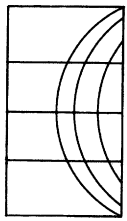

KNOWLEDGE SOCIETY AND THE PROFESSIONS

Steven Brint

Professionals and the 'Knowledge Economy': Rethinking the Theory of Postindustrial Society

The idea that the United States is moving toward a knowledge-based economy has become a commonplace in popular social analysis and public discourse. The idea goes under a variety of labels: 'the knowledge industry', 'the information economy', 'postindustrial society' – even 'post-capitalist society'. In the broadest outline, the thesis is similar whatever name it is given. In the new economy, knowledge has become the key factor in production, diminishing the primacy of capital and labor. In the words of a pioneering theorist of postindustrial society, Daniel Bell, 'If capital and labor are the major structural features of industrial society, information and knowledge are those of post-industrial society' (Bell, 1973: xiii). The 'knowledge sector' is located outside the old iron-belt manufacturing sector. It consists, in most accounts, of new science-based industries and the professional services industries. Professionals and professionally educated managers are the 'knowledge workers' on which the new economy relies. Universities, therefore, are central to the economy for they are the producers of the 'knowledge workers' and are consequently closely tied to dynamic sectors of the new economy.

The idea that knowledge industries are an increasingly important part of advanced economies has its origins in the work of the Princeton economist Fritz Machlup (1962), who calculated that 'knowledge industry' accounted for fully 29 percent of adjusted GNP in the USA as early as 1958. In his Godkin Lectures at Harvard in 1963, Clark Kerr first popularized Machlup's

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ideas. Kerr famously evoked the industry metaphor to describe the increasing importance of research universities, outraging humanist professors and radical students. In later years, the image of a knowledge-based economy appeared in the work of many popular writers on economic and social trends, including Peter F. Drucker (1969), Alvin Toffler (1970) and Robert Reich (1991). Because it crystallized an important feature of the national interest in education, the theme of a knowledge-based economy became a staple also of the writings and speeches of many politicians, including the Speaker of the House during the mid-1990s, Newt Gingrich (Gingrich, 1995) and President Bill Clinton (Clinton, 1997).

With such a corps of popularizers, it is not surprising that ideas about knowledge industries and postindustrial society have thoroughly penetrated public discourse. Eric Schmidt, the CEO of the software company Novell Corporation, for example, recently observed that the people he hires are knowledge workers and that these knowledge workers as a class have distinctive outlooks and tastes – in Schmidt's view, they like living near other knowledge workers in western states where outdoor sports are popular (National Public Radio, 1997). In 1997, Ikujiro Nonaka, much to the chagrin of the philosophy department, was appointed the first 'professor of knowledge' at the University of California, Berkeley. Following one contemporary usage, Nonaka's interests have to do with organizational processes that allow for constant attention to knowledge-based product innovations (Nonaka, 1995).

Ideas about the knowledge economy and postindustrial society have not yet penetrated as far into social science thinking. Most social scientists continue to talk of industrial or advanced industrial societies, or in some cases of capitalist or advanced capitalist societies. Some have been explicitly critical of the 'knowledge economy' idea (Ginzberg, 1976; Collins, 1979; Applebaum and Albin, 1990). Social scientists have been wary for good reason. In the first place, a number of different versions of the idea exist. These vary considerably in the features of 'knowledge-based' economic development they highlight. Many of the theorists have seemed, in the eyes of social scientists, to be using the term 'knowledge worker' more as a status term than as an analytical term. Few of the theorists expressed rigorous ideas about the measurement of knowledge as an economic resource. Some recent trends have also seemed to weigh in against the idea. The dynamism of some purportedly 'knowledge-based' industries – such as education and government – cooled off in the years after the idea's inception (Rubin and Huber, 1986), and many social scientists have been more interested recently in trends toward contingent labor and economic dualism in the services sector (Applebaum and Albin, 1990; Christopherson, 1990).

In this article, I attempt to reformulate the knowledge economy idea in a way that preserves its insights while discarding the social and political

biases, visionary exaggerations, inconsistent conceptualizations, and analytical weaknesses that have given it a dubious reputation among social scientists.

In the first section of the article, I provide an overview of the history of the idea, looking at each of the four major streams of thought on the centers and boundaries of the knowledge economy. In the second section of the article, I attempt to reformulate the knowledge economy idea. I argue that a fundamental choice is necessary between three conceptions of knowledge found in these theories: one that sees knowledge as anything that is intended to create an impression on other people's minds, one that sees it as important only in its direct implications for product innovations, and another that defines it as the verifiable systems of thought generated and transmitted in universities. I argue that the last of these is the most useful conceptualization of the role of knowledge in the economy and that the knowledge sector should therefore be conceptualized as the 'scientific-professional knowledge' (SPK) economy. I show how this conceptualization can reduce the extraneous status and political interest elements in the earlier theories, while meeting other important objections to the idea. Among the most important of these other objections is that educational credentials are a more important factor in the demand for educated labor than the knowledge these workers bring to the market. I discuss the need to look at a very high layer of educated labor and the inseparability of knowledge as a force in production and educated labor as simultaneous agents of knowledge-in-production and employees of organizations.

I provide evidence that the SPK economy is a sizeable, but far from predominant, part of the larger economy. I criticize the tendency of most of the early theorists to assume either a linear or 'S-curve' growth in the size and influence of the knowledge economy. I show that a meaningful conception of the knowledge economy must have a more realistic sense of subsector dynamics to replace the simplistic notions of linearly expanding influence that marred much of the earlier visionary work on the SPK economy. I argue that structural influences on the growth of particular industries in the knowledge economy (including the potential for productivity gains in the different SPK industries, demographic changes related to demand for services, and legal environment-influencing relationships between universities, government and corporations) are necessary features of an adequate social science understanding of this growing sector of the economy. Finally, I differentiate five major subsectors of the SPK economy and show that the conditions and opportunities at work faced by professionals vary greatly by the subsector in which they are employed. In the conclusion of the article, I use this reformulation of the knowledge economy idea to discuss why the social changes associated with the coming of a professionally dominated, knowledge-based postindustrial society have not, by and large, come to pass.

Competing Versions of the 'Knowledge Economy'

The idea of the 'knowledge economy' has three main branches. Although the major branches of the idea are clearly overlapping, any effort to reformulate the knowledge economy idea must make a fundamental choice between distinct ways of thinking about knowledge as a force in economic production. The first branch originates in the work of the Princeton economist Fritz Machlup (Machlup, 1962). Machlup based his work on a conception of information-centered industries whose purpose it is to make an impression, any impression, on the minds of other persons. This is clearly a very broad definition of 'knowledge'. The second branch originates in the work of the Harvard economist J. K. Galbraith and concerns the organization of control and the management of change in large-scale enterprises (Galbraith, 1967). This tradition was radically revised in the 1980s by the management consultant Peter Drucker and his followers to focus on the application of intellect to constant renovation and growth in mature corporations. This revision encouraged a very different approach to knowledge as a factor of production. The only knowledge that counts is knowledge directly related to product development (Drucker, 1993). The third branch, which has much older roots in the utopian writings of Francis Bacon and Saint-Simon, is based on analyzing industries that make particular use of scientific and professional knowledge and of highly educated workers. In this tradition, the central idea is that knowledge transmitted through universities has become an increasingly important engine of economic development. The theorists in this branch have not agreed about which forms of knowledge deserve special attention or why they deserve special attention. Indeed, three distinct emphases exist. The first emphasis, which can also be associated with Galbraith (1967), focused on the 'techno-structure' of highly trained managers, engineers and planners who exercise control and manage change in mature corporations. The second, associated with the Harvard sociologist Daniel Bell (1973), focused on high tech industries and non-profit services (notably, health, education and government). The third, associated with the NYU economist Thomas M. Stanback (1979) and his associates, focused on 'producer services' – that is, finance, accounting, advertising, management consulting and other business services.

