Chapter 1

SIZE, STRUCTURE AND GROWTH OF THE US INFORMATION ECONOMY

Uday M. Apte[1] and Hiranya K. Nath[2]

[1]Graduate School of Business and Public Policy, Naval Postgraduate School, 555 Dyer Road, Monterey, CA 93943; [2]Department of Economics and Intl. Business, Sam Houston State University, Huntsville, TX 77341-2118

Abstract: This paper presents the results of our empirical research in measuring the size and structure of the US information economy in 1992 and 1997, and in assessing the growth experienced by different industries and sectors since Porat's research on the US information economy in 1967. The study indicates that the share of the information economy in total GNP grew from about 46 percent in 1967 to about 56 percent in 1992, and to 63 percent in 1997. The study further indicates that during this time period the share of service sector information activities in total GNP increased substantially, while the shares of non-service sectors declined correspondingly. The industries displaying the highest growth rates include business services, and medical and educational services. The paper also provides a critical assessment of Porat's methodology and suggests specific improvements that may be made to obtain a more plausible measure of the size and structure of the information economy.

Key words: information economy; primary information sector; secondary information sector; input-output analysis; services

1.   INTRODUCTION

That we live today in an information economy is a frequently encountered assertion that few people would have any disagreement with. However, to our knowledge, in the past few decades since the pioneering research work of Machlup (1962) and Porat (1977)[1], comprehensive studies concerning the size and structure of the information related activities in the

---

[1]   Porat started this study and Rubin joined him later. We will refer to this study as Porat (1977).

US have been few and far in between[2]. Hence, the current research is specifically aimed at measuring the size and structure of the US information economy based on the latest available data. Other main objective of the research is to compare the results of the current study with those of Porat's study so as to identify the sector/s and industries that may have experienced the fastest growth in their information related activities. It is expected that the results of the current research will unveil new directions for future fruitful research in today's information economy.

In developed economies today, information has come to play an important role in almost every walk of life. For example, consumers can make more informed decisions today in their purchasing activities. Producers, on the other hand, can now decide more easily on what to produce, how to produce, and for whom to produce. The unprecedented progress of computers and communications technology in last few decades has increased the information intensity of most activities in value chains (Apte and Mason (1995)). In brief, information is increasingly holding 'the key to growth, output, and employment' (Martin (1988)), a role that was played in the past by traditional factors of production such as land, labor and capital in the industrial society. The all-pervasive impact of information revolution also has important implications for the economy at macro level in terms of the increasing share of information activities in national income. Hence, we believe that it is important to measure the size, structure and growth of the information economy in the US.

As we have already mentioned, there exist two well-known studies, which have tried to define and measure the so-called information economy. Fritz Machlup's 1962 study is one of the first attempts to conceptualize what he calls the 'knowledge industry' and to present a comprehensive statistical profile of this industry. This study provides a conceptual framework for research into quantitative as well as qualitative aspects of knowledge-based information activities. It identifies the components of the 'knowledge industry' and measures its contribution to Gross National Product (GNP). According to Machlup, 29 percent of the US GNP was generated by the knowledge industry in 1958.

In 1977, Marc Porat undertook an extensive study of information based activities in the US economy on behalf of the U. S. Department of Commerce. Using a conceptual framework similar to that of Machlup, he measures the size and structure of the US information economy in 1967. However, to define and measure the information economy, Porat adopts an approach that is quite distinct from the one used by Machlup. He strictly

---

[2] Recently, the U.S. Census Bureau, in their 1997 Economic Census, has created a new 'Information Sector'. However, as we will discuss, the scope and size of this new sector is much smaller than most earlier studies suggest.

follows the national income accounting framework. Machlup, on the other hand, includes a number of economic activities that are not part of the national income accounts. The difference was about a choice between orthodoxy and completeness. Machlup's approach would require a new system of national accounting if one wants to analyze the information sector ('knowledge industry' a la Machlup) within the broader concept of the national economy. Porat recognizes Machlup's innovation and its novelty but justifies his stance in using conventional national income accounting framework: "the concept of an information sector was sufficiently new that a simultaneous overhaul of the GNP scheme would confuse and obfuscate more than it would help" (Porat, 1977, vol.1, pp. 45). Moreover, the compilation and manipulation of data is significantly easier using Porat's method that makes use of the BEA National Income Accounts that already exists. However, it has its limitations. Because the BEA data are collected largely at the four-digit SIC level many of the information activities which can only be identified at a high level of disaggregation are not included in Porat's method.

Moreover, Porat in his study distinguishes between "primary" and "secondary" information sectors whereas Machlup does not make any such distinction. The primary information sector includes industries that produce information goods and services for the market. The secondary information sector, on the other hand, includes information activities that are used as inputs in the production of other goods and services. The measurement of the secondary information sector requires dividing 'noninformation' firms and industries into two parts: one is involved in 'pure' non-information activities and the other is involved 'pure' information activities. Machlup argues that this approach "mixes information inputs in industries outside the information sector with outputs of industries in the information sector" (Machlup 1980, pp. 240)

Finally, Machlup uses "final demand" whereas Porat uses "value added" as the measure of GNP[3]. Thus, Machlup's method is based on measuring GNP by product sales and Porat's method is based on measuring GNP by income. Although the total for each of these measures will be the same for the entire economy the total for individual industries can vary substantially. Porat justifies the use of 'value added' on the following grounds. "First, it allows the researcher to measure the cost of the secondary information services directly. Second, value added is a more accurate measure of wealth and income originating in the economy since it is insensitive to the cost of goods sold. An item with costly intermediate purchases will "sell" more to final demand since its output price will be correspondingly higher. Two goods with with identical wealth-generating attributes could have very

---

[3] For a detailed discussion on the differences see Huber and Rubin, 1986, Chapter II.

different final demand sales, depending on the use of the item." (Porat, 1977, vol. 1, pp. 47). However, as Huber and Rubin (1986) later concede, 'the depth of detail is substantially greater when the Machlup method is used....' although it '...could overstate the size of the knowledge industries compared to GNP, if care is not taken.'

The methodology developed by Porat is subsequently employed by the Organization of Economic Cooperation and Development (OECD), to study the information sectors in nine of its member nations in 1978 and 1979. The results were published in 1981 under the title Information Activities, Electronics and Telecommunications Technologies: Impact on Employment, Growth and Trade. This study shows that the share of the primary information sector in the US GNP increases from 19.6 percent in 1958 to 24.8 percent in 1972 (OECD (1981), Table I.8). The contribution of the secondary information sector, on the other hand, increases from 23.1 percent in 1958 to 24.4 percent in 1972 (OECD (1981), Table I.10)[4].

Machlup planned an ambitious project of bringing out the series Knowledge: Its Creation, Distribution and Economic Significance with ten volumes highlighting different aspects of knowledge industry. However, because of his untimely demise this project remained unfinished with only three volumes having been published. Nevertheless, as a sequel to his unfinished work, Michael Rubin and Mary Huber brought out a volume in 1986 entitled The Knowledge Industry in the United States: 1960-1980. Following Machlup's methodology, this study presents measurements of knowledge industry for the years when the U.S. Bureau of the Census conducted economic censuses. These 'census years' include 1963, 1967, 1972, 1977 and 1980. Contrary to expectations of high growth of the knowledge industry as documented by Machlup in his 1962 study, they find that its contribution to the US GNP increased from 29 percent in 1958 to only about 34 percent in 1980.

