The Internet Revolution and the Geography of Innovation

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Abstract: How will the Internet and related digital technology affect the tendency for innovation activity to cluster geographically? This article argues that innovation has characteristics that make it unique from other types of economic activities. At a fundamental level, innovation is a non-routine social process that involves the creative deployment of knowledge. By examining the individual, the social and the geographic dimensions of innovation, the article concludes that while the Internet, while offering advantages in access to information, will not disrupt the geographic advantages associated with concentrations of resources, face-to-face interactions and serendipity or chance occurrences.

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Introduction

History has witnessed the search for ways to transmit information over distance greater than range of the human voice, at lower cost and with improved accuracy. Beginning perhaps with the advent of the written word and continuing with the invention of the printing press, information and communication technologies (ICT) have changed in rapid succession, from the telegraph, radio, telephone, fax and most recently the Internet. While previously individuals had to be face to face to communicate, technology makes it possible to exchange information at great distance, and enables the transmission, storage and access of more advanced and complex context. The result is a decrease in the cost of communication and correspondingly, economic relationships become easier to negotiate across geographic space. Geographically disparate activities may more easily be connected. Geographic separation no longer implies information depravation.

The Internet, and more general digital information technologies, promise broad-based changes to the organization of economic activity that are so profound to warrant the title of revolution. Information may be more easily collected, stored, processed, accessed, communicated and used. The falling cost of communication is expected to lead to increased traffic, greater information access, personal autonomy in location decisions and ultimately, greater dispersion of economic activity. The impacts of the Internet will be different across diverse industries and various types of economic activities.

This article focuses on the location of innovation, a particularly knowledge-intensive economic activity. The tendency for innovative activity to cluster spatially is well known and identified with places such as Silicon Valley, Research Triangle Park, Route 128 in Boston in the United States, Wireless Valley in Finland, Oxbridge in England, and Singapore, among others. Economists have been studying this phenomenon since Marshall (1890) and more recently, have considered the reasons why high rent and high wage places such as New York, San Francisco, London, Paris and other prominent cities

continue to grow and provide a preferred address (Feldman 2000 provides a literature review). There are few empirical studies, to date, which examine how ICT will affect the locational patterns of economic activity. The objective of this article is to provide a framework to consider how the Internet may affect the location of innovative activity, specifically if innovation will become more geographically disperse because of the Internet and related digital technologies. To begin, the next section considers what we know about the impact of the Internet to date. The Internet has facilitated information exchange and resulted in management efficiency and greater consumer choice. The productivity impacts have been profound and promise to continue, but by in large, routine economic activities have benefited.

What is different about innovation, by contrast, is that it relies on knowledge creation and deployment. Innovation, at a fundamental level, is a social process that bridges individuals from different disciplines with different competencies, distinct vocabularies, and unique motives. Innovation involves creativity and is a cognitive process for individuals. The Internet provides tools that allow individuals to access information easily and certainly aids innovative activity yet factors such as the tacit nature of knowledge and the social nature of the innovation process limit the impact of the Internet. Geography provides a platform for organizing individuals and resources and for containing the positive externalities associated with knowledge creation. Thus, three levels of analysis will condition the impact of the Internet on innovation: the individual, the social dimension and the geographic.

Understanding the Internet Revolution

We live in an age of easy global communications, instantaneous information access, and the ability to store, search and manipulate large amounts of information. According to the United States Bureau of Labour Statistics, the Information and Communications Technologies (ICT) sector became the largest commercial sector in the U.S. in 1999, with a rate of employment growth that was six times the national average. Alan Greenspan, Chairman of the United States Federal Reserve, estimates that the growth of business in ICT contributed at least one-third of the total growth of the United States' economy since 1992. The ITC sector represents a variety of devices, technologies and services built on

scientific breakthroughs in computers, software design, photo-optics, circuit switching, and satellites, among others. The most visible representation of the ITC Revolution is the Internet, which integrates telecommunications and computing.

What is most profound is the accelerating rate of acceptance of ITC technologies. Radio was in existence for 38 years before it achieved a market of 50 million. It took 16 years from the release of the first personal computer kit in 1973 to the point where there were 50 million users. Once the Internet was open to commercial traffic in 1993, it took four years to reach this point. One specific application, Napster, a protocol for transferring music files, registered 25 million users within one year of its introduction.

