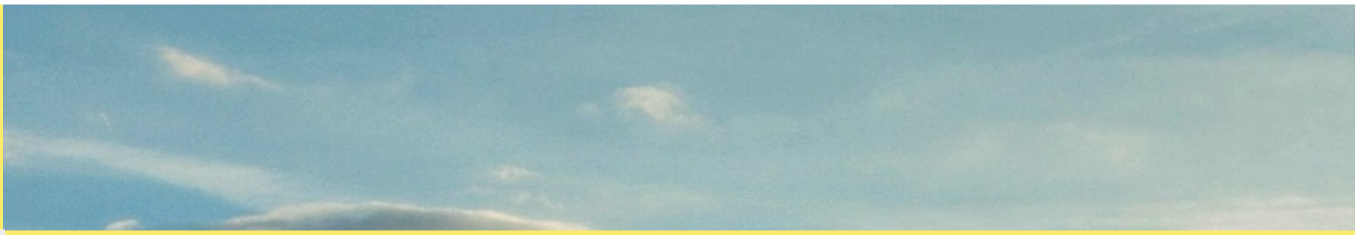

Knowledge Spillover and Innovative Entrepreneurship in Urban Areas

Erasmus School of Economics

Bachelor Thesis for International Bachelor of Economics and Business Economics

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Consequences of Urban Knowledge Spillover on Regional Innovativeness and Start-Up Rate

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Abstract

In response to a widely confirmed notion that entrepreneurship plays substantial role in economic growth and that it varies across environments, literature analyzing the conditions that may stimulate it is growing extensively. By reviewing existing literature, this thesis employs qualitative approach to investigate the unexplained role of knowledge spillover in making urban areas in the U.S. a favorable environment for entrepreneurship, as indicated by higher start-up rate. The main proposition is that in urban areas, knowledge spillover stimulates regional innovativeness and further stimulates entrepreneurial activity. Aside from explaining basic concepts and notions regarding the case, this thesis bridges established relationships to construct a framework that may explain the process. Indeed, there are evidences supporting the idea that urban areas exhibit knowledge spillover, which makes them more innovative than elsewhere (rural areas and areas of specialization). High-density and diversity, two main distinctive natures of urban areas, are proven to promote this phenomenon. When extended, we find evidences proving that regions with higher innovativeness are more likely to yield higher entrepreneurial establishments. Considering that the scale of impact increases by metropolitan size and that it is more prevalent among service industries, it strengthens the presumption that the tendency for entrepreneurs to create new businesses in innovative areas is more of a large urban area phenomenon. Compiled into a chain of relationships, those empirical findings serve a justification to the proposition. This thesis is expected to be able to provide a strong base in helping policy efforts that aim at enhanced entrepreneurship and overall improvement of the economy.

Table of Content

Chapter 1: Introduction

In modern economic growth, entrepreneurs are perceived as the machine of job creation and conveyor of innovation. Many studies have analyzed and proven that entrepreneurship plays an important role in wealth creation and economic growth (such as Smith, 1776; Marshall, 1890; Schumpeter, 1921; Baumol, 1996; Glaeser, 2010). As expected, the importance to analyze drivers and factors affecting entrepreneurial activity increases.

Researches linking entrepreneurship with innovativeness are a subject of great interest nowadays as globalization and modernization makes research and development activity, innovation, and knowledge availability more prevalent to business creation and sustainable business development. Confirmed by many empirical studies, innovativeness is undoubtedly believed to significantly affect the growth and performance of businesses, and consequently of regions (i.e. Audretsch and Thurik , 2001; Audretcsh and Keilbach, 2008).

While firms are the sites where business organization and innovative activity takes place, the resources required are not restricted to the firms individually and therefore, geography plays a role in organizing factors of production. As a response to this insight, a large amount of empirical and theoretical literature focus on the drivers of entrepreneurship related to regional aspects like characteristics of location, spatial distribution, and attributes of the environment. The growth of entrepreneurship and innovation are not evenly spread across regions. Especially in the U.S., urban areas continue to attract relatively more of new inhabitants and businesses (Ciccone, 2002; Ciccone and Hall, 1996; Audretsch and Feldman, 1999; Harris and Ioannides, 2000; in Feldman and Kogler, 2010). This phenomenon of spatial concentration or clustering, also known as agglomeration, seems to conjointly occur in the distribution of innovative activity. Data shows that number of patentable innovations is higher in populous regions and bigger cities. In addition, the most successful and innovative firms like Apple, Google, and Coca Cola tend to base their core activities in large metropolitan areas. Ever since Alfred Marshall, academicians have put a great amount of effort developing researches linking dense concentrations and economic agglomerations.

1.1. Problem Definition

There must be some distinctive characteristics of urban areas that facilitate this predominance. Looking at the similar concentration pattern of both activities, there might be a connection between the mechanisms of how urban areas attain higher entrepreneurial activity and how they better foster innovations. To date, much research activity on urban innovativeness has emerged but only little investigates urban entrepreneurship and nearly none connects the mechanisms and examines both in one research simultaneously. This gap is what this thesis aims to fill. Drawing from works found in entrepreneurship, urban structure, and innovation literatures, this thesis develops a conceptual framework that can propose a confirmable explanation to how attributes of urban areas foster entrepreneurship by stimulating innovation.

This thesis will intensively comprise the theory of knowledge spillover into the discussions. Knowledge spillover is a part of Agglomeration Economies—or the economies generated from locating in clusters and center of concentrations. Since Alfred Marshall introduced the concept of Agglomeration Effect, it has served basis for extensive researches that examine economies of scale and of scope in areas of concentration. The theory of knowledge spillover mainly suggests that dense areas increase the speed and intensity of interactions and hence idea transfers (Marshall, 1920). Agglomeration economies can be acquired from two different sources, which are localization and urbanization. However, while studies regarding urban areas obviously relate to discussions on urban agglomeration only, existing literature appears to lack clarity in separating between urban agglomeration and localized agglomeration and thus isn't capable of explaining the impact that knowledge spillover has, specifically in urban areas.

A large part of literatures that bridge entrepreneurship and knowledge spillover bring up 'the knowledge spillover theory of entrepreneurship' that was first introduced by Audretsch (1995). The theory suggests that knowledge doesn't automatically spill. Rather, entrepreneurship serves a conduit of the process because entrepreneurs are the agents who actually take action of creating a new business by commercializing knowledge and ideas that otherwise would only be overlooked (Audretcsh and Keilbach, 2008). Although lots of researchers have observed the connection between knowledge spillover and entrepreneurship, none can yet provide an answer to how and by what magnitude urban entrepreneurship is affected by urban knowledge spillover. Most of previous works observe the impact that entrepreneurship has in creating knowledge spillover among entrepreneurs—not the other way around—and are not specified on urban agglomeration. Many studies have acknowledged the propensity of high-tech industries to cluster and the importance of industrial districts like Silicon Valley, but only a few put emphasize on inter-industrial diversity. Besides, information from existing literatures is fragmented and cannot yet explain the whole process. By far, literatures are lacking of clear understanding and evidences on whether knowledge spillover contributes in explaining high urban entrepreneurial activity.

1.2. RESEARCH QUESTION

In order to clarify the relationship between knowledge spillover and entrepreneurship—specifically in urban areas—and to find the possible mechanism of how knowledge spillover foster entrepreneurship, this thesis is written to answer this following question:

Does knowledge spillover—by stimulating higher innovativeness—explain higher entrepreneurial activity in urban areas?

The basis of the research is a rather pragmatic framework, consisting of three fundamental sub-questions containing (1) "Is it true that urban areas are generally more innovative than elsewhere?" (2) If so, is it true that knowledge spillover—as a consequence to not only high density but also diversity—is the cause?" (3) "Does higher innovativeness lead to higher entrepreneurial start-ups in a region?"

1.3. METHODOLOGY AND RESEARCH PROCESS

As the purpose of this thesis is explanatory, this thesis is written to provide better insight and understanding, diagnoses of current situation, analysis on established causal relationships, and screening results of alternatives to be able to create a new conceptualization. This thesis employs qualitative approach where the analyses will be based on secondary data, through literature reviews. There will be no test performed throughout the entire research process. The analyses consist of two parts; theoretical analysis and empirical finding analysis, so that the main concepts are clearly explained and proposed ideas are strongly supported with valid evidences. All evidences and justifications for the propositions are compiled from test results gathered by other researchers. Selection of literatures is based upon the frequency of the researches being referred, their relevancy, credibility of the authors and journals, and attributes of the researches like measures, units of analysis, and variables. Unpublished papers are excluded from our discussion to ensure that this thesis in correspondence with scientific paper standards. However, since the author does not perform empirical tests, evidences contained in this thesis are indeed debatable. Among findings related to the case, there are some contradictions in existing literature. The existence of contrasting results is acknowledged and will be presented in the discussions as some comparisons and alternative explanations.

For a better base of understanding, the second chapter will elaborate the theoretical analysis consisting basic concepts and notions, where the nature and measures of each contributing variable will be discussed. After comprehending the concepts, a framework will be presented in Chapter 3, which is constructed by bridging some possible causal relationships. Chapter 4 will provide evidences from existing empirical researches to justify each relationship, so that the ideas building the overall framework are adequately supported. Chapter 5 will provide conclusions, limitations, and directions for future research.

1.4. RELEVANCE OF THE STUDY

This thesis cannot yet contribute to policymakers and businesses because the overall framework has not been empirically tested yet. It however can start by contributing for scholars and researchers. This thesis is expected to present a clear understanding that is more specific by carefully picking and distinguishing literatures about urban concentration from industrial concentration, while most of previous work on knowledge spillover provide mixed results. This thesis also bridges information about two of aspects that are currently receiving much attention, which are entrepreneurship and urban innovativeness.

In the end, the writer proposes a theoretical framework explaining possible mechanism that links knowledge spillover to entrepreneurial activity in urban areas. The author believes that the established framework has high possibility to be valid, as it is supported by empirical evidences from secondary data. If the framework is further tested and the predicted relationship is proven to be true, the results can reveal another cause behind urban entrepreneurial success, which would be useful for policymakers to even out the distribution of wealth by replicating characteristics of urban area that can boost up entrepreneurial activity.

Chapter 2: Theoretical Analysis

2.1. Entrepreneurship

Since the early writing about entrepreneurship, economists have met a general consensus that entrepreneurship is essential in determining the economic prosperity of a country and the distribution within it (Faggio and Silva, 2014). However, despite the large number of published works related to theory on entrepreneurship and its relevance to policy-making, up to this point, there is no confirmed agreement on the definition of entrepreneurship or what makes a person entrepreneur. Among various notions, the author adopts Kao et al. 's definition (in Saiman, 2009). Entrepreneurs are people who innovate by exploiting opportunities that others haven't paid attention on and entrepreneurship is the way or the process of establishing businesses by organizing resources like labor, goods, capital, ideas and skills to generate value despite of the risks.

It is worth to note that entrepreneurship is not the same with self-employment. A prevalent classification by Reynolds et al. (2002) distinguishes self-employment into two types, "necessity-driven" and "opportunity-driven". Necessity-driven self-employment is generally perceived as the attempt to escape from unemployment while opportunity-driven self-employment is established by capturing value and exploiting entrepreneurial opportunities, which is exactly the kind of entrepreneurship that we're discussing. As the studies about entrepreneurship grow throughout years of changes and advances, basic distinction between necessity-driven and opportunity-driven is no longer ideal and researchers began to separate 'innovative entrepreneurship' from 'ordinary entrepreneurship' (Waasdorp, 2002). The basic concept of innovative entrepreneurship is essentially defined in the definition that we mentioned earlier. Innovative enterprises generate value through a creation or an improvement that originates from novel innovative ideas. It is believed that unlike ordinary entrepreneurship that only contributes to job creation, innovative entrepreneurship contributes to growth, wealth creation, and innovativeness.