In this paper, following Porat's definitions and methodology as closely as possible, we estimate GNP accrued to the information related activities in the US in 1992 and 1997. Our results confirm the findings of the OECD study (1986): the primary information sector is growing faster than the secondary sector[5]. We also examine in detail the contributions of various sectors, particularly of the service sector, to the rapidly growing information activities. Discussion of the analysis we conduct and the results we find are the main subject matter of this paper.

The rest of the paper is organized as follows. The second section discusses the main concepts and definitions. The sources of data and the

---

[4]   See Appendix Table A.1
[5]   During 1992-97 this does not seem to be the case. However, as we will discuss, it may
       have to do with the recent reclassification of industries.

computational methodology are described in section three. The fourth section presents the measures of the size and structure of the US information economy in 1992 and 1997. It includes a comparison of these measures with the measures for 1967 as reported by Porat, and a discussion on the growth of various sectors of the economy during the 1967-92 and 1992-1997 time periods. It also analyzes in detail the growth of the information components of the service sector between 1967 and 1992, and between 1992 and 1997. In section five, we include a discussion on the 'information sector' as defined and measured by the U.S. Census Bureau. Section six critically evaluates Porat's approach and suggests certain improvements for arriving at more plausible measures of the information economy. The last section briefly indicates the direction of future research and makes a few concluding remarks.

2.   CONCEPTS AND DEFINITIONS

In order to measure the information economy, Porat divides the economy into two distinct but inseparable domains: one 'involved in the transformation of matter and energy from one form into another' and the other 'in transforming information from one pattern into another' (Porat (1977), vol.1). The second domain is referred to as information economy. The notion of information economy rests on the concepts of 'information' and 'information activity'. Porat defines information as the 'data that have been organized and communicated,' while his operational definition of information activity encompasses 'all workers, machinery, goods and services that are employed in processing, manipulating and transmitting information.'

He then divides the information economy into two sectors: 'primary information sector' and 'secondary information sector' (PRIS and SIS respectively hereafter). The PRIS is defined as one that includes all industries which produce goods and services which intrinsically convey information or are directly used in producing, processing or distributing information for an established market. The broad categories of PRIS industries are: (1) knowledge production and invention: private R&D and private information services; (2) information distribution and communication: education, public information services, telecommunications etc.; (3) risk management: insurance and finance industries and others; (4) search and coordination: brokerage industries, advertising etc.; (5) information processing and transmission services: computer based information processing, telecommunications infrastructure etc.; (6) information goods: calculators, semiconductors, computers; (7) selected

government activities: education and postal service; (8) support facilities: buildings, office furniture etc.; (9) wholesale and retail trade in information goods and services. These major categories, in turn, are composed of hundreds of industries.

The SIS, on the other hand, is defined to 'include all information services produced for internal consumption by government and non-information firms.' It comprises most of the public bureaucracy and all of the private bureaucracy. It includes 'the costs of organizing firms, maintaining and regulating markets, developing and transmitting prices, monitoring the firm's behavior and making and enforcing rules' (Porat (1977), vol.1). The public bureaucracy comprises all the informational functions of the federal, state and local governments. Governments perform planning, coordinating, deciding, monitoring, regulating and evaluating activities. Those portions of public bureaucracy which have direct analogs in the primary information sector - such as printing, law and accounting – are, however, included in the primary sector for accounting purposes. It should also be noted that education is one of the largest components of public bureaucracy that is included in the primary sector.

The private bureaucracy, on the other hand, is that portion of every non-information firm that engages in purely informational activities. It produces information services similar to those in the PRIS, such as data processing and library services. Conceptually, they are the informational costs of providing a non-information good. However, these information services are not sold in the market and hence are included in SIS.

3.   DATA SOURCES AND COMPUTATIONAL METHODOLOGY

The main source of data for this study is Benchmark Input-Output (I-O) Tables for 1992 and 1997 as compiled by the Bureau of Economic Analysis (BEA) of the US Department of Commerce. Note that the 1997 I-O table is the most up-to-date table currently available. The BEA compiles the underlying statistics for the construction of the benchmark I-O tables at 5-year intervals. This compilation takes several years and that is why the 1997 I-O table was released only in 2002. Other important data sources include (1) 'National Income and Product Accounts' (NIPA) detailed tables on 'Income, Employment and Product by Industry' as compiled by BEA; (2) Occupational Outlook Handbook, 1994-95, and Occupational Employment Statistics for 1992 and 1998, both published by the Bureau of Labor Statistics (BLS), U.S. Department of Labor; (3) 1997 Economic Census: Summary Statistics for United States (1997 NAICS Basis) and 1997

Economic Census: Information – United States, as available on the Census Bureau's website (www.census.gov).

3.1 Measuring primary information sector

In order to measure the PRIS, Porat identified 25 major 2-digit I-O industries[6] and aggregated them into four broad categories of construction, manufacturing, service and government sectors. Following Porat, we identify the 6-digit information industries within each of these 2-digit I-O categories. Out of 480 6-digit industries included in the detailed I-O table in 1992, we identify 87 industries as belonging to the PRIS. We then obtain value-added figures from 1992 Benchmark Detailed I-O Use Table for each of these 6-digit information industries. Aggregating over 6-digit industries we obtain the information value added at the corresponding 2-digit industry levels.

In the 1997 Benchmark I-O Tables, the I-O industry classification system is, however, based on the new North American Industrial Classification System (NAICS)[7] and therefore, different from the 1992 I-O industry classification. We use Appendix A of Lawson et al (2002) to obtain the 1997 NAICS industries corresponding to the 6-digit 1997 I-O industries, which are then mapped to 1987 SIC industries using a detailed matching between these two different classification systems as available from www.naics.com/files/sic2naics.htm. This exercise helps us identify 63 of 1997 6-digit I-O industries as belonging to the PRIS.

In case of a few industries at 2-digit level, such as communications, office, computing and accounting machines, radio, television and communication equipment, and electronic equipment, the entire industries are identified as belonging to the PRIS. More often, however, only a part of an industry's value added is identified as being information-based.

3.2 Measuring secondary information sector

As we discussed in the previous section, the SIS accounts for the resources devoted to the production of information services for the in-house consumption of private and public bureaucracies. In order to measure the SIS, non-PRIS firms and public bureaucracies are taken apart, in an accounting sense, into an information division and a non-information division. To measure the non-marketed services of the SIS, Porat uses a

---

[6] I-O classification of industries is different from more familiar Standard Industrial Classification (SIC).

[7] Under NAICS, establishments are grouped according to the similarities of their production processes rather than the similarities of their products. For detailed discussion on the changes, see Lawson et al (2002).

rather restrictive definition of value added. According to this definition, value-added of an SIS industry includes (1) employee compensation of information workers, (2) part of proprietors' income and corporate profits earned for performing informational tasks, and (3) capital consumption allowances on information machines. To calculate compensation of information workers, Porat uses a BLS matrix[8] (unpublished) that shows detailed occupational structure of all U.S. industries, together with wages and salaries for various occupations. He imputes the value of proprietors' income earned for performing informational tasks by matching them with information workers in similar occupations and using their salaries as the value of compensation for proprietors for informational activities. Similarly, he uses an unpublished BEA matrix that shows the detailed capital flows of all industries to calculate depreciation allowances on information capital goods.