The Internet allows anyone with a small capital investment in a computer and access to a server to connect to other computers all over the world in an interconnected web of machines, data and people. Estimates are that 320 million people will be using the World Wide Web by 2002 (Lange 1999:35). The number of messages sent via email is currently about 6.5 billion per day worldwide and growth will be exponential as more users come on-line. In addition, the technology is going wireless; further decreasing the costs of being connected and potentially bringing more people into the digital world.

Digital information is compact, transportable, and, therefore, more efficient to use. Economists note that information is costly to create but once it exists the costs of reproducing information is significantly lower. With new digital media, the cost to reproduce and transmit information approaches zero. Multiple copies can easily be made and it is difficult to control dissemination and access. This contrasts to the physical goods that economists typically consider. The ease of transmitting information raises a set of issues about intellectual property protection and fair use and concerns about privacy, unauthorized access and data piracy.

Few empirical studies, to date, analyse the ways in which business uses the Internet. Litan and Rivlin (2001) consider the impact of the Internet on different sectors and cite three distinct economic impacts: decreasing the cost of transactions; increasing the ease of management; and, moving the economy closer to the model of perfect competition. The greatest impact of the Internet has been to decrease the cost of transactions. Faster than conventional post, more accurate than telephone, Internet commerce is predicated

upon the rapid exchange and eased coordination of transactional information between firms and their suppliers and customers. From the perspective of business, the Internet facilitates lower purchasing costs, reductions in inventories, lower cycle times and allows for lower sales and marketing costs and more efficient and effective targeting of customer services and sales materials. From the perspective of consumers, the Internet allows for greater choice, convenience and the potential for increased customisation. Second, the Internet allows for more efficient management by increasing the ease of information access, searching and sharing. When information is available in a digital form it is easier to use than in the alternative paper form. This has greatly reduced costs for business in terms of their routine internal record keeping, inventory control and the costs of processing transactions. Finally, the Internet moves the economy closer to the economist's ideal model of perfect competition, which implies greater efficiencies. It is easier for suppliers and consumers to find information about one another, search for alternatives and complete transactions. This direct access reduces the need of middlemen and distributional intermediaries. Better information, greater choice and lower operating and transaction costs are expected to drive reductions in prices or improvements in quality. In sum, these three factors are expected to contribute .2-.4% per annum in future productivity growth to the U.S. economy. In addition, the Internet and power of digital distribution may lead to new products and services not previously imagined, offering further increases in economic growth (Economist 2000).

The economic impacts of the Internet are profound but they pertain to routine economic activities that rely on information flows with well-defined parameters and using relatively standardized content. Innovation, by contrast, is a special type of non-routine activity and we may expect the Internet to have a different impact.

Innovation, Knowledge and Information

To begin, it is useful to define how scholars conceptualise innovation, an overused words in modern dialogue. Innovation is a specific type of economic activity that is concerned with the development of products, processes or organizational methods that create novelty–the stroke of human genesis that produces originality and uniqueness. Innovation is typically associated with commercial applications and we draw a distinction

between invention, the original idea and innovation as its commercial realization. Not all inventive activity has commercial application, although invention is certainly a part of innovation.

The most decisive input for innovation is knowledge. While information is the flow of data, knowledge is a stock of information that is organized into a conceptual schema. Innovation is the ability to blend and weave different types of knowledge into something new, different and unprecedented that has economic value. Similar to art, innovation is a creative expression. However, unlike art, the measure of innovation is not in the eye of the beholder, but in acceptance within the marketplace that brings commercial rewards to the innovating entities and returns to society in terms of economic well being, prosperity and growth.

The Nature of the Innovation Process

While information may easily transmit across great distances, translating information into useable knowledge is a more complex, cognitive process. Information refers to knowing something, a piece of data. Knowledge exists when an individual understands what to do with the information, what it implies, what its limitations are and how to create value from it. Consider the simple case of a weather report, a piece of information. Understanding what to wear and whether to carry an umbrella requires knowledge. For activity that is familiar, anyone with the required knowledge understands how to use the information and it is easy to transmit information in such as way that it will be useable. This is the case of a standardized or routine activity.

Innovation, by contrast involves new activity and there is great uncertainty about the application of information. Consider the case of a new discovery. A scientist working in a lab may come up with something unprecedented–the classic EUREKA! moment. At this early stage, there may not even be a lexicon or vocabulary to communicate key concepts. At the most basic level, innovation and creativity take place within the individual mind and rely on the synthesis and interpretation of information into existing ways of looking at the world or cognitive schemata.

