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THE INFORMATION ECONOMY IN CANADA: AN "INