Jacobs' Externalities: Where We Have Been and Where We Might Go in Studying How Urbanization Externalities Affect Innovation

Innovation is key to firms' sustainable competitive advantage. When deciding where to locate the firms' innovation activities, managers must consider the locational factors that affect firms' innovation performance. Understanding what the most important factors are and how they come into play is important. Existing literature on agglomeration and clusters emphasizes one important factor: externalities. Externalities originate from the co-location of firms and relevant institutions. Organizations are like leaking containers whose resources constantly spill over to their immediate environment. The spillovers can be information, knowledge, talent, customers, etc. As a result, co-located firms spontaneously create common goods shared by all neighbors. The existence of externalities means when deciding where to locate their firms, managers must pay attention to their neighbors.

Depending on the nature of externalities, researchers have differentiated two kinds of externalities (Gleaser et al., 1992). One is the Marshall-Arrow-Romer externalities, or the MAR externalities. The MAR externalities root its theoretical foundation in the works of Alfred Marshall (1890), Kenneth Arrow (1962), and Paul Romer (1986). In his seminal book ***Principles of Economics*** (Book IV, Chapter X), Marshall's (1890) listed four forces that drive agglomeration: 1. Access to natural resources and transportation; 2. Labor pooling; 3. Knowledge spillover; 4. Share of middle suppliers. Aside from access to resources and transportation, all three other forces are externalities endogenously generated by lo-located firms. Marshall's externalities are complemented later by Arrow (1962) and Romer (1986), both of whom emphasize the role of knowledge in fostering endogenous growth. Arrow (1962) points

out that because most learning happen in the process of doing, new technologies often emerge from accumulated knowledge base. Similarly, Romer (1986) assumes knowledge has increasing returns (because of spillover) and proposes an endogenous long-run growth model. Because of its power in explaining agglomeration phenomena, the MAR externalities are further studied by many other researchers such as Porter (1990), Krugman (1991a, b) and Saxenian (1994).

The other kind of externalities is Jacobs' externalities. In contrast to the MAR externalities which are generated by firms in the ***same*** industry, Jacobs' externalities refer to externalities generated by firms in ***different*** industries. Jane Jacobs believes knowledge spillovers across industries are the most important source of innovation, and that economic diversity is a key to urban prosperity (Jacobs, 1969). The rationale is diversity enables the cross-fertilization of ideas. In addition, diversity offers local labor force a broader mix of skills to working with new technologies.

An intriguing question to management scholars is whether Jacobs' externalities have practical implications to managers. Most researchers studying Jacobs' externalities share a primary interest in urban prosperity and growth issues (Beaudry & Schiffauerova, 2009; Fujita, Krugman, & Venables, 1999; Fujita & Thisse, 2002) and the investigations often stay at the industry level. Much fewer researches have been done to investigate the micro foundations of Jacobs' externalities, i.e. how the forces function at the firm level. However, if we can observe Jacobs' externalities at the urban economies level, we should be able to observe them at the firm level as well and see how they affect certain activities of firms. Yet we know very little about what is going on when zooming in to look at how individual firms are affected.

Despite of the relatively sparse knowledge we have on the micro foundations of Jacobs' externalities, some pioneering studies have cast some light on the topic. Among them is a study

by Duranton and Puga (2001). By observing the relocation of French manufacturing and business services firms, Duranton and Puga (2001) find a significant amount of firms in innovative industries have relocated from diversified metro areas to more specialized metro areas over time. They interpret the phenomenon as firms exploiting different agglomeration externalities at different stages of the products' life-cycle. In the firms' product innovation stage, firms benefit more from locating in diverse metro areas as diversity offers richer opportunities to experiment and lower searching costs. As production becomes standardized, however, firms have the incentive to relocate to smaller, more specialized metro areas to reduce inefficiency and lower production costs. Van der Panne and van Beers (2006) find contradictory evidence in their study of firms in the Netherlands. They find that firms in Jacobian regions are more successful than firms in Marshallian regions in commercialization, while firms in Marshallian regions are more successful than firms in Jacobian regions in product development.