The Machlup School: Knowledge-as-Information

Machlup defined knowledge as 'any human (or human-induced) activity effectively designed to create, alter, or confirm in a human mind – one's own or anyone else's – a meaningful apperception, awareness, cognizance, or consciousness' (Machlup, 1962: 30). Knowledge is not necessarily important – or even true – in this definition, as long as it produces an impression on someone's mind. Thus, for Machlup, many kinds of knowledge exist, and

intellectual knowledge is only one kind. In addition to 'intellectual knowledge' associated with liberal education, there is 'practical knowledge' in professions, business, craft and production work, politics and the household; small-talk and pastime knowledge (for instance, information picked up in the popular media); spiritual knowledge; and 'unwanted knowledge' (information outside one's interest and acquired accidentally) (Machlup, 1962: 21–2). It is but a short step from this inclusive definition to a survey of the major sectors of the production and distribution of knowledge in the USA: (1) education (including education in the home, on the job, in church, in the military and in formal educational institutions), (2) research and development, (3) mass media and communications, (4) information machines and (5) professional services.[1]

It is not clear that Machlup applied his definition of knowledge consistently. Machlup admitted that his chapter on professional service industries as part of the knowledge industry was written in 'a somewhat defensive tone' and that the eligibility of some of the service industries 'may be questioned' (Machlup, 1962: 323). Without serious empirical evidence, Machlup argued that the provision of information in the form of advice is 'a very large part' of the 'total activities' of professional firms (Machlup, 1962: 323). Thus, in Machlup's framework, engineering and architectural firms were treated solely as consultative – and therefore information based – whereas clearly some are substantially engaged in the actual construction of buildings and other structures.[2] Even more implausibly, government was included as part of the 'knowledge economy' because 'the formulation of rules and orders and their communication to those subject to them amount to the production of knowledge in the minds of those to whom they are directed' (Machlup, 1962: 325). Thus, Machlup applied what could have been a coherent definition inconsistently in the service of an expansive view of the role of specifically professional knowledge production in the modern economy. In this respect, Machlup could not fully decide on the importance of information in the economy as opposed to the importance of professional knowledge.[3]

Porat and Rubin's eight-volume *The Information Economy* (Porat, 1977; Rubin, 1977) followed the underlying conception of knowledge proposed by Machlup but relabeled it 'information'. Porat also challenged several of Machlup's measurement conventions.[4] An OECD study published in 1981 followed Porat's conventions and discovered significant growth in the 'information economy' throughout the industrialized world. Estimates of the size of the primary information sector varied from 14.8 percent of GNP in Australia to 24.8 percent of GNP in the USA and France (OECD, 1981).

Machlup responded with an ambitious plan for an eight-volume update of his work, completing the first three volumes before his death in 1983. In 1986, two associates, Michael R. Rubin and Mary Taylor Huber, published a summary volume including a comparison of the Porat and Machlup

approaches with data from 1972 and a time series using Machlup's conventions through 1980 (Rubin and Huber, 1986). By this time, the enthusiasm among economists for studying Machlup's 'knowledge industry' had waned. In these years of slow growth in higher education, many had sensed that the 'knowledge industry' might not be quite the rocket booster for the economy that Machlup and others had imagined. Rubin and Huber (1986) acknowledged the 'extremely modest rate of growth' in the 'knowledge economy' between 1958 and 1980 relative to other components of GNP. Indeed, according to their calculations, the Machlupian 'knowledge industry' had rested on a plateau of 34 percent of adjusted GNP since 1972 (Rubin and Huber, 1986: 19).

Some economists nevertheless continued to use a Machlupian approach to the knowledge economy. In the work of Applebaum and Albin (US Congress, Office of Technology Assessment, 1987; Applebaum and Albin, 1990), a measure of 'information and knowledge-intensity' was used to create a taxonomy of firms and industries. The taxonomy was based only partly on Machlup's classificatory criteria, but it nevertheless produced a picture of the 'information-knowledge sector' very similar to Machlup's knowledge industry.

Galbraith, Drucker and Nonaka: The Rationalized Control and Management of Change in Mature Corporations

This stream of thought emphasizes the role of knowledge in rationalizing control and managing change in mature capitalist firms. It is important to emphasize that this argument has never been based simply on the application of technical knowledge to industrial production, since such an application is more or less synonymous with the beginning of the industrial revolution. One of the first great industries, steel production, was the product of advanced knowledge of metallurgy and mechanical engineering. Similarly, the pills produced by the pharmaceutical industry were from the beginning little more than encapsulated knowledge of biochemistry efficiently produced. Therefore, further developments along these lines could hardly be considered a radical break with the past, or as evidence of the rise of an important new sector of the economy.

Galbraith (1967), consequently, focused on how the research, marketing and planning activities of mature firms had led corporations to become more 'knowledge-centered' than before. Because of the needs of corporations to control uncertainties and develop capacities for continued growth, engineers, managers and other educated workers (the 'techno-structure') replaced entrepreneurs and their close associates as the central figures in corporate life. This development enhanced the importance also of the professional associations and research universities (the 'scientific and educational estate'). One difficulty with Galbraith's argument was that corporations had also been

knowledge-based *in this sense* for quite a long time. The incorporation of economic and engineering principles into organization, marketing and planning is a technical development more or less synonymous with the 'managerial revolution' of the last decade of the 19th century and first decades of the 20th, representing extensions of Fredrick Taylor's productivity-enhancing work on job design to other functions in the corporation (Chandler, 1977).

A radical revision in the Galbraithian stream occurred in the 1980s and 1990s, when management theorists began to argue that 'cutting-edge' corporations were 'knowledge-centered' because they had developed tools for creating *self-consciousness* about innovation. According to Peter Drucker, 'knowledge is applied to knowledge itself.' (Drucker, 1993: 20). A follower of Drucker's, Ikujiro Nonaka, described how this process works in 'knowledge-creating organizations' in Japan, where project teams guided by consumer-oriented maxims search for ways to make tacit understandings explicit. At Honda, for example, the guiding principle 'man-maximum, machine-minimum' led to the development of the 'tall boy' sedan – a design that has become standard in the automobile industry (Nonaka, 1995). Many firms try to think systematically about new applications for existing technologies; the most 'knowledge-centered' firms purportedly do so in a more comprehensive and organized way than others (see, for example, Gates, 1995).

Bell: Non-Profit Services and High Tech Industry

Bell's (1973) concept of postindustrial society has been the most familiar version of the knowledge economy idea among sociologists. Certainly, the term has gained wide currency, often taking on meanings far from Bell's intent. Bell's work was intended to describe one *possible* long-term trajectory in social development. It was therefore both more of a speculative essay than a description of actual developments, and it was also more of a social than an economic theory. Bell envisioned a number of possibilities for the future, including the following: Work could become more a 'game between people' than a 'struggle between man and nature'. Science could become a relatively autonomous force in society, capable even of 'taming' the negative consequences of profit-seeking behavior of corporations. A new class of scientific and technical professionals could emerge as an important force in cultural and political life. Women could become more important in society by virtue of their increasing employment in the higher levels of the service sector.

Bell's evocation of postindustrial society showed the imprint of his early socialist sympathies; the new possibilities for social relations in postindustrial society develop out of changes in the economic base of society. In the case of postindustrial society, two economic changes were regarded as particularly

important. The first of these had to do with the increasing importance of non-profit services. Bell argued that as societies develop they move from a reliance on agriculture and mining (primary sector) to a reliance on manufacturing (secondary sector) and finally to a reliance on services. Further, the pattern of services-based industrial growth follows a trajectory of population and wealth. Industrial centers move from services related to the production and movement of goods (such as transportation and repair) to personal services (such as restaurants, hotels, travel, entertainment) and, at the last stage, to knowledge-based services providing access to the 'good life', especially health, higher education, recreation and government. Bell's second emphasis was on the rise of theory-based high technology industries. In Bell's view, science should be considered the great transforming power in the contemporary capitalist economy – increasing productivity while it brings whole new industries to life. 'The new industries . . . the polymers and plastics, electronics and optics, chemicals and synthetics, aerospace and communications – are all science-based' (Bell, 1973: 197–8). However, since it is clear that many industries have been science based from the beginning, Bell emphasized a novel element in the situation: the centrality of theoretical knowledge as a source of innovation (Bell, 1973: xix, 14, 20ff.): 'Most of the new science-based industries (computers, electronics, optics, polymers), unlike industries which arose in the 19th century, are primarily dependent on theoretical work prior to production' (Bell, 1973: 185). With the increasing centrality of theoretical knowledge comes the rise of new intellectual technologies for solving organizational as well as mechanical problems.