All problem-solving activity uses cognitive models to evaluate what information is valuable and how to organize the information usefully. The process of understanding and making sense of new information requires the translation of new information into something that resonates with the individual and involves repeated questioning, the use of analogies, and an understanding of context. This is a complex process of trial and error, feedback, and evaluation facilitated by face-to-face interaction. Innovation, as both a cognitive and social process requires these types of complex reciprocal interactions that result in negotiations, clarifications and re-conceptualizations as an idea moves to become an innovation.

As individuals work on a problem they develop a shared language and common frames of reference. As a result, it becomes possible to assimilate new information into these cognitive structures and for individuals to effectively accumulate knowledge that facilitates innovation. When knowledge is tacit or uncertain much information is communicated in gestures, facial expression, and tone of voice. Such subtleties provide important clues in the search for meaning and context and favors direct face-to-face interaction. At the point when knowledge may be codified it is more easily transferred to others in a variety of media. Among economic activities location matters most for innovative activity, which by its nature is creative and relies on tacit knowledge. The greatest tendency towards geographic cluster is in new industries, at the earliest stages of their lifecycle. Once activities become standardized and more routine we see a pronounced tendency for industries to be less geographically concentrated.

The Internet will certainly aid innovative activity. Being able to search and easily access large amounts of information are valuable to creative work. While videoconferencing and web content get more sophisticated all the time, it is just not the same as being there. Anyone who has ever been on the Internet knows the joys of having new things suggested to you in the style of a personal assistant as well as the frustration of not being able to get the information that you want. At the basic level Internet information is provided by the web page, an HTML (hypertext markup language) file and any related files for scripts and graphics that are often hyperlinked to other documents on the Web and browsers and search engines. Content provided on the web page, the media for the Internet information sharing ii fairly standardized and must be organized and prioritised.

The technical design and support team in posting a web page makes value judgements about the user's priorities, requirements, and frame of reference interpretation. The essential elements of dialogue appear to be compromised. For example, the web designers decide what hotlinks to provide and inquiry is limited to what the web designers identify as issues. Most websites will have frequently asked questions (FAQs) as a mechanism to help individuals use and interpret information. FAQs are a means of providing answers to anticipated questions or reoccurring inquiries. Users are asked to browse FAQS before submitting a question via email or phone contact. FAQS require the distillation of questions about user inquiry and the standardization of questions and response. This requires the programmer or systems analyst to characterize the user and how the information will be used. Certainly, with a routine transaction such as checking movie times or making a purchase this is straightforward. But more tacit knowledge, such as the solution to a complex problem, or advice about how to define a problem has a higher degree of uncertainty. In this case, precise meaning is more difficult to convey, requires interpretation and elucidation and, thus, is difficult to convey in any standardized medium. When knowledge is highly tacit in nature, face-to-face interaction and communication are important to transmit knowledge and geographic proximity may promote the transmission of knowledge. The less codified and the more difficult it is articulate the knowledge, the greater the need for frequent face-to-face meetings and the greater the resulting degree of centralization in geographic organization.

As the technology gets more sophisticated more content may be embedded but there are limitations that give the advantage to direct human interaction. Web designers use an interface that is characterized by the phrase *What You See Is What You Get (WYSIWYG).* This describes any commonly used design protocol or user interface that does not require intricate code and obscure commands. It is useful as it increases the number of individuals who can post web pages but as with any standardization it comes with a cost. The worst case is described as *What You See Is All You Get (WUSIAYG)*, a dumbed-down version that lacks depth and flexibility. In order to appeal to mass markets, content must have broad-based appeal which means targeting to the lowest common denominator. The high quality of content that is a legacy of the initial university-based and scientific users is likely to dissipate with greater commercial presence on the Internet.

Innovation as a Localized Social Process

Innovation, rather than the result of the efforts of an individual inventor, is most likely predicated on the orchestration of different and complementary streams of knowledge. In studying the networks in California's Silicon Valley, Saxenian (1990, pp. 96-97) emphasized that it is the communication between individuals that facilitates the transmission of knowledge across agents, firms and even industries. "It is not simply the concentration of skilled labour, suppliers and information that distinguish the region. A variety of regional institutions—including Stanford University, several trade associations and local business organizations, and a myriad of specialized consulting, market research, public relations and venture capital firms—provide technical, financial, and networking services which the region's enterprises often cannot afford individually. These networks defy sectoral barriers: individuals move easily from semiconductor to disk drive firms or from computer to network makers. They move from established firms to start-ups (or vice versa) and even to market research or consulting firms, and from consulting firms back into start-ups. And they continue to meet at trade shows, industry conferences, and the scores of seminars, talks, and social activities organized by local business organizations and trade associations. In these forums, relationships are easily formed and maintained, technical and market information is exchanged, business contacts are established, and new enterprises are conceived... This decentralized and fluid environment also promotes the diffusion of intangible technological capabilities and understandings."

