

Chapter 1

COMMUNICATIONS AND INNOVATION, BUSINESS ORGANIZATION AND TERRITORY

Economies and technologies are historical creations. The way human beings organize their economic activity, and the technologies available to them for producing, buying, and selling, emerge from historically constructed settings and evolve in conjunction with the historical process. This study tells a comparative story of economic development and technological change that takes place during two historical periods. One period encompasses the early years of the mass production economy in the late 19th century. The other focuses on the formative years of the Internet economy at the end of the 20th century. Two business firms, one from each period, are the central protagonists in this comparison. These two firms reveal parallel stories of innovation and economic transformation with a set of common narrative themes.

The narrative for these two stories begins by tracing how business users of transport and communications systems reorient their competitive strategies and business practices as the technology of these systems changes. It goes on to describe how, as businesses alter their strategies and routines, they transform what is arguably the defining organizational element of business activity, the *networks* of production and trade through which firms compete and seek profit. What this study compares are the production networks that emerge as firms use new transport and communications technology to innovate their competitive, profit-seeking activity. At the center of this comparison is a profile of how transformations in production networks are part of a general process of innovation within the firm, and how these networks, in turn, reshape the geographical territory for economic activity.¹

¹Geographical territory in this study derives from the definition of the region developed by Perloff et al. who refer to the region as an area “tied by extensive interareal activity or flows” (Perloff et al., 1960: 4)

The Research Question

The research for the comparison in this study is organized around a central research problem:

How does technological change in systems of transport and communications enable business users of such systems to innovate the networks in which they produce, buy, and sell, and how do such networks assume geographical characteristics that reshape the development of territory for economic activity?

This problem, in turn, derives from an analytical framework that seeks to explain the relationships between four phenomena: 1) transport and communications technology; 2) the process of innovation within the firm; 3) the organizational structure of the firm; and 4) the geographical space where the firm operates. This study casts the relationships between these phenomena as a series of questions framing the central research problem.

The questions that frame the research in this study are the following: 1) How does technological change in systems of transport and communications transform opportunities for profit-making by firms? 2) How do changes in profit-making opportunities stemming from new transport and communications systems, compel and enable business users of these systems to transform their strategies, routines and organizational structure for producing and trading? 3) How do the changes in strategies, routines and structure result in the reorganization of production and trade networks through which firms compete and make profit? and 4) How do these production networks assume territorial characteristics in the way they organize production and trade flows in and across geographical space?

In order to address the central research question, and the analytical relationships upon which this question is based, this study examines two highly innovative business users of transport and communications systems as case studies. One case is historical and focuses on a user of the rail and telegraph system for production and trade during the late nineteenth century. The other case is contemporary and examines a user of the Internet as an infrastructure for producing, buying, and selling. The two firms in question are the G.F. Swift Company and Dell Computer Corporation.

Swift is the pioneering founder of the mass produced, fresh beef industry during the late nineteenth century. Dell is the contemporary developer of custom-built personal computers (PCs). Both firms rank among the most innovative companies of their respective time periods. They ascended to this

shared status, however, by responding to different communications revolutions in a similar way. Both companies used the technologies of communications revolutions to create high-volume production and distribution networks that redefined competitive practices for business activity in their own time. As they created these networks, both firms established new models for business organization. These organizations, in turn, were the basis for the economic exploitation of extended geographical territories, namely the American market space in the case of Swift, and the global marketplace in the case of Dell. In effect, both companies created innovative organizations for producing and marketing goods from new technologies of transport and communications. In changing how products were built and distributed, the network organizations created by these two companies redirected the routes by which goods traveled within and between firms to final customers. In the process, the production networks of Swift and Dell reconfigured territories for the accumulation of profit.

The focus on these two firms, however, is far from a worshipful paean to individual entrepreneurial heroism. This study seeks to tell a more fundamental story about innovation and capitalist development. Within this broad frame, Swift and Dell reveal that forms of business organization are inherently spatial, and that the economy, fueled by innovation and organizational change, is a territorial phenomenon (Walker, 1988: 385). How these two firms deployed the rail and telegraph for producing and distributing fresh beef, and the Internet for producing and delivering custom-built PCs, along with the organizations deriving from this innovative activity and the territorial outcomes of their efforts, form the thematic outlines of this study. Within this narrative lies one of the most compelling issues of capitalist development: how the territory for economic activity gets reconfigured from the innovative activity of businesses. The stories of Swift and Dell aim to uncover answers to this puzzle.

Admittedly, this comparison draws upon a compelling model. Ten years ago, Paul David, in a provocative and beguiling essay, set up a comparison between the computer and the electric motor of the late nineteenth century in an effort to explain the so-called, “productivity paradox” of the 1980s and 1990s (David, 1991). In his piece, David accounted for the anomaly in the productivity statistics beginning in the 1980s when computers entered the workplace, by reference to the lag in productivity growth following the introduction of electric dynamos in factories of the late nineteenth century. A

period of adjustment following the introduction of new technology, he reasoned, was necessary before productivity gains were possible. David's comparison represented a potent example of the use of history to explain contemporary technology and economic development outcomes. By casting technology and the economy of the late twentieth century into what he described as "a not-too-distant mirror," David found answers to questions about technology in the present that would not have been discernible from observations taken from the current period alone. The comparison of Swift and Dell, the rail and telegraph system and the Internet, fresh beef and custom-built PCs, in this study has a similar objective. It seeks to use history in order to gain insight about the economy around us.²

Findings at a Glance

When applied to the cases of Swift and Dell, this historically-oriented comparative approach to innovation and economic development reveals several critical findings.