Our study, however, is mainly based on published data, and hence of necessity, we make a few modifications. The most important one is that since most data are available at the 2-digit level of Standard Industrial Classification (SIC), we use those data for the subsequent quantitative calculations. In order to be consistent with the use of I-O industry classification in our calculation for the PRIS, we also make a few minor adjustments, which are discussed later in this section.

3.2.1   Measuring employee compensation of information workers

To calculate employee compensation of information workers in 1992 a matrix of occupations versus 2-digit SIC industries is compiled from the Occupational Employment Statistics for 1992. This matrix consists of 181 information occupations and 41 2-digit SIC industries in 1992. In identifying the information occupations we strictly follow the scheme developed by Porat. This matrix represents the distribution of information workers over all occupations in all industries. Average/median salaries of information workers are obtained from the Occupational Outlook Handbook, and then each entry in the above matrix is multiplied by the average/median salary for the corresponding occupation to calculate the total employee compensation by industry. As noted earlier, a few exceptions have been made in implementing this methodology. For 'agriculture, forestry and fishing', 'finance, insurance and real estate', 'government enterprises' (federal, state and local) and 'general governments', the data by occupational categories, unfortunately, are not available for 1992. For these industries the shares of

---

[8]   Vol. 6 and Vol.7 of Porat (1977) contain two matrices showing the employee compensation paid to 422 occupations in the 108 industries by I-O classification for 1967 and 1970 respectively.

the SIS in total employee compensation for 1967 are taken from Table 9.2 of volume I of Porat (1977) study, and are applied to the BEA-compiled total compensation of employees in these industries in 1992.

For 1997, we create a matrix of 232 information occupations and 70 2-digit SIC industries from the 1998 Occupational Employment Statistics that also reports the mean hourly wages in different occupations. The survey uses fourth quarter of 1998 as the reference period and adjusts the wage data for inflation accordingly. In order to make them comparable with other components, after calculating the compensation of information workers for each industry group we adjust them back to 1997 values by applying industry-wise GDP deflator calculated from the Bureau of Economic Analysis.

3.2.2   Measuring proprietors' income and depreciation allowances

Data on proprietors' income and depreciation allowances by broad industry groups for 1992 are obtained from the Bureau of Economic Analysis. We need to calculate the shares of these two categories respectively as accounted for by the information activities and information capital. We again apply the percentage shares of the secondary information sector in total proprietors' income, and percentage shares of the SIS in total depreciation allowances by industries, as reported in Table 9.2 of volume 1 of Porat (1977) study, to 1992 figures.

Since these proportions are available for aggregate industries (roughly at 1-digit level of SIC), applying them to 2-digit level industry data would ignore the fact that there could be some variations among 2-digit industries within each of these aggregate industries. To get around this problem, we first calculate proprietors' income for informational activities and depreciation allowances on information capital at aggregate levels (at 1-digit level) and they are apportioned according to the shares of corresponding 2-digit industries in aggregate (1-digit level) employee compensation of information workers, as obtained in the previous subsection. However, we want to make it clear that the procedure we use does not take into account the possibility that over the years the informational activities of the proprietors or relative use of information capital goods may have increased. However, we also want to point out that by using the above-mentioned procedure, we arrive at very conservative estimates of proprietors' income for informational activities and for depreciation of information capital goods. In any case, these two items represent only a very small part of the total SIS, and therefore this method presumably has a negligible impact on the overall accuracy of estimation.

For 1997, however, we use a slightly different approach. The 1997 Benchmark I-O Tables report three components of gross value added for each I-O industry: 'Compensation of Employees', 'Indirect Business Tax and Nontax liability' and 'Other Value Added'. The component 'Other Value Added' mainly includes proprietors' income and depreciation allowances. We use the mapping between 1997 NAICS and 1987 SIC to calculate other value added for each of the 2-digit SIC industry. We then calculate the shares of proprietors' income and depreciation allowances accounted for by information activities in total for 1992, and apply them to the 1997 'other value added' to obtain corresponding components of SIS value added.

As we mentioned earlier, in measuring the SIS we use SIC rather than I-O classification as used by Porat. It is important to recognize that while calculating the value added contributions of different 2-digit SIC industries to the SIS using the procedure described above, we carefully make suitable adjustments for those disaggregated industries, which have already been entirely or partially allocated to the PRIS. Otherwise, it would lead to double counting of parts of value added of PRIS industries. To prevent double counting, we calculate the shares of the 6-digit I-O industries included in PRIS, in total value added of corresponding 2-digit SIC industries. We then apply these proportions to the SIS value added as calculated above, to purge out the pure contributions of the 2-digit SIC industries to the SIS.

By carrying out the above-described computational methodology we arrive at the estimation of the size and structure of the US information economy in 1992 and 1997. The results are then compared with Porat's results for 1967 to compute the growth rates experienced by different industries. The results are presented and discussed in the next section.

4.   SIZE, STRUCTURE AND GROWTH OF THE INFORMATION ECONOMY

Table 1 below presents the value added contributions of primary and secondary information sectors to the US GNP in 1967, 1992 and 1997[9]. As

---

[9]   For comparison, we also append a table (Appendix Table A.1) that presents the size and broad structures of the U.S. information economy for 1958, 1967 and 1972 as measured by the OECD (1981). Although OECD study follows Porat's methodology, the size of the primary information sector is smaller and that of the secondary sector is larger as compared to Porat's estimates for 1967. Overall, OECD measure of the US information sector is larger than Porat's. Note that OECD study calculates percentage shares in GDP at factor cost whereas Porat (1977) uses GNP. As we can see from the table, the information sector accounted for about 43 percent of GDP in 1958. Between 1967 and 1972 the size grew from 48.5 percent to 49.2 percent of GDP. Interestingly, Rubin and Taylor (1981)

seen in Table 1, 55.9 percent of the total US GNP in 1992 was generated in the information sector. About three-fifth of this - or 33.0 percent of total GNP - was generated in the PRIS and the rest was contributed by the SIS. In 1997, the share of the information sector in the total U.S. GNP rose to 63 percent, of which the larger part: 35.2 percent, was accounted for by the PRIS. In comparison, the share of the information sector in the total GNP was about 46.2 percent in 1967. Moreover, the share of PRIS in the total GNP in 1967 was only about 25.1 percent. Thus, it is evident that the PRIS has shown a substantial growth in the 30 years since 1967. During 1992 – 1997, the SIS registered much faster growth.

Table 1-1. Value added contribution of Primary and Secondary Information Sector to GNP in 1967, 1992 and 1997. (Values in millions of current dollars)

Sector	1967	1992	1997
Primary	200,025	2,055,950	2,940,121
	(25.1%)	(33.0%)	(35.2%)
Secondary	168,073	1,427,119	2,317,419
	(21.1%)	(22.9%)	(27.8%)
Information	368,098	3,483,069	5,257,540
[Total value added]	(46.3%)	(55.9%)	(63.0%)
Non-information	427,290	2,750,836	3,088,106
[Total value added]	(53.7%)	(44.1%)	(37.0%)
Total GNP	795,388	6,233,905	8,345,646
	(100.0%)	(100.0%)	(100.0%)

Note: Numbers in parentheses represent percentage shares in total GNP.