Stanback, Noyelle and Sassen: Producer Services

Stanback's work concentrated on the analysis of the services economy rather than the knowledge sector, but he nevertheless played an important dual role in the development of the knowledge economy idea. He was both an influential critic of the idea in the 1970s and, indirectly, a contributor to its revival in the 1980s. As a critic, he showed the many complementarities between goods production and services, and marshaled data to show that no significant trend existed toward the substitution of services for goods in consumer expenditures. Instead, Stanback argued, goods and services were complementary in many ways. The purchase of a boat might, for example, be associated with the purchase of repair services and sailing lessons. He was also among the first to observe the effects of taxpayer resistance and demographic changes in flattening the growth of two key industries in the 'knowledge economy', government and higher education (Stanback, 1979).

As a contributor to the revival of the idea, Stanback promoted an interest in 'producer services' as important engines of growth in the service sector and, therefore, in the larger economy (Stanback, 1979; Stanback et al., 1981). By producer services, Stanback meant services that contribute to the solution

of corporate needs, whether in gaining access to capital, procuring personnel, handling legal problems, or introducing new technology. These are often 'intermediate goods' in the production of final output, but they may be the final output of a firm. Much as in Galbraith, both size and growth contributed to the need for producer services.

> Larger firms need certain functions to be carried out in a more specialized way than do smaller firms. These functions include management, communication and control functions, employee screening, selection and evaluation, employee training, contract negotiating and marketing. Service functions that become increasingly important when the firm is dealing with processes of change include product development, research, strategic planning, and development of new sources of funds, either internal or external. These latter functions are also likely to be more specialized the larger the size of the firm. (Stanback et al., 1981: 55)

Trends toward larger and more differentiated markets and toward larger firms servicing those markets contribute to the rapid growth of producer services. 'Highly differentiated, consumer-oriented products and services have created new niches for small specialty shops and service firms. . . . [The availability of producer service firms, in turn] makes it possible to 'farm out' functions, such as accounting, legal and pension work, and procurement of people' (Stanback et al., 1981: 63).[5]

The other writers in this stream, notably Thierry Noyelle (Noyelle and Dutka, 1988; Noyelle, 1990) and Saskia Sassen (Sassen, 1991, 1994), also came from the world of urban economics. Noyelle and Sassen extended Stanback's analysis to the global stage, observing that Bell's high tech industries were less important in the new urban and global economies of the 1980s and 1990s than financial and business services. In the producer services group, these writers include business services, such as corporate law, advertising, accounting and management consulting, as well as auxiliary services, such as design, cleaning, security and storage (Sassen, 1994: 55). Once again, but on a global scale, organizational size and market reach greatly encouraged this service intensity (Sassen, 1994: 55). Where Stanback was opposed to the term 'postindustrial society' (Stanback, 1979: 98–100), Sassen fused Stanback's emphasis on the growing importance of producer services to the ideas of Bell and others about the role of educated labor in the class structure of postindustrial societies.

The urban economists have, together with Machlup and his followers, been the most scholarly and the least prone to visionary overstatements. They have been careful to differentiate the dynamics and causes of growth among the various service industries. And they have been explicit about negative features of the new economy. Following Stanback's lead, Sassen (1991, 1994), for example, argued that growth of multinational corporations and producer services generated great wealth for the executives of these firms and at the

same time a 'greater share of low-wage jobs than was the case when manufacturing was the leading sector' (Sassen, 1991: 217). They have also provided fascinating, empirically rigorous accounts of the ripple effects of the growth of producer services on amenity and other services in urban economies and on the interrelations of urban centers.

Major Controversies

Existing theories of the knowledge economy are problematic in a number of ways. Perhaps most importantly, the definitions of knowledge as an economic resource or product are incommensurable. Therefore, a choice must be made among the major definitions. Yet this is by no means the only difficulty. Whether consciously or unconsciously, most theorists of the knowledge economy have used language with strong ideological overtones, involving political preferences and misleading status claims. Moreover, the theories, because they have often been based as much on visionary as scientific impulses, including exaggerations about the importance of the knowledge sector in relation to the larger economy. They have also largely failed to appreciate the dynamics behind the growth and organization of the industries in the knowledge sector.

The first three steps in a reformulation of the 'knowledge economy' idea are preliminary in that they are necessary to resolve existing controversies. (1) A choice must be made between the three major conceptions of knowledge in the existing theories. I argue for a conception of knowledge as verifiable systems of thought generated and transmitted through advanced university-level instruction. Several streams of thought must be joined to understand why this knowledge has become increasingly important in the economy. (2) Extraneous political and status elements in the existing theories should be removed. I do this by describing these elements and by maintaining a distinction between practical and scientific-professional knowledge with an understanding that both are economically relevant. (3) An argument must be made about when scientific and professional knowledge should be treated as a central factor of production rather than as a privileged form of labor in advanced capitalist societies.

Choosing among the Definitions of Economically Relevant 'Knowledge'

In theories of the knowledge sector, knowledge has been conceived as 'any impression-making information' (Machlup), 'the organization of understandings and processes intended to yield constant product innovation' (Drucker and Nonaka), and 'economically-relevant systems of thought generated and transmitted in higher education' (Galbraith, Bell, and

Stanback). A strict classification of firms and industries using each of these definitions leads to radically different constellations of the knowledge sector. Therefore, a choice must be made between the three major definitions.

For sociologists, the role of scientific and professional knowledge has been of greater interest than the role of *all* forms of 'impression-making' information or the role of self-conscious and continuous innovation in some 'cutting-edge' corporations. There are many reasons for this, but the primary one is that the topic is closely related to sociologists' long-standing interests in the class structure of the advanced societies. Has the role of scientific and professional knowledge in economic production created a new class? If so, what are the outlooks associated with this class? And how, if at all, has this class or its outlooks changed capitalism?

Although an important part of the choice is inevitably based on the kinds of interests sociologists have in the question of the knowledge economy, it is also true that the other approaches can be criticized on logical grounds. From the sociologists' perspective, Machlup and his followers include a great many industries that are implausibly related to 'knowledge'. Radio and television may make an impression on the minds of audience members, but they are not, by and large, based on the kind of knowledge that can be validated through procedures of organized inquiry. The same is true of education in the home and of the production of some information machines, such as clocks and scales. The views of Drucker and Nonaka are tied to insights about new, more or less continuous processes of innovation in corporations. These may be an important feature of the intellectual technology of some innovative firms. Certainly, it is a topic worthy of the attention of management theorists. However, this is a far narrower and more specialized focus than seems appropriate for a theory of the knowledge sector and its social consequences.

In rethinking the knowledge economy idea, I therefore focus on the economic role of knowledge generated and transmitted by higher education institutions. I label this 'scientific and professional knowledge'. This conception is consistent with the usage of Galbraith, Bell and Stanback, but not with the usages of Machlup, Drucker and Nonaka.

None of the theorists, however, has provided a complete picture of the 'knowledge-intensive' industries or of the major sources of demand for educated labor in those industries. Only by joining the streams of thought originating in the work of Galbraith, Bell and Stanback – and developing them further – is it possible to develop a rationale for paying attention to the SPK economy as a growing, and strategically important, component of the larger economy.

In this way, it is possible to see five separate sources of growth in the SPK economy. (1) Large firms with extensive and highly differentiated markets profit from intellectual technologies that reduce uncertainty in their environments. The creation and implementation of operational and managerial

technologies involves the highly educated people in Galbraith's 'techno-structure'. (2) These developments, as Stanback emphasized, encourage the development of producer service industries, supplying expertise both in-house and out-of-house. (3) In addition, as Bell and others emphasized, some industries relying on new and fast-developing technologies (the computer software and biotechnology industries are the most important current examples) employ high proportions of scientists and engineers who can keep the firm competitive during periods of rapid change. (4) With the increase in national income characteristic of affluent capitalist economies, services in the quinary sector (health, education and recreation) become, as Bell again emphasized, important as a means of access to 'the good life'. (5) In a more highly developed and complex economy with strong private sector and citizen interests in security and human capital development, government takes on new and expanded regulatory and social welfare roles. It too relies on forms of expertise. Taken together, these forces make for a rather impressive river of socioeconomic development and change.