Firstly, the two cases reveal communications revolutions to be *control* revolutions that act as catalysts for innovation in the *circulation* of goods. The rail and telegraph revolution, and the Internet revolution enable Swift and Dell to create production networks that elevate the role of distribution and logistics as the sources of innovation, value-creation, and competitive advantage. Although both firms succeeded in using new infrastructure systems to create new products -- dressed beef shipped long-distance, and PCs configured through Internet communication represented new commodities -- the innovations pioneered by Swift and Dell from communications revolutions are *process* innovations. These process innovations, in turn, are linked to the creation of business *organizations* designed to coordinate the movement of the product from supplier, to producer, to customer. With this emphasis on distribution and logistics, the networks of Swift and Dell reveal a striking symmetry in attributes and aims. Dell uses the Internet to link the process of order intake with procurement, production, and delivery

²In his observations, David notes the human tendency to lose sight of the past when confronted by the achievements of current innovation, an affliction he vividly describes as "technological presbyopia" (David, 1991: 317). To sufferers of this malady, the technological future appears closer at hand than the historical path leading to it and the afflicted, in their neglect of the past, tend to exaggerate the sense in which the present is "unprecedented" and unique. Such fixation on the future, insists David, and neglect of the historical route to present-day innovation leads to a truncated, ultimately superficial engagement with technology in the present itself.

of PCs in creating an extremely innovative “direct-pull,” “just-in-time” production and distribution network. Dell is far from the first, however, in using new transport and communications technology to create such an innovation. Swift constructs a similar network from rail and telegraph technology. It uses telegraphy to link order intake from retail butchers, with procurement of cattle supplies, (dis)assembly, and final marketing in close to real time. This network of Swift anticipates by a century Dell’s logistics-oriented business model of creating a “closed loop” that eliminates intermediaries between the producer and the customer.

Secondly, research in this study on the operational characteristics of the networks created by Swift and Dell challenges the belief that the mass production age created wealth from goods while the Internet age creates wealth from information. Such partial truths ignore the ways in which the production and distribution networks of both Swift and Dell relied on the processing of enormous amounts of real time information and the manipulation of high-volume flows of goods, made possible by new communications and transport infrastructure. Swift built its network not only from its rail-transported fresh beef. It created this network on the basis of telegraphic information coordinating the movement of this product from stockyard cattle pens, to retail butcher shops. Real-time information exchange between the primary nodes in Swift’s network -- stockyards, slaughtering facilities, and branch distribution houses -- was fundamental in shaping a process of procurement, production, and sale of fresh beef that was modulated daily and even hourly in order to balance conditions of supply and demand in the context of a highly-perishable product (Bureau of Corporations, 1905: 21). Information, in effect, proved as critical to Swift in capturing value from its production and distribution activity, as the product itself. Dell in turn, captures value from its production and distribution activity not only by the Internet information it maintains to link the nodes in its network. It makes profit and distinguishes itself from competitors by the way it executes the movement of supplies and final product through the primary nodes in its network consisting of supplier factories, supply logistics centers where components are staged for assembly, and Dell’s own assembly sites. Internet-generated information is indeed critical in this execution. Nevertheless, movements of actual physical goods through these nodes are as critical to Dell’s success as

the Internet-generated information that underlies how the PCs in this network get assembled and delivered.

Thirdly, these networks of Swift and Dell reveal a similar geographical tendency of territorial spread *and* concentration. From the rail and telegraph system, Swift built a production and distribution network extending throughout the entire U.S. that obliterated the formerly localized character of beef production and consumption, and helped create a national market space. Within this territory, the Company decentralized slaughtering activity away from its original hub in Chicago to other facilities in the Midwest, creating a new pattern of industrial concentration while simultaneously widening routes of distribution across the entire continent. Similarly, Dell is building a production and distribution network on the basis of Internet technology that is establishing a new set of operational standards for the organization of globally-extended and regionally-concentrated production and distribution complexes. It has decentralized and spread PC assembly activity from its original hub in Austin to locations around the world. At the same time, it has created concentrations of assembly activity in selected regional locations in an effort to build and sell its products for the regions where assembly sites are located. This pattern of elongation and concentration created by the two firms, however, reveals a clear difference. In the case of Swift, the decentralization of cattle disassembly created a nationally based set of regionally concentrated production complexes. In the case of Dell, the decentralization of PC assembly has created a globally based set of regional production ensembles. Nevertheless, in the place-based concentrations of manufacturing organized by Swift and Dell, both firms rely on critical relationships of geographical proximity between key nodes in their networks -- stockyards and disassembly facilities, branch houses and rail trunk line switching heads in the case of Swift, supplier factories, supply logistics centers, and assembly facilities in the case of Dell. The two companies shape these relationships of proximity in order to manage and control the movements of materials between these nodes, and execute their closed-loop, direct-pull, real time systems of production and distribution.

Finally, in comparing Swift and Dell, this study clears a new pathway for understanding production networks and business organization.

In the first place, the comparison of Swift and Dell calls into question the idea that economic activity in the current period is distinguished by the organization of firms in *networks*. Such a view is ahistorical. Throughout the history of economic life, the fundamental activities of producing, buying, and selling have always occurred in networks linking individuals and firms (Braudel, 1977; 1979). Far more critical in assessing this phenomenon is how firms and individual economic actors in different historical periods organize the linkages necessary to produce, buy and sell, and the attributes of the networks deriving from this competitive activity. Consequently, production networks in the current period, as well as networks from the past, have distinct characteristics that change over time. The integrated organizations of firms such as Swift are no less networks than the dis-integrated organizations currently being created by firms such as Dell.

Secondly, while the two networks reveal organizational differences, the integrated intrafirm network of Swift, and the dis-integrated interfirm network of Dell actually share similar mechanisms of administrative control over the process of procurement, production, and distribution. In the case of Swift, these control mechanisms, achieved through rail and telegraph technology, are exercised within the boundaries of the firm through the process of vertical integration. In the case of Dell, these mechanisms of control, achieved through Internet communication, are exercised over other firms that lie outside the organizational boundaries of Dell but within the network of the PC maker.³ Dell is compelled to use such controls in achieving what it calls *virtual integration* with its suppliers and logistic partners in order to manage the high-speed information and material flows within its network. These controls enable Dell to interact with other firms in its network not through markets and the price system. Instead, Dell enforces a structure of controlled relationships upon its network partners -- and uses the Internet to facilitate this control. Consequently, this study takes issue with prevailing views of interfirm production networks as the organizational embodiment of ascendant market forces. This study presents an alternative view of interfirm networks as organizations also dependent on mechanisms of power and administrative planning

³In a compelling article on the new economy, Varian (2002) points out how, despite the lower communication costs from the Internet, companies still tend to favor organizing their activities through hierarchical mechanisms of control rather than through market-oriented Internet transactions.

used by vertically integrated firms such as Swift. Far from a revolution in production that is reverting to market coordination within interfirm networks, the experiences of Swift and Dell emphasize how communications revolutions and their attributes of control, along with the principle of corporate power, enable firms to create production networks with similar non-market mechanisms of administrative coordination. Such similarities, in turn, establish bridges between the late nineteenth and the late twentieth centuries.