Table 2 and 3 show value added contributions of major industries to the primary and secondary information sectors and to the total information economy. Consider first the broad categories of 'agriculture, forestry and fishing', 'mining', 'construction', 'manufacturing', 'services', and 'government.' As we can see from Table 3, the shares of service sector industries in both PRIS and SIS increased substantially over the past 30 years. We observe that the share of service industries was 59.05 percent of total value added generated in the PRIS in 1967 and this share rose to 68.52 percent in 1992, and then to 72.37 percent in 1997. Similarly, the share of service industries in the SIS increased from 45.05 percent in 1967 to 66.64 percent in 1992, and to 72.60 percent in 1997. A part of these increases can be ascribed to the growth of the information components of the service industries. The

---

find that the primary information sector accounted for 24.8 percent of GNP (same number as the OECD study) in 1972, a decline from Porat's estimate for 1967, and observe that while the 'information service industries outpaced the economy as a whole, ... the growth in these industries was offset by a contraction in many of the manufacturing elements of the sector.' .... However, in real terms, 'virtually every industry in the information sector lagged behind the economy as a whole' (Rubin and Taylor, 1981, pp. 164).

emergence of new information services may also have contributed to the faster growth of services in the information economy. However, further research is needed to gain a more complete understanding of the newly emerging information services. The size, structure and growth of information activities in service industries have been discussed in further detail in Apte and Nath (1999).

At a more detailed level of individual industries within the manufacturing and services categories, we can see that in 1967, 'finance and insurance' made the largest contribution (13.01 percent) to PRIS. This was followed by the contributions of 'business services' (11.44 percent) and 'communications services' (8.80 percent). In contrast, in 1992 and 1997, 'business services' constituted the largest component (22.56 percent in 1992 and 24.97 percent in 1997) of the PRIS, followed by 'finance and insurance' (16.61 percent in 1992 and 20.36 percent in 1997) and 'medical, educational and non-profit organizations' (8.51 percent in 1992 and 8.73 in 1997). Evidently, 'business services' have shown a high rate of growth during the 1967-1992 time frame.

Within the SIS, the changes over the span of same 30 years were more dramatic. In 1967, 'wholesale and retail trade' was the largest contributor (25.26 percent), followed by 'transportation equipment' (7.07 percent) and 'transportation services' (4.83 percent). In 1992, the 'wholesale and retail trade' retained its position with 31.25 percent of total SIS value added. However, 'medical, educational and non-profit organizations' (12.79 percent) and 'business services' (11.85 percent) took the second and third positions respectively. Interestingly, in 1997 'medical, educational and non-profit organizations' with 26.45 percent of total SIS value added had the largest contribution, followed by 'wholesale and retail trade' with 20.36 percent. This can partly be explained by changes in I-O industry classification system. As Lawson et al (2002) point out, "….In the 1997 benchmark accounts, 3.1 percent of total value added is moved into these industries, mostly from manufacturing and from wholesale and retail trade" (pp. 20)

For the information economy as a whole, in 1967, the 'wholesale and retail trade' was the largest contributor (15.89 percent) followed by 'business services' (7.99 percent) and 'finance and insurance' (7.23 percent) respectively. In comparison, in 1992, 'business services' had the largest contribution (18.18 percent), followed by 'wholesale and retail trade' (16.12 percent) and 'medical, educational and non-profit organizations' (10.26 percent). In 1997, 'business services retains its position at the top (17.51 percent of total information value added), closely followed by 'medical, educational and non-profit organizations' with 16.54 percent. 'Wholesale and retail trade' finishes a distant third with 11.87 percent.

Table 1-2. Panel A: Value added Value Added of Information economy by Major Industries: 1967, 1992 and 1997. (Values in millions of current dollars.) Sources: Porat (1977) and Authors' Calculation.

Year/Sector Industry	1967			1992			1997		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Agriculture, Forestry and Fishing	0	467	467	0	3401	3401	0	9969	9969
Mining	0	1512	1512	0	13242	13242	0	22556	22556
Construction	8527	13243	21770	58752	72781	131533	94550	72692	167242
Manufacturing	32693	57879	90572	229434	234393	463827	267649	360365	628014
Food and kindred products	0	5248	5248	0	17448	17448	0	25724	25724
Tobacco products	0	254	254	0	692	692	0	1625	1625
Textile mill products	0	1373	1373	0	6677	6677	0	7410	7410
Apparel and other textile products	0	2670	2670	0	8748	8748	0	10062	10062
Lumber and wood products	0	1069	1069	0	6811	6811	0	9506	9506
Furniture and fixtures	528	777	1305	4384	3651	8035	6497	5512	12009
Paper and allied products	1539	2109	3648	2399	7707	10106	2520	12758	15278
Printing and publishing	10224	565	10789	83868	9743	93611	91137	0	91137
Chemicals and allied products	0	5266	5266	0	26469	26469	0	44405	44405
Petroleum and coal products	0	1337	1337	0	3270	3270	0	4661	4661
Rubber and miscellaneous products	0	1702	1702	0	11104	11104	0	21102	21102
Leather and leather products	0	520	520	0	1197	1197	0	1243	1243
Stone, clay, and glass products	0	2035	2035	0	6880	6880	0	11313	11313
Primary metal products	0	4350	4350	0	8535	8535	0	15075	15075
Fabricated metal products	0	4681	4681	0	18709	18709	0	32300	32300
Industrial machinery and	3198	7259	10457	19319	30539	49858	20317	58353	78670

Year/Sector Industry	1967			1992			1997		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
equipment									
Electronic & other electric equipment	12235	3273	15508	61779	8700	70479	101492	27557	129049
Transportation equipment	0	11887	11887	0	36752	36752	0	55722	55722
Instruments and related products	4198	365	4563	53391	16448	69839	39589	9768	49357
Miscellaneous manufacturing	771	1140	1911	4294	4312	8606	6097	6269	12366
Service	118108	75719	193827	1408826	951088	2359914	2127727	1682535	3810262
Transportation	0	8115	8115	0	53038	53038	0	82452	82452
Communications	17609	0	17609	132370	0	132370	198517	0	198517
Electric, gas and sanitary service	0	2612	2612	0	20602	20602	0	34835	34835
Wholesale and Retail Trade	16053	42447	58500	115462	446004	561466	145234	478952	624186
Finance and Insurance	26031	577	26608	341571	3907	345478	598575	18894	617469
Real Estate and Rental	15394	2764	18158	153516	4595	158111	158051	171366	329417
Hotels, Personal repair services except auto	853	3740	4593	1389	37757	39146	2007	60051	62058
Business Services	22886	6535	29421	463925	169185	633110	734216	186273	920489
Amusements	2010	780	2790	25669	18364	44033	34515	19710	54225
Medical, Education & Non-profit organization	17272	6773	24045	174924	182516	357440	256612	613053	869665
Other services	0	1376	1376	0	15120	15120	0	16951	16951
Government	40699	18735	59434	358938	151046	509984	450195	169136	619331
Rest of the World	0	517	517	0	1168	1168	0	166	166
Total	200027	168072	368099	2055950	1427121	3483071	2940121	2317419	5257540

Sources: Porat (1977) and Authors' Calculation.

Table 1-3. Panel B: Shares of Different Industries in PRIS and SIS value Added. (Values in percentages.)

	SIC Industry	1967			1992			1997		
		Primary Info Sector	Secondary Info Sector	Total	Primary Info Sector	Secondary Info Sector	Total	Primary Info Sector	Secondary Info Sector	Total
1	Agriculture, Forestry and Fishing	0.00	0.28	0.13	0.00	0.24	0.10	0.00	0.43	0.19
2	Mining	0.00	0.90	0.41	0.00	0.93	0.38	0.00	0.97	0.43
3	Construction	4.26	7.88	5.91	2.86	5.10	3.78	3.22	3.14	3.18
	Manufacturing	16.34	34.44	24.61	11.16	16.42	13.32	9.10	15.55	11.95
4	Food and kindred products	0.00	3.12	1.43	0.00	1.22	0.50	0.00	1.11	0.49
5	Tobacco manufactures	0.00	0.15	0.07	0.00	0.05	0.02	0.00	0.07	0.03
6	Textile mill products	0.00	0.82	0.37	0.00	0.47	0.19	0.00	0.32	0.14
7	Apparel and other textile products	0.00	1.59	0.73	0.00	0.61	0.25	0.00	0.43	0.19
8	Lumber and wood products	0.00	0.64	0.29	0.00	0.48	0.20	0.00	0.41	0.18
9	Furniture and fixtures	0.26	0.46	0.35	0.21	0.26	0.23	0.22	0.24	0.23
10	Paper and allied products	0.77	1.25	0.99	0.12	0.54	0.29	0.09	0.55	0.29
11	Printing and publishing	5.11	0.34	2.93	4.08	0.68	2.69	3.10	0.00	1.73
12	Chemicals and allied products	0.00	3.13	1.43	0.00	1.85	0.76	0.00	1.92	0.84
13	Petroleum and coal products	0.00	0.80	0.36	0.00	0.23	0.09	0.00	0.20	0.09
14	Rubber and misc. plastics products	0.00	1.01	0.46	0.00	0.78	0.32	0.00	0.91	0.40
15	Leather and leather products	0.00	0.31	0.14	0.00	0.08	0.03	0.00	0.05	0.02
16	Stone, clay, glass, and concrete products	0.00	1.21	0.55	0.00	0.48	0.20	0.00	0.49	0.22
17	Primary metal industries	0.00	2.59	1.18	0.00	0.60	0.25	0.00	0.65	0.29
18	Fabricated metal products	0.00	2.79	1.27	0.00	1.31	0.54	0.00	1.39	0.61
19	Industrial machinery and equipment	1.60	4.32	2.84	0.94	2.14	1.43	0.69	2.52	1.50
20	Electrical and electronic equipment	6.12	1.95	4.21	3.00	0.61	2.02	3.45	1.19	2.45
21	Transportation equipment	0.00	7.07	3.23	0.00	2.58	1.06	0.00	2.40	1.06

SIC Industry	1967 Primary Info Sector	1967 Secondary Info Sector	1967 Total	1992 Primary Info Sector	1992 Secondary Info Sector	1992 Total	1997 Primary Info Sector	1997 Secondary Info Sector	1997 Total
22 Instruments and related products	2.10	0.22	1.24	2.60	1.15	2.01	1.35	0.42	0.94
23 Misc. manufacturing industries	0.39	0.68	0.52	0.21	0.30	0.25	0.21	0.27	0.24
Service	59.05	45.05	52.66	68.52	66.64	67.75	72.37	72.60	72.47
24 Transportation	0.00	4.83	2.20	0.00	3.72	1.52	0.00	3.56	1.57
25 Communications	8.80	0.00	4.78	6.44	0.00	3.80	6.75	0.00	3.78
26 Electric, gas and sanitary service	0.00	1.55	0.71	0.00	1.44	0.59	0.00	1.50	0.66
27 Wholesale and retail trade	8.03	25.26	15.89	5.62	31.25	16.12	4.94	20.67	11.87
28 Finance and Insurance	13.01	0.34	7.23	16.61	0.27	9.92	20.36	0.82	11.74
29 Real estate and rental	7.70	1.64	4.93	7.47	0.32	4.54	5.38	7.39	6.27
30 Hotels, personal repair services, except auto	0.43	2.23	1.25	0.07	2.65	1.12	0.07	2.59	1.18
31 Business services	11.44	3.89	7.99	22.56	11.85	18.18	24.97	8.04	17.51
32 Amusement	1.00	0.46	0.76	1.25	1.29	1.26	1.17	0.85	1.03
33 Medical, education & non-profit	8.63	4.03	6.53	8.51	12.79	10.26	8.73	26.45	16.54
34 Other services	0.00	0.82	0.37	0.00	1.06	0.43	0.00	0.73	0.32
35 Government	20.35	11.15	16.15	17.46	10.58	14.64	15.31	7.30	11.78
36 Rest of the World	0.00	0.31	0.14	0.00	0.08	0.03	0.00	0.01	0.00
37 Total	100	100	100	100	100	100	100	100	100

In addition to analyzing the shares of different industries in the information value added, it is also interesting and important to estimate and analyze the growth rates experienced by these industries. For this purpose, we first converted the 1967 value added measures from current dollars to 1996 constant dollars by using GDP implicit deflators by industries with 1996 as the base year. We then compared the 1967,1992 and 1997 measures, all stated at 1996 prices, to estimate the average annual growth rates for different industries. The results are shown in Table 4 below.

Table 1-4. Growth of the Information Economy between 1967 and 1992 and between 1992 and 1997.

Year/Sector Industry	Information value added in 1996 constant dollar			Average annual growth rates	
	1967	1992	1997	1967-1992	1992-1997
Agriculture, Forestry and Fishing	2064	3981	11015	2.66	22.57
Mining	6233	14460	22186	3.42	8.94
Construction	95262	152462	160527	1.90	1.04
Manufacturing	362688	500889	614038	1.30	4.16
Food and kindred products	24259	21364	24697	-0.51	2.94
Tobacco products	1068	772	1584	-1.29	15.46
Textile mill products	5840	7523	7296	1.02	-0.61
Apparel and other textile products	11128	9658	10078	-0.56	0.85
Lumber and wood products	4194	7078	9366	2.12	5.76
Furniture and fixtures	4001	6526	13281	1.98	15.27
Paper and allied products	9380	6884	16781	-1.23	19.51
Printing and publishing	47568	109329	91634	3.38	-3.47
Chemicals and allied products	24540	32674	41248	1.15	4.77
Petroleum and coal products	5308	3438	4592	-1.72	5.96
Rubber and misc. products	6760	11683	20234	2.21	11.61
Leather and leather products	1357	828	1119	-1.96	6.22
Stone, clay, and glass products	7662	6861	10965	-0.44	9.83