Many researchers have analyzed the impact of entrepreneurship towards economic performance and proven it to be significantly positive, at least since former work by Adam Smith (1776) proved that entrepreneurship is essential in wealth creation process. Schumpeter's writing (Schumpeter, 1921), supported by Marshall (in Faggio and Silva, 2014), lead to a formalized idea that entrepreneurship shapes spatial distribution of economic activities and is a key source of economic success. Since then, many researchers support this idea through studies with various approaches such as Acs et al. (2009) who suggest a positive relationship between entrepreneurial start-ups and economic growth, and Reynolds et al. (2003) who report findings supporting the idea that the rate of business establishments is positively associated with economic productivity. Glaeser, Rosenthal, and Strange (2009) prove that entrepreneurship is a crucial source of innovation and economic development while Baumol (1996) concludes that entrepreneurship encourages innovation and makes the society in its surrounding better off. Concisely, attempt to increase the welfare of a region can be done by encouraging entrepreneurship.

Plenty of previous works associate entrepreneurship with self-employment and use self-employment level as variable to measure entrepreneurial activity in the model. However, as stated in a writing of Faggio and Silva (2014), studies show that self-employment is inadequate in measuring the level of entrepreneurial activity (Ramirez, 1994; Earle and Sakova, 2000; Martinez-Granado, 2002; and Santarelli and Vivarelli, 2007; in Faggion and Silva, 2014). Reynolds et al.'s (2002) classification of entrepreneurship emphasizes that although self-employment is important and makes a large part of global entrepreneurship, businesses without paid employees cannot significantly contribute to the generation of innovation and regional wealth (Low et al., 2005). Only opportunity-driven self-employment is relevant in explaining the development of urban areas. Alternatively, substantial attention is put upon number of business start-up, which is suggested as a better estimate for entrepreneurial level (Faggio and Silva, 2012). This measurement allows us to capture size of the firm, which makes it more suitable for this thesis since this thesis focuses on entrepreneurs that play a role on boosting the economic growth.

2.2. Regional Innovativeness

An important aspect regarding entrepreneurship is innovativeness, which nowadays receives a great attention as the link between both is considered to be consequential. The relationship was suggested in The Endogenous Growth Theory (Romer, 1986, 1990; in Beaver, 2002); that knowledge capital is becoming the most important input as a driving factor of firms and overall economic development. The term 'innovativeness' is often mixed and interchangeably used with the term 'innovation' (Hurley and Hult, 1998). Innovativeness, as the predecessor, represents the ability to innovate whereas innovation is the output of the whole process. Similar with most of other academicians' idea, Hurley and Hult (1998) define innovativeness as organization's intention to be innovative and open to new ideas. Regarding entrepreneurship, Berthon et al. (1999) and Hult et al. (2004) relate innovativeness to firm's capacity to introduce new ideas, new product, new way of producing existing product, or opening up a new market through incorporating innovative behavior to its strategy.

Measures of innovativeness commonly involve one of three dimensions in innovative process; input (e.g. budged allocated for R&D activities), output (e.g. number of patents), and direct measure of innovative output (Acs et al., 2001). An approach frequently used in measuring innovativeness is through indices that represent innovations generated within a region like—most commonly—patents (e.g. Feldman, 1994; Feldman and Florida, 1994; Fritsch, 2002; in Brokel and Brenner, 2007). An empirical study by Acs et al. (2001) provides evidence that number of patents is a reliable representation of innovativeness. A more comprehensive examination was done by Comanor and Scherer (1969), who examine a sample of firms to find the correlation between patents and two alternative measures; number of R&D employment (input) and value of new product sales (output). They found that patents are significantly associated with both input and output measures. Number of patents is capable to reflect not only mere magnitude of innovation generated but also willingness and effort that firms put in the innovation process. Despite its inefficacy in distinguishing quality of innovations, recent evidence still advances the use of patent data to measure innovative outcomes (Sedgley and Elmslie, 2001).

In addition to patents, patent citations reflect innovativeness that specifically results from spillover. Patent citation is often utilized to approximate the flow of knowledge between firms (Jaffe et al., 2000). This proxy is helpful especially that very little of research has provided a way to quantify the mechanism of knowledge spillover. Based on a research conducted in France, Duguet and MacGarvie (2005) propose the legitimacy of using patent citations as a measure of innovativeness resulting from knowledge dispersion.

To measure innovativeness of a region, the above measures are adjusted with spatial units, usually by dividing them by number of inhabitants or number of workers (Faggian and McCann, 2005). The measure of innovativeness or innovation performance of a region reflects whether the region is attractive to more or less new firms, whether the region is attractive to firms from innovative industry sectors, whether the region attracts firms to conduct more or less R&D, whether the region provides more or less innovative input like skilled employees, and whether it provides environment that support the development of innovative activities (Brokel and Brenner, 2007).

2.3. Urban Areas

It is accepted as a stylized fact among literatures that large portions of the global population and most of productive economic activities are sorted into concentration centers, commonly referred as urban areas. In attempt to explain the reason behind urban areas' remarkable growth, a specific field of study then emerged and has been continuously developed, namely urban economics, which is described as studies about firms' location, spatial structure, and regional determinants (Quigley 2008).

Although it is easy to roughly say whether a place is urban by seeing it, the scholarly definition of 'urban area' is actually complex since it does not involve visible administrative boundary. Despite the recognized need, there has not been any agreed formulation on a 'core' set of definitions that is suitable for studies and policy-making (Weeks, 2010). According to the United Nations (2000), of 228 countries, 51 countries use basis of population size or density, 39 use functional characteristics such as economic concentration, 22 have no base of classification, while the rest define either none or the entire country as urban area. This inconsistency might lead to ambiguous observation results.

Responding to that obscurity, John Weeks (2010), supported by many other academicians, stated that the best way to explain the definition of urban is by elaborating the characteristics. Defining the term 'urban', and by extension the term 'rural', in fact involves several dimensions. *Urbanness* is a function of population size, land attributes (area and physical feature), functionality, and economic and social organization (Weeks, 2010; Squires, 2012). Considering that numerous urban researchers define urban as a characteristic of place, then being urban means having relatively high population size and density, covering a vast area of land that constitutes a center and the commuter belt (an essentially sub-urban region surrounding it), providing facilities and amenities inaccessible in smaller settlements, and serving as the center of activities including governmental and economic with distinct social characteristics like heterogeneity and multi-culture (Sujarto, 1997; Weeks, 2010; Glaeser, 2010;). In addition, another criterion that should be regarded is that urban areas have dominant employment proportion in non-agricultural sectors and thus, any spatial concentration of people whose lives depend on agricultural activities should be excluded from urban areas (Weeks, 2010).

2.4. Urban Agglomeration, Knowledge Spillover, and The Consequences on Innovative Entrepreneurship

(Preliminary framework of consequential effects)

Entrepreneurship is a vast area of study as entrepreneurship itself is dynamic. It affects and is affected by various aspects. Among them are spatial and regional attributes (Glaeser et al., 2009). Differences in level of entrepreneurial activities may lead to regional disparities and the other way around, different regional attributes of location may generate different effects on businesses and on entrepreneurial success (Audretsch and Fritsch 1994). This is also the case for innovativeness. Calantone et al. (2003) believe that innovativeness is greatly affected by the nature of the external environment. Knowledge, the main source of innovation, is not easily available at every point in space. Consequently, the flow of knowledge and hence the development of innovation are geographically bounded (Jaffe, 1989).

The fact that space is naturally heterogeneous is not enough to serve a justification for unevenness of development. The most plausible way to explain the organization of population around urban areas and the remarkable growth within it is linking to agglomeration economies, defined as the benefits that firms attain by locating themselves close to each other (Duranton and Puga, 2004; Glaeser, 2010).

The economies of agglomeration, which is a concept that was first proposed by Marshall in 1890, can be derived from two types of clusters; localization and urbanization. Bigger cities tend to exhibit urbanization rather than localization. Marshallian agglomeration is commonly associated with localization economies, which are attributed to the spatial concentration of firms belonging to the same industry sector (Feldman and Kogler, 2010). Meanwhile, urbanization economies are resulting from dense and diverse population with inter-industry diversity (Jacobs, 1969). Agglomeration economies in this thesis are more related to urbanization with special focuses on discussions regarding diversity rather than specialization.

As Marshall suggested, empirical literatures commonly classify agglomeration economies into three mechanisms; input sharing, labor market pooling, and knowledge spillovers (Marshall, 1920). By locating close to each other in a geographical area, firms are able to share input suppliers, easily access a cluster of skilled workforce, and facilitate a more intense transmission of knowledge in proximity, which may lead to higher efficiency and lower cost. This thesis will mainly discuss urban economies of knowledge spillover, which arises as the consequence of high density and diversity among population and businesses (Helsley and Strange, 2002). In summary, innovation is stimulated when personal creativity and experiences of human capital are combined with knowledge learned from spillovers (Knudsen et al., 2007). Many of previous literatures have formalized the role of knowledge spillover in regional innovativeness and urban growth. Modern growth models suggest that it facilitates innovation through the exchange of nonappropriable information. As Glaeser (1996) points out, proximity in urban areas erases—or even eliminates—the physical distance between innovations, and has served as an engine by which ideas are transmitted across individuals. High concentration of inhabitants and firms in urban areas makes knowledge and ideas transfer more quickly and thus, provides an environment that supports innovation development better (Duranton and Puga, 2004). In addition, different natures of environments like the socio-economic conditions may lead to different shapes of knowledge creation and deviated innovativeness across regions (Cooke et al., 1997). This thesis will consider the role of both scale and scope to the increasing return. As we are discussing urban areas, it is worth to note that in this case, spillovers occur not only as the consequence of high density but also inter-industry diversity.

Knowledge spillover is, however, cannot be measured directly. Knowing that urban knowledge spillover is the consequence of high density and diversity and that regions with high density and diversity will undoubtedly exhibit knowledge spillover (Helsley and Strange, 2002), quantifying the extent and impact of knowledge spillover can be done alternatively by examining those measures. In other words, measuring how much density and diversity affect patent activity can give a representation of how much knowledge spillover affect innovativeness in urban areas. Density is a very common variable simply denoted as population, while diversity is quite complex to measure. Some literatures promote the use of Diversity Index, which will be explained in the next chapter.

There are widespread arguments supporting the positive relationship between entrepreneurship and innovation (Schumpeter, 1934; in Anokhin and Wincent, 2012). Entrepreneurs are considered as the promoter of regional creativity and innovativeness, since enterprising agents play a major role in recognizing and exploiting innovative opportunities via business establishments (Kirchhoff et al., 2007; Reynolds et al., 2003). Implicitly, it is suggested that there is a positive interconnection between innovative activity and entrepreneurial activity in a region.