Theoretical Framework

Three distinct but often-overlapping sets of literature provide the theoretical context for the comparison in this study.

Technology as History

The first set of literature employs a fundamentally historical approach in examining the phenomenon of technological change and innovation within the firm.⁴ Deriving primarily from the work of Joseph Schumpeter and elaborated more recently by theorists influenced by his notion of “evolutionary” economic change, this literature seeks to uncover the sources of innovation and its impacts on economic development within and across historical periods (Schumpeter, 1939; 1942; 1947; Nelson and Winter, 1982; Freeman, 1982; 1990; 1991; Perez, 1983; Dosi, 1982; 1984; Dosi et al., 1992; 1998). Within this framework, innovation is conceived more broadly than the accumulation of discrete inventions and new technologies. Innovation is the deployment and transformation of inventions into commercially viable products and profit-making activities, and the diffusion of these new products and processes throughout the entire economy (Freeman, 1991: 305). It involves what Schumpeter described as the “creative response” of entrepreneurial firms, and the adaptive response of other firms who, in trying to compete with innovators, essentially imitate the original innovation.

⁴Technology in this study refers to knowledge embedded in products and routines for accomplishing purposeful and reproducible activity (Nelson and Winter, 1982; Mokyr, 1990: 275-76; Castells, 1996: 29-30). Innovation involves an epistemological transformation -- new knowledge -- which leads to the creation of new products, new processes and organizations for making them, and new places where new products are produced, bought, and sold, and where new processes and organizations function.

In seeking to explain how this process of invention, innovation, and diffusion occurs, theorists in this tradition focus on the influence of the profit-making environment on the process of *learning* within the firm, and the process of firm-level decision-making. This process of learning to compete differently, and choosing how to implement a new vision of profit-making, is what leads to the creation of new strategies, products, routines, and business organizations. These activities of learning about new profit opportunities, and selecting alternatives for capturing profit in new ways, transform patterns of competition, and enable firms to create new trajectories of growth and development in what is commonly termed, *economic space*. This body of theory is used to position Swift and Dell as innovative firms.

The Firm As *Network*

The second set of literature examines how businesses organize their activity in production *networks* that link firms both internally, and with other businesses. Theorists within this literature focus on two primary network attributes. One group of theorists examines how production networks reflect *organizational linkages* within and between firms that result when firms choose how to undertake and divide up the various activities in producing and selling a good or service (Coase, 1937; Williamson, 1975). These choices, in turn, stem from a search by firms for “competitive advantage” (Porter, 1985; Lazonick, 1991; Saxenian, 1994; Cohen and Borras, 1997; Borras et al., 2000). In this way, organizational linkages within and between firms reflect operational decisions on competing. Such linkages establish boundaries between firms. These linkages also lie at the core of theories on the organizational structure of enterprise in terms of the degree to which firms internalize various economic activities and are integrated, or the degree to which firms transact with other firms across markets for these activities and are *dis*-integrated. Networks, whether intrafirm reflecting integration, or interfirm reflecting dis-integration, are thus the outcome of how firms choose to compete in economic space.

A second group within this tradition extends the idea of organization into the realm of territory insisting that business organization is inseparable from geographical organization (Walker, 1988: 385). This group examines how production networks reflect *geographical linkages* in the organization of economic activity (Gereffi and Korzeniewicz, 1994; Castells, 1996; Sturgeon 1997a; 1997b; 2000).

Using insights from the first group, these theorists seek to identify how production networks become geographically-embedded in the way they organize the physical locations of activities (nodes), and the routes of product and information flows between these nodes. The pivotal concern in the work of these theorists is how the territory through which production networks operate, is constructed and gets reconfigured. While the starting point of this literature is the structure of the firm as a competitive unit in economic space, theorists in this tradition also emphasize how forms of business organization occupy a second analytical realm -- *geographical space*. This body of theory is used to position Swift and Dell as creators of production networks with specific organizational attributes that occupy an economic realm of competition, and a spatial realm of territory.

Communications As Revolution

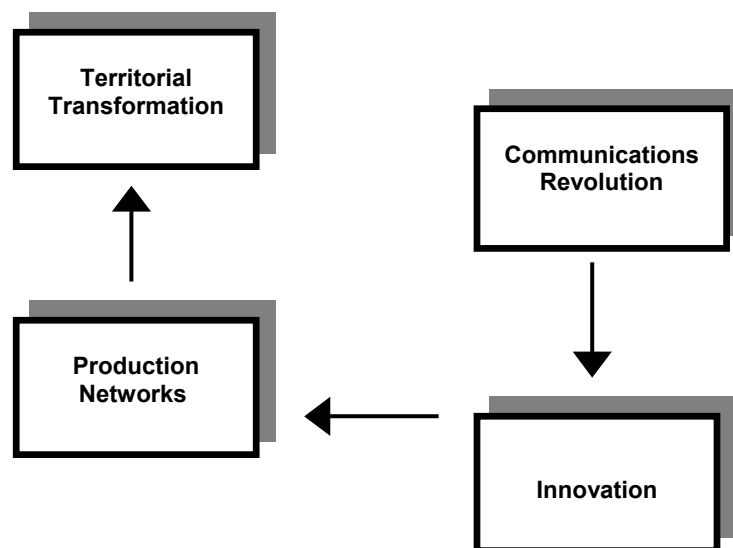
The final set of literature focuses on a technological phenomenon occurring in different historical periods, the phenomenon of the *communications revolution*. Pioneered by historian Robert Albion (Albion, 1932; John, 1994), this concept provides the catalytic thread for the process of innovation within the firm, the reorganization of networks, and territorial transformation.⁵ The basic idea that has emerged from Albion's insight is that new transport and communications systems play a decisive role in changing the competitive behavior of firms and the organization of economies. Theorists from Harold Innis (1950; 1951), to Alfred Chandler (1962; 1977), to Manuel Castells (1996) have contributed to this literature highlighting the role of communications revolutions on firms and economic development while more broadly, William McNeill has argued that major innovations in human history itself have depended principally on breakthroughs in communications and transport (McNeill, 2000: 10). This framework, however, is not used to create some autonomous, external force that imposes a predetermined logic on