Year/Sector Industry	Information value added in 1996 constant dollar			Average annual growth rates	
Primary metal products	16614	8636	15025	-2.58	11.71
Fabricated metal products	21376	22630	34965	0.23	9.09
Industrial machinery & equip.	48300	61000	74566	0.94	4.10
Electronic & other elec. equip.	65249	78549	128645	0.74	10.37
Transportation equipment	33457	27400	45403	-0.80	10.63
Instruments & related products	17010	68970	50429	5.76	-6.07
Misc. manufacturing	7618	9087	12130	0.71	5.95
Service	803051	2612956	3739352	4.83	7.43
Transportation	30664	53088	78407	2.22	8.11
Communications	68666	136729	195792	2.79	7.45
Electric, gas & sanitary service	10516	21971	34181	2.99	9.24
Wholesale and Retail Trade	237006	602548	643212	3.80	1.31
Finance and Insurance	114224	392852	598172	5.07	8.77
Real Estate and Rental	75556	174273	323564	3.40	13.17
Hotels, personal repair services, except auto	18929	42734	56998	3.31	5.93
Business Services	123296	702807	893878	7.21	4.93
Amusements	12019	50245	52560	5.89	0.91
Medical, education & non-profit organization	106327	418685	846265	5.64	15.11
Other services	5849	17023	16323	4.37	-0.84
Government	254703	578922	602298	3.34	0.79
Rest of the world	2125	1272	163	-2.03	-33.71
Total	1513037	3864942	5149579	3.82	5.91

Note: The growth rates are average annual compound growth rates calculated from real value
    added at 1996 constant prices.

We can see from Table 5 that the US information economy, in constant 1996 dollars, grew at an average annual growth rate of 3.82 percent during the 25 years between 1967 and 1992 and at an even faster rate of 5.91 percent between 1992 and 1997. Among the broad industry categories, information activities in services were growing at 4.83 percent per year between 1967 and 1992 and at 7.43 percent between 1992 and 1997, rates considerably higher than the average for the information economy. Within

the service sector, value added of 'business services', 'amusements', 'medical, educational services and non-profit organization' and 'finance and insurance' were each growing at rates higher than 5 percent annually between 1967 and 1992. During 1992-1997, on the other hand, 'medical, educational and non-profit organizations' and 'real estate and rental' registered growth rates higher than 10 percent. In the manufacturing sector, 'instruments and related products' was the fastest growing industry during 1967-1992. However, information activities in most manufacturing industries experienced a decline during this period. Among them, 'tobacco products', 'paper and allied products', 'petroleum and coal products', 'leather and leather products' and 'primary metal products' were declining at an annual average rate of more than 1 percent. These declines may reflect two factors. First, there could have been substantial outsourcing of information activities in the manufacturing industries to outside vendors. That is, industries are possibly relying more and more on marketed information services provided by vendors rather than on in-house production. The growth in the contribution of service industries to the information value added indicates that this may, in fact, be the case. However, it needs further investigation to fully substantiate this argument. Secondly, the estimation methodology we use for the SIS may have caused an underestimation of actual contribution of the manufacturing industries to the information economy. It is our belief that the first possibility, i.e. outsourcing of information services, is the most likely cause of declining contribution of manufacturing industries to the information economy.

Table 1-5. Growth of Total GDP and of Value Added in Broad Sectors between 1967 and 1992 between 1992 and 1997.

Sectors	Values in billions of 1996 constant dollar			Average Annual	
	1967	1992	1997	1967-1992	1992-1997
Total GDP	3428	6880	8160	2.83	3.47
Agriculture, forestry & fishing	110	131	144	0.69	1.91
Mining	63	96	117	1.67	4.10
Construction	172	272	325	1.84	3.62
Manufacturing	838	1085	1387	1.04	5.04
Services	1708	4259	5151	3.72	3.88
Government	508	1015	1036	2.81	0.39

Between 1992 and 1997, 'paper and allied products' seems to be the fastest growing industry. However, one needs to be careful in interpreting the growth rates by industries during this period. Because of the new industry classification system, many industries have been reclassified and therefore it does not make much sense to compare the growth performances of the disaggregate industries in this period with those during the earlier

period. The growth performances are more reasonable only when we compare them by broad categories such as 'manufacturing', 'services' etc.

In order to assess the growth performance of the information economy we now consider the overall performance of the US economy during the 25 years between 1967 and 1992, and between 1992 and 1997. As we can see from Table 5, the US GDP was growing at an average annual growth rate of 2.83 percent between 1967 and 1992, and at a faster rate of 3.47 between 1992 and 1997. Among the broad sectors, the service sector was growing at 3.72 percent, which is higher than the average for the economy during the 25 years between 1967 and 1992. The manufacturing sector on the other hand was growing merely at 1.84 percent annually during the same period. This is not surprising if we consider the productivity slowdown of the manufacturing industries during the 1970s. All the other sectors were growing at rates slower than that for the aggregate economy. Between 1992 and 1997, on the other hand, the manufacturing sector was growing the fastest. According to our calculations, the service sector was growing at a rate higher than the average annual growth rate for the overall economy. The high growth rate might have been driven by the unprecedented growth of the high-tech sector. Since the data are based on the old SIC classification, value added accrued to many of the auxiliary services may have been included in manufacturing value added.

It is interesting to note that information value-added of all these broad sectors were growing faster than total value added of the respective sectors between 1967 and 1992. During 1992-97, the information manufacturing sector was growing slower than overall manufacturing and the information service sector was growing much faster than the overall service sector. One has to be cautious in interpreting these results. These differences between the recent period (1992-97) and earlier period (1967-92) may partly be explained by redefinition and reclassification of some of the industries that we use in our calculation of 1997 information economy. The patterns of growth of information components within broad sector, however, reinforce our finding that the share of the information economy in the US GNP has grown from 46 percent to 56 percent in 1992, and to 63 percent in 1997.

From the above analysis, we can draw several important conclusions about the size, structure and growth of the US information economy. First, more than half of total GNP in 1992 and in 1997 was generated by information related activities. Second, growth of the primary information sector was much higher than that of the secondary sector during 1967-1992 whereas the secondary information sector seemed to grow faster during 1992-1997. Third, within the information economy the shares of the service industries increased by leaps and bounds. Until 1992 business services registered the highest growth while during the 5 year period between 1992

and 1997, 'medical, education and non-profit organization' witnessed the fastest growth in its information component. Finally, information activities in a number of manufacturing industries experienced decline during 1967-92 that possibly had its origin in the increased outsourcing of information services by these industries[10].

Given the increasing prominence and high growth of 'business services' and 'medical, educational and non-profit organizations', it would be important to gain a better understanding of the specific services that have been included in these two broad categories. The I-O category of 'business services' includes four 2-digit SIC industries: business services (73), legal services (81), engineering and management services (87) and services not elsewhere counted (89). Details are provided in Chart A.1, with a listing of all 4-digit SIC industries included in this I-O 'business services' category. We would like to point out that in 1992, the SIC industry of business services (73) accounted for more than half of the value added of this category. For the reasons of brevity, the detailed calculation of this number hasn't been shown in any of the tables. It can also be seen in Chart A.1 that the I-O category 'medical and educational services, and non-profit organizations' consists of the following SIC industries: health services (80), educational services (82), social services (83), museums, botanical and zoological gardens (84) and membership organizations (86). More than two-third of the value added of this category in 1992 was accounted for by health services (80).