Based on the abovementioned arguments, we can summarize in a sentence that hypothetically speaking; the reason than entrepreneurship is more flourished in urban areas is possibly that urban areas exhibit knowledge spillover, which encourages the development of innovation. That presumption is in accordance with what we are facing in reality. Statistical data shows that urban areas have relatively larger portion of self-employment and higher number of business establishments (Faggio and Silva, 2012). Aside from the existence of higher demand that is derived from more inhabitants, urban areas are more dynamic and enable firms to be more adaptive due to the diversified opportunities within (Glaeser et al., 2009). There is certainly a tendency of new and incumbent firms to locate in urban areas rather than elsewhere, be it rural areas or specialized areas. The statistics show that urban areas generally have higher level of entrepreneurship. Even among urbanized areas, smaller metropolitan areas generally have fewer new business establishments than larger one. According to an analysis by Stolarick et al. (2011), average-sized regions added approximately one new establishment for every 1,300 inhabitants while median-sized regions added one new establishment for every around 10,000 inhabitants. In nearly all industries observed in United States, almost all of 225 metropolitan statistical areas contain a large proportion of business start-ups (Campbell and Hopenhayn, 2005).

Different economic function that urban areas serve also appears in headquarter clustering. Duranton and Puga (2005) document that management and information-intensive activities tend to take place in larger cities whereby smaller cities are more specialized on production, and that the proportion has becoming substantially more uneven since 1950. To illustrate, urban areas are on top of the hierarchy as incubators for new firms, which benefit most from urbanization economies. Followed by more of medium-sized cities that serve as regional hubs and large amount of small areas that typically are more specialized and focused in production. Finally, the link extends from town to rural areas that commonly facilitate internal scale economies for agriculture products and rural output.

There are strong bases to believe that the phenomena of high entrepreneurship and high innovativeness in urban areas are linked, especially considering that the exchange of ideas underlies the creation of new product, new ways of producing existing product, or creation of a whole new business (Carlino et al., 2001). In the United States, almost all product innovations take place in large metropolitan areas (Gill and Goh, 2009). According to data from National Bureau of Economic Research, most counties with high patenting are located in populated coastal regions. Many researchers find that patenting is largely a metropolitan phenomenon (Feldman and Audretsch, 1999; and Huallachain, 1999; in Carlino et al., 2006). In 1982, less than 4% of innovations take place outside metropolitan areas (Audretsch and Feldman, 1999). During the 1990s, metropolitan areas host 92 percent of all patents granted in the U.S. whereas the areas only cover 20 percent of the U.S. land, inhabited only by around three quarter of the U.S. population (Carlino et al., 2001). Similar pattern is also found by Pred (1966) and Higgs (1971). There was a positive relationship between number of patent issued in a region and its level of urbanization. As an example of the results, the sum of patent activity in the 35 principal cities in 1966 was even four times greater than the national average.

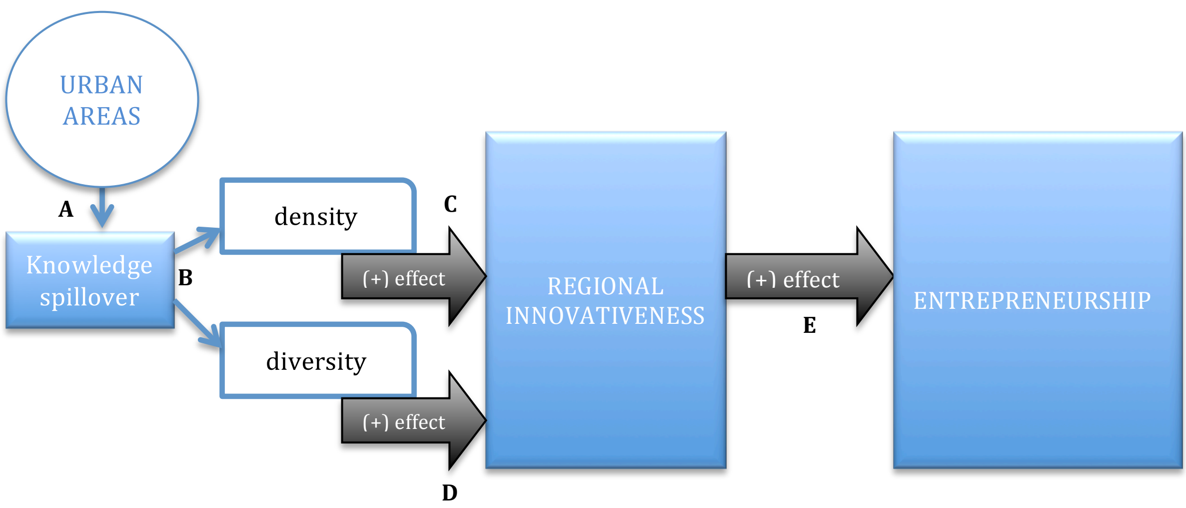
The phenomenon is consistent with Glaeser's (2010) information exchange model analyzed by Jacobs, which shows that more ideas are generated in large clusters. More inhabitants are proven to provide higher potential to generate more innovation as number of inhabitants strongly correlates with resources of innovation such as the more important one—knowledge (Brokel and Brenner, 2007). Besides, Helsley and Strange (2002) provide evidences that ideas are applied more productively in a large urban center. Considering that patent output is a reflection of regional innovativeness, the skewed national distribution of patenting activity implies that urban areas are indeed more innovative compared to elsewhere.

Chapter 3: Theoretical Framework

The ideas in this thesis' propositions begins with the author's interpretation that the presence of spikes in business establishments across regions reflects entrepreneurs' perception that locating in urban areas increases their competitive advantage. The reasons might be rooted in the distinctive characteristics of urban areas itself. One possible explanation is urban knowledge spillover, which is a consequence to proximity, high density, and inter-industrial variability in urban areas. Knowledge spillover makes urban areas relatively more innovative (Marshall, 1920; Helsley and Strange, 2002; Duranton and Puga, 2004). Considering that innovation is proven to be one of important sources of entrepreneurship (Beaver, 2002; Reynolds et al., 2003), it can be presumed that knowledge spillover indirectly stimulates entrepreneurship in urban areas.

This thesis aims to explain how knowledge spillover makes entrepreneurial activity in urban areas higher through higher innovativeness by providing explanation to answer three sub-questions: (1) urban areas are generally more innovative than elsewhere, (2) Urban knowledge spillover—as a consequence to not only high density but also diversity—is the cause (3) Higher regional innovativeness lead to higher entrepreneurial activity. Proposition (1) is already confirmed in previous section, as statistical data shows that urban areas have relatively higher patent activity whereas patent, as an output of innovation process, is an indicator of a region's innovativeness. Theories from the previous section are inadequate to justify the other two propositions. Therefore, they will be discussed in empirical data analysis.

3.1. Theoretical Framework



Information contained in this thesis is arranged based on the above framework. To provide an answer to the research question, this thesis analyzes as well as provides evidences on information and causal relationships of the following points:

(A): Urban areas exhibit knowledge spillover

(B): Urban knowledge spillover is as a consequence of high density and diversity

(C): Density promotes knowledge spillover and has a positive effect on innovativeness of the region

(D): Diversity promotes knowledge spillover and has a positive effect on innovativeness of the region

(E): Regional innovativeness has a positive impact on entrepreneurial start-ups in urban areas

3.2. PROPOSITIONS

By analyzing existing empirical studies, the next section will present explanation and justification to these following propositions:

(1) Urban knowledge spillover increases innovativeness

(2) Regional innovativeness stimulates entrepreneurial activity in urban areas

Chapter 4: Empirical Study Analysis

4.1. Knowledge spillover does exist and is geographically bounded (A)

Jaffe (1989) was the first to ever came up with a solution to the invisibility of knowledge spillover and made it possible to observe its existence and quantify it. He acknowledged the use of patented inventions—introduced as a paper trail of knowledge flow—to prove that the mechanism of spillovers comprises some geographic component. In 1993, Jaffe, Trajtenberg, and Henderson (1993) conducted a research aiming to examine whether and to what extent knowledge externalities are geographically bounded and concentrated. The results of their observation happen to be fundamental findings that underlie the basis of many later researches about knowledge spillover.

To observe the geography of knowledge flow, they used an approach of examining patent citation patterns in the U.S by comparing the location of citing patents to the originated patents. The data incorporates various sets of patents for more accurate results; two sets of university patents from different year (1975 and 1980), and two sets of corporate patents from different types in 1986 (patents granted to 200 'Top U.S. Firms' with greatest R&D expenditure and patents granted to all 'Other Corporate'). In order to focus the research regarding their interest in externalities only, they exclude 'self-citations', or a patent citation granted to the same investors as the originating patent.

They find statistical evidences that prove that new patents in the U.S. are more likely to come from the same state as the cited patents. Their statistic table (Table 1) shows that around 80-90% patents in 1975 and 70-80% patents in 1980 are cited—at least once—by inventors from the same location. The geographic localization effect seems to be a lot greater at SMSA level (Standard Metropolitan Statistical Area). In 1975 at SMSA level, 9 to 17% of total patent citations come from the same location as the originating patents. The results for 1980 data are even more significant, showing that citations are 5 to 10 times more likely to come from the same SMSA. When considering patents' technological field, the results show a substantial amount of cross-classification activities. Apparently, a citing patent and the originating patent are not always classified to the same technological category.

The results suggest that knowledge flow is indeed geographically concentrated and that it apparently occurs across fields. Consistent with Marshall (1920) and Krugman 's (1991b) argument, location and proximity are prerequisites for knowledge spillover to take place, whereas it does not necessarily rely on the concentration of technological activities in the same sector. The authors, agreed by other researchers, take those findings as a robust evidence of knowledge spillovers in urban areas and as a justification that high innovativeness is not merely caused endogenously by R&D input of each firm (Carlino et al., 2001; Glaeser, 1996; Berliant et al., 2006). This paper also serves basis for further observations on knowledge spillover within industry diversity.

However, as what they stated as a limitation to their work, Jaffe et al. (1993) acknowledge that the intensity of knowledge flow in different regions and the tendency for innovative activity to form a geographic cluster are possibly just the consequences of spatial concentration of production. If it is true that the knowledge flow and innovativeness of a region depend merely on the structure of production activities within the region, then attributes of urban areas (e.g. high-density and heterogeneity) as business location might not be the most legitimate answer to explain high urban innovativeness.

Audretsch and Feldman (1996) examine the case further with special focus on the link between geographic concentration of industrial activity and spatial distribution of innovative activity. They use The Small Business Administration Innovation Data Base, or SBID, compiled from data of 8,704 commercial innovations introduced in the U.S. in 1982. Their empirical test shows that at the state level, even after controlling for production concentration, innovative activity in the U.S. still shows a tendency to cluster.

In the 3SLS regression results estimating Gini Coefficient across state, the coefficients of industry R&D, skilled labor, and university research remain positive even after controlling for the degree of production concentration. Another important finding is that the propensity for innovative activity to cluster is higher in industries where knowledge is considered important. The results suggest that innovativeness of a geographic area is determined more by the role of knowledge spillovers and not solely the spatial concentration of production; supporting Jaffe et al.'s argument on the existence and contribution of knowledge spillover in promoting innovativeness among businesses and individuals. Presumably, innovative development is facilitated by proximity among corporate R&D, university research activities, or knowledge transfers among dense skilled workers.