⁵Although Albion was the first to examine the phenomenon of the communications revolution systematically, earlier insights about the role of revolutions in communications technologies in economic development can be found in the writings of Marx, (1867, 1885, 1894), and slightly later in the work of Durkheim (1893). Marx was perhaps the first to write about distance compression and market expansion stemming from advances in transport and communications technology. Slightly later, Emile Durkheim observed how transport and communications technologies of the late 19th century tended to break down "segmented" or local markets in creating larger markets of an "organized" type (Durkheim, 1893: 305).

users of transport and communications systems. Communications revolutions emerge from historically-conditioned environments. While communications revolutions in different historical periods share certain fundamental characteristics and affect firms in broadly similar ways, they vary with respect to the specific impacts they exert on firms. As a consequence, the response of firms to communications revolutions is open-ended and contingent. Both Swift and Dell were profoundly influenced by communications revolutions.

From the synthesis of these literatures, this study seeks to trace the route in both cases from breakthroughs in transport and communications systems, to the innovative behavior of the firm, to the production network and organizational change, to territorial transformation.

Figure I-1
From Communications Revolution
To Territorial Transformation



The Argument

The argument in this study seeks to explain how firms, in confronting revolutions in transport and communications technology, create new models for producing, buying and selling, and how these innovations reshape economic development patterns and the territory for profit-making. In this argument, the innovative activity of firms is connected to territorial transformation and economic change through the production and distribution networks created by firms when they develop new products, organize new routines for making those products, and seek new markets for selling the new products. Four key concepts developed from the theoretical framework, provide the threads in this argument. These concepts are: 1) the *communications revolution* referring to the deployment of new transport and communications systems; 2) the process of *innovation* in the firm referring to the creation of new products, routines, organizations and markets along with the diffusion of this process; 3) the *production network* of the firm consisting of organizational and geographical linkages connecting flows of goods and information between different network nodes; and 4) *territory* for economic activity referring to the geographical pattern of the goods and information flows between nodes within networks.

Theoretical Contours

From these concepts as a starting point, the argument in this study builds upon the observation made roughly seventy-five years ago by economist Allyn Young, that the marketplace is “essentially the aggregate of productive activities tied together by trade” (Young, 1928: 533). Myriad individual firms engaged in purchasing supplies, producing finished goods and services, and selling what they produce to other firms or final consumers, are the agents for this activity. When firms procure, produce, and sell, their activity creates flows of production and trade between and within firms, and between companies and consumers. These production and trade flows in which increments of value get added to goods and services, are the basis of production networks. The economy is, in essence, the collective product of this network activity.

Firms organize flows of production and trade on the basis of choices about strategies for competing against other firms, and routines for generating profit from their competitive activity. These

choices result in specific types of linkages within and between firms that connect product and trade flows, and define the organizational and territorial structure of networks. The marketplace and the profit system establish the basic parameters for such choices. Nevertheless, within these parameters, the strategic, operational, and organizational choices of firms are at all times open-ended and contingent.

Among the most disruptive historical forces affecting the choices of firms and igniting the process of innovation and economic transformation, is the phenomenon of communications revolutions. The railroad and telegraph system, and the Internet represent different manifestations of this phenomenon. As developed by Albion, this concept described a “veritable age of speed” appearing at the turn of the nineteenth century at which new transport and communications systems moved goods, people and information (Albion, 1932).⁶ Although Albion acknowledged the role of the communications revolution as the prelude to the “Machine Age” and “Big Business,” his model emphasized the exogenous character of this phenomenon, and did not seek out systematic connections between communications and the broader process of economic change (Albion, 1932: 718-719; John, 1994: 101). It was Alfred Chandler, at one time a student of Albion, who sought to develop this bridge between communications and economic development. In supplementing Albion's work with insights from Schumpeter and Max Weber, Chandler provided a compelling story of 19th-century industrialization by focusing on the transformation of a single institution, the capitalist business firm.⁷ In his account, new transport and communications systems ignite a process of creative and adaptive rationalization in the *Strategy and Structure* of the business enterprise (Chandler, 1962). During the late nineteenth century, these changes in strategy and structure diffused among firms and established the basis of a new economic order, the mass production system (Chandler, 1977; 1992).⁸

This study builds upon Chandler's model of the relationship between transport and communications technology, and the strategy and structure of the firm. It broadens this framework,

⁶It is worth noting that other scholars, most notably Elizabeth Eisenstein (1979) trace the lineage of the “communications revolution” earlier to the phenomenon of printing during the fifteenth century.”

⁷On the influence of Schumpeter and Weber on Chandler, see McCraw (1988: 304-305).

⁸See Chapter 2 for Chandler and his critics.

however, by adding to it the notions of production networks and territory. At the same time, the argument incorporates the comparative, historical approach of Paul David in extending the idea of the communications revolution to present day. While acknowledging the unique character of the communications revolution at different historical moments, this study uncovers common attributes of the rail and telegraph and the Internet revolutions in launching the comparison of the production networks created by Swift and Dell.

Two distinct, though often overlapping groups of firms participate in the creation of communications revolutions. Spearheading this phenomenon are *builders* of transport and communications systems. This group encompasses an array of actors including inventor entrepreneurs, investors, and firms that undertake the actual build-out of infrastructure. Invariably aided by government, this group succeeds in constructing new transport and communications infrastructure that, in turn, creates new systems of access across space. Such new systems of access in which people, merchandise and information circulate over distance in new ways, reshape the horizons for economic activity and influence a second, more numerous group. This second group consists of business *users* of this infrastructure. It is these users that complete a more widespread set of transformations in the economy by deploying the new infrastructure in their networks for producing, buying, and selling. Swift and Dell represent two such users that exploit the capacity of communications revolutions to change the environment of profit-making opportunities in the economy.