Removing Extraneous Political and Status Elements

Implicit political and social objectives were evident from the beginning in theories of the knowledge economy. As political predictions and social assumptions, these elements have proven to be an embarrassment to the theories.

Machlup deserves to be remembered as a gifted intellectual politician who introduced the sense of social glamour surrounding the knowledge economy idea and helped to frame the outlines of a new coalition of workers located primarily in the tertiary sector of the economy. The incorporation of the term 'knowledge', long associated with culture and morality, into the prosaic field of economic analysis helped to create the connotations of social glamor surrounding the 'knowledge economy' idea in a way that the alternative term, the 'information industry', could not have done. Moreover, by including professional services and government as part of the knowledge industry, Machlup created an important political coalition – a coalition of the educated – spanning key communications industries in the private sector and virtually the whole of the non-profit and government sector.

Extraneous political purposes have biased the vision of some other of the theorists as well. By placing science, health and education (rather than management and producer services) near the center of his postindustrial society, and by highlighting tensions between scientific and business world-views, Bell expressed his latent hopes for the development of a liberal technocracy to guide the emerging postindustrial society. Where Bell used knowledge workers to challenge the competitive premises of business people, Drucker and Nonaka used them to legitimate business. No longer searching for profits, the larger corporations instead had, in their view, come to rely on

knowledge and innovation to provide the means for continuous renovation and thereby to serve the public interest. In this way, it is possible for Drucker to argue that leading corporations are heralding the development of a 'post-capitalist economy'. The politically liberal Galbraith combined both themes in his work: the reconstruction of narrow business outlooks through contact with a variety of educated specialists, and the hope for liberal political leadership from representatives of the scientific and educational establishments.

The use of the term 'knowledge' as a status label has also continued to be a general problem in the theories. If we hear that medicine, technology, higher education and finance are knowledge industries, and the professionals who work in them members of the knowledge class, gradually the convention can become a constitutive principle of every day understandings of social reality. The term 'knowledge worker' is now far along the path of appropriation as a status term by scientific-technical experts and those who idealize them. Clearly, one gains quite a bit more social glamour being a 'knowledge worker' at the cutting edge of postindustrial society than a 'specialist worker' who is, let us say for the sake of argument, employed in an industry that contributes in a moderate way to the GNP.

It is necessary, therefore, to criticize the tendency of theorists to give professionals an honorific label like 'knowledge worker'. First, such a label is not descriptively accurate: All workers have economically valuable, *practical* knowledge and can, in this sense, be considered 'knowledge workers'. Second, the label tends to encourage overgeneralizations about the situation and capacities of professionals and highly educated managers as compared to other workers. The typical portrait is of the global investment banker in a bull market, the jet-hopping academic, or the software engineer in a fast-growing start-up company. It is not of a teacher in a crowded urban classroom, a part-time accountant, or an engineer mired in a dead-end job.

I do not privilege scientific and professional knowledge as much as the earlier theorists did. Instead, following John Dewey (1966), I assume that all workers have economically valuable knowledge and that this knowledge contributes materially to their work performance and therefore to their productivity. At a minimum, workers use rules of thumb and experience to reduce the amount of time and bother it takes to get something done.[6] (For discussions by sociologists of knowledge, see Schutz, 1962; Berger and Luckmann, 1967; Giddens, 1984: Ch. 2, among others.) I assume further that organizations also rely on practical knowledge to create economies of interaction. At the organizational level of analysis, these practical knowledge economies are created by setting the premises of jobs, channeling communication in selective ways, setting up routines of reporting, and relying on limited searches for solutions to problems (March and Simon, 1958).

What, then, distinguishes practical knowledge analytically from the type of knowledge transmitted in higher education? Since Dewey, a number of

candidates have been proposed as distinguishing attributes of the 'advanced' knowledge represented in science and the professions. The knowledge transmitted in higher education is variously held to be: (1) more logically interrelated than other forms, (2) more highly organized in rational, discursively accessible frameworks, (3) broader in coverage, (4) more complex in the amount of information that must be kept in mind, (5) requiring more advanced or refined judgments, (6) more capable of generating abstract concepts and propositions that can then be used to investigate other problems, and (7) based on highly developed investigative methods and analytical tools.

The primary difficulty here is that different forms of 'advanced' knowledge have one or more of these properties, but not necessarily all of them. Furthermore, the various disciplines are distinguished from one another by very different qualities, each of which may entitle them to be considered an 'advanced' form of knowledge, at least in relative terms. Thus, knowledge in the natural sciences (and, to some degree, also in economics) may be characterized as having all seven of the aforementioned characteristics, but it is distinguishable from other forms of 'advanced' knowledge primarily in its levels of mathematical formalization. Knowledge in some of the more historical social sciences is distinguished from many other forms of 'advanced' knowledge by its ability to generate abstract concepts and propositions that can be used to investigate new problems. In law and literature, refined and expert forms of 'case' interpretation are clearly among the most important defining features. Some other fields contain a mix of central attributes. Indeed, the various fields of graduate level study may be united by one property only: they are not self-contained, packaged entities; instead, existing knowledge and methods of inquiry can be used to generate new knowledge.[7] As I use the term, scientific-professional knowledge involves: (1) principles and methods of analysis (in some cases, scientific theory) that can be used to expand the knowledge base, to solve new problems, or to develop new applications; and (2) a continuous body of research aimed at advancing and utilizing these principles and methods. Institutionally, the mental demand of the work is clearly an important organizing factor as well. Not all people are capable of mastering disciplines that are either innately demanding or have been made that way through incorporation into academic study and research settings. Because of this, the mechanisms of educational credentialing and occupational licensing can be used to create a strong and direct link between scientific and professional programs and the industries that rely on graduate degree holders (Freidson, 1986: Ch. 4).

Scientific and professional knowledge can be understood as economically useful in the same sense as practical knowledge *and* at the same time a dominant element in the activities of certain industries, such as health care and legal services. At a minimum, we can say that firms and organizations in

the scientific and professional knowledge sector rely heavily on scientifically and professionally trained experts to accomplish key tasks and to remain competitive.

When is Knowledge the Central Factor in Production?

One final question remains: should professionals be treated as bringing a central resource to economic production, or should they be considered a privileged stratum of workers whose labor is ultimately subordinate to those who own and control organizations? This question strikes at the heart of the knowledge economy idea, because only the first formulation is consistent with an emphasis on knowledge as a factor of production in its own right. In Marxist terms, the question is whether knowledge should be considered analogous to capital or labor.

Professionals should not be confused with owners or managers. They are owners only when they are independent small businesspeople or vested partners in a professional firm. They are managers only when they have taken on administrative roles that occupy a very substantial amount of their working time – in general, this would mean more than half of their working time (Derber et al., 1990). In other cases, they are clearly workers, however privileged they may be.

Salaried professionals are subordinates in relation to all executive decisions. Nor does 'knowledge' necessarily prevail in executive decision-making; instead, market conditions, politics and vision often play more decisive roles. The most important executive decisions have to do with new initiatives and resource allocations. The labor of professionals can, in addition, become subject to rationalization by managers. Professionals can be told how many clients to see, what procedures they can and cannot use, what kinds of support workers will be available to them, and what work can be assigned to these support workers.

Although most scientists and professionals are workers, scientific and professional knowledge can *at the same time* be a central resource in production. The two are not mutually incompatible. Therefore, certain industries can be accurately described as 'knowledge-centered'. Professionals in SPK industries are analogous to athletes in professional sports franchises. Athletes can be told when to practice, for how long, what techniques they can and cannot use and so on. They are clearly workers, however privileged. At the same time, the franchise could not operate without the resource – in this case, high level athletic ability – the workers bring to their work. The question, then, is what kinds of industries rely on scientific and professional knowledge to such a degree that they can be considered 'knowledge-intensive' or 'knowledge-centered' industries?