The result may be the existence of social networks defined as a "collectivity of individuals among whom exchanges take place that are supported only by shared norms of trustworthy behaviour" (Liebeskind, et al. 1995: 7). Location may facilitate the social contacts necessary for the development of these networks and may decrease the costs of monitoring untrustworthy behaviour. Trust is much more difficult to broker over long distance and in digital media encryption, digital signatures and other technical solutions seek to provide accurate, valid and reliable information but trust then becomes something mediated by the technology or a set of standards and is removed from the discretion of the individual.

In this case, geographic location provides a means to monitor the activity of other firms such as suppliers, partners or the competition. A professionally presented web page can lend legitimacy to the virtual corporation. There is a famous *New Yorker* cartoon that features two dogs working on computers. The caption reads "On the Internet nobody knows you're a dog." While the lack of scrutiny implies freedom on one hand, it also raises issues of information security, information integrity, and trust. One advantage of seeing with one's own eyes, touching the fabric and handling the merchandise, is that we trust our own perceptions. Frequent interaction and observation, confirmation and verification from known sources and the ability to monitor are some of the advantages of close proximity.

Consider the case of venture capital in the innovation process. Few start-up firms receive venture capital, but venture capital provides financing, connections to key resources and operations advice that appear to be important for innovative new start-up firms. Venture capitalists tend to make their investments locally because the financing of a new company involves a moral hazard problem (Sahlman 1990). Since entrepreneurs have intimate knowledge about the company and they have an incentive to report what they believe the venture capital investor wishes to hear so as not to endanger the funding relationship. The result is an information asymmetry unless the venture capitalist can closely monitor the new company and can make an informed assessment. Monitoring requires seeing with one's own eyes, dropping in unexpectedly and being able to form an independent assessment. The need of venture capitalists to monitor the new firms in which they invest makes close geographic proximity valuable (Gompers and Lerner 1999).

Information security, the search for new methods to ensure data integrity and accuracy is emerging as an important topic. Privacy is a related concern as individual correspondence, digital records and web-postings become evidence about an individual that may be taken out of context (Rosen 1999). While computer scientists work on more sophisticated encryption technologies and there is an appreciation that technology alone will not be able to provide complete security but that supporting social institutions are required (Schneier 2000). The interception and breaking of secret codes for transmitting data has a long historical tradition that Kahn (1996) and others have traced. As long as

people have sent messages, by whatever means, there have been other individuals who seek to gain by unauthorized access to that material. One of the most daunting limitations in Internet security is the inability of people to use multiple passwords and change them frequently. Information security concerns are the most frequently cited reason that financial transactions are not undertaken on the Internet. If we are reluctant to share our financial data will be we share other secrets?

The Internet provides information to everyone as soon as it is posted to the Web. Once the information is available to everyone, it presumably loses any specific strategic value– it becomes a commodity. If a technical area is changing rapidly with a high rate of knowledge obsolescence there may be a tendency to delay making information available until a dominant design has emerged or until some strategic advantage has been realized from the information. For example, we notice that in certain industries there is a tendency to bypass patenting because the patent application reveals too much information about the technology. Firms will choose to establish a first-mover market advantage by keeping information flows in check until the firm is able to have completed the innovation. Economic actors therefore enter into "races" in order to be first to market and to reap the economic rewards and do not share their most valuable information on-line.

Geography as a Platform to Organize Innovation

Alfred Marshall, writing in 1890, noted the importance of agglomeration, a form of external scale economy that accrued to geographic location for economic activity and many economists who study location and innovation invoke Marshall's logic: "When an industry has chosen a locality for itself, it is likely to stay there long; so great are the advantages which people following the same skilled trade get from near neighbourhood to one another. The mysteries of the trade become no mysteries; but are as it were in the air, and children learn many of them unconsciously. Good work is appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed; it one man starts a new idea, it is taken up by other and combined with suggestions of their own; and thus it becomes the source of further new ideas. And presently subsidiary trades grow up in the neighbourhood,

supplying it with implements and materials, organizing its traffic, and in many ways conducing to the economy of its materials."

