trademarks have high value rivalry. Replicating a mere ‘sign’ is not that difficult, thus the abundance of counterfeit products in markets where the IP rights are not enforced. When consumers are unable to distinguish fake goods from genuine goods, they can no longer rely on the reputation mechanism to guide their purchases. Producers, in turn, have a reduced incentive to invest in product differentiation, thus undermining product quality and diversity. Despite this, trademarks are one of the most commonly used forms of IP (WIPO 2013, Graham et al 2013). They are employed in all range of product categories, from high-tech to low-tech and services. Finally, trademarks do not have expiration period. Registered trademarks in US are perpetually renewable so long as they are used in commerce. According to US and WIPO not everything is trademarkable. Offensive marks, generic terms (e.g. tissue), descriptive names (e.g. “Florida Orange Juice” where the product is actually produced in California), scandalous and immoral marks and finally name marks (e.g. a name, portrait, or signature identifying a particular living individual *except* by his or her written consent), cannot be registered as trademarks. These restrictions to large extent deal with the repugnance issue.

Transactions: Cost effect vs. Revenue Effect

As mentioned earlier, trademarks can be renewed indefinitely as long as they are used in commerce. However, "use" and remaining active in the marketplace is expensive. Therefore, an increase in costs, for example renewal fees, can affect firms' decisions in keeping the trademark live, let it expire or sell their trademarks. The study by Landes and Posner (2002) shows that trademark renewals are highly cost sensitive. In this regard a shock in the renewal fees can affect the transaction rate of the trademarks in the period after enforcement of the new fees. Selling the trademarks becomes favorable when the "revenue effect" (Fosfuri, 2003) of the trademarks, which is driven from the transaction, is higher than the "cost effect" of maintaining the trademark live. In other words, trademark transactions entail a tradeoff between revenue and cost effect. Owners prefer to continue renewing their trademarks so long as the expenses associated with maintaining a trademark in the marketplace does not surpass the revenues obtain through its conveyance to another economic party. Below, I elaborate on a formal mechanism for this situation.

At any point in time, two possible outcome can happen to a trademark TM: a) to be transacted b) non-transacted. If TM is transacted to another party, as a result the owner (assignor) enjoys a revenue effect of P. However, if the trademark is not transacted the owner is left with A, where A is denoted in (1).

$$P = Revenue\ Effect\ \ ,\ \ Cost\ Effect\ \ \ A = {}_{t_0}^{t_R}E\ (\pi) - C^R \quad (1)$$

In this specification, ${}_{t_0}^{t_R}E\ (\pi)$ is the expected value of the profit corresponding to TM between time t_0 till upcoming renewal time t_R, and C^R is the renewal cost. Now, if $P > A$, that is the revenue effect is more that the overall expect value after deducting the renewal cost, then transacting the trademark becomes more optimal. Conversely, if $P < A$ then two possible situation can happen either A has a positive value or a negative one. If A>0, the overall expect value after renewal cost deduction has a positive value, but this positive value is still less than the revenue effect P, then the owner would prefer to renew the trademark. On the other hand, if the $A < 0$ then letting the trademark expire would be the optimal situation. Table 2 summarizes these specifications and mechanisms.

<Insert Table 2 here>

Now suppose that renewal cost increases due to an exogenous shock. In this case, the under-bar renewal cost $\underline{C^R}$ is the renewal cost before the shock and the over-bar $\overline{C^R}$ indicates the increased price after the shock as denoted in (2).

$$\underline{C^R} \quad \rightarrow \quad \overline{C^R} \qquad\qquad (2)$$

This increase in renewal cost, affects the absolute value of $\underline{A}$, such that the absolute value of $\overline{A}$ decreases, where $\underline{A}$ and $\overline{A}$ are, respectively, the cost effect before and after the shock. In this case, the cost effect of some trademarks decrease, so much so that their revenue effect becomes more appealing as result of this cost difference. Thus, these trademarks switch from no transact situation (a) to transacted situation (b) after the shock.

$$P < \underline{A} \quad \rightarrow \quad P > \overline{A} \qquad (3)$$

Hence I hypothesize:

H1: Ceteris paribus, an increase in trademark's renewal cost leads to increase in number of transactions.