From the pioneering studies on the micro foundations of Jacobs' externalities we can see Jacobs' externalities seem to benefit certain firm activities more than others. But what activities benefit more is far from clear. Moreover, preliminary findings are observatory in nature. The mechanisms through which Jacobs' externalities function are not fully examined. Generally speaking, existing literature that covers Jacobs' externalities lacks attention to "how." Many researches focus on isolating and comparing the effects of MAR externalities and Jacobs' externalities, while the underlying processes through which the forces function remain largely unexplored (Desrochers and Leppala 2011; Beaudry and Schiffauerova, 2009). The problem is, without thoroughly understanding how the forces function, the indicators we choose may risk to be irrelevant and the conclusions we draw risk to be biased.

The purpose of this paper is to examine where we have been in studying Jacobs' externalities and discuss where we may go further down the path, and whether there is a need to adjust our direction. The following two sections provide a brief review on existing literature on Jacobs' externalities and discuss some major challenges. The next section specifies important unanswered questions for future researches to consider.

Prior Literature

As there are different dimensions in firm performance, existing studies on Jacobs' externalities use a variety of indicators to measure performance. For the purpose of this study, the following review focuses on studies that concern innovation performance primarily. This focus on innovation is consistent with the theoretical origin of Jacobs' externalities, as Jacobs believes the primary benefit of diversity is it fosters innovation (Jacobs, 1969).

Table 1: Empirical Studies on Jacobs' Externalities and Innovation

Study	**Industry**	**Time Frame**	**Level of Analysis**	**Innovation Measures**	**Indicators of Jacobs' Externalities**	**Geographic Unit of Analysis**	**Summary of Relevant Findings**
Henderson (1986)	Multiple U.S. and Brazilian industries	1970	Industries	Productivity	Urban population, total employment	MSAs, urban areas	Find no support for urbanization economies
Gleaser et al. (1992)	The largest six industries within a given MSA in the U.S.	1956-1987	Industries	Employment growth[1]	Employment in other industries	MSA	Diversity and competition encourage employment growth

[1] This study does not investigate innovation directly but focuses on employment growth. Here I treat employment growth as part of the result of innovation.

Audresch & Feldman (1996)	Miscellaneous U.S. manufacturing industries	1982	Industries	Documented commercial innovation	none	states	Industries for which knowledge spillovers are particularly important have a higher tendency to cluster
Harrison, Kelly, & Gant (1996)	U.S. manufacturing	1987	Firms	Likelihood to adopt new technology	Metro area size and centrality	counties	Firms located near large metro areas have the highest likelihood to adopt new technologies
Baptista & Swann (1998)	UK manufacturing	1975-1982	Firms	Direct innovation counts based on a pre-defined innovation database (SPRU)	Employment in other industries	U.K. standard regions	Strong employment in other sectors does not appear to be significant in affecting innovation
Baptista (2000)	CNC machine tools and microprocessors	1981	Firms	Time to adopt a new technology recorded by UK CSO technology adoption survey	none	U.K. standard regions	Regional learning effect is mediated by stock of earlier adopters
Duranton & Puga (2001)	French manufacturing and business services	1993-1996	Firms	Relocation from diversified to specialized areas	Inverse of a Herfindahl index (employment diversity)	France employment areas	Firms learning about the production process benefit from locating in large, diverse metro areas; however, for standardized production, firms benefit more from locating in smaller, specialized metro areas

Beaudry & Breschi (2003)	UK and Italian manufacturing industries	1990-1998	Firms	Number of patents	Employment in other industries	UK counties and Italian provinces	Preliminary results seem to indicate strong presence of firms in other related industries lead to more patenting
Henderson (2003)	U.S. high tech and machinery industry	1972-1992	Firms	Productivity	Number of plants in other industries	MSAs	Count of other own industry plants increases the productivity of high-tech but not machinery industries. Find little effect of diversity on productivity
van der Panne and van Beers (2006)	Miscellaneous Dutch industries	2000-2002	Firms	Innovation counts	The complement of the Gini coefficient	Postal areas	Firms in Jacobian regions are more successful than firms in Marshallian regions in commercialization, while firms in Marshallian regions are more successful than firms in Jacobian regions in product development
Desrochers & Leppala (2011)	NA	NA	Individual inventors	Innovation counts	Qualitative	NA	Qualitative survey of Canadian inventors

Challenges

Industry or Activity. Recent studies on agglomeration show economic activities agglomerate not by sector but by function (Duranton and Puga, 2005). Yet because in reality data often comes in packages organized by industries, many studies on Jacobs' externalities have used industries as the channel of observation and have not dug deeper to explore how the externalities affect specific firm activities. Audresch and Feldman (1996) find that innovative activities tend to cluster spatially, even after controlling for the agglomeration of production. Duranton and Puga (2001), van der Panne and van Beers (2006) find different activities of firms in the same industry benefit differently from different agglomeration externalities. That means when choosing the channel to observe the effects of Jacobs' externalities, it should make a difference between choosing an industry and choosing a set of activities. Few research by far has addressed this issue well.