Theorists of the knowledge economy have often missed the historical dimension of industrial growth and maturation. Are the insurance or the

automobile industries knowledge-intensive? Most of the theorists would likely say that they are less knowledge-intensive than the computer industry. However, both the concept of life insurance and the actuarial studies on which contracts were based were intellectual innovations in their time (Clough, 1946, Ch. 3). The internal combustion engine was, of course, a marvelous technological breakthrough in its time. Our sense of the computer software industry as particularly knowledge-intensive reflects the rapid growth and turbulence in the industry and the constantly upgraded products the industry has been producing in recent years (McLauglin, 1999). These are market factors, not substantive factors of production. Many years in the future, we shall see the same standardization in the computer software industry that a previous generation witnessed in the insurance and automobile industries. Computer software will no longer seem knowledge-based at all, but just another 'off-the-shelf' standard product. Therefore, many industries can be excluded from the SPK sector because their technology and products are sufficiently stable to have become predictable and routine. Railroads are therefore not part of the SPK sector, although at one time they were. The same is true of a great many manufacturing, transport and service industries. By contrast, telecommunications and pharmaceuticals remain part of the formal-knowledge economy, because they maintain active research and product development units, even though their primary organizational emphasis is on production, marketing and consumer service related to highly stable products and technologies.

From this observation, it follows that only three types of industries are 'knowledge-centered'. The first are industries in which the speed of change is an important factor. These are industries in which technological change is fast moving (as in the Internet industry currently) or in which relevant events are fast moving and a number of variables come into play in making decisions (as in the securities industries). The second are industries in which new issues susceptible (at least in part) to expert analysis regularly emerge from an unstable or unpredictable environment (as in the political and the judicial arenas). The third are industries in which the primary activity is providing service to clients and the knowledge necessary for providing the service is embedded in the providers themselves (as in the medical, education and legal services industries). As in goods-producing industries, if services become entirely standardized and commodified, they are no longer part of the SPK economy. (This occurs much less often in services, because these services are based in part on understanding the specific problems of clients.)[8]

We should therefore think of industries and professional occupations as intersecting sets. Only some industries will be based on fast-changing technologies or events, or professional services that require high levels of training and have not as yet been commodified. Similarly, only some professionals and managers will be primarily involved in creative or analytical activities

involving scientific and professional knowledge. (Many will be involved in routine activities much or even all of the time.)[9] These two sets are both relevant to the discussion of the scientific and professional knowledge sector and, so, particularly, is the intersection of the two sets. This intersecting set is properly considered the true core of the SPK economy. However, it is difficult to isolate this core from the available data. Consequently, an industry-based analysis is necessary. In such an analysis, the best measure of the knowledge-intensity of an industry is the ratio of employees with graduate degrees to the entire labor force.

The Scientific and Professional Knowledge Economy: A Reformulation

Once these preliminary steps have been taken, the structure of the SPK sector can be described and analyzed. This reformulation involves the following steps. (1) A clear description of the dimensions of the SPK sector must be developed, including an estimate of its rate of growth over time in relation to other sectors of the economy. (2) A description of the major structural forces bearing on the growth of the SPK sector must be developed. Finally, (3) a typology of subsectors must be developed that can help to explain the large variations in the opportunities and working conditions of the professionals employed in the SPK economy.

This reformulation makes a number of concrete contributions. My description of the dimensions of the SPK economy (the first issue in the preceding paragraph) draws heavily on the work of Galbraith, Bell and Stanback, but it provides a new criterion for classification of industries and new empirical evidence on the size and growth rate of the SPK sector. My analysis of the structural forces bearing on the development of the SPK economy (the second issue in the preceding paragraph) substantially extends the pioneering work of Stanback et al. (1981) by examining institutional relationships as well as forces related to supply, demand and productivity. No previous work on the knowledge sector has adequately addressed the third issue listed.

Dimensions of the Scientific and Professional Knowledge Sector

The existing theories also suffer from the visionary's desire to be at the crest of the evolutionary wave. Because the knowledge economy is regarded by virtually all of the theorists as increasingly important, analyses are often based on overly simplified linear or S-curve models of the growth in size and influence of the knowledge economy. After Machlup famously estimated that the knowledge industry contributed 29 percent to adjusted GNP in 1958, new estimates of the knowledge industry contribution grew past 35 percent with expectations that the knowledge industry would account for half of

GNP before the new millennium (see Burck, 1964; Marschak, 1968; Drucker, 1969). These figures turned out to be overly optimistic (Rubin and Huber, 1986). In the same spirit Bell bases much of his work on the 'dimensions of knowledge and technology' on models of logistic growth in information and technological change (Bell, 1973: 188–212). Even the new urban economists, the most cautious of the contributors to the idea of the knowledge economy, are not immune to overestimating the importance of knowledge-based industries (see, for example, Sassen, 1991: 60).

Estimating the Size of the Knowledge Sector

Employment of high proportions of people with the baccalaureate degree can no longer be used successfully as a criterion for classification in the formal knowledge economy. This is because the US baccalaureate has become a qualification for many jobs that do not require much in the way of higher level training. Durable manufacturing and retail trade are, for example, among the industries that have been the fast-growing employers of college graduates over the last 25 years (Applebaum and Albin, 1990: 61).

A more reasonable estimate of the size of the knowledge sector includes only those industries employing the highest proportion of professionals with graduate degrees. In the following analysis of cumulative General Social Survey (GSS) data (1972–96), I have defined the SPK sector as composed of those three-digit SIC industries whose workforce includes at least 5 percent with advanced degrees (that is, master's degrees and above).[10] I define the industries that fit into this categorization as constituting the scientific-professional knowledge economy (SPKE). SPKE includes: agricultural services, mass media industries, chemicals, plastics, pharmaceuticals, computers and electronic equipment, scientific instruments, banking, accounting, consulting and other business services, health services and hospitals, education services, legal services, nearly all of government and religious organizations.[11] Table 1 provides estimates for the percentage of employees with graduate degrees during the period 1973–96 in three-digit SIC industries classified as part of the scientific professional knowledge sector. Note that standard errors of estimates are potentially large for industries with sample Ns less than 50.

The SPK sector accounts for approximately 36 percent of total employment in the US economy. Virtually every industry that might plausibly be considered part of the knowledge sector is included.[12] The great majority of industries are not, however, part of the SPK sector, including virtually all of agriculture and mining, manufacturing, wholesale and retail trade, and consumer repair and amenity services (such as eating and drinking establishments). Approximately 85 percent of all workers with advanced degrees are employed in SPK. The remaining 15 percent are scattered across the 180 three-digit industries not included as part of the sector.

Table 1 Three-Digit SIC Industries in Scientific-Professional Knowledge Economy

Industry	*Est. Percentage of Employees with Graduate Degrees*	N
Legal services	41.7	96
Colleges and universities	35.9	23
Educational services, n.e.c	29.0	31
Commercial research	27.3	22
Elementary and secondary schools	26.2	595
Social services, n.e.c.	21.9	96
Physicians' offices	18.6	70
Accounting and auditing services	17.8	45
Religious organizations	17.3	52
Pharmaceuticals	16.7	30
Engineering services	16.7	66
Govt administration of human resources	15.9	44
Business management consulting	12.5	40
Security companies	12.0	50
Computer and data processing	11.8	34
Dentists' offices	11.6	43
General govt administration	10.5	133
Govt administration of economic affairs	10.3	39
Industrial chemicals	10.0	50
Electronic computing	9.8	51
Hospitals	9.6	485
Plastics and synthetics	9.5	21
Agricultural services	9.4	32
Motor vehicles and equipment	9.1	22
Printing and publishing	8.6	105
Libraries	8.3	24
Misc. professional services	8.3	36
Health services, n.e.c.	8.0	75
Justice and public order	7.8	167
Radio and television broadcasting	7.7	26
Membership organizations	7.3	39
Credit agencies	7.3	41
Public finance and taxation	7.1	28
Optical and health equipment	6.7	30
Electrical machinery	6.5	77
Newspaper publishing	6.1	49
Banking	5.3	169
Govt national security/international affairs	5.3	187
Business services, n.e.c.	5.0	101

Note: Industries with 20 or fewer employees in sample not included. The following industries with fewer than 20 employees in the sample had percentages of workers with advanced degrees well above 5 percent: non-commercial educational and scientific research (44.4 percent), government executive and legislative offices (33.3 percent), scientific instruments (25.0 percent), agricultural chemicals (25.0 percent), guided missiles and space exploration (18.8 percent), book and stationery stores (12.5 percent), and museums and art galleries (11.1 percent). n.e.c. = not elsewhere classified.
Source: General Social Survey, 1972–96.