Mode of Transaction: Security interest and Assignment

In the previous section we discussed that in presences of an increase in the trademark cost trademark owners face three possible choices after the shock: renewal, expiration and transaction. We posited that sudden increase in cost effect triggers trademark transactions. Now, these transactions can be in different modes. The literature on IP law and the study by graham et al (2014) indicated the two most common modes of transaction for trademarks are assignment and security interests.

Assignment refers to change of ownership of right, title and interest of a mark from the assignor to assignee through conveyance. The other most prevalent usage of trademark is security interest or collateral asset, which is transferring the title to the intellectual property from the debtor to the creditor. Security rights in a trademark are created by entering into a conditional assignment that passes title in the event if the assignor-debtor's default. This collateral assignment is subject to defeasance through reassignment to the assignor after repayment of the debt. In other words, a trademark is released from collateral once creditor has received back the payment. However, the literature of IP collateralization is sparse, predominantly using legal analyses to examine the use of intangibles to secure debt (Bezant, 2003; Brian, 2011).

In this section I build upon this emerging literature and I intend to investigate fluctuation in cost effect triggers which of these two modes of transaction.

The sudden increase of cost effect renders a process of “shakeout” for the existing trademarks in the market place. Owners have to evaluate the trade-offs and decide on the faith of their trademarks: live, expire or sell. In this process several of the weak and poor-functioning trademarks are forced out of the market. Therefore, those that remain are those that are strong and valuable enough for their owners to continue functioning in the commerce or worth enough to be sold to others. Then on the one hand, number of active trademarks decreases through the shakeout, which can lead to lower competition and higher economic value for the remaining trademarks. Naturally, these stronger and resilient trademarks command higher prices from the buyers. Such circumstances generate difficulties in finding a match and suitable buyer. Therefore I expect that the increase in cost effect result in decrease in rate of assignments.

On the other hand, this shake out can be beneficial for the owners. The higher economic value of their trademarks allows them to use their trademarks as collateral assets in return for higher levels of credit. In other words, it enables them to access more financial resources. Intensifying trademark collateralization, by providing a means to raise capital in the credit market, may benefit trademark holders and possibly affords an alternative to the sale of trademark assets (WIPO, 2013). Hence I hypothesize:

H2: *Ceteris paribus, an increase in trademark’s renewal cost leads to increase in number of security interests and decreases the assignments.*

Geography of Transactions

In this section I attempt to look at trademark transaction behavior from geography perspective. Economic geography literature is built upon one premise: importance of geographic distance (Saxenian, 1996; Stuart and Sorenson, 2003; Jaffe et al, 1992). There are extant number of studies that have focused on the role of geography on innovation, knowledge flows and labor mobility at city or regional level (Gittelman, 2006, 2007; Gambardella and Giarratanta, 2010, Gleaser, 2005). Large portion of these studies focus on patent-level studies. Once again, the relationship between geography and other forms of IP is scant. Therefore, I intend to investigate whether increase in costs associate to trademark maintenance affects the location of transaction. The interested level of analysis here is cities.

In previous sections I discussed that an increase in cost effect can trigger the rate of trademark transaction, particularly, resulting in higher number of security interests and lower number of assignments. Every trademark can then be transacted either *locally* or *distantly*. I define local transactions as those that the assignor (seller) and assignee (buyer) are located in the same city. And conversely, when they belong to different cities this type of transaction is considered to be distant.

We are only considering the location of those which were transacted, that is, $P > A$. Now, if we assume that every transaction involves a search cost of C^S for finding a suitable buyer. Then we have two cases as below:

$$P - C^S > {}_{t_0}^{t_R}E\,(\pi) - \underline{C^R} = A \qquad (4)$$

$$P - C^S < {}_{t_0}^{t_R}E\,(\pi) - \underline{C^R} = A \qquad (5)$$

In the case denoted in (4), the trademark transacted both locally and distantly. If it is a local transaction we can assume that the search cost is normalized to zero. Conversely, if it is a distant transaction then it will be the case that the revenue P is so large that makes paying the search cost of finding distant assignee worthy. Contrarily, in the case of (5) the transaction happens only locally, and distant transactions are not economically optimal. Now, suppose the situation that renewal cost increases to $\overline{C^R}$ as result of an exogenous shock. This increase in renewal cost decreases the value of the A in (5) creating the instances denoted in (6) that makes transaction favorable.

$$P - C^S > {}_{t_0}^{t_R}E\,(\pi) - \overline{C^R} = A \qquad (6)$$

This means, that some trademarks transaction that before the cost increase were only optimal if there were conducted locally, after the increase have the possibility to be traded also to distant assignees.