Industry scope. One tricky conceptual problem in studying Jacobs' externalities is how to define "diverse." Essentially, diversity depends on the standard researchers use to group industries or activities. Two industries can be identified as the same or similar using one standard, or they can be identified as different using another standard. The conceptual trick perhaps explains most of the ramifications in findings using two, three, and four-digit SIC codes (Ellison and Gleaser, 1997). In addition, defining relevant industries is challenging (Rosenthal and Strange, 2004). Standard industry classification may not be accurate. Ellison and Gleaser (1997) try to address the issue by analyzing product components. But most studies have not taken similar measures but instead adopted restrictive treatments of industrial scope (Rosenthal and Strange, 2004). Failing to adopt a flexible industrial scope may be a major limitation for studies on Jacobs' externalities, as the theory essentially deals with the cross-fertilization of ideas

and products across industries. A side effect of failing to consider industrial distance is using coarse measurements for diversity. Many studies use employment in other sectors or Gini index to proximate diversity. The measurements are too coarse to draw insightful conclusions.

Geographic scale. As Marshall (1890) and Krugman (1991b) argue, knowledge spillovers are confined to certain geographic boundaries. Jaffe et al. (1993) find knowledge spillovers tend to fade out over distance in their observation on patent citations. Rosenthal and Strange (2003) find proxies for knowledge spillovers (the number of new products) positively affect agglomeration at the zip code scale, but not significant at the county or state scale. Rosenthal and Strange (2003) find agglomeration affect employment much more within the 1-mile radius distance than the 5-mile radius distance, and there is virtually no effect at the 15-mile radius distance at all. Although those studies do not target Jacobs' externalities and innovation directly, the findings seem to indicate that certain externalities function at finer scales. Given the fact that existing researches investigating Jacobs' externalities have mostly focused on the MSA or county scale, it would be of interest to zoom in and conduct the investigation at finer scales.

Unanswered Questions

Jacobs' externalities and the evolution of firms. Because many studies are confined to industry boundaries, how externalities affect the evolution of industries and firms is virtually unknown. However, we should take into consideration that firms are constantly evolving with the environment, as Nelson and Winter (1982) point out firms are constantly searching for new routines. Some routine innovations are local, while others are distant. Distant routine innovations could mean the firm has ventured into some new businesses. It is therefore biased to view the

nature of a firm's businesses as static. The evolutionary point of view is supported by evidences documented in Chandler's (1962) seminal book. For research on Jacobs' externalities, the evolution of firms is theoretically interesting, as the theory emphasizes knowledge spillovers across industries and how the spillovers foster the development of new industries. Consistent with Jacobs' theory, Marshall (1890), Brezis et al. (1993) and Porter (1990) point out that highly specialized regions face higher risks of technological locked in. For future studies on Jacobs' externalities, it would be of great interest to investigate how diversity affects the evolutionary path of firms and fosters the development of new industries.

Jacobs' externalities and entrepreneurship and radical innovation. Similar to the arguments above, how diversity affects entrepreneurship opportunities is another question of interest. If diversity is indeed as predicted a source of creativity, the spaces between industries should be the cradle for new opportunities. Whether diversity nurtures more new opportunities and how entrepreneurs exploit the opportunities are questions of interest to researchers interested in geography and entrepreneurship. Following Joseph Schumpeter (1934), researchers differentiate two kinds of innovation: progressive innovation and radical innovation (Brezis, Krugman & Tsiddon, 1993; Anderson & Tushman, 1990). According to Jacobs' prediction, firms in diversified regions should have a better chance to generate radical innovation. Whether radical innovations are more likely to happen in diversified regions and what specific conditions are required to channel the process are little explored.

Demand-side externalities. To date, the majority of studies have investigated the supply-side externalities only. The rationale is that supply-side externalities are most pertinent to production. However, with businesses increasingly integrate user participatory design in their production process, proximity to customers might be important to innovation (Feldman, 1994;

van der Panne and van Beers, 2006). It is therefore important to reconsider the role of demand-side externalities in affecting innovation.