The above findings provide evidences that knowledge flow and innovative activity are geographically concentrated. The concentration is not merely a result of production concentration or firm concentration, but rather determined by knowledge spillover among businesses and individuals. Knowledge does spill in its environment, and proximity among innovations promotes the creation of new innovation. When new knowledge is created, the ones who are closest to them can benefit the most and have higher likeliness to be able to utilize it as a resource to generate other knowledge. Another important note, knowledge spillover can occur across fields. When similar observations were performed in Europe, Caniels (1999) and Breschi (1999) found corresponding results. However, all the above authors admit their limitation that their approaches are not capable to demonstrate the mechanism of knowledge spillover in urban areas. Their findings cannot yet explain how and to what extent urban characteristics influence the creation of the spillovers.

4.2. DENSITY AND DIVERSITY AS ALTERNATIVE ESTIMATES IN EXAMINING URBAN KNOWLEDGE SPILLOVER (B)

The findings that innovative activities are robustly spatially agglomerated have initiated researchers to further investigate the likely forces of this phenomenon. While it is by far not feasible to directly quantify the extent to which knowledge spillovers contribute in promoting innovativeness, it is possible to identify prerequisites of urban knowledge spillovers and measure their effect on innovativeness. As Jaffe et al. (1993), Marshall (1920), and Kruggman (1991) point out; mandatory components for knowledge spillovers to occur are location and proximity. Proximity, or in other words, relatively high density within a geographic context, will most certainly result in fast and agile knowledge transfer and the other way around; economies of knowledge spillovers cannot possibly exist without high density (Marshall, 1920; Jacobs, 1969). Since we are focusing on urban knowledge spillovers, we must also highlight the difference between diversified-urban and localized-industry economies, which is obviously the presence of heterogeneity (Glaeser, 1996). Hence, another way to prove whether and to what extent urban knowledge spillover foster urban innovativeness better—in comparison to what other areas experience—is by providing proofs that higher density promotes knowledge spillover and innovativeness, and that diversity provides better environment for innovation development than specialization does.

4.3. DENSITY PROMOTES KNOWLEDGE SPILLOVER AND HAS A POSITIVE EFFECT ON INNOVATIVENESS OF THE REGION (C)

Authors	Title	Data and Period	- **Findings**
Sedgley and Elmslie (2001)	The Geographic Concentration of Knowledge: Scale, Agglomeration, and Congestion in Innovation across U.S. States.	Patent data from U.S. counties and metropolitan areas (1970-1995)	- Positive relationship between population and innovation output (patent), even when controlling for possible alternative explanations other than knowledge spillovers. - 1 percent increase in population density will result in 0.2 percent increase in the rate of innovation.
Carlino, Chatterjee, and Hunt (2001)	Knowledge Spillovers and the New Economy of Cities	Patent data from 296 MSAs and PMSAs (1990-1999)	- Local employment density of urbanized area within an MSA has a positive effect on the rate of patenting - Doubling the density will result in 20-30% higher rate of patenting.
Strumsky, Lobo, and Feming (2005)	Metropolitan Patenting, Inventor Agglomeration and Social Networks: A Tale of Two Effects	United States Patent Office records on all U.S. patents granted from 1980-2001	- Positive relationship between population density and patenting output - Positive relationship between population density and number of inventors - Agglomeration of inventors is highly correlated with metropolitan patenting
Knudsen, Florida, Gates, and Stolarick (2007)	Urban Density, Creativity, and Innovation	Patent data from 240 geographic metropolitan areas in the U.S (1999), Labor Statistics Occupational Employment Statistics Survey (1999), 1999 Census population	- All variables of density (Census Population Density, Percent Population in Urbanized Areas, Urban Density, Creative Density) have positive effect on metropolitan patent. - Density of creative workers has the most significant positive effect - Even when examined separately, both marginal effects of density and creativity have positive relationships with metropolitan patenting.
Bettencourt, Lobo, and Strumsky (2007)	Invention in the city: Increasing returns to patenting as a scaling function of metropolitan size	United States Patent Office records on all U.S. patents granted from 1980-2001, BEA's Regional Economic Accounts (2005)	- The relationship between population size and innovation output is super linear; there is an increasing return of patent output with respect to population size.

(Overview Table: The Effect of Density on Knowledge Spillover and Innovativeness)

Despite the broad, in-depth theorizing and empirical observations about the economies of spatial cluster of businesses and individuals, ideas regarding dense concentration had not been extended to researches in economics of innovation, at least until Sedgley and Elmslie's work in 2001. In an attempt to account how the forces of knowledge spillovers relate to innovations, they propose an idea of using average patent rate per 10,000 workers within the state, a proxy to measure innovativeness, as a dependent variable. Using data collected from U.S. counties and metropolitan areas during the period 1970-1995, their results show that innovativeness is substantially higher in states with greater population level. The findings remain significant even when controlling for possible alternative explanations other than knowledge spillovers, which are differences in human capital, high technology industry structure, and university R&D infrastructure. The results suggest that every 1 percent increase in population density will result in 0.2 percent increase in the rate of innovation. They took these results as evidence that urban areas better promote innovation. However, although they seem convincing, their findings are classified weak because urban density is understated in their work. Since knowledge spillovers are attributed only to areas of concentration while their measures of density generalize population in the entire state, their conclusions are therefore not accurately drawn.

Shedding some light regarding the bias, Carlino, Chatterjee, and Hunt (2001) came up with a solution to properly examine the role of urban density in fostering innovativeness. Their work specifically observes 296 MSAs and PMSAs (Primary metropolitan statistical areas) to examine the role of knowledge spillovers on innovativeness at the MSA level. In their cross-sectional model, they take rate of patenting (patent per capita in an MSA) over the period of 1990-1999 as the measurement of region's innovativeness. Meanwhile, since there is no exact way to measure urban employment, they regress the rate of patenting on two alternative measures of urban employment density—which are (1) MSA employment per square mile in MSA's urbanized area and (2) employment in the county containing MSA's central city per square mile in urbanized area—along with some other variables that might influence patenting activity at MSA level (Equation 1). With the first alternative overstating local employment density and the second alternative understating it, they believe that comparing results using both estimates will capture an accurate effect that density has on innovativeness.

With both estimates, the results show that there is a positive relationship between local employment density of urbanized area within an MSA and the rate of patenting with correlation coefficient of 0.50 and 0.43 (Figure 1 and Figure 2). Further results show that both local employment density measures have significant, positive effect. Turns out, doubling the density of the local economy in an MSA will approximately result in 20 to 30 percent higher rate of patenting (Table 2). Those findings confirm the consensus that nation's densest areas—urban areas and their dense inner-ring suburbs—play an important role in promoting faster knowledge transfer that fosters innovativeness.

Suggested ideas are supported and advanced by Strumsky, Lobo, and Feming (2005) through a research attempting to investigate separate effects of density and inventor agglomeration on patenting activity in the U.S. metropolitan areas. The data was extracted from records of United States Patent Office on all U.S. patents granted from 1980-2001. To create an index of information by not only the patent but also the inventor, they use several conditional-matching algorithms and come up with a final database containing information on 2,058,823 individual inventors and 2,862,967 patents.

As expected, they find that metropolitan density has a positive relationship with metropolitan patenting output (R^2 approx. 0.69) (Figure 3). Some of novel, important findings are (1) that there is a positive relationship between population density and number of inventors (R^2 approx. 0.69) (Figure 4) whereas inventors, as skilled human capital, are an important source in the mechanism of knowledge spillover, and (2) agglomeration of inventors is very strongly, positively related to metropolitan patenting (R^2 approx. 0.97) (Figure 5). It suggests that the tendency of high-skilled human capital to locate themselves in larger metropolitan areas also mediates a positive relationship between density and regional innovativeness, specifically in urban areas. Those findings formalize the idea that the denser an area, the greater the likelihood of accelerated knowledge flow and the higher the number of skilled individuals that play a decisive role in creating knowledge spillovers.

A more specific research was done by Knudsen, Florida, Gates, and Stolarick (2007). They argue that not the entire population contributes to the creation of knowledge spillover. They conducted a systematic research that specifically investigates the role that density of 'creative workers' has in metropolitan innovation development. While many studies have proven that knowledge flow is determined by proximity rather than innovation input, the model in their research proposes a merged idea that innovativeness is a function of creative-density. To observe a specific form of density namely density of 'creative capital', they establish a new measure that incorporates creative-class employment. Additionally, they use several different variables to measure density (Census Population Density, Percent Population in Urbanized Areas, Urban Density, Creative Density) to capture outcomes from different dimensions.

With patent data from 1999, Knudsen et al. perform multivariate regression over 240 geographic metropolitan areas in the U.S. and find that all variables of density in general have positive relationship with metropolitan patent. Among other variables, density of creative workers has the most significant positive effect. Even when examined separately, both marginal effects of density and creativity exhibit positive relationships with metropolitan patenting. The results suggest that density alongside creativity, conjointly and separately fosters metropolitan innovation. To add, they estimated separate regressions for different classes of metro size and find that the effect is multiplied in largest metros. The larger the size of an urban area, the higher the marginal return that firms within it can obtain regarding innovation development. All those findings test their hypothesis that density of creative individuals is crucial in facilitating 'creative' spillovers, and subsequently in determining innovativeness of metropolitan areas.

Although there are enough robust evidence proving the positive relationship between size of an area and its innovativeness, it cannot yet adequately answer whether dense urban centers are better environment for innovation development. If the proportion between number of innovation output and population size is constant, then innovation output will only be a scaling function of urban size. Let's say if, for example, the patenting rate in an area of 10 million inhabitants is equal to sum of patenting rate in 10 areas of 1 million inhabitants, we can interpret that higher output is merely a consequence of larger cluster instead of a result obtained from facilities that agglomeration serves. Shedding a light on this case, Bettencourt, Lobo, and Strumsky (2007) particularly examine U.S. metropolitan patenting activity to identify whether the relationship between patent output and population size is general scaling relation. They aim to elucidate not only the magnitude but also the nature of the statistical relationship. The research adopts the dataset composed by Strumsky, Lobo, and Feming (2005) as they have corresponding view on the importance of indexing patents by the inventors. Methodologically, they employ a 'power law' functional form to the relationship between measures (Equation 2). The quantification of scaling relations denoted by β can tell whether larger cities are more innovative, equally innovative, or less innovative *per capita*. By using a panel data fixed effects feasible generalized least squares (FGLS) framework, they find that the value of β is 1.29 (superlinear). When the exponent β is estimated individually for the year 1980, 1990, and 2000, the coefficients remain significant and superlinear, where β are 1.29, 1.25 and 1.26. The superlinearity ($\beta > 1$) suggests that there is an increasing return of patent output with respect to population size. The results imply that denser urban areas are indeed more conducive environment to stimulate the generation of innovation output.

The results of those researches are consistent with the idea that density has a positive impact on regional innovativeness. Knowledge spillover is believed to be the mediation, considering most of the above researches control for other possible explanations. Researches confirm that innovative output is not merely determined by innovative inputs, like firm's R&D expenditure and human capital, but rather greatly affected by how the environment facilitates information exchange and idea development. Nonetheless, urban areas indeed show a tendency to contain more high-skilled individuals and R&D allocation, which makes the effect of knowledge spillover even greater.

Comparing results from observations that use various spatial units of analysis to measure regular density and urban density allows us to distinguish the observed effect from other factors that go along with some types of density. Yet, the results consistently indicate positive effect of various types of density. Considering evidences that the there is an increasing return of patent output with respect to population size, it is clear that the effect is not just a scaling effect of regional size. Moreover, the effect is multiplied in largest metros. When the size of an urban area is larger, firms within it are more likely to yield higher marginal return regarding innovative development. Taken together, all the findings above confirm the proposition that density promotes knowledge spillover and centers of concentration are indeed more conducive for innovative activity to take place.