Table 2 Gross Product by Industry as a Percentage of GDP, 1959–94 (selected years)

	1959	*1967*	*1977*	*1987*	*1994*
All SPK	**27.2**	**30.0**	**31.4**	**35.1**	**37.0**
SPK industries and services	14.4	15.9	16.9	21.2	23.6
SPK government	12.8	14.1	14.5	13.9	13.4
All other	**72.8**	**70.0**	**68.6**	**64.9**	**63.0**
Agriculture and mining	6.5	4.8	5.4	3.8	3.0
Construction	4.7	4.7	4.6	4.6	3.9
Non-SPK manufacturing	21.3	20.2	17.1	13.2	11.7
Non-SPK transport and utilities	8.7	8.3	8.6	8.6	8.1
Wholesale and retail trade	16.8	16.3	16.4	15.7	15.5
Non-SPK services	15.2	15.6	16.5	19.0	20.8

Note: The SIC changed in 1980. Percentages for 1959–77 are shown for 1970 SICs. Percentages for 1987 and 1994 are shown for 1980 SICs.
Source: Adapted from Yuskavage (1996: 151).

Estimating the Growth of the Scientific Professional Knowledge Sector

How fast is the SPK sector growing relative to other sectors in the economy? Scholarly circumspection rather than visionary prophecy is called for. In the end, the knowledge economy concept is useful only if we recognize that, although it is clearly a growing part of the larger economy, it is far from the largest contributor to the national product.

We can gain a sense of the importance of industries in the formal-knowledge economy relative to other industries by looking at changes in their contribution to GDP over time. In Table 2, I have grouped together SPK sector industries and compared their contribution to GDP between 1959 and 1994 (the last year for which data are available). Because data are not available at the three-digit SIC level, I have used two-digit SIC industry data (Yuskavage, 1996).

In 1994 current dollars, GDP grew from a little over US$500 billion in 1959 to nearly US$7 trillion in 1994. None of the major industry groups in Table 1 declined in absolute size over the 35-year period. Nevertheless, it is clear that the service sector continued its rapid rise as a contributor to GDP – and that the formal-knowledge economy services were particularly robust. Business services increased from just over 3 percent of GDP in 1959 to over 8 percent in 1994. As a set, health, legal, educational and social services increased from just over 3 to nearly 9 percent of GDP. The health industry tripled as a contributor to GDP and legal services more than doubled.

The SPKE is still smaller in the aggregate than other parts of the economy, but it is clearly fast growing. The sector does not, however, include all of the fastest growing industries. During the period 1977–94, nine industries recorded gains of 5 percent or more in real gross product. Three of these – agricultural services, securities and commodity brokerages, and social services – are part of the SPKE, as I have defined it. Other fast-growing industries include coal mining, rubber and miscellaneous plastics products, transportation services and motion pictures (Yuskavage, 1996: 135).

One might, alternatively, argue that the leading export industries should be considered at the center of economic development. Only about half of the leading export industries are part of the SPK sector. In the mid-1980s the largest export industries in the service sector were: transportation (US$17.1 billion in receipts), travel and tourism (US$14.1 billion), insurance (US$7.15 billion), licensing arrangements (US$5 billion) and construction (US$4.8 billion). None of these are typically considered among the knowledge-intensive business service industries. By contrast, exports were much lower in most of the industries considered to be on the cutting edge of the business services subsector of the knowledge economy. They were much lower for accounting services (US$0.35 billion), advertising services (US$0.30 billion), data processing services (US$0.65 billion), legal services (US$1 billion), management consulting services (US$1 billion), telecommunications services (US$1.3 billion), information services (US$1.45 billion), education services (US$1.95 billion), and even software (US$2.55 billion) (Sassen, 1991: 60).[13]

Five Subsectors of the Scientific-Professional Knowledge Economy

The actual situation of professionals within the formal-knowledge economy – their numbers, their prestige and power in relation to managers, their qualifications and pay, and their volume of activity – all varies greatly by the sector in which they are employed. For example, not all members of this supposedly dominant stratum are as well rewarded in the labor market as the theories might lead us to expect. Among professionals employed in autonomous professional firms, only partners reap large earnings and those earnings are often based on their ability to attract and hold clients – a social as much as an expert capacity. Even in the most knowledge-intensive industries, the top stratum of managers and entrepreneurs derives the lion's share of income and wealth (Hacker, 1997). Rank-and-file professionals employed by large organizations are not nearly as well rewarded. Engineers, the largest expert category, are not well paid unless they are very senior, have responsibility for large projects, or have moved into upper management. The same is true of professors, unless (as in the case of law, medical, engineering and finance professors) they have good options outside of academe (Brint, 1994: 67–70).

We can begin to specify the conditions of professional employment only

by looking separately at the major sectors of the formal-knowledge economy. The different sectors are connected to differences in the circumstances of the professionals employed in them.

Characteristics of technology, markets and the organization of production are all important for differentiating sectors of the formal-knowledge economy. Specifically, the key variables defining sectors of the formal-knowledge economy are as follows:

1. *Technology*: is the technology volatile or stabilized?
2. *Markets*: are markets volatile or relatively stable?
3. *Markets*: does the good or service have a particularly high status or practical value for consumers?
4. *Organization of production*: are producing organizations more dependent on technology and distribution channels for performance or are they more dependent on professional services?

The answers to these questions are at the heart of the classification of industries into subsectors of the formal-knowledge economy.

In the subsections which follow, I discuss the five major sectors of the formal-knowledge economy. These are: (1) the entrepreneurial sector; (2) the industrialized sector; (3) the professional services sector; (4) the 'professionalized' bureaucratic and craftwork sector; and (5) maverick knowledge activities. The first three of these are the major sectors of the formal-knowledge economy and the last two peripheral sectors. I also develop hypotheses about the connection between these sectors and specific conditions of the work life of those professionals employed in them.

The Entrepreneurial Sector

The entrepreneurial sector is characterized by high volatility and high potential profitability. It is composed of two types of industries. One type is based on production of new technologies with high consumer demand. The other is based on the production of corporate business services for an elite clientele. In both cases, the profit stakes are high. In high tech production, large mass markets exist. In business services production, mass markets do not exist but clients are wealthy and the services offered are potentially very valuable to them. In both cases, volatility is high. In high tech production, technology is constantly changing and new applications come regularly into view. In business services production, clients have the money to search for the best service providers, the competition is keen, and new markets come regularly into view.

This analysis helps to explain why writers on postindustrial society pointed to such different industries as the main engines of growth in the knowledge economy. Both Daniel Bell with his emphasis on high technology

industries and Saskia Sassen with her emphasis on financial and business services have their fingers on dynamic industries. During the period in which these theories were developed, some business service industries, for example, grew at twice the rate of GNP and none were less than 60 percent higher (Brint, 1994: 48). These are not the most important parts of the economy, but they are fast-changing and fast-growing industries. It is not surprising that they have been a focus of attention.

The entrepreneurial knowledge sector is organized around the work of a particular expert occupation (such as software engineers or management consultants) and, not surprisingly, firms have high professional to manager ratios and flat organizational hierarchies. Among professionals, competition for employment in successful firms is higher than anywhere else in the knowledge economy. These firms attract the most highly qualified and motivated young professionals, pay the highest beginning salaries, and can create high levels of wealth among those who obtain shares in the firm through vesting in partnerships or as a benefit attached to promotion.