Communications revolutions change the profit-making environment for transport and communications users by transforming one of the most fundamental elements in the economic system -- the geographical boundaries or *range of markets*.

Market boundaries take shape most decisively from technologies of transport and communications, which define an upper range for individuals and firms to engage profitably in economic activity (Irwin and Kasarda, 1994: 342; Christaller, 1933: 72). These technologies establish limits on market size by influencing the costs of producing and trading. Market boundaries become fixed where “costs of transfer” -- the costs of moving goods or securing information in a timely manner across space -- drive the prices of goods and services beyond their original value (Ohlin, 1933: 100). In addition to

costs, market boundaries also emerge from the actual capabilities of available transport and communications technology to overcome geographical barriers in moving materials and information. In this way, the size of markets is dependent on the costs to, and capacity of market actors to produce and exchange goods and services over distance, and communicate information needed to organize these activities (Du Boff, 1980: 478). Market size thus reflects a set of relationships in economic activity structured around the elements of *time* and *space*.

Market boundaries also emerge from politics (Polanyi, 1944; Christopherson, 1993; Zysman, 1994). Markets expand and contract as a result of control over territory exercised by political authorities that set rules for economic activity and establish systems of entitlements, rewards, and costs on market actors in the areas under their rule. Such authorities condition the extent to which market actors engage in, benefit from, or abandon economic activity within the territory in question. Politics also plays a critical role in influencing the actual development and deployment of communications systems.

Consequently, market boundaries, whether derived from technology, geography, or politics, establish limits on firms in their pursuit of profit.

As communications revolutions shift market boundaries, the profit-making environment changes. Such shifts in the profit environment are the result of transformations in the time and space relationships in economic activity. In accelerating and extending the linkages between spatially-dispersed firms, and between geographically-separated economic activities, advances in transport and communications enable goods and information to circulate faster over greater distances. These changes, in turn, enlarge the area in which economic actors can profitably conduct business activities (Stone, 1997: 4-5). What communications revolutions do is recalibrate the *costs* of moving goods and securing information over distance. As costs of moving goods and communicating over distance decrease, firms gain access to opportunities for conducting their business operations differently. At the same time, new transport and communications systems enhance the capacity of firms to *control* these activities in fundamentally new ways. In this way, control over time and space, linked to breakthroughs in transport and communications, provides firms with new pathways to profit-making.

Control over time and space is in all periods of capitalist development a centrally-important strategic, operational, and organizational problem for the firm (Schoenberger, 1997: 12). Businesses are constantly engaged in reshaping their strategies, routines, and organizations in an effort to overcome the temporal and geographical barriers to accumulating profit. The new forms of control over time and space available to firms from communications revolutions create new opportunities for profit-making by redefining pathways for efficiency in the economy. As a result of breakthroughs in communications, and the resultant reconfiguration of markets and restructuring of time and space in economic activity, what is inefficient or even impossible as a business model for producing, buying, and selling at one point in time, is viable as a profit-making venture in another historical moment.

Communications revolutions, in effect, are control revolutions (Beniger, 1986; Yates, 1989; Mulgan, 1990). They change the environment of profit opportunities by reshaping markets, and providing firms in these reconfigured territories with new routes to efficiency through greater levels of control over space and time. What firms gain from this newly achieved control in economic activity is how to accelerate the turnover of goods, services, and information, and extend these accelerated flows of activity in new ways over larger and differently-configured territories.

Not all business firms are equally successful in learning about new profit opportunities in economic environments transformed by new transport and communications systems. As communications revolutions reshape markets and enhance systems of control over space and time in business activity, only a small number of firms are able to grasp how to profit in new ways from the transformed economic environment. Such variation stems from the fact that the choices of strategies, routines and business organizations made by firms do not derive from some omniscient understanding of the most profit-optimizing pathway available in the market as assumed in rational choice models of human action. Firms make choices with imperfect knowledge and an incomplete picture of profit opportunities and the technological and organizational solutions available for pursuing them (Dosi, 1997: 1531; Lamoreaux et al., 1999: 6-8). This imperfect knowledge enables firms to perceive the world differently and gives rise to differences in the choices firms make regarding strategies, routines, and structure (Metcalf: 1998: 35). While most businesses adapt to the innovations of others, a few firms

succeed in making choices that result in what Schumpeter described as creative responses in economic history. Swift and Dell are two such firms.

Empirical Outlines

As innovative firms, Swift and Dell are creations of communications revolutions. They used new transport and communications systems in conceiving new products and perhaps more importantly, new ways to distribute and market those products to final customers. The new product developed by Swift was mass-produced fresh beef (Kujovich, 1970). The new product created by Dell was a personal computer, mass-produced but individually-configured through Internet communication. The real innovation of both firms, however, was the creation of *organizations* for not only for producing, but more importantly for distributing these products.

In order to solve the problems of making and marketing mass-produced fresh beef, and Internet-customized, mass-produced personal computers, both Swift and Dell had to reinvent logistics systems for the entire circuit of procurement, production, and distribution for these two products. Through a process of learning by doing, Swift and Dell deployed new transport and communications systems as the foundation of logistics-oriented business models. These business models linked new products, to process innovations for securing supplies, assembling and disassembling supplies into finished goods, and selling finished output. The outcome of this learning process was the development by both firms of high volume, geographically-extended, logistics-oriented networks of production and distribution. These networks accelerated flows of product and information during the circuits of procurement, production, and selling, and established new competitive standards in their respective industries.

As they created these networks, Swift and Dell made critical choices with respect to the organizational structure and systems of control within their enterprise. These choices centered on the degree to which firms absorb sequential steps in procurement, production, and selling, and the degree to which they contract with other businesses in allocating these tasks. Operational decisions on whether to “make or buy,” however, affect more than the systems of organization and control in firms. Decisions to

produce in-house or secure goods and services through other firms, result in production networks with specific geographical characteristics.