5. INFORMATION SECTOR AS DEFINED BY THE CENSUS BUREAU AND THE BEA

In its 1997 Economic Census, the U.S. Census Bureau creates a new 'Information Sector' that is also added in 1997 benchmark I-O table under a separate I-O industry category which corresponds to a new NAICS industry. This new sector is "created by combining industries from manufacturing, services, and transportation, communication, and utilities" (Lawson et al. (2002), pp. 23). The information sector is formally defined to include "establishments engaged in producing and distributing information and cultural products, providing the means to transmit or distribute these products and data, or communications services" (Lawson et al. (2002), pp. 25). Table 6 shows the detailed break-up at 6-digit I-O level of the information sector and corresponding value added.

---

[10] The extraordinary growth of some of the manufacturing industries, such as 'paper and allied products', 'tobacco products', 'furniture and fixtures' should be interpreted with care as they may simply be the consequences of reclassification of industries.

Table 1-6. Value Added by the Industries in the BEA's New Information Sector, 1997. (Values in millions of current dollar.)

I-O Code	Description of the Industry	Value added
511110	Newspaper publishers	25808
511120	Periodical publishers	15940
511130	Book publishers	10122
5111A0	Database, directory, and other publishers	12975
511200	Software publishers	40881
512100	Motion picture and video industries	18796
512200	Sound recording industries	6744
513100	Radio and television broadcasting	13807
513200	Cable networks and program distribution	21217
513300	Telecommunications	154946
514100	Information services	6987
514200	Data processing services	23559
	Total (Information Sector)	351782
	Total GNP	8345646
	As share of Total GNP	4.22%

As we can see from the definition and the table, the scope of the information sector is very narrow and substantially different from Porat's conceptualization and measurement of the information economy. According to BEA's estimate the information sector accounts for only 4.22 percent of the total GNP which is substantially lower than our calculation.

6.   CRITICAL ASSESSMENT OF PORAT'S APPROACH TO INFORMATION ECONOMY

Porat's conceptual framework and the computational methodology provide a reasonable, interesting and useful way of looking at the structural aspects of the national economy using the conventional national income accounting framework. Also, use of 'the I-O framework enables analysts to investigate the intersectoral relationships between the information economy and the rest of the economy' (Engelbrecht (1997))[11]. However, Porat's study has been criticized on various grounds.

For example, although the decomposition of the information economy into PRIS and SIS is conceptually appealing, the methods of measuring them may lead to inconsistency. As Machlup (1980) argues, the integration of the PRIS and SIS in one approach is perhaps inappropriate as it mixes

---

[11] Also see Carter (1989) for discussion on use of I-O tables in measuring information economy.

information inputs in non-PRIS industries with outputs of PRIS industries. Furthermore, this method of aggregation may lead to an overstatement of the size of the information economy as it fails to exclude the non-information activities in the PRIS.

The scheme developed by Porat for identifying and classifying information workers is used to assess the GNP contribution of the secondary information sector. But as he himself admits, every occupation has an informational component. Thus, it is possible to argue that his identification scheme, to some extent, is arbitrary and ad-hoc. Even if we accept Porat's scheme of designating information occupation, the facts that new information occupations have been continually emerging with the advent of new technology, and that the nature of occupations has been continually changing make it imperative that the list of information occupations be updated regularly.

In order to measure the information economy, Porat uses various concepts of the national income accounting. It should be noted that the size of the information economy was measured in terms of its contribution to GNP. At the sectoral level the term 'value added' has been used to represent GNP, as they are equivalent concepts. Porat uses detailed Input-Output table to measure information value added at disaggregated levels. By concentrating on value added he puts more emphasis on the production side of the information economy. On the contrary, Machlup uses 'final demand' to measure the contribution of knowledge industries. Since they represent two distinct methods of measuring GNP, the total for each of these measures will be the same for the entire economy. However, the total for individual industries can substantially vary. Therefore the methodologies used by Machlup (1962) and Porat (1977) may lead to different measures of the information economy. Hence, care must be taken in comparing and interpreting the results of these two methodologies.

Perhaps, the most vehement criticism of Porat's study is that it lacks the foundation of a theory (see Wellenius (1988), Miles (1990), and Engelbrecht (1997)). As these critics argue, Porat's information economy includes very diverse activities whose growth cannot be explained by unitary theory, that Porat's concept of information economy does not provide a theory to explain the development of advanced capitalist economy, and finally, that there are no theories to explain the different components making up the information economy.

We believe that Porat's methodology can benefit from several improvements, the principal ones of which are identified next. In order to exclude the non-information activities in the PRIS, we would propose that the employee compensation of information workers, part of proprietors' income earned for performing informational tasks, and capital consumption

allowances on information machines in the PRIS be calculated to measure their contribution to value added. It may be noted that Engelbrecht has already advocated this approach and in one specific case it has already been put to use (see Rabeau (1990)).

As we discussed earlier, new information services have emerged to cater to the needs of the society that is increasingly becoming more information-intensive. To capture this phenomenon we need to study newly emerging as well as older information services more carefully and in more detail. For better accuracy, the categorization of information occupation should be revised in the light of the facts that industries such as computers and communications have grown substantially over the last few years, and so have various occupations related to these industries. A detailed study of these industries and related occupations would therefore be useful. In other words, the growth of new information-based industries should be studied separately in all their varied dimensions. Furthermore, their linkages with the other sectors of the economy should be examined using the input-output matrix.

7.   CONCLUSIONS

The main contribution of this research is not only in confirming our intuitive understanding about the growth of information economy, but also in quantifying its current size and structure, and its growth during the past 30 years. Following the concepts and methodology developed by Porat (1977), we calculate the contribution of the information activities to the US GNP in 1992 and 1997. A two-way classification into primary and secondary information sectors suggests that marketed information goods and services, i.e., the primary information sector, accounted for a third of the total GNP in 1992 and more than a third in 1997. The primary information sector also registered a higher growth rate during 1967-1992. The information services produced for internal consumption of non-information firms, i.e., the secondary information sector, on the other hand, contributed about one-fifth of total GNP in 1992 and more than one-fourth in 1997, thus registering a faster growth during the later period.

The results indicate that on the whole the information economy is growing faster than the aggregate economy. Within the information economy, it is the service category that is growing at the highest rate; and among the service industries, the most dynamic industries are the 'business services', and 'medical, educational, and non-profit organizations'. Information activities in a number of manufacturing industries, on the other hand, declined during the period between 1967 and 1992. This indicates that

the manufacturing industries are possibly outsourcing information services to outside vendors. Higher growth in the information components of the business services also lends support to this hypothesis. However this conjecture needs further investigation which we intend to carry out in future.