4.4. Diversity promotes knowledge spillover and has a positive effect on innovativeness of the region (D)

Authors	Title	Data and Period	- **Findings**
Glaeser, Kalal, Scheinkinan, and Shleifer (1992)	Growth in Cities	Bureau of the Census' County Business Patterns Data (1956 and 1987)	- Specialization has a significant negative effect on growth - Local competition has a significant positive effect on growth
Audretsch and Feldman (1999)	Innovation in cities: Science-based diversity, specialization and localized competition	United States Small Business Administration's Innovation Data Base (SBIDB)	- Specialization has a significant negative effect on innovation output - The presence of science-based related industries (complementary industries) has a significant positive effect on innovation output

(Overview Table: The Effect of Diversity on Knowledge Spillover and Innovativeness)

Ever since the introduction of Marshall's theory of agglomeration effect, Jacobs (1969) was the first to propose a different perspective on agglomeration economies regarding specialization and diversity. As explained in Chapter 2, both Jacob's and Marshall's theories are fundamental basis in literatures about agglomeration. While Jacob's argument that firms in agglomeration benefit more from inter-industry diversity contradicts Marshall's statement that economies of agglomeration are generated from cluster of firms from similar industry, none of them are incorrect. Both circumstances can indeed generate agglomeration economies, albeit rely on different sources of externalities. Although many researches have confirmed that agglomeration is the most outstanding geographic space for economic growth, not much are focused on examining any specific type or composition of economic activity within the agglomeration. Only a few attempted to compare the consequences of diverse economic activities with specialized ones towards the region they occupy. In this part, we are going to analyze empirical findings that could be evidences to whether knowledge spillovers are more prevalent with diversity, and subsequently whether innovativeness is more encouraged in urban areas.

In 1992, Glaeser, Kalal, Scheinkinan, and Shleifer put some empirical structure on Marshall's vs. Jacob's theories by conducting a research with an aim to investigate and compare the extent of diversity and specialization in promoting innovation and growth. In their work, they introduce a way to identify and quantify the extent to which the economic activity in a geographic space is either diverse or specialized in a particular industry, so that we can analyze how both compositions influence the performance of consequent region.

They use a dataset constructed from Bureau of the Census' County Business Patterns Data, which contains information and details on U.S. industries in 1956 and 1987. They adjust the dataset to city level by aggregating data across counties into 170 SMAs. Using the data, they compare the growth rate (employment growth) of an industry sector across cities as a measure of knowledge spillovers in order to find whether an externality is important to growth. They use city's employment fraction as a measure of industry variety in a city. To quantify degree of city specialization and local competition, they compose measures as follow:

$$Specialization^1 = \frac{industry\ employment\ in\ city\ /\ total\ employment\ in\ city}{industry\ employment\ in\ US\ /\ total\ employment\ in\ US}$$

$$Competition^2 = \frac{firms\ in\ city - industry\ /\ workers\ in\ city - industry}{firms\ in\ US\ industry\ /\ workers\ in\ US\ industry}$$

The cross-section regression results shows that industries that are more concentrated in a city (compared to they are elsewhere in average) have significantly slower growth (Table 3). They find that the coefficient of competition is significantly positive. Industries in diverse cities without the presence of dominating industry have better growth. When another measure of growth is used (wage growth), similar results come out except that local competition depresses wage growth. The results serve a justification that comparatively to those in areas of industry specialization, firms within urban areas are more likely to grow better due to local competition and urban diversity.

Still, although they relate most part of the discussions to knowledge spillover, in the end the findings only suggest that diversity increases productivity. Their evidences are not feasible enough to confirm that diversity promotes innovativeness since the variables used are growth of employment and wages, which cannot be considered appropriate proxies to measure innovativeness. Nevertheless, they present strong evidences proving that relatively to diversity, specialization and within-industry knowledge spillovers are not capable to advance higher regional growth and may even lead to the opposite.

The work was further developed by Audretsch and Feldman (1999). The purpose of Audretsch and Feldman's research is similar—examining the effect of different compositions of economic activity—but is specifically linked to innovativeness. In addition to a set of measures used by Glaeser et al. (1992), they rely upon the measure of innovation output. They constructed a new dataset that integrates data of patented inventions reported by United States Small Business Administration's Innovation Data Base (SBIDB), with four-digit standard industrial classification (SIC) industries and Metropolitan Statistical Area (MSA). The data enables an analysis of 3,969 new product innovations with identifiable industrial classification and location. The test examines the impact that 'specialization' and 'competition' have on the number of innovations attributed to a specific industry in a city. In

[1] Specialization: higher value of this index suggests a greater degree of specialization in that city

[2] Competition: higher value of this index suggests grater number of firms per worker relative to its size. Index >1 = less competitive relatively to other cities in the United States.

addition to Glaeser's measures, they add a measure that includes science-based related industries to identify the effect of complementarity within industry diversity, denoted as follow:

$$Science\ base\ diversity^{3} = \frac{Employment\ in\ cluster\ in\ city\ /\ total\ employment\ in\ city}{Employment\ in\ cluster\ in\ US\ /\ total\ employment\ in\ US}$$

The regression results (Table 4) show a negative and statistically significant coefficient of industry specialization. It suggests that increased specialization within a city depresses its innovative output, which justifies Jacob's theory regarding innovative economies of diversity. The positive and significant coefficient of variable 'science-based related industries' suggests that a strong presence of complementary industries within the diverse city leads to even higher innovativeness. Even after controlling for city scale and technological opportunity in regard to the concerns that competitiveness is merely determined by city size and that some industries are naturally more innovative (Model 3 and 4 in Table 4), the impact of specialization and complementarity remain the same. The results indicate that specialization does not promote innovation. Rather, the test results provide robust evidence that inter-industry diversity, especially with the presence of complementarity among industries sharing common science base, makes cities more conducive in promoting knowledge spillovers and innovativeness.

There is still uncertainty among existing literature as to answering the issue of Marshallian vs. Jacobian externalities in promoting regional innovativeness. Obviously, an obstacle in examining the case of whether diversity or specialization better promotes innovation is the intangibility of these traits and the hindrance in defining what measure to use. Although a large amount of literature provides empirical support for both source of externalities on regional economic performance, only a limited part of it investigate the effects specifically on regional innovativeness and among the observations, only a few analyze both externalities in one research simultaneously. Numerous other researches have proven the positive effect of industry specialization on regional innovativeness (Griliches, 1992; Duranton and Puga, 2000; Paci and Usai, 2000; Greunz , 2004) while there are also plenty proving the opposite, that diversification better promotes innovation (Hitt et al., 1997; Lahiri, 2010; Wang et al., 2011). Their findings are however inadequate to answer which trait is superior to the other.

[3] Index definition: the share of total city employment accounted for by employment in the city in industries sharing the science base, divided by the share of total United States employment accounted for by employment in that same science base

Just because an observation result suggests that diversity does favor regional innovativeness, doesn't mean diversity has no contribution in the consequent region. Both often happen simultaneously in a region and indeed, both can be beneficial for innovativeness (Kelley and Helper, 1997; Helsley and Strange, 2002).

Researches that have been discussed in this part are chosen because they incorporated both diversity and specialization in one research model and compare the effects based on the results of an observation done in the same region at the same time period. Based on findings from those observations, there are supporting evidences that firms are more likely to be innovative when they operate within an area with inter-industry diversity. When similar researches are conducted in European region, corresponding results appear supporting the thesis for Jacob's diversity externalities (van Oort, 2002; Ouwersloot and Rietveld, 2000).

4.5. Regional innovativeness has a positive impact on entrepreneurial start-ups in urban areas (E)

Authors	Title	Data and Period	- **Findings**
Lee, Florida, and Acs (2004)	Creativity and Entrepreneurship: A Regional Analysis of New Firm Formation	Longitudinal Establishment and Enterprise Microdata (LEEM) constructed from Statistics of US Business by Bureau of the Census (1997-1998)	- Firm birth rate is strongly correlated with creativity, diversity, and regional innovativeness - The effect is stronger for service industries
Stolarick, Lobo, and Strumsky (2011)	Are creative metropolitan areas also entrepreneurial?	NETS database built by Walls and Associates (1993-2007), Occupation Employment Survey by Bureau of Labor Statistics (1999-2006)	- Creative Class Employment has a positive and significant impact on growth of businesses establishments in metropolitan regions (number of new establishments, expansion of existing ones, and migrations of firms into the region) - The scale of impact varies by metropolitan size
Anokhin and Wincent (2011)	Start-up rates and innovation: A cross-country examination	World Bank's World Development Indicators, GEM, and World Health Organization (1996-2002)	- Development stage indeed positively and significantly interacts with innovation in explaining start-up rates - The positive relationship between innovation and start-up rates is only found among developed countries

(Overview Table: The Relationship Between Innovativeness and Entrepreneurship)

Holding to Schumpeter's writings and the extension of his suggestions by many academicians in mainstream entrepreneurship literature, one would expect a positive impact of innovations on firm creation. However, the direct association between innovativeness and entrepreneurship is more often assumed than empirically tested. This part of analysis discusses whether and to what extent innovativeness of a region induces and fosters the creation of new firms, an important issue that is largely left unexamined in literatures.

Lee, Florida, and Acs (2004) extend Jacobs and Lucas' insights arguing that urban areas contain higher, diverse human capital with agile knowledge flows within, and thus generate more new ideas and higher economic growth. In their work, they focus on the associations between entrepreneurship and regional characteristics by specifically investigating the effect of social factors like creativity and diversity on creation of new businesses. Creativity is defined as the potential of the mind to conceive new ideas and is perceived as the origin of innovations (Lee et al., 2004). It is argued that regions that are more diverse and creative have higher potentials in generating innovations. In this particular work, they propose an idea that entrepreneurial activity is better supported in environments where diversity, creativity, and innovativeness are encouraged.

They use two different spatial units of analysis; MSAs and PMSASs (Primary Metropolitan Statistical Areas) containing information on firms for all 320 MSAs/PMSAs in urbanized areas of United States. The data used to observe business establishments is Longitudinal Establishment and Enterprise Microdata (LEEM) for 1997-1998 that is constructed from Statistics of US Business by Bureau of the Census, which covers all private-sector businesses except agricultural production and private households. Lee et al. employ the *Diversity Index* (Florida and Gates, 2011) to measure regional diversity and *Creativity Index* by Florida (2002) to measure regional creativity and intellectual dynamism, which reflects the capability of a region to attract creative human capital while stimulating generation of ideas and accelerating knowledge flow. Aside from Creativity Index, they comprise a patent variable, *Number of Patents Issued per 100,0000 Inhabitants*, for more accurate results in investigating the role of innovativeness. To control for natural characteristics related to regional size, business establishments is represented by *firm birth rate* or number of firm births per 1 million inhabitants. The model also controls for the effects of other factors that are greatly believed—and have been proven in many of previous researches—to affect entrepreneurship such as human capital, income change, and size of the region.