Swift created a long-distance network for the manufacture and sale of fresh beef that helped establish the foundations for a national market space. This network obliterated both the localized character of beef markets prevailing in the U.S. before the 1870s, and the interregional character of beef markets based upon long distance rail shipments of live cattle. At the same time, as Swift extended the circuits of production and distribution, the Company concentrated slaughtering activity in new places. Swift and other large packers centralized slaughtering in Chicago and the Midwest where they pioneered a work process and division of labor in the factory that became a model for other mass production firms (Brody, 1964). In this way, Swift was a critical actor in contributing to a location pattern of spread and concentration that defined the geography of a newly-emergent national market.

In establishing its network, Swift represents a transformation in the accumulation process during the late nineteenth century. In this transformation, American capitalists sought profit not as in the early part of the century from commercial ventures centered on coastal trading activity. Swift, and other industrial capitalists of the period generated profit both from manufacturing, and from the conquest of the American interior as a market area for distributing their products (Pred, 1966: 18-19; 1977: 66-70; Porter and Livesay, 1971; Chandler, 1988: 72). On the basis of these manufacturing and distribution activities, Swift and other larger packers promoted a pattern of what has been termed, the “agro-industrialization” of the U.S. (Page and Walker, 1991). In this pattern, new products, routines, and business organizations, evolving from changes in manufacturing and distribution activity in the U.S. interior, extended and concentrated economic activity in new ways while reshaping the nation’s economic geography.

The network of Swift consisted of three primary nodes: 1) stockyard facilities where the firm secured cattle raw materials; 2) (dis)assembly facilities located immediately adjacent to the stockyard sources of supply; and 3) branch distribution houses located throughout the country where the firm shipped its product in order to supply retail butchers with fresh beef. Through the links between these nodes, Swift operated what is essentially an early type of “just-in-time” production and distribution system. Orders taken at branch houses from local retail butchers were telegraphed to Swift purchasing

agents at stockyards where cattle supplies were “pulled” into slaughtering factories, butchered, and sent to branch houses to fulfill orders. Stockyards served as collection points for cattle shipped daily from locations on the cattle ranges, and warehouses for inventories of cattle supplies that firms such as Swift would purchase and immediately pull into slaughtering plants for disassembly. Slaughtering facilities were located either adjacent, or in close proximity to stockyards and acted as concentration points in the process of beef production and distribution. Branch houses, on the other hand dispersed the product over a wide territory. The railroad and telegraph provided the basic infrastructure for this process of concentration and dispersal.

As it built this national network, Swift integrated into its own organization virtually all of the steps from production to final marketing of fresh beef. The result of such integration, however, in terms of the relationship between company and customer was seemingly paradoxical. Vertical integration created a more *direct* route from production to the final customer. Much like other large manufacturers of the period, as Swift assumed ownership of these various functions, it eliminated -- disintermediated -- a large layer of traditional wholesalers in the beef trade and established a more direct path to the buyers of beef (Porter and Livesay, 1971). This direct system of distribution was one of the key sources of value-creation and profit-making for the Company.

In the case of Dell, the route from communications, to operational and organizational innovation, to territorial transformation runs parallel to Swift.

Dell’s Internet-driven production and distribution network consists of three primary nodes: 1) assembly plants; 2) supplier factories; and 3) supply logistics centers. The geography of this network emerges from the globally-spread locations of these facilities, and the territorial character of the product and information flows circulating between them. Through Internet communication, Dell has organized these nodes into decentralized “just-in-time” pull systems of production and distribution. These decentralized systems, spread across four continents, form concentrated production complexes in six selected regional locales. While there is some variation in these six concentrations, the territorial placement of these nodes, and the way they operate, is essentially identical in each place. Through the

establishment of these production ensembles, Dell is reinforcing the proliferation of economic globalization as an essentially homogenizing phenomenon.

Similar to Swift, Dell is compelled to organize critical relationships of proximity in each of the six locations between key network nodes, in this case between inventories of supply, and assembly sites in order to coordinate its production and distribution logistics on a just-in-time basis.⁹ As a consequence, Dell has established supply logistics centers where components are stored as inventory within twenty minutes driving time of assembly facilities at each of its six different computer assembly locations. In these warehouses, components originating from supplier factories located throughout the world get stored and “pulled” into Dell’s assembly plants as they are needed on a just-in-time basis, while suppliers operate these warehouses and thus assume the inventory carrying costs. Patterns of global spread, regional concentration, and relationships of proximity are thus part of a just-in-time production and distribution system fused together by Dell through Internet communication.

Organizationally, Dell does not aim to assume formal ownership of the adjacent procurement, production and distribution activity in the network. Instead, much like other PC makers, it relies upon the *external capabilities* of other firms to help produce and deliver its custom-configured products (Langlois, 1990; 1992). Nevertheless, Dell does not use the market and the price system to structure its contracting relationships with these other firms. It employs mechanisms of power and administrative planning in organizing these relationships with firms lying outside of its own organizational boundaries.

Similar to Swift, Dell creates value and captures profit by eliminating traditional intermediaries in the PC channel, and creating a direct route to its final customers. This direct system is organized around Internet communication. This Internet-based closed loop with customers is the catalyst for pulling parts into and through Dell’s assembly plants. It is the foundation of the high speed, just-in-time logistics system used by Dell as the innovation for out-competing other PC firms.

With both Swift and Dell, the route to organizational and territorial transformation occurs through a process of innovation in production networks ignited by changes in technologies of transport and

⁹On the role of proximity in the technology of modern manufacturing systems see Gertler (1995).

communications. In both cases, these networks recast how products are made, and how products reach the customer. As they forge a more direct path from the manufacturer to the customer, the production and distribution networks of both Swift and Dell create a similar pattern of geographical spread and concentration. At the same time, however, the rail and the telegraph, and the Internet enable the two firms to organize ownership and territory in the networks differently. One network is vertically integrated, with the primary nodes dispersing and concentrating over a fundamentally national market space. The other network is *dis*-integrated, dispersing and concentrating over a global market space. This study seizes upon these structural, operational, and geographical attributes of production networks in seeking to tell a comparative story of innovation and economic change.