APPENDIX

Table A.1 Size of PIS, SIS and the Information Economy in 1958, 1967 and 1972: OECD Study. (Percentage share in GDP at factor cost)

	1958	1967	1972
Primary Information Sector	19.6	23.8	24.8
Secondary Information Sector	23.1	24.7	24.4
Information Economy	42.7	48.5	49.2

Source: Table I.8 and I.10, OECD (1981)

Chart A.1 Detailed SIC Industries included in I-O Categories of 'Business Services' and 'Medical and Educational Services, and Non-profit Organizations'

SIC Code	Industry Description
Industries included in 'Business Services'	
73 Business Services	
7311	Advertising agencies
7312	Outdoor advertising agencies
7313	Radio, TV, publisher representatives
7319	Advertising, not elsewhere classified (nec)
7322	Adjustment and collection services
7323	Credit reporting services
7331	Direct mail advertising services
7334	Photocopying and duplicating services
7335	Commercial photography
7336	Commercial art and graphic design
7338	Secretarial and court reporting
7342	Disinfecting and pest control services
7349	Building maintenance services, nec
7352	Medical equipment rental
7353	Heavy construction equipment rental
7359	Equipment rental and leasing, nec
7361	Employment agencies
7363	Help supply services
7371	Computer programming services
7372	Prepackaged software
7373	Computer integrated systems design
7374	Data processing and preparation
7375	Information retrieval services
7376	Computer facilities management
7377	Computer rental and leasing
7378	Computer maintenance and repair
7379	Computer related services, nec
7381	Detective & armored car services
7382	Security systems services
7383	News syndicates
7384	Photofinishing laboratories
7389	Business services, nec

SIC Code	Industry Description
81 Legal Services	
8111	Legal services
87 Engineering and Management Services	
8711	Engineering Services
8712	Architectural services
8713	Surveying Services
8721	Accounting, auditing & bookkeeping
8731	Commercial physical research
8732	Commercial nonphysical research
8733	Noncommercial research organizations
8734	Testing laboratories
8741	Management services
8742	Management consulting services
8743	Public relations services
8744	Facilities support services
8748	Business consulting, nec
89 Services, not elsewhere counted	
8999	Services, nec

Industries included in 'Medical, Educational Services and Non-profit Organizations'

80 Health Services	
8011	Offices and clinics of medical doctors
8021	Offices and clinics of dentists
8031	Offices of osteopathic physicians
8041	Offices and clinics of chiropractors
8042	Offices and clinics of optometrists
8043	Offices and clinics of podiatrists
8049	Offices of health practitioners, nec
8051	Skilled nursing care facilities
8052	Intermediate care facilities
8059	Nursing and personal care, nec
8062	General medical & surgical hospitals
8063	Psychiatric hospitals
8069	Specialty hospitals exc. Psychiatric
8071	Medical laboratories
8072	Dental laboratories
8082	Home health care services
8092	Kidney dialysis centers
8093	Specialty outpatient clinics, nec
8099	Health and allied services, nec
82 Educational Services	
8211	Elementary and secondary schools
8221	Colleges and universities
8222	Junior colleges
8231	Libraries
8243	Data processing schools

SIC Code	Industry Description
8244	Business and secretarial schools
8249	Vocational schools, nec
8299	Schools & educational services, nec
83 Social services	
8322	Individual and family services
8331	Job training and related services
8351	Child day care services
8361	Residential care
8399	Social services, nec
84 Museums, Botanical, Zoological Gardens	
8412	Museums and art galleries
8422	Botanical and zoological gardens
86 Membership organizations	
8611	Business associations
8621	Professional organizations
8631	Labor organizations
8641	Civic and social associations
8651	Political organizations
8661	Religious organizations
8699	Membership organizations, nec

Source: http://weber.u.washington.edu/~dev/sic.html

REFERENCES

Apte, Uday M. and Mason, R. O., 1995, "Global Disaggregation of Information-Intensive Services", Management Science, Vol. 41(7), 1250-1262

Apte, Uday M. and Hiranya K Nath, 1999, "Service Sector in Today's Information Economy", Proceedings of the Service Operations Management Association, 106-111

Carter, Anne P., 1989, "Input-Output Recipes in an Information Economy", Economic Systems Research 1(1), 27-43.

Engelbrecht, Hans-Jurgen, 1997, "A comparison and critical assessment of Porat and Rubin's information economy and Wallis and North's transaction sector", Information Economics and Policy 9, 271-290.

Huber, Mary Taylor and Rubin, Michael Rogers, 1986, The Knowledge Industry in the United States: 1960-1980 (Princeton University Press, Princeton, New Jersey).

Karunaratne, Neil Dias, 1986, "Issues in Measuring the Information Economy", Journal of Economic Studies 13(3), 51- 68.

Lamberton, D.M. 1994, "The Information Economy Revisited" in: Robert E Babe (ed.) Information and Communication in Economics (Kluwer Academic Publishers, Boston).

Lawson, Ann M, Kurt S Bersani, Mahnaz Fahim-Nader, and Jiemin Guo, 2002, "Benchmark Input-Output Accounts of the United States, 1997", Survey of Current Business, 19-109.

Machlup, F. (1962), The Production and Distribution of Knowledge in the United States, (Princeton University Press, Princeton, NJ).

Machlup, F. (1980), Knowledge: Its Creation, Distribution and Economic Significance, Volume 1: Knowledge and Knowledge Production (Princeton University Press, Princeton, NJ).

Martin, William J. 1988, The Information Society. (Aslib, London).

Miles, I. 1990, Mapping and measuring the information economy, Library and Information Research Report 77. (British Library Board).

OECD, 1981, Information Activities, Electronics and Telecommunications Technologies: Impact on Employment, Growth and Trade, volumes I and II, (Paris).

OECD, 1986, Trends in The Information Economy (Paris).

Porat, Marc U and Rubin, Michael R. 1977, The Information Economy (9 volumes), Office of Telecommunications Special Publication 77-12 (US Department of Commerce, Washington D.C.)

Rabeau, Y. 1990, The information economy in Canada: An 'input-output' approach, (Department of Communications of Canada, Laval).

Rubin, Michael R and Elizabeth Taylor, 1981, "The U.S. information sector and GNP: An input-output study". Information Processing and Management 17 (4) 163-194

U.S. Census Bureau, 1997 Economic Census: Summary Statistics for United States (1997 NAICS Basis) and 1997 Economic Census: Information – United States, http://www.census.gov.

U.S. Department of Commerce: Bureau of Economic Analysis, 1997, "Benchmark Input-Output Accounts for the U.S. Economy, 1992; Detailed Use Table". Diskette.

U.S. Department of Labor: Bureau of Labor Statistics, 1994-95, Occupational Outlook Handbook, (U.S. Department of Labor, Washington, D.C.)

U.S. Department of Labor: Bureau of Labor Statistics, Occupational Employment in Manufacturing, 1992, (U.S. Department of Labor, Washington, D.C.)

U.S. Department of Labor: Bureau of Labor Statistics, Occupational Employment in Mining, Construction, Finance, and Services, 1993, (U.S. Department of Labor, Washington, D.C.)

U.S. Department of Labor: Bureau of Labor Statistics, Occupational Employment Statistics 1998, http://www.bls.gov.

Wellenius, B. 1988, "Foreword: Concepts and issues on information sector measurement" in: Jussawalla, M. Lamberton, D and Karunaratne, N (eds) The Cost of Thinking: Information Economies of Ten Pacific Countries (Ablex, Norwood, NJ.)