The analyses are done separately on manufacturing industries and service industries using bivariate along with multivariate OLS regression models. The empirical results support their propositions. The summary statistics for regions by size show that in general, larger urban areas tend to have higher firm birth rate. The results of the correlation analysis show a strong, positive correlation between firm birth rate and Creativity Index (0.515), firm birth rate and Diversity Index (0.332), and firm birth rate and Patents (0.245) in both service and manufacturing industries (Table 5). When the results for manufacturing industries and service industries are compared, the extent to which creativity, diversity, and innovativeness affect entrepreneurship seem to be weaker in manufacturing industries. Those positive relationships confirm the idea that entrepreneurship is better promoted in diverse, creative, and innovative regions. In addition, the effect is more prevalent for establishments in service industries, which matches the fact that relatively large part of firms in urban areas operate in service industries since manufacturing industries are commonly resource-demanding and big in terms of physical size.

In their published work entitled "Are creative metropolitan areas also entrepreneurial?" Stolarick, Lobo, and Strumsky (2011) attempted to examine the relationship between innovative workforce and entrepreneurship. As stated in their published work, the research is conducted to specifically answer whether conditions that stimulate innovativeness of metropolitan workforce are also favorable for entrepreneurial activity. They examine creative capital as a reflection of regional innovativeness, and relate it to local business establishments as a proxy for regional entrepreneurship. Their spatial units of analysis consist of data gathered from 549 metropolitan areas in the U.S. Aside from analyzing entrepreneurial activity through new business formations, they take into account the expansion of existing businesses and businesses relocations across regions as recorded in National Establishment Times Series (NETS) database containing complete records for US-based establishments from 1993 to 2007. Meanwhile, to measure relative level and amount of creative capital, they use 'creative class employment' by Florida that is measured using data from Occupation Employment Survey by Bureau of Labor Statistics for the years 1999-2006. Creative class employment identifies individuals whose occupations demand thinking. They take this measure because it is specifically designed to distinguish and capture human capitals that are generating innovation (Florida, 2002).

They construct a model that comprises past growth and economic cycles (annual fixed effects) while controlling for systematic location-specific natures. The results serve robust evidence that creative employment indeed positively and significantly affects growth of businesses establishments in metropolitan regions; number of new establishments, expansion of existing ones, and migrations of firms into the region. These findings support their presumption that regions with innovative capital are likely to stimulate higher entrepreneurial activity. The results remain consistent across different classifications of establishment size and when the investigation is extended, the results show that the positive impact that creative employment has on entrepreneurial activity further affects overall regional growth. As expected, the scale of impact that creative employment has on entrepreneurship varies by metropolitan size. Analyses by region size show that entrepreneurship growth from new establishments is generally higher in larger metropolitan areas while entrepreneurship growth resulting from business migrations and expansions is more prevalent in smaller metropolitan areas. It implies that the tendency for entrepreneurs to create new businesses in innovative areas is more of large urban area phenomenon.

Some of entrepreneurship literature however proposes that the association between business establishment and innovation is not uniformly positive. Some recent entrepreneurship literatures suggest that the relationship is moderated by the development stage of the country (van Stel, Carree, and Thurik, 2004). Entrepreneurs in different stage of country's development have different preferences of opportunities to which they respond and entrepreneurs of each type do not contribute equally to their environment. Entrepreneurial activities in developed countries are mostly opportunity-driven, where start-ups rate is largely determined by innovation and the role of knowledge spillovers is substantial to economic growth. The existence of necessity-driven entrepreneurs, who are unlikely to own the capabilities required to engage in innovative activities, thus leads to the overrepresentation of entrepreneurship in the assumed relationship between innovations and start-ups that result from exploiting those innovations. Therefore, it could be argued that the relationship between innovativeness and entrepreneurship may not always be in line with the mainstream entrepreneurship literature.

To provide a sufficient answer regarding the case, Anokhin and Wincent (2011) conducted a cross-country observation. The dataset used in their research covers the period of 1996-2002 and is assembled from data on start-up rates, innovation, and numerous control variables in

35 countries acquired from World Bank's World Development Indicators, GEM, and World Health Organization. Patent and productivity (considered as a measure of realized innovation) is intensively observed while controlling for education level, human capital, net inflow of foreign direct investment, log of population, and countries' economic freedom. The models employ population-averaged negative binomial regression and feasible generalized least-squares regression techniques along with semi-robust standard errors. All the models show significant results. Development stage indeed positively and significantly interacts with innovation in explaining start-up rates. Apparently, the positive relationship between innovation and start-up rates is indeed found among developed countries yet it is not the case for countries in early stage of development (Figure 6). It is concurrent with the proposition that entrepreneurs in developed countries are driven by innovativeness more than entrepreneurs in developing countries are.

Different natures of entrepreneurial opportunities explain these contrasting results. Entrepreneurs in developed countries respond to innovations by exploiting the ideas into new products or establishments while ones in less-developed countries are often entrepreneurs simply to escape from unemployment (Shane, 2009). Baumol's argument adds another explanation regarding this issue. In less-developed countries, innovations are more prevalent to incumbent firms with steadier R&D activity instead of new establishments (Baumol, 1993).

To conclude, mainstream entrepreneurship literature supports the proposition that higher innovativeness promotes higher entrepreneurial start-ups of a region. When the effects of creativity and diversity on firm birth rate are simultaneously analyzed, it is found that both are more favorable to business establishments. It implicitly suggest that urban areas are more likely to have higher rate of entrepreneurial start-ups as a result of diversity along with other conditions that stimulate innovativeness. The extent to which innovativeness fosters firm creations is not uniform depending on the context. Positive association is found to be stronger in areas with later stage of development, while the effect is even greater among service industries. Considering that urban areas are indeed relatively more developed than rural areas and are dominated with businesses in service industry, taken together, those findings support the idea that urban areas have salient capability in fostering firm formation by providing a more conducive environment for innovative activity. It also implies that knowledge spillover and regional innovativeness are contributive only to opportunity-driven entrepreneurship.

Chapter 5: Concluding Remarks

In response to a widely confirmed suggestion that entrepreneurship plays substantial role in economic growth and that it varies across environments, literature analyzing the factors is growing extensively. Urban areas, a type of concentration centers, continue to attract academicians' attention with their prominence in acquiring higher rate of entrepreneurship as well as innovation, which underlay business creation. One distinctive feature of urban areas that is relevant to both cases is that proximity allows them to utilize externalities from knowledge spillover. This thesis aims to provide an explanation to the role of knowledge spillover in making urban areas a favorable environment to foster entrepreneurship, as indicated by start-up rate. Mainly, this thesis proposes that in urban areas, knowledge spillover stimulates innovativeness and further stimulates entrepreneurial activity. Literatures are largely lacking of empirical proofs on the direct relationship. By reviewing findings from previous researches, this thesis bridges established relationships to construct a framework that may explain the whole mechanism.

This thesis employs qualitative approach and the analyses are based on secondary data. The theoretical analysis elaborates basic concepts and notions, where underlying theories are discussed. Especially in opportunity-driven entrepreneurship, which is common in urban areas, innovations are perceived as the origin of entrepreneurial opportunities. Agglomeration effect facilitates faster knowledge flow among the agents and allows them to yield more innovations. Two sources of agglomeration externalities are discussed; Marshallian specialization and Jacobian diversification externalities. Another striking feature that differs urban areas from elsewhere is the diversity within. Therefore, the importance to distinguish findings that are consistent with Jacobian diversity is emphasized. This part of analysis also discusses the measures of each contributing variable that have been carefully picked, including business establishments, rate of patent and patent citation, population, and diversity index.

This thesis proposes three ideas; (1) urban areas are generally more innovative than elsewhere, (2) urban knowledge spillover—as a consequence to not only high density but also diversity—is the cause, and (3) higher innovativeness lead to higher entrepreneurial activity. The first proposition is confirmed by statistical data. Literatures provide supporting evidence to the second proposition by proving that knowledge flow and innovative activity are quantitatively observable and indeed geographically concentrated; and that knowledge spillover does actually exist (Jaffe, 1989; Jaffe et al., 1993; Audretsch and Feldman, 1996; Caniels, 1999; Breschi, 1999). The effects of diversity and diversity are further examined. In researches gathered, density is unambiguously found to positively affect the innovativeness of a region (Sedgley and Elmslie, 2001; Carlino et al., 2001; Strumsky et al., 2005; Knudsen et al., 2007). The relationship remains positive even when controlling for possible alternative explanations other than knowledge spillovers and when some works use more specific measures of urban density, their findings suggest that the relationship becomes even statistically stronger. Some of the literatures suggest that innovative workers play a decisive role in this relationship. From the empirical study analysis we can conclude that the higher the density of an area, the higher the number of skilled individuals it has, the higher the likelihood of knowledge spillover to occur, and the higher the number of innovative output. It is also important to note that the effect that density has on innovations is proven not to be only a scaling effect. Indeed, there are supporting evidences that it has a lot to do with knowledge spillover. On the other hand, literature is less clear to answer whether diversity promotes regional innovativeness better than specialization does. Apart from works discussed in this thesis, there are plenty that provides evidences supporting Jacob's diversity externalities yet there are also plenty proving the opposite. We believe that researches conducted by Glaeser (1992) and Audretsch and Feldman (1999) are capable to provide an appropriate answer, considering that both externalities are incorporated and compared in their model. There found to be sufficient evidences that firms are more likely to be innovative when they operate within an area with inter-industry diversity. Those findings, taken altogether, serve justification to proposition 2 that density and diversity lead to knowledge spillover and result in higher innovativeness in urban areas.

Literature also supports proposition 3; innovation is positively associated with entrepreneurial start-ups. There found to be a strong, positive correlation between rate of business establishments and regional capability in stimulating the generation of ideas, and also between rate of business establishments and patent output (Lee et al., 2004). Similar results appear when innovation input—instead of innovation output—is observed. Evidences support the idea that innovative workforce, the most potential agents for knowledge spillover, indeed positively and significantly affects the growth of business establishments in metropolitan regions (Stolarick et al., 2011). This effect remains consistent across establishment size and varies by metropolitan size. Considering that the scale of impact varies by metropolitan size and that it is more prevalent among service industries, it can be concluded that the tendency for entrepreneurs to create new businesses in innovative areas is more of large urban area phenomenon. According to the cross-country analysis, the positive relationship is only found among developed countries. It emphasizes the idea that knowledge spillover and regional innovativeness are contributive only to opportunity-driven entrepreneurship.

When bridged, evidences on all three propositions together serve a justification that knowledge spillover explains high entrepreneurial activity in urban areas by creating a more conducive environment for innovation development. Not only providing a yes no answer, the analyses integrate fragmented information from existing literatures regarding the case, and compile some novel findings to construct a framework that further explains the process. Findings in this thesis are expected to provide a strong base for further empirical analysis. If empirically tested, the framework can be able to help in policy efforts that aim at enhanced entrepreneurship and overall improvement of the economy. Understanding the nature and forces behind urban areas' prominence can help determining how to replicate the success, or at least increase the innovativeness of rural areas, and consequently even out the distribution of wealth.

Because existing literatures are largely lacking in evidences on the direct relationship, this thesis alternatively attempts to compile researches that observe the mediating relationships. As a consequence, models in the analyses employ different measures and different methodologies, and are tested in different time periods, which make the accuracy of the conclusions questionable. Another significant concern is that this thesis neglects the quality of innovations and treats all innovations as being homogeneous. In fact, innovations are classified into various levels of significance, and clearly each does not contribute equally to entrepreneurship. The proposed framework is after all remains untested. If this thesis is further empirically tested in the future, it is also necessary to identify the most appropriate measures, build a specified dataset that distinguishes urban agglomeration externalities from specialization, and reconfirm the direction of the relationships by performing path analyses.