On Method: Why Compare Swift and Dell?

The two companies examined in this project are *intensive* (as opposed to extensive) case studies in which the unit of analysis is the business firm. Whereas extensive research seeks to discover common patterns and characteristics in a population of research subjects based on analysis of a large number of cases, intensive research has a different objective. The aim of intensive research is to show how a generalized causal process occurs in a particular case, and how the case is representative of a broad-based trend (Sayer, 1992: 242-243).

As intensive and comparable cases, Swift and Dell reveal experiences of a shared causal process. The causal process shared by these two case studies focuses on the impacts of communications revolutions on the firm, and the connection between the innovative responses of the firm, organizational change and territorial transformation. In the case of Swift, the production network of the firm is connected to an economic environment and a set of capabilities created by the railroad and telegraph revolution. In the case of Dell, the production network of the firm is linked to an economic environment and a set of capabilities created by the Internet revolution. Although intensive research does not necessarily aim to build a “testable” model with specified relationships between dependent and independent variables, there is an implicit formal structure in the comparison of the two cases. In this

study, the production network as it becomes territorially embedded, functions as a dependent variable responding to the communications revolution and the process of innovation in the firm.

The Swift case uses both secondary literature, along with primary sources. One of these primary sources enables the Swift case to utilize a type of “interview” method. Extensive testimony from over 200 witnesses before the Senate Select Committee on the Transportation and Sale of Meat Products chaired by Senator George Vest of Missouri in 1890, gives voice to actors of the period involved in virtually all aspects of the beef trade, and provides a veritable wealth of information on the industry. This study makes use of this testimony in an effort to recreate first hand accounts of Swift’s innovation and its impacts.

The Swift case covers the initial years of the Company from 1875 to roughly 1903. These dates cover two significant developments in the American economy. In the first place, this period witnesses the completion of a nationally integrated and standardized rail and telegraph infrastructure in the U.S. Secondly, this period marks the appearance of the mass production economy and the large-scale, integrated industrial corporation connected to new production and distribution systems pioneered by firms such as Swift. Infrastructure, firm structure, and market structure evolve together during this period. The year 1903 as an end point is also not arbitrary. As the culmination of the first great merger wave in American history, this date, in most accounts of the period, brings the initial period of the mass production economy to a close. Whether by chance or fate, it also marks the date when Swift surpasses all of its competitors and becomes the largest meat packing firm in the country and even the entire world.

The Dell case, much like the case of Swift, covers the firm from its founding in 1984 and carries the story forward to the present. These dates frame two critical developments. In the first place, this period witnesses the creation of a mass market for the personal computer. Perhaps more significantly, the latter years of this period mark the development of the Internet as a communications and commerce system. Similar to the advent and expansion of the rail and telegraph, the Internet as a commerce system has enabled business firms to use the new infrastructure for producing and selling goods and services and coordinating business operations in entirely new ways. Dell has managed to reorganize its business

model for producing and selling PCs in responding to the opportunities presented by the Internet. Much like Swift, Dell has used the Internet to assume a position of first rank in the personal computer industry.

In the case of Dell, the “corporate interview” with Dell managers is the primary research strategy (Schoenberger, 1991; Markusen, 1994). There is actually very little published scholarship that analyzes details of Dell’s production and distribution network (Kenney and Curry, 2000: 5). The aim of these interviews is to uncover new facts about Dell’s operations absent in the secondary and journalistic literature about the company, and contribute to the creation of new knowledge about one of the most innovative firms of the period.

Despite the years that separate them, and the different products that define them, both firms reveal stories with striking symmetries that link communications revolutions and business innovation across time.

In the first place, Swift and Dell are comparable as two of the most innovative firms in their respective time periods. In this sense, they are representative of what has been termed, “the innovative business organization” (Lazonick, 1991). Both began as small upstarts in industries with much larger, well-established companies. Both succeeded in out-competing their older rivals and transforming existing business practices in their respective industries. Both used breakthroughs in transport and communications to create process innovations linking procurement and manufacturing to distribution systems for reaching the final customer.

For both Swift and Dell, these process innovations were oriented around a more *direct* route from manufacturer to the customer. This direct business model enabled the two firms to bypass existing distribution channels in the delivery of beef and personal computers and resulted in large-scale disintermediation in the structure of the beef and PC industries. The direct business models of both companies also established new competitive standards for meat packing and computer assembly and sale, including the customization of products based upon orders received in advance, that also influenced -- and in the case of Dell, is continuing to influence -- business practices in other industries. In using rails and telegraphy and the Internet as the foundation for their respective manufacturing and distribution systems, both firms essentially created production and distribution networks that extended the geographical activity

of the firm while bringing the firm into more direct contact with final customers. The networks pioneered by Swift and Dell are, in effect, paragons of communications revolutions, one born with rail and telegraph economy, the other the progeny of the Internet economy.

Other similarities also link the innovations of these two companies. While dressed beef and personal computers may appear oddly-matched, they actually share a common status as new products. Although dressed beef and personal computers had already emerged as new products when Swift and Dell began to do business, both firms succeeded in transforming these products through new systems of distribution. As a result of the innovations in production and distribution networks created by these two firms, dressed beef and personal computers became accessible, affordable, and mass consumed. Perhaps most importantly, however, dressed beef and custom-created personal computers share a fundamental attribute as “perishable” goods. They both have a limited shelf life before they start to devalue and essentially spoil. This shared quality of perishability played a decisive role in motivating both Swift and Dell to transform the channels of distribution in the beef and PC industry, and develop their innovative networks for making and selling these products.