Often, high tech and business services firms in the formal-knowledge economy are associated with the new, more participative forms of firm organization. This makes them appear not just economically successful, but possibly also heralds of a new and better stage of capitalist firm organization. But firms in the entrepreneurial sector are not necessarily small. Nor are they necessarily less formalized or organized than other firms. In fact, once a successful product is devised, it is imperative for high tech firms to have a large organization behind them to handle regulation, mass production and mass distribution. Therefore, as soon as high technology start-up companies develop a successful product, they develop an alliance with a large company for purposes of production and distribution, or they become large themselves. Microsoft, for example, now employs some 17,000 people (Gates, 1995). Similarly, investment, brokerage and other business service firms can also be very large – with tens of thousands of employees. In the mid-1980s, the five largest accounting firms had worldwide fees of over a billion dollars and staffs of 20,000. Worldwide revenues in the hundreds of millions of dollars were found among the leading management consulting firms and the leading advertising firms. The largest law firms had legal staffs of 1000 lawyers and did enough business that some senior partners earned more than US$1 million a year (Noyelle and Dutka, 1988; Brint, 1994). Large organizations allow managers to draw on many types of specialized expertise, if necessary, for staff to handle larger caseloads, and for the firm to market the company's name most efficiently.

If they become large, firms in the entrepreneurial sector must, however, find ways to continue to be innovative. Even very established firms try to replicate the creative pace of small firms at the departmental or project team level. They usually do so by hiring the top talent and by decentralizing

research and product development processes. Still growing firms in these industries encourage the active involvement of asset-holders and workers alike, replacing the classic capitalist firm order of passive asset holders, active management and deskilled labor with a new order of active capital, active management and smart labor.

The Industrialized Sector

Business services and high tech industries do not have the same trajectory over time. Elite investment and business service firms can remain entrepreneurial because they cater to a class rather than a mass market. High tech firms with mass markets have no choice but to gravitate in the direction of the industrialized knowledge sector, once technology and product forms have stabilized.

Many industries have changed from entrepreneurial to routine mass production industries. This is what happened in the insurance and automobile industries – at one time industries based on exciting new knowledge – and it is what will happen in the computer software and biotechnology industries (although perhaps not for many years). As products and technologies stabilize, knowledge becomes embedded in standard, slowly changing forms.

Formal knowledge continues to play a role in the industrialized sector, but it is only one component of the production process. From the perspective of contingency theory, firms in the industrialized sector are characterized as commodity-producers operating under conditions of a stabilized technology. Furthermore, as mass production organizations, they depend on investments in technology and distribution more than on investments in professional services.

In general, in the industrialized sector organizational energy shifts away from the specialized professional labor force, just as it does in other large commodity-producing sectors. Because most production is routine and markets are large and scattered, the largest amount of organizational energy goes into coordination. A high manager to professional ratio exists, organizational hierarchies are steep, and most professionals are management service professionals (accountants, management computer analysts, public relations and personnel specialists and so on), rather than scientists or engineers with advanced degrees. Seniority is more important than qualifications in salary setting and promotions. Firms in the industrialized knowledge sector pay managers well and professionals less well. Because responsibilities are well specified and support services are available, the pace of organizational life is somewhat slower for professionals than in either entrepreneurial or professional service industries. The classic industrial pattern of relatively passive capital, extremely active management, and substantially deskilled labor is typical.

Professional salaries are high only in industries that monopolize the

provision of a critical resource (such as petroleum) or have benefited from high barriers to entry in relation to a product that has been insatiably demanded by government or private consumers (such as military hardware or prescription pharmaceuticals). Insofar as they intend to remain innovative, firms in routine industrial production try to retain a culture of innovation among their product development or purchasing teams. Scientists are primarily involved in new product lines, although some may have responsibility for maintaining quality in established product lines.

The Professional Services Sector

Professional services are, quantitatively, the core of the formal-knowledge economy. These industries are produce services rather than commodity producing, and the technology they use is relatively stable. Their clients are not uniformly high status, but the services they offer have high status or practical value to clients. Most specialties and professional organizations in medicine (including mental health), dentistry, higher education, law and architecture fit in this sector. So do most business service firms that are situated below the top of the market.

Health and higher education are the largest industries in this sphere. Bell states the reasons for the prominence of the health services industry well: 'The claims to the good life which the society has promised become centered on the two areas that are fundamental to that life – health and education. The elimination of disease and the increasing numbers of people who can live out a full life, plus the efforts to expand the span of life, make health services a crucial feature of modern society' (Bell, 1973: 128). One might say that the growing importance of educational qualifications for access to the better-paid and most prestigious positions in the occupational structure, together with the growing importance of analytical skills in jobs employing postgraduate labor, increase the importance of higher education.

The professional services group has been able, by and large, to remain independent of corporate control for two reasons. First, they provide services that are difficult to standardize and that individual clients are willing to pay for. Second, the contribution of professional services to the performance of the organization is greater than the contribution of technology and distributional activities. The first increases the power of professionals and the second reduces the need for the high levels of capitalization and organization that corporations seem best able to provide efficiently.

Where the service has a political constituency to support its provision as a 'public good', the industry is organized as a non-profit or government activity. Elsewhere, it is organized as a profit-making activity with professional ownership and control. There are some qualifications necessary, however, to this generalization. Doctors have been able to organize in for-profit group practices, while delegating responsibility for long-term care and

specialty technology to non-profit or for-profit hospitals, a unique arrangement. Higher education services can be provided only by organizations involving a number of quite distinct specialty groups and substantial cost in technology and other equipment. This increases the management influence and reduces the professional influence somewhat.

In general, however, the manager to professional ratio is high in the professional services sector, and the manager to professional salary ratio is low. Professional salaries are comparatively high and increase substantially with rank or advancement to partnership. The prominence of professionals in the organization is much greater than in the industrialized sector and quite often as great as in the entrepreneurial sector.

In most cases, it is possible to intensify the utilization of professional services and professionals, consequently, tend to see many clients or process many materials during a typical day. Although good data are not available, the pace of professional life should be relatively fast and demanding compared to the pace of professional life in the industrialized sector, but not as fast-paced and demanding as professional life in the entrepreneurial sector. The professional services sector is highly stratified by the market situation and wealth of employing organizations. Qualifications for access to the better situated and wealthier organizations in this sector are higher than in the industrialized sector, and in some cases also as high as in the entrepreneurial sector.

The Professional Periphery

Professions are the characteristic form of the organization of educated labor. They provide a model even for many non-professions employing educated people of middle-class aspiration. Because of this, it is possible to speak of professionalized work environments, even in the absence of labor markets organized rigorously through the credential system and even in the absence of work clearly involving the application of a body of formal knowledge.

These professionalized work environments are typical of organizations and industries with a close relationship to the formal-knowledge economy – either because production staff are in close and regular contact with professionals, or because hiring is based on advanced educational qualifications, even though the work itself does not necessarily involve the application of formal knowledge. Librarianship and parts of government are good examples of the former; school teaching, social work and parts of the news media are good examples of the latter. It is reasonable to consider these spheres as a periphery of the formal-knowledge economy. In most cases, the prominence of these 'quasi-professionals', their qualifications and pay reflect this peripheral situation. In a few occupations on the periphery of the formal-knowledge economy, the size of the market served makes a large difference. This is particularly true of journalism. Senior reporters and editors in the

national media earn more than twice as much as their counterparts in the small regional markets. In television, salaries are very closely aligned to the size of the market in which the professional personnel are working. Here the major economic principle is this: the larger the market, the higher the price of the advertising minute, and, consequently, the higher the salaries of the professional people who help to attract potential consumers to the medium (Brint, 1994: 71–2).

Maverick Knowledge Activities

To complete the picture of the formal-knowledge economy, it is necessary to mention work that has not yet found a viable commercial or public purpose. Maverick knowledge is the work of inventors who dream of practical applications, but have not yet realized their aspirations. Some important industries in the formal-knowledge economy, including personal computer software (Gates, 1995), laser technologies, and even new financial instruments (Stearns and Allan, 1996) began as maverick knowledge activities, though often within established industries.