Marshall was writing after the general acceptance of the telegraph and his observations stand in contrast to predictions about the impact of the telegraph. The expected impact of the telegraph mirrors current predictions about the Internet so closely that Tom Standage (1999) describes about the telegraph as *The Victorian Internet.* One official advocating the trans-Atlantic line predicted "All the inhabitants of the earth will be brought into one intellectual neighbourhood" (Jackman in 1846 as quoted in Standage 1999). *Scientific American* in 1858 described the Atlantic Telegraph as "the instantaneous highway of thought between the Old and New Worlds."

One hundred years later, economists are still finding empirical evidence of a spatial dimension of innovation. In popular language, this clustering of innovative activity is described as the Silicon Valley phenomenon due to the prominence of the development of the computer industry in Santa Clara, California near Stanford University. Our understanding of this finds that spatial clustering extends to a variety of innovative activities in a range of industries and activities, highlighting the importance of regional specialisation to economic activity, the importance of locational clusters as a source of increasing returns, and the productivity effects that stem from co-location of industrial and university research and development.

Consider the Internet as a case in point. The story of the Internet usually begins with the development of packet switching and the formation of the United States Advanced Research Projects Agency Networks (ARPANET) at the U.S. Department of Defense in the 1960s and its development took decades. Abbate (2000) demonstrates the role of individual users and social networks in shaping the network to meet their own objectives, and constantly defining and redefining the architecture and concept of what the Internet became. Applications such as Electronic mail and the World Wide Web were created informally without any formal coordinated design. It is no surprise that companies that work on Internet applications are geographically concentrated in a few prominent locations in the United States and around the world (Zook 2000; Pelletiere and Rodrigo 2001).

There is a direct relationship between the propensity for industries to concentrate geographically and the knowledge intensity of the industry's activity. The importance of geographic location may depend on the rate at which new ideas outdate old ideas, that is the obsolescence of knowledge. Intellectual capital, just like physical capital depreciates and becomes obsolete. Industries that face rapid rates of knowledge obsolescence would benefit more by locating near sources of new knowledge so that they can easily access and evaluate new ideas. As expected, empirical work finds a high degree of spatial clustering in industries that face both rapid knowledge depreciation and high technological opportunity. This typically describes industries that are at earliest stages of their industry life cycle when the pace of innovation is rapid.

The telecommunications revolution makes the transfer of work easy around the globe. Companies such as Cisco Systems Inc., Deutsche Bank, IBM Corp., Nortel Networks Ltd. and Tektronix are reported to transfer work to different locations around the world in order to benefit from three eight-hour work shifts. A programming job can originate in Silicon Valley, and be transferred to Bangalore. India as the close of one workday corresponds to the start of another. The process is then repeated, transferring the work to Ireland for the third work shift in a 24-hour period. The process continues until the product is complete. This is certainly highly productive. Is it innovative? We might say that the writing of code, debugging and implementation are a part of innovation but that part which can be reutilised. I wish that there were more research on this topic. It seems to me that someone somewhere must be orchestrating the process and has the decision-making authority to respond the crises and unexpected problems. Theory predicts that individual would reside in an agglomeration that provides the resources to find novel solutions and delegate work as required.

Consider the book, *Geeks: How Two Lost Boys Rode the Internet Out of Idaho* written by Jon Katz, a writer for *Wired*, an Internet and paper magazine devoted to understanding telecommunications technology. The term Geek describes technically proficient but socially inept individuals and the etymology of the word is insightful. The original meaning was for a carnival performer who bit the head off live chickens. The use of the term itself gives insights into the poor regard for such individuals. The situation has changed and the economic importance of this technical ability has evolved to the point

where MIT students now wear t-shirts proclaiming "Geek Pride." The story that Katz tells reveals insights about how individuals in remote locations can master the skill set of this new technology and become connected to a larger world. Living in a local community where they were outcast, two bright teenagers were able to tap into a virtual community that recognized, cultivated and rewarded their talents. Nevertheless, at the end of the story, these individuals move to opportunity in locations where they can have real interaction with their mentors and with other individuals who have similar interests. The Hackers and the Geeks social-skill set may not be mainstream but there is no denying that it exists and it is social. The Internet can provide a rich and interesting virtual life. It can provide information and connections to those that are geographically isolated. Nevertheless, it is no substitute for a real life.