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Appendices

***Equation 1**: Rate of Patenting and Urban Employment (source: Carlino et al., 2001)*

$$P_i = C + a_i D_i + a_2 E_i + a_3 U_i + a_4 PCTLG_i + a_5 PCTMAN_i + a_6 PCTOL_i + a_7 HI_i + a_8 COMP_i + a_9 EMPGT_i$$

P_i	=	Average patents per capita, 1990-1999 in MSA i
D_i	=	Density of employment in 1989 in the ith MSA's urbanized area. (1) Employment density = MSA employment divided by square miles in the MSA's urbanized area (2) Employment density = employment in the county containing the MSA's central city divided by square miles in the urbanized area
E_i	=	1989 level of employment in MSA i
U_i	=	University R&D spending in science and engineering programs, average for the period 1989-1991 in MSA i
$PCTLG_i$	=	Percent of firms with 1,000 or more employees in 1989 in MSA i
$PCTMAN_i$	=	Manufacturing share of total employment in MSA I in 1989
$PCTOL_i$	=	Percent of 1990 population with at least a college degree in MSA i
HI_i	=	Herfindahl index $\sum_{j=1}^{9} (Sj, i)^2$, where $s_{i,j}$ is the share of industry j in MSA i
$COMP_i$	=	Measure of local competition (total number of firms in MSA I divided by total employment in MSA i)
$EMPGT_i$	=	Employment growth rate in MSA I during 1979-1989

***Equation 2**: 'Power Law' Functional form to the Relationship Between Patent Output and Population Size (source: Bettencourt et al., 2007)*

$$\ln Y_{i,t} = \alpha + \beta \ln N_{i,t} + \varepsilon_{i,t}$$

Y	= Patenting output in the ith metropolitan area at time t (unit of year)
N	= Metropolitan population
α, β	= Constants
ε	= Gaussian white noise

*Note: control for demographic, social, or industry characteristics are excluded because of the author's interest in scaling, instead of a model for metropolitan patenting estimation

***Table 1**: Descriptive Statistics for Location Patterns of Patent Citation in the U.S (source: Jaffe et al., 1993)*

Originating Dataset	Percent Receiving Citations	Total Number of Citations	Mean Citations Received	Average Citation Lag[1,2]	Percent Self Citations[2]	Percent Same Patent Class[2]
1975						
University	88.6	1933	6.12	6.53	5.6	54.3
Top Corporate	84.2	1476	4.70	7.17	18.6	55.7
Other Corporate	82.3	1341	4.22	7.82	9.1	57.5
1980						
University	79.9	2093	4.34	4.36	8.9	56.3
Top Corporate	79.9	1701	3.54	4.41	24.6	58.3
Other Corporate	74.1	1424	2.95	4.46	12.6	57.2

Notes 1: Application year of citing patent minus application
2: For those patents receiving any citations

***Table 2**: The Determinants of Patents Per Capita, Averaged over the Period 1990-1999, Fixed Effects Model (source: Carlino et al., 2001)*

	(1)	(2)
1989 employment	0.2985***	0.3368***
Urbanized area MSA Employment Density	0.3058***	
Urbanized area Central City County Employment Density		0.2056***
University R&D Spending	-0.0086	-0.0102
Percent of Firms with 1,000 or more employees	202.1**	227.9***
Percent Mfg.	3.66***	4.12***
Percent College Educated	6.63***	6.60***
Herfindahl Index	1.4785	1.8249
Firms per Employee	0.5298	0.5654
Employment Growth 1979-89	0.1018	0.1253
Far West	0.1060	0.1130
Great Lakes	0.5431***	0.5198***
Mideast	0.3782**	0.4381**
New England	0.2545	0.2571
Plains	0.1153	0.1124
Rocky Mountain	0.3505	0.3433
South West	-0.0958	-0.1609
Constant	-13.8***	-13.1***
No. of observations	270	257

R^2	0.6138	0.6169

***Table 3**: City-Industry Wage Growth Between 1965 and 1987 (source: Glaeser et al., 1992)*

Variable	**Log (wage in 1987/wage in 1956) in the city-industry**			
	(1)	(2)	(3)	(4)
Constant	0.332 (5.090)	0.379 (5.886)	0.398 (5.767)	0.440 (6.477)
Log (U.S. wage in 1987/U.S. wage in 1956) in the industry outside the city	0.961 (22.400)	0.975 (23.214)	0.959 (22.457)	0.973 (23.210)
Wage in the city-industry in 1956	-0.270 (-9.835)	-0.270 (-10.080)	-0.266 (-9.733)	-0.267 (-9.973)
Employment in the city-industry in 1956—in millions	1.025 (3.794)	1.111 (4.179)	0.849 (3.075)	0.938 (3.461)
Dummy variable indicating presence in the South	0.0175 (1.353)	0.0161 (1.271)	0.0094 (0.713)	0.00853 (0.660)
City-industry's share of city employment relative to industry's share of U.S. employment in 1956	0.00053 (0.739)	. (.)	. (.)	-0.000233 (-0.326)
Establishments per employee in the city-industry relative to establishments per employee in the U.S. industry in 1956	. (.)	-0.0850 (-6.164)	. (.)	-0.0845 (-6.057)
City's other top five industries' share of 1956 city employment	. (.)	. (.)	-0.172 (-2.732)	-0.161 (-2.732)
Adjusted R^2	0.3832	0.4099	0.3889	0.4139
Number of observations	833	833	833	833

***Table 4**: Poisson Regression Estimation Results (source: Audretsch and Feldman, 1999)*

	Model 1	**Model 2**	**Model 3**	**Model 4**
Industry Specialization	-0.209 (-8.360)	-0.334 (-14.522)	-0.527 (-17.684)	-0.142 (-5.680)
Science-Based Related Industries	0.168 (3.812)	0.104 (2.122)	0.089 (2.405)	0.069 (2.091)
Localized Competition	-0.175 (-3.365)	0.576 (7.481)	0.221 (0.269)	0.168 (1.976)
City Scale		1.044 (28.216)		1.004 (20.917)
Technological Opportunity			0.079 (26.333)	0.034 (1.700)
n	5946	5946	5946	5946
Log-likelihood	-1296.793	-901.489	-693.046	-652.264

*Note: The t-values of the coefficient is listed in parentheses

Table 5*: Regression results at Metropolitan Statistical Areas (MSAs) / Primary Metropolitan Statistical Areas (PMSAs) (source: Lee et al., 2004)*

	Firm birth per 1 million people (1997-1998)		
	All industries	**Manufacturing Industries**	**Service Industries**
Creativity Index	476.595 (3.30)***	50.421 (5.09)***	166.095 (2.85)***
Diversity Index	52.158 (1.28)	0.940 (0.34)	32.763 (1.99)**
Melting Pot Index	503.671 (0.85)	-5.545 (0.14)	287.801 (1.20)
Human Capital	1651.893 (2.01)**	-236.561 (4.20)***	1161.862 (3.51)***
Population (1990)	-0.000 (0.01)	0.000 (0.67)	0.000 (0.69)
Income growth rate (1990-1996)	0.102 (2.54)**	0.004 (1.51)	0.042 (2.59)**
Patents per 100,000 people (1995)	-0.091 (0.43)	0.056 (3.86)***	0.048 (0.56)
Population growth rate (1990-1996)	3374.308 (5.81)***	94.757 (2.38)**	1354.182 (5.77)***
Constant	1264.370 (9.53)***	67.006 (7.36)***	293.348 (5.47)***
Observation	236	236	236
R^2	0.41	0.25	0.50
Beta-coefficients			
Creativity Index	0.262***	0.454***	0.207***
Diversity Index	0.083	0.024	0.118**
Melting Pot Index	0.054	-0.010	0.070
Human Capital	0.161**	-0.377***	0.256***
Population (1990)	-0.001	0.046	0.039
Income growth rate (1990-1996)	0.151**	0.100	0.141**
Patents per 100,000 people (1995)	-0.027	0.269***	0.032
Population growth rate (1990-1996)	0.316***	0.145**	0.187***
Constant	1.895	1.643***	0.996***

*Notes: Absolute value of the t-statistics is in parentheses
Significant at *10%, **5%, ***1%

***Figure 1**: Correlation Between Log of Patents per Capita and Log of Local Employment Density, using measure (1) (source: Carlino et al., 2001)*

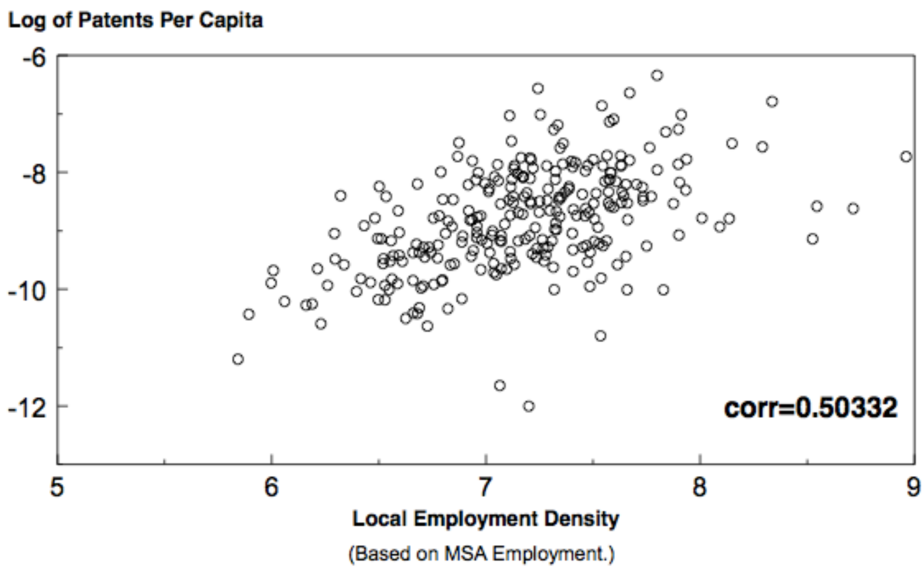


***Figure 2**: Correlation Between Log of Patents per Capita and Log of Local Employment Density, using measure (2) (source: Carlino et al., 2001)*

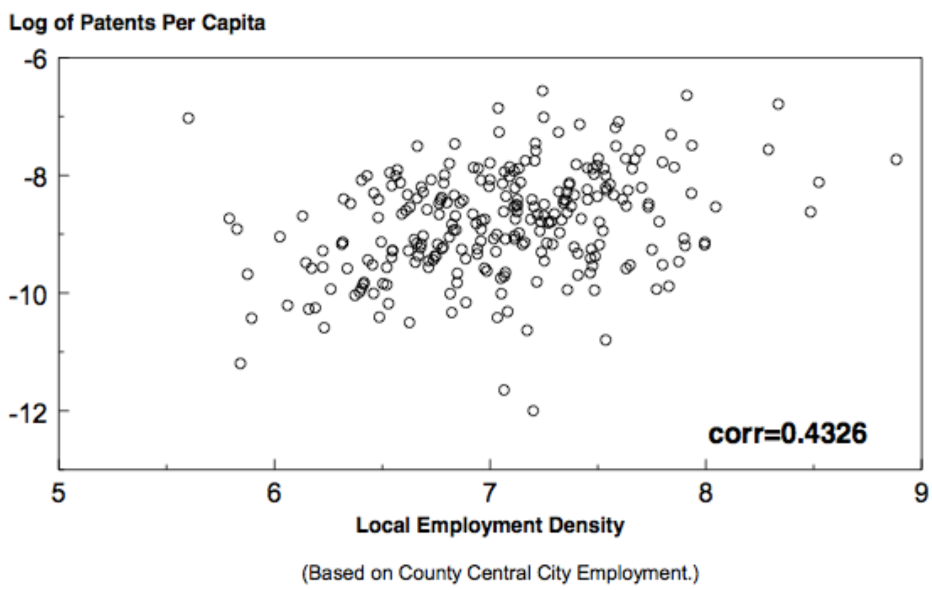


__Figure 3__: Correlation Between Metropolitan Patents and Population (331 MSAs) in 1980, 1990, and 2000 (source: Strumsky et al., 2005)