Existing data cannot be disaggregated by the major sectors discussed in the preceding subsections. However, it is possible to gain a sense of the relative significance of the domains in which professionals are employed by looking at the distribution of workers with advanced degrees by functional spheres.

If we look across all industries, we see the following distribution of workers with advanced degrees (see also Table 3):

- 36 percent are employed in professional services (primarily health, higher education, religion and law);
- 27 percent are employed in human services (primarily social services and elementary and secondary education);

Table 3 Public and Non-Profit Sector Employment by Industry Group Scientific–Professional-Knowledge Economy

Industry Group	*Percentage of Workers with Advanced Degrees*	*Percentage Non-Profit*
Professional services	36	20
Human services/media	29	25
Business services	10	0
Government	8	8
High tech industry	7	0
Other	10	2
Total	100	55

Sources: General Social Survey, 1972–94; Brint (1994).

- 10 percent are employed in business services;
- 8 percent are employed in government;
- 7 percent are employed in high tech industries;
- 2 percent are employed in the mass media.

The size of the human services and government groups help to explain why the formal-knowledge economy is predominantly a non-profit economy. In particular, only a small fraction of human services workers are employed in the private economy.

Conclusion

It has become a commonplace that professional knowledge is becoming more important in the economies of advanced capitalism. However, theorists do not necessarily agree on why this is so. Three separate streams of thought give rise to the 'knowledge economy' concept: (1) ideas about the management of innovation in mature corporations; (2) ideas about the rise of consumer services and high tech industry; and (3) ideas about financial and business services.

I have argued that a better representation of the 'knowledge economy' and of the role of professionals in it is possible if we aggregate these views and then differentiate sectors of the knowledge economy. By looking at industries that employ a comparatively large proportion of professionals with advanced degrees, I have traced the boundaries of the formal-knowledge economy. This economy includes business service industries, high technology manufacturing industries, professional services industries, some mass media industries and large parts of government. I have shown that this economy is a fast-growing part of the larger US economy, but one that still accounts for substantially less than two-fifths of GDP. I have used a version of contingency theory to define three major and two minor sectors of the formal-knowledge economy and to hypothesize sectoral influences on the distribution, prominence, qualifications, pay and work pace of the professional labor force employed in each sector.

Some may feel that the framework presented in this article runs counter to the one I developed to analyze the political economy of expert labor in *In an Age of Experts* (Brint, 1994). I do not see any contradiction between the two. The framework in this article is meant to contribute to analysis of that part of the total professional labor force working in the most knowledge-intensive parts of the economy. By contrast, the analysis in my book was intended to have a broader application to the professional labor force as a whole (including professionals with lower level qualifications). The earlier analysis remains entirely relevant to understanding the socioeconomic bases of political divisions among the broad stratum of professionals.

Notes

1 Machlup acknowledged that 'knowledge work' goes on outside the knowledge industries, but argued that a choice must be made between an industrial and an occupational approach to defining the boundaries of the knowledge economy. For purposes of economic analysis, an industrial approach is preferable in his view since national accounts information is organized by industries. Therefore, a lawyer working in a legal firm is part of the knowledge industry, but a lawyer working for a manufacturing corporation is not. One is involved in an industry that produces information and advice; the other in an industry that produces things.

2 Occasionally, he was required to compromise. Surgeons apply medical knowledge to transform the bodies of patients (and therefore could not be considered part of a knowledge industry). Machlup therefore divided the medical services industry in half, with the advice-giving half considered to be part of the 'knowledge economy' and those working on bodies excluded.

3 According to one of his later collaborators, between the publication of his first book on the subject and his death in 1983, 20 large file drawers of new material on the various branches of the knowledge industry were collected by Machlup and his graduate assistants. See Rubin and Huber (1986: 4).

4 He simplified the analysis of national income accounts data by eschewing many of the finer estimates favored by Machlup. He measured the contribution of the 'information industries' through a 'value-added' approach rather than a 'total sales' approach and introduced a distinction between 'primary' and 'secondary' information sectors. In this approach, primary information sectors were those in which firms supplied information goods and services exchanged in a market sector. The secondary information sector produced for internal consumption by government and firms outside the information economy.

5 Stanback's interest in producer services stemmed from his work as an urban economist; an early study discovered the decreasing importance of manufacturing-dominated cities and the continuing strength of metropolitan centers of trade and business services.

6 Insofar as this is true, it makes sense to talk about practical knowledge economies at the individual level. Thus, in a 'conservative test' of the proposition that ordinary knowledge is a factor of production, Kusterer examines the knowledge-based activity of machine operators in a factory that makes cones for foods and beverages.

> The basic knowledge of machine operators includes all the procedures necessary to routinely carry out their work task: how to start and stop the machine, clean it in the prescribed manner, 'bridge' the cones, unfold the boxes, pack the cones, label the cases, etc. Supplementary knowledge includes all the know-how necessary to handle the obstacles to this routine work performance that arise from time to time: how to keep the machine running, keep the inspectors happy, secure the cooperation of mechanics and machine handlers, etc. (Kusterer, 1978: 45)

7 This leads to difficulty in finding the right term to distinguish practical knowledge from these various forms of intellectual knowledge. It would miss the point to label the economic sector organized around scientific and professional knowledge as the

'expandable' or 'regenerating' knowledge economy. The term 'advanced-knowledge economy' would introduce problematic status elements in another form. 'Formal-knowledge economy' is not quite accurate, since many crafts can be formalized in the weak sense of the term (that is, knowledge organized around analytical ideas communicated in written or other media) and, on the other hand, most professional disciplines are not formalized in the strong sense of the term (that is rendered in mathematical formulas). In the absence of a better term, I will therefore use the term 'scientific-professional knowledge' (SPK) economy or sector.

8 This analysis should make clear my reservations concerning Bell's (1973) emphasis on theoretical knowledge as the new element in science-based industries. As has always been true, empirical and theoretical activities have both been important in the development of new industries.

9 Clearly, a good many professionals with advanced degrees do not use much expert knowledge on their jobs. Studies of two leading professions, doctors and lawyers, show that rank-and-file practitioners frequently rely on standard reference works and accumulated experience as a basis for many of their decisions (Hogan, 1979; Schon, 1983) and this is also true of many engineers and professors (Derber et al., 1990). Recently, a colleague, Robert Lien, and I interviewed a number of people in two southern Californian cities about the kinds of knowledge they use in their work. We found that professionals, as much as other types of workers, rely on knowledge based on experience and 'feel' for situations as much or more than they use formal, disciplinary knowledge. One engineer we interviewed, for example, observed that the most important part of his work is learning what clients want, and he has learned to ask several questions at the beginning of a job to raise the probability that he is on the same track as the client. This is a kind of knowledge that allows for a practical economy of motion, but it is not the kind of technical expertise that theorists of the knowledge economy emphasize.

10 Industries employing fewer than 20 people in the cumulative GSS data were treated differently. Here I raised the cutoff point to 15 percent to protect from biasing due to sampling distribution. Industries employing fewer than ten people in the cumulative GSS data were excluded altogether.

11 Specifically, the following three-digit SIC codes are part of SPKE: agricultural services, agricultural chemicals, newspaper publishing, printing and periodical publishing, radio and television broadcasting, industrial chemicals, plastics and synthetics, pharmaceuticals, electronic computing, electrical machinery, motor vehicles and equipment, guided missiles and space vehicles, scientific instruments, optical and health equipment, banking, credit agencies, securities and brokerage companies, commercial research, business management consulting, computer data processing services, other business services, physicians' offices, dentists' offices, optometrists' offices, other health practitioners' offices, hospitals, other health services, legal services, elementary and secondary schools, colleges and universities, libraries, other educational services, social services, religious organizations, membership organizations, engineering services, accounting and auditing services, non-commercial educational and scientific research, miscellaneous professional services, general government administration, justice and public order, public finance and taxation, administration of human resources, administration of economic affairs, and national security and international affairs.

12 Among those missing from the list: the telephone industry, art galleries and museums and insurance. Each had nearly a high enough percentage of workers with advanced degrees to be included.
13 Sassen's discussion of export industries relies on Office of Technology Assessment data that use both direct exports of US firms and their overseas affiliates.

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