Moreover, as we argued previously, the cost shock leads to increased rate of security interests type of transactions. Then the main motivation of this transaction is accessing financial resources. This motivation can make the hassle of the geographical distance less problematic. Such that, assignors are willing to make the effort of going extra miles to find suitable creditors.

Hence, I Hypothesize:

H3: *Ceteris paribus, an increase in trademark's renewal cost leads to increase in number of distant transaction.*

Sample

Data

The empirical setting of this study is based on the data obtained from USPTO based on the Trademark Assignments (Graham et al, 2014). The Assignment data provides a comprehensive dataset of all assignments and other transactions recorded during the 1952-2013 period. These transactions have affected over 4 million registered trademarks or applications. Transactions over registered trademarks are not uncommon. In fact, the study of Graham et al (2014) provides evidence that among the 3.4 million registrations issued during the 1978-2013 period: 31 percent of were affected by some transaction over their life; 21 percent changed ownership through assignment or merger; and 12 percent were affected by a security interest agreement. However, recordation of any of these types of transactions in USPTO is not mandatory, but statutory and regulatory law provides compelling incentives for parties to record.

Building upon this data, I used the information about the trademark's owner (*assignor*) and the recipient (*assignee*). This information includes, type of transaction, transaction date, both the assignor and assignees name, address, type of legal entity.

For the interest of this study I used the address, particularly the *city name* of the assignor and the assignee. However, assignor address data coverage basically disappears for transactions recorded after 1992, presumably because the USPTO-1594 coversheet was revised and ceased recording addresses for assignors (Graham et al). Hence I restricted the period of analysis on transaction executed 1952-1992 where the city-level information about both assignee and assignor is not missing. Moreover, since geography is a key element in this study all the other observations which either assignor or assignee's city were missing were also excluded from the sample. These restrictions leave us with 399,281 recorded transactions. If the assignee and assignor were located in the same city then the transaction was defined to be *local*. On the contrary, if the two parties were located in the different cities then the transaction was considered to be *Distant*.

Based on the nature of conveyance text USPTO categorizes the transaction in 6 different types. The transaction can be recorded as an assignment, name change, security interest agreement, merger, release or other instrument. In this study I focus on the top two most common modes of transactions: assignments (ownership transfer) and security interest. Other modes, mergers and release occurrence are pretty scant in the period of analysis and consist only 2% of overall transactions. Finally, name change does not really involve actual transaction.

This data also indicates the legal entity of assignor and the assignee. These entities can be individuals, company, corporation, partnership, national banking, non- profit, etc.

By using the *serial number* indicated in the Assignment data I combined this data with the data on case-files of registered USPTO. Doing so allows me to have valuable information on the corresponding NICE product classification of each transacted trademark. Based on NICE classification, each trademark can be assigned to one or more of the 45 of products or service classifications.

The case-file data also includes the filing-date of the trademark in USPTO. Comparing this date with the *execution-date* of transaction allows me to calculate each trademark's *age* at the time of transaction. In the instances were the execution-date was missing the *acknowledgement-date* was used to calculate the age at time of transaction. The *status* allows me to determine the current status of the trademark, whether it is live, expired or abandoned.

Main Variables

My main variables of analysis are the RATE of TRANSACTION, GEOGRAPHIC LOCATION and MODE of TRANSACTION. Empirically, I define RATE of TRANSACTION, proportion of transacted trademarks compared to total number of existing live trademarks in each year. Next, GEOGRAPHIC LOCATION is a dichotomous variable that is equal to 1 if the assignor and assignee are located in the same city and 0 otherwise. Finally, MODE of TRANSACTION is set by information on conveyance type, if obtains values 1 if the conveyance is assignment and 2 if the conveyance is security interest. Other variable of interest are Nice product CLASSIFICATION (WIPO, Graham et al 2013). Out of 45 classifications the first 34 are goods and last 16 services. Hence, CLASSIFICATION gets the values 1 if it belongs to goods and 2 if it is a service mark. As for control variables, we control for FILING YEAR, which is the year the trademark was first filed in USPTO. Further more, we include the type of LEGAL ENTITY of both assignor and assignee. We also control for AGE, which is the difference between filing date and each transaction's execution date. Table 3 summarizes these variables.