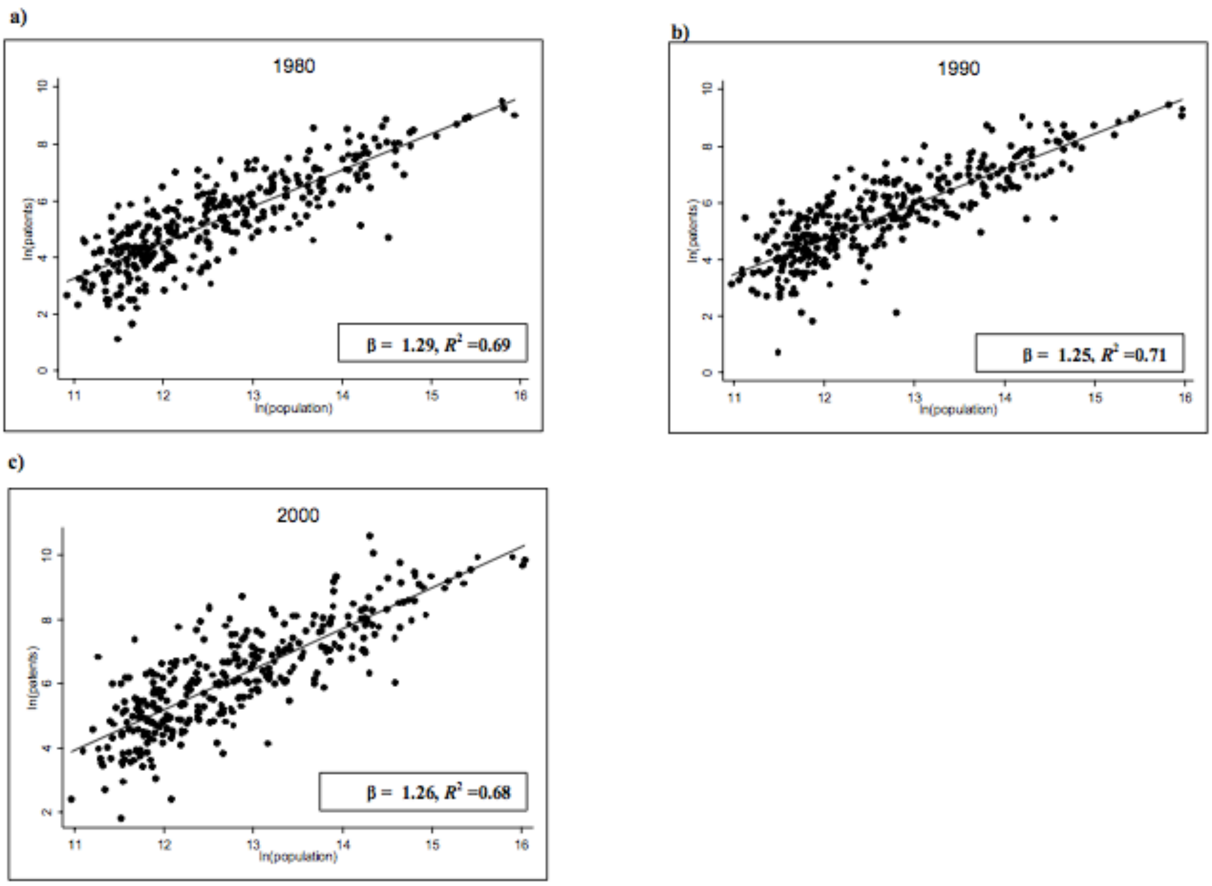
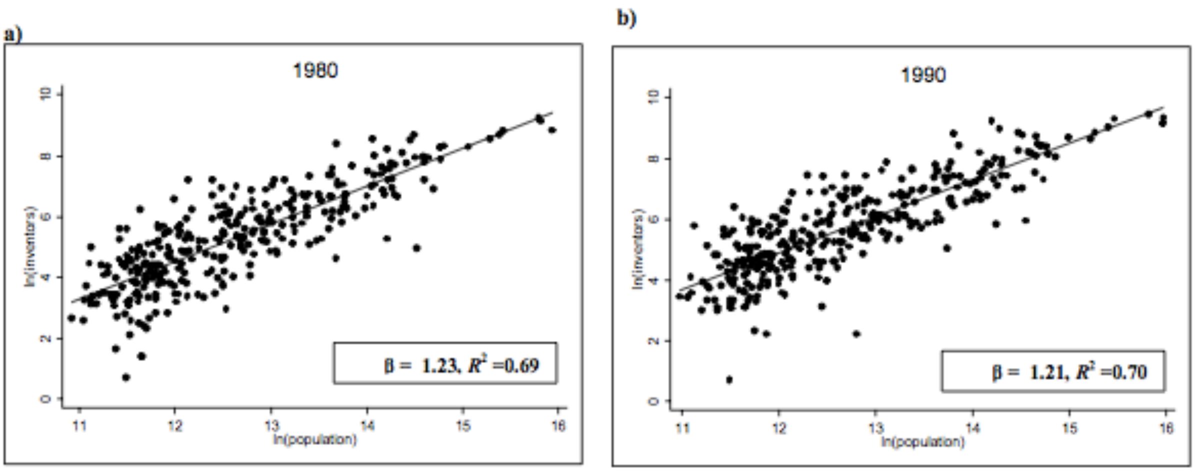


__Figure 4__: Correlation Between Metropolitan Inventors and Population (331 MSAs) 1980, 1990, and 2000 (source: Strumsky et al., 2005)



c)

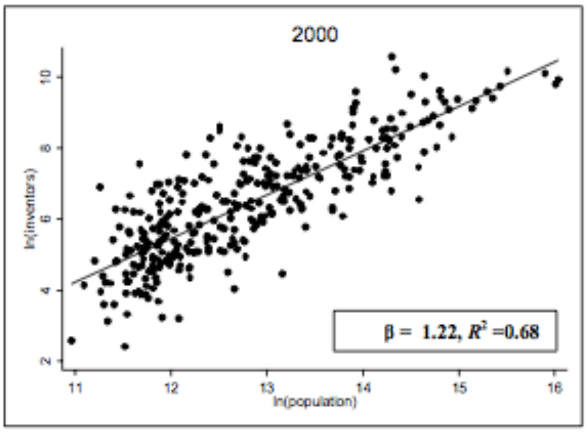


Figure 5*: Correlation Between Metropolitan Inventors and Patent (331 MSAs) 1980, 1990, and 2000 (source: Strumsky et al., 2005)*

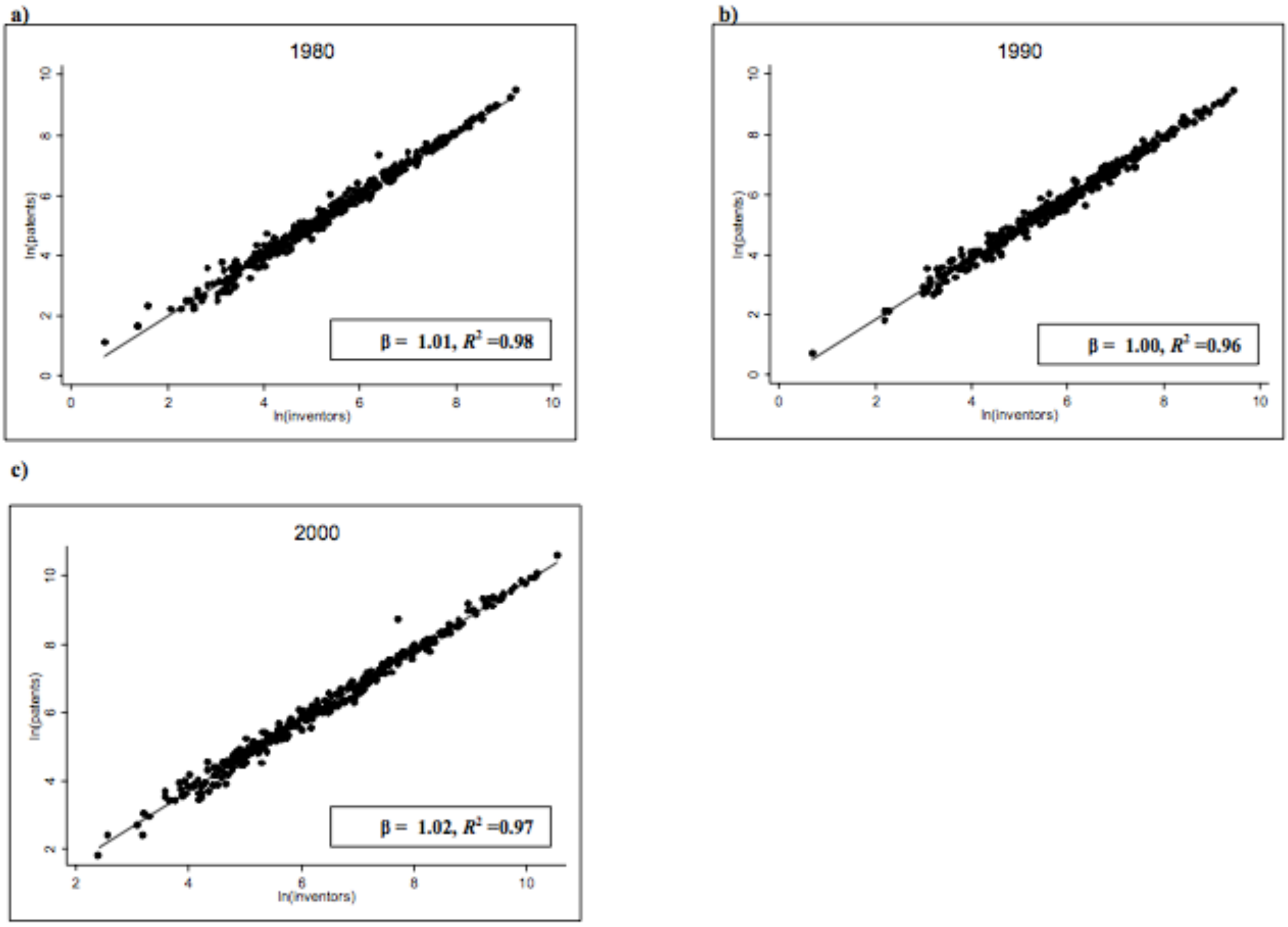


Figure 6: *Relationship between Patenting and Start-Up Rates in Developed and Less-Developed Countries as Indicated by GDP (source: Anokhin and Wincent, 2011)*