Organizational parallels between Swift and Dell also contribute to the choice of these firms as case studies. These parallels highlight both similarities and differences. Differences focus on how Swift and Dell organized capabilities and boundaries of the firm. In the case of Swift, the transformation of fresh beef into a readily available, mass-consumed commodity through a more direct distribution channel, resulted in a process of vertical integration in which Swift absorbed the bulk of the adjacent steps in the value chain into its own organization. In the case of Dell, the direct channel of producing and delivering personal computers emerged from a focus on two basic tasks, computer assembly and logistics, and reliance on external capabilities of other firms to build PC components (Langlois, 1990; 1992). Despite these differences in organizational structure, however, both firms rely on mechanisms of administrative coordination rather than interfaces across markets, to organize the various procurement, manufacturing and distribution activity in their networks. Both networks used the advances of communications revolutions as the foundation for coordinating these adjacent steps.

Finally, the choice of Swift and Dell as case studies is the result of unique research opportunities presented by the two firms.

Surprisingly, while there are a number of studies on meat packing in the late nineteenth century, notably the work of Mary Yeager (1981), Margaret Walsh (1982), and Louise Carroll Wade (1987), and numerous references to the innovations of Swift in both general and specialized economic histories of the period (Chandler, 1977; Cronon, 1991), there is only one scholarly work on the firm of Swift itself. This work on Swift is a dissertation written fifty years ago (Unfer, 1950).¹⁰ The present study revisits these works along with archival material on Swift in an effort to uncover how the Company created its pioneering dressed beef network from the rail and telegraph, and the economic development impacts of this innovation.

Dell on the other hand, presents a different type of opportunity. With its modest beginnings and meteoric rise within the PC ranks, Dell has generated a type of modern business folklore. As a consequence, the company has garnered a large following in the business and trade press during the past five years. CEO Michael Dell added to his firm's reputation with his own book about Dell and the business model he created (Dell and Fredman, 1999). A plethora of "how-to" books on "Business the Dell Way," mostly repeating insights from Dell's own book, have followed (Saunders, 2000). There is, in effect, an abundance of available information on the firm. Nevertheless, there are actually few scholarly studies of Dell (i.e. Kenney and Curry, 1999; 2000; Kraemer et al., 1999; Albers, 2000; Kraemer and Dedrick, 2001). With the exception of the study by Albers who worked as an intern at Dell, these works reveal limited access to sources inside the company. As a consequence, much remains unknown about the specific mechanisms of Dell's logistics oriented business organization. Through interviews with Dell managers in supply chain operations and logistics, the present study aims to overcome this gap.

This study uses both familiar, and new facts to position the two firms within an historically-comparative theory of the communications revolution and innovation in networks of production and trade. The aim of the comparison that follows is to reveal new insights about the two firms, the transport and

¹⁰Surprisingly, one of the most celebrated works on the origins of mass production in the U.S. (Hounshell, 1984) does not contain any material on Swift or the meat packing industry.

communications systems they used, the innovations they created, and the economies of both past and present that they helped transform.

Plan for the Study

This study consists of three Parts that follow this Introduction.

Part I, consisting of Chapter 2, establishes the theoretical framework for the study. This chapter creates a model of communications, innovation within the firm and territorial transformation based upon a synthesis of the three literatures on innovation and evolutionary economic change, production networks, and communications revolutions cited above. The model built from this synthesis is an *appreciative* taxonomy that establishes three basic connections: one linking communications revolutions to the entrepreneurial behavior of the firm; the second connecting the entrepreneurialism of the firm to the production network; the third linking the network to patterns of territorial formation.¹¹

Part II focuses on the railroad and telegraph and the case of the G.F. Swift Company. Chapter 3 provides the set-up for this Section by examining how the impacts of rails and telegraphy created preconditions for Swift's beef network in terms of the geography of markets, and the pattern of urbanization during the mid- to late-nineteenth century. It outlines how the rail and telegraph system opened markets for more long-distance, interregional trade, and created a system of cities in which manufacturing and the consumption of manufactured goods became concentrated in large urban areas. Swift, in effect, relied on the rail and telegraph not only for the operation of its highly innovative production and distribution network. The G.F. Swift Company built this network from the interregional markets and entrepôts of consumption concentrated in cities that the rail and telegraph system helped to establish. Chapter 4 examines the story of how Swift used the rail and telegraph infrastructure to create a mass production and mass distribution network for fresh beef that revolutionized the meat industry. This

¹¹On appreciative theory see Chapter 2.

chapter details how Swift created this innovative network, and how it diffused to other firms in the industry. It analyzes how this innovation established new patterns of territorial development in the economy of the late nineteenth century that spread business activity nationally, while at the same time concentrating development in new places, notably Chicago and other cities in the American Midwest. This chapter also examines how Swift was forced to confront the politics of interstate commerce in order to protect the far-flung market for beef it had engineered.

Part III focuses on the Internet and the case of Dell Computer Corporation. Chapter 5 is a mirror image of Chapter 3. It sets up this section by outlining how the Internet evolved from a communications system to an infrastructure for commerce, and how the phenomenon of Internet commerce established the foundations for Dell's innovative production and distribution network. Chapter 6 is the parallel of Chapter 4 and is the case study of Dell Computer. It examines how Dell is using the Internet to organize what is arguably the most innovative production and distribution network of any current manufacturing firm and how it has redefined competitive standards for Internet commerce. The research for this chapter focuses on the operational and organizational mechanisms used by Dell to create its direct model production and distribution network, and the role of Internet communication in enabling this network to function. This chapter also describes the territorial outcomes of this network, and how it has emerged as a paradigm of how global markets actually function.

The concluding chapter to this study subjects the two cases to comparative analysis. It examines the innovations of Swift and Dell both as similar phenomena, and as uniquely tied to the two periods in question. This concluding chapter seeks to intervene in several current, cross-disciplinary debates on the nature of the firm, the relationship of the firm to innovation and economic development, and the nature of production networks in the modern economy. In intervening in these debates and framing conclusions about the two cases of Swift and Dell, this section also aims to uncover the meaning of the communications revolution from past and present. At the core of this revolution is a story of what occurs when the journey traveled by commodities from production to consumption assumes a different character and takes a different route. How fresh beef becomes mass produced, travels across a continent in

breaking the boundaries of localized markets, and in the end takes a more direct path in arriving at the butcher, and how the personal computer is custom-assembled in large volumes and travels across the globe in arriving on the desktop, and the economic development consequences of these routes, are the themes of the story that follows.