<Insert Table 3 here>

Method

Setting

US trademark law went through some major revisions during the 1980's. This changes affected trademarks in different levels. The first major change in the early 80's affected the renewal process. The registration fees has remained pretty much stable over last 60 years and there has been little variation in this type of fees. Currently, USPTO charges a filing fee of $325 per class of goods and services. For example, if the trademark is used on goods and services in two different classes, such as musical sound recordings in Class 9 and live performances by a musical group in Class 41, then a $650 filing fee is required.

However, renewal fees have varied over time. Especially, in the beginning of 80's renewals faced a sudden increase in their price. Renewal fees were $15 from 1935 to 1945, $25 from 1946 to 1981, were increased sharply in the next two years (to $150 in 1982 and $300 in 1983), and have remained at $300 since then. Landes and Posner (2003) provide evidence that trademark renewal rates declined following the substantial fee increases in 1982 and 1983. Renewal rates averaged 0.27 in the five-year period 1977–1981 compared to 0.23 in the five-year period 1984–1988, when the fees were much higher.

I use this drastic change in renewal fees in years 1981-82 as a cost shock and test my aforementioned hypotheses in periods before and after this shock. In this specification, transacted trademarks are the treated group. And for control, I consider the subset of trademarks, which are least, affected by increase of renewal cost. This subset is identified as follows. Before 90's the registration and renewal period of trademarks was in place for 20 years. The study by (Landes and Posner, 2002) indicates that the average life of US trademarks are 15 years. Therefore, those trademarks that had been renewed or registered just before the shock are the ones least affected by the shock. In other word, say that they have close to 19, 18 years left to their next renewal. Therefore the shock does not impact the decision to renew, expire, or sell.

Results

In this section I start by looking at some basic statistics about trademarks. Table 4 refers to mode of transactions. It indicates that total number *399,382* of transactions had been conducted between period 1952-1992. Out of this number a large portion of them, almost 82 % were assignment. That's indicates that assignment transactions are the most common modes of transaction. With larger difference, security interest, come in the second with about 12% present. The remaining 5 % includes, corrections name changes, release from security which are not conventionally considered as transactions. Only mergers merger can lies within transactions that due to very small number of occurrence (0.19 %) these type of transaction in our setting is negligible.

<Insert Table 4 here>

Next we focus on the cross tabulation between main variables of interest, particularly before and after the increase of renewal fees. Table 5 presents the cross tabulations between location of transaction and modes of transaction. A first glance at the table indicates that on average security interests have increased after the increase in renewal fees. Especially, distant security interests that had a striking increase from less that 1% in periods before the transaction to more that 15%

of transactions after the cost shock. However assignments seem to follow an opposite path. Despite the increase in frequency of assignments regardless of their location, their proportion after the shock was reduced. Particularly, in case of local assignments, they faced more than 12% reduction.

<Insert table 5 here>

Table 6 shows the cross tabulations between product classifications and location of transaction. The results indicate that on average distant transactions have increased after the shock. Interestingly, distant service transactions have almost tripled from less than 2% to 5.8 % after the increase in the fees. Moreover, services seem to have jump in transaction regardless of their location. Where as when it comes to goods location seems to matter and play a role; while local transaction of the goods plummeted from 38% to 26.9 %, percentage of goods that were transacted distantly had increase after the shock.

<Insert table 6 here>

Finally, table 7 presents the cross tabs between product classifications and mode of transaction. The noteworthy results of this table are: assignment of services and security interest of goods. These results suggest that after the shock, trademarks associated with goods are more likely to be used as collateral assets. They have skyrocketed from mere 1% of transactions before the shock to17% after the cost shock. When it comes to assignment though, services seem to be more positively affected by the shock and service mark assignments more than doubles from 4.5% to 9.2 %.

<Insert Table 7 here>

Conclusion

Market for brands play an important but underappreciated economic role. Similar to patents, trademarks are increasingly licensed, bought and sold at the national and international levels. Markets for brands allow companies to diversify their business and to expand into additional product categories. Although concept of brand equity (Aaker, 1996, 2009) is well established in marketing literature, market for trademarks in strategy literature is largely understudied.

In this study I tried to address this notion of market for trademarks. The initial comparison between trademarks and patents from market efficiency suggested that market for trademarks are more efficient than patents. Patent markets proved to be inefficient mainly inefficient since complementarity, user reproducibility, and value rivalry significantly undermine the ability to achieve certain types of contracts and engage in certain types of bargaining, which are essential for an effective multilateral trading mechanism. The main drivers of trademark market efficiency vis-à-vis patents are then; higher market *visibility*, less *complementarity*, less *value rivalry*, lack of *repugnance*, indefinite *renewability* and broader *range of product coverage*. Second I posit a formal model to discusses how fluctuation in cost effect impacts location and mode of trademark transactions.

This study contributes to literature on market for IP both conceptually and empirically. Moreover, by focusing on cost driven fluctuations of this market I investigate the behavior of the local and distant transactions. This research also brings attention on the importance of IP collaterization, which is currently highly scant in the strategy literature. This research was merely an initial attempt to explore trademarks as a collateral asset for accessing financial resources. Intensifying trademark collateralization, by providing a means to raise capital in the credit market, may benefit trademark holders and possibly affords an alternative to the sale of trademark assets (WIPO, 2013). Several more detailed studies are required to examine the impact of IP collaterization in firms' innovative process.

The initial comparison market for trademarks indicated in Table 1, can suggest that such credit practices may have emerged from greater market efficiency and improved valuation practices. If that is the case, then the drivers and welfare effects of trademark collateralization may have implications in the increasingly innovation-driven economy and warrant further study.

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Tables

Table 1. Comparison between trademark and patent from market efficiency perspective.

Main Elements	Trademark	Patent
Visibility (Lemley and Myhrvold, 2008; Hagiu and Yoffie, 2013)	Yes	No
Thick (Roth, 2007)	Yes	No
Lack of Congestion (Roth, 2007)	Somewhat yes	No
Safety and lack of opportunism (Roth, 2007)	Somewhat yes	No
Repugnance (Roth 2007; Gans and Stern, 2010)	No	Maybe
Complementarity (Gamabardella et al, 2001; Gambardella, 2002; Gambardella et al, 2010; Fosfuri, 2006; Pisano 2006; Giarratana and Fosfuri 2010)	Medium/ Low	High
User-reproducibility (Fosfuri, 2006; Pisano 2006; Giarratana and Fosfuri 2010)	High	High
Value Rivalry (Fosfuri, 2006; Pisano, 2006; Giarratana and Fosfuri, 2010)	High	High
Expiration (Graham et al, 2013, 2014; Landes and Posner, 1989)	No	Yes

Range of product Coverage (Graham et al, 2013, 2014; Landes and Posner, 1989)	All	Only patenting Industries

Table 2. Revenue effect and Cost effect mechanisms

$\boldsymbol{P > A}$		Transaction
$\boldsymbol{P < A}$	$A > 0$	Renewal
	$A < 0$	Expiration

Table 3. Definitions of variables

Variables	Definition	
RATE of TRANSACTION	Proportion of number of transaction over total number of live trademarks per year	# transacted trademarks/total
GEOGRAPHIC LOCATION	Local if assignor's city= assignee's city Distant if assignor's city≠ assignee's city	Local= 1 Distant=0
MODE of TRANSACTION	The type of conveyance recorded in USPTO	Assignments=1 Security Interest=2 Others =0
CLASSIFICATION	WIPO's NICE product classification	1<Nice code<35 =1 34<Nice code<46 =2
FILING YEAR	The year the trademark was first filed in USPTO	
LEGAL ENTITY	Dummy variable, indicating whether the assignee or assignor is individual, corporation, bank, etc.	
AGE	Round of (Transaction execution date – Filing data)/ 365.25	

Table 4. Frequency and percentage of mode of transaction

Transaction Mode	***Freq.***	***Percent***
Assignment	*329,237*	*82.44*
Security interest	*46,260*	*11.58*
Other	*23885*	*5.98*
Total	*399,382*	*100*

Table 5. Cross tabulation of location of transactions and mode of transactions

	Assignment		***Security Interest***	
	Before	***After***	***Before***	***After***
Local	56,450 (41.6 %)	70,632 (28.9 %)	206 (0.1%)	6,590 (4.5%)
Distant	77,908 (57.4%)	128,642 (52.7%)	1,230 (0.9%)	38,234 (15.7%)

Table 6. Cross tabulation of Location of transactions and product classifications

	Good		***Service***	
	Before	***After***	***Before***	***After***
Local	54,472 (38 %)	68,964 (26.9 %)	3,537 (2.5%)	11,781 (4.5%)
Distant	80,061 (56.9%)	162,723 (62.9%)	2,702 (1.9%)	15,041 (5.8%)

Table 7. Cross tabulation of product classifications and mode of transactions

	Assignment		***Security Interest***	
	Before	***After***	***Before***	***After***
Good	128,295 (94.5 %)	176,829 (72.5 %)	1,411 (0.1%)	41,462 (17%)
Services	6,035 (4.5%)	22,388 (9.2%)	25 (0.01%)	3,354 (1.4%)

Chapter 5

Conclusion

My dissertation provides several important contributions as well as future research opportunities within the field of strategy and economic geography.

First, my dissertation underscores the importance of geographic distance on the external sources of knowledge spillover. Our results confirmed that for firms that claim local interaction is important for innovative activities there is positive correlation between the customers and competitors (as a source of knowledge). And the weaker correlation holds for distant customers and competitors. The underlying mechanism is the presence (absence) of randomness in local (distant) interactions. The randomness factor facilitates the cheap effortless and incidental contacts for market players.

By showing that geographical distance results in changes between correlation between customers and competitors- as firm's external sources of knowledge- we contribute to the growing literature highlighting the strategic value of geographic distance. Moreover, from managerial perspective, the results have implications for firms to actively and intelligently benefit from the local (distant) spillovers. Our findings extend the economic geography literature (Jaffe et al, 1993, Shaver and Flyer, 2000) by demonstrating that the strength of correlation among external sources depends on their distance from a focal firm.

Identifying which other sources and under what circumstances one mechanism is more appropriate than another calls for more future research. Moreover, understanding what variables can have a modifying role in this process (e.g. competition level) would offer a better insight about when firms benefit or suffer from intentional or unintentional spillovers.

The second section of my dissertation, I discus the importance of value chain structures in explaining the demand driver mechanisms that link innovations to regional economic growth. The findings suggest that demand mechanisms convey through two sets of vertically differentiated products innovations over time. Our results indicate that, a unidirectional relationship runs from metropolitan area's GDP to subsequent generation of Final goods and services in that same area. This increase in generation of Final goods calls for increase in the Intermediate products that are used as an input for generation of the Final goods. Which in turn, triggers the GDP over time.

By doing so, I contribute to the literature on innovation and industrial change. More over from empirical perspective, I contribute to the sparse but extensively growing literature on trademarks. While the existing studies have elegantly expanded our understanding about the nature of innovation, they tend to be focused on the patent-producer industries. Hence our knowledge about characteristics of innovation and their impact on growth in non-patenting industries and services has so far remained scarce and limited. The emergence of attention toward trademarks as an alternative IP for measuring innovation helps us to complement our previous knowledge and shed light on nature of product innovation in larger range of products and services.

This study opens avenues for future research. It would be interesting to examine whether similar vertical relationship between Intermediate and Final products exits in other units of analysis, particularly at the firm level. In other words whether innovating Intermediate goods affects the subsequent Final goods innovations in the same firm. And if that is the case how this within-firm vertical relationship affects firms' diversification decisions.

It is also worth to further investigate the impact of the Intermediate and Final product innovation on regional entrepreneurship. Identifying which one on the two types triggers regional entrepreneurship and start-ups it is important for firms, policy makers and society as a whole.

Finally, the last part of my dissertation focuses on notion of market for trademarks. The initial comparison between trademarks and patents from market efficiency suggested that market for trademarks are more efficient than patents. The main drivers of this efficiency are; higher market *visibility*, less *complementarity*, less *value rivalry*, lack of *repugnance*, indefinite *renewability* and broader *range of product coverage*. Second I posit a formal model to discusses how fluctuation in cost effect impacts location and mode of trademark transactions. This study contributes to literature on market for IP. Moreover, by focusing on cost driven fluctuations of this market investigated the behavior of the local and distant transactions. This research also brings attention on the importance of IP collaterization, which is currently highly scant in the strategy literature. This research was merely an initial attempt to explore trademarks as a security interest for accessing financial resources. Several more detailed studies are required to examine the impact of IP collaterization in firms' innovative process.

Together, these three studies emphasize on the significant role of geography and regional studies on innovative process, economic growth and markets. Moreover, this essay sheds light on importance of investigating other understudied forms of IP, in particular trademarks, to expand our existing knowledge in field of innovation and strategy.