The key resource in the innovation process is skilled labour–individuals who have the knowledge and insight to be creative, formulate the insightful questions, see new connections and ways of doing things and understand the possibilities. Indeed, the geographic concentration of what is known is agglomerations of skilled labour is the most difficult condition to replicate in regions that are trying to develop high-technology industrial clusters. The reasons maybe that it is not the skills of the individuals alone but the resources they command in specific locations.

The technology is going to get more sophisticated and the difficulties that are associated with lack of adequate bandwidth are bound to be solved, making teleconferencing and collaborative work more acceptable. Still an interesting question remains: If you could live anywhere and still do your work, where would you live? How would your organize your life and your time? Perhaps the greatest aspect of the ITC revolution is that it will free us from the tyranny of distance that dictates and limits locational choice.

The term Hacker has come to represent the larger movement of individuals who are technically proficient but still maintain the soul of non-conformist. In contrast to the Weber's Protestant work ethic associated the Industrial Revolution, the hacker ethic is associated with the Information Revolution. Pekka Himanen (2001) articulates a new ethos for the information age in *The Hacker Ethic and the Spirit of the Information Age* predicated on passionate and individually rhythmic life that integrates creativity into

work. The Hacker Ethic is predicated on the belief that individuals can create great things by joining forces in imaginative ways. The new ethic defends the need to maintain ethical ideals and standards and promote social ideals such as privacy and equality. The terms Hackers in this context refers to enthusiastic computer programmers who share their work, not the type of criminal behaviour that some individuals have found challenging. The computer and the Internet, for this group, provide a new mechanism to organize work and life in ways that are more meaningful.

How does location enter in to the *Hacker's Ethic*? As long as an individual has access to the Web, their immediate location is irrelevant–they have access to all the information and resources available on the web and can converse with all the other individuals connected. Of course, we should recognize that not all individuals are connected and have access to the web. Certainly, those locations that lack Internet connectivity will be left behind; creating a digital divide that separates the haves from the have-nots and may only serve to exacerbate existing economic disparities.

The End of the Tyranny of Distance and the Increased Importance of Location

Cairncross (2001) writes "The death of distance as a determinant of the cost of communications will probably be the single most economic force shaping society in the first half of the next century. It will alter, in ways that are only dimly imaginable, decisions about where people live and work, concepts of national borders, and patterns of international trade. The death of distance will mean that any activity that relies on a (computer) screen or a telephone can be carried out anywhere in the world" Yet, this is a far cry from being able to say that location will no longer matter. Indeed, we may expect that when economic activities and economic actors are freed from location constraints, geography may become more important. Fewer people would have to live in a location simply because it was proximate to natural resources, or transportation or the vagaries of their employer. This is a vision of a utopia where the Internet and the Digital revolution will give individuals freedom of location choice.

Shapiro and Varian (1999) argue the fundamental rules of conduct and economic life have not been changed. Our society has become accustomed to the decreased cost of transmitting information and the Internet is just another in a series of innovations. The Internet is a tool and the issue becomes how we would choose to use it.

The question becomes, if you could live anywhere, where would you choose? My belief is that as social beings we will want to co-locate with others like ourselves, in locations that offer amenities that we value and interesting opportunities, and that wonderful element of serendipity–the chance meeting, the unexpected cup of coffee, the unanticipated revelation. There will be certain centres of innovative activity that will be the most desirable locations, the most productive places to be. And anyone who can will want to be there. After all, we are physical and not virtual entities and need to be somewhere.

The Internet is a new medium, a faster tool that allows economic actors to do the activities that they were already doing. Life has certainly changed as a result of the Internet just as it did during the Industrial Revolution. Indeed, while the Industrial Revolution yielded great economic and social benefits, it also brought large-scale dislocation of people, changed work habits and work conditions in many socially undesirable ways, and increased pollution and exploitation of the environment. We are now on the precipice of the new digital revolution and perhaps the way to formulate the question is to ask how we may harness this new technology to build a society and an economy of greater opportunity, greater freedom, and harmony. Human beings, as physical beings, much locate in some geographic space and we now have the tools to be freed from the tyranny of distance. Rather than try to predict the future I hope that we will be able to use these new tools to shape it.

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