References

Arrow, K. J. 1962. The economic implications of learning by doing. *Review of Economic Studies*, 29: 155–173.

Anderson, P., Tushman, M. 1990. Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative Science Quarterly, 35*(4): 604-633.

Audretsch, D. B., Feldman, M. P. 1996. R&D spillovers and the geography of innovation and production. *American Economic Review,* 86(3): 630-640.

Baptista, R., Swann, P. 1998. Do firms in clusters innovate more? *Research Policy,* 27: 525–540.

Baptista, R. 2000. Do innovations diffuse faster within geographical clusters? *International Journal of Industrial Organization, 18*(3): 515–535.

Beaudry, C., Breschi, S. 2003. Are firms in clusters really more innovative? *Economics of Innovation and New Technology,* 12: 325–342.

Beaudry, C., Schiffauerova, A. 2009. Who's right, Marshall or Jacobs? The localization versus urbanization debate. *Research Policy,* 38: 318–337.

Brezis, E., Krugman, P., Tsiddon, D. 1993. Leapfrogging in international competition: a theory of cycles in national technological leadership. *The American Economic Review, 83*(5): 1211-1219.

Chandler, A.D. 1962. *Strategy and structure: Chapters in the history of the industrial enterprise*. Cambridge: M.I.T. Press

Desrochers, P., Leppala, S. 2011. Opening up the "Jacobs Spillovers" black box: local diversity, creativity and the processes underlying new combinations. *Journal of Economic Geography,* 11(5): 843–863

Duranton, G., Puga, D. 2001. "Nursery cities: urban diversity, process innovation, and the life-cycle of products". *American Economic Review,* 91(5): 1454-1477.

Duranton, G., Puga, D. 2005. From sectorial to functional urban specialization. *Journal of Urban Economics, 57*(2): 343–370.

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Ellison, G., Glaeser, E. 1997. Geographic concentration in U.S. manufacturing industries: a dartboard approach". *Journal of Political Economy,* 105: 889-927.

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., Shleifer, A. 1992. Growth in cities. *The Journal of Political Economy*, 100: 1126–1152.

Harrison, B., Kelley, M. R., Gant, J. 1996. Specialization versus diversity in local economies: the implications for innovative private-sector behavior. *Cityscape*, 2(2): 61–93.

Henderson, J. V. 1986. Efficiency of resource usage and city size. *Journal of Urban Economics,* 19: 47-70.

Henderson, J.V. 2003. Marshall's scale economies. *Journal of Urban Economics,* 53: 1-28.

Jaffe, A. B., Trajtenberg, M., Henderson, R. 1993. Geographic localization of knowledge spillovers as evidenced by patent citations. Quarterly Journal of Economics 108, 577–598.

Jacobs, J., 1969. *The Economies of Cities*. New York: Random House.

Krugman, Paul, 1991a. *Geography and Trade*. Cambridge, Mass.: MIT Press.

Krugman, Paul, 1991b. Increasing returns and economic geography. *Journal of Political Economy* 99, 483-492.

Marshall, A. 1890. Principles of Economics, 8th edn. London: MacMillan. Available online at: http://www.econlib.org/library/Marshall/marP.html

Winter, S. G., Nelson, R. R. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, Mass.: Harvard University Press

Porter, M., 1990. *The Competitive Advantage of Nations*. London: Macmillan.

Breschi, S., Lissoni, F. 2001. Knowledge spillovers and local innovation systems: a critical survey. *Industrial and Corporate Change*, 10: 975–1005.

Romer, P. M. 1986. Increasing returns and long-run growth. *Journal of Political Economy*, 94: 1002–1037.

Rosenthal, S., Strange, W., 2003. Geography, industrial organization, and agglomeration. The Review of Economics and Statistics 85, 377–393.

Rosenthal, S. S., Strange, W. C. 2004. Evidence on the nature and sources of agglomeration economies. In J. V. Henderson, J.-F. Thisse (eds) *Handbook of Regional and Urban Economics,* Vol. 4, pp. 2119–2171. Amsterdam: Elsevier.

Saxenian, A., 1994. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge, Mass.: Harvard University Press.

Schumpeter, J.A. 1934. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Transaction publishers.

Van der Panne, G., van Beers, G. 2006. On the Marshall–Jacobs controversy: it takes two to tango. *Corp Change*, 15(5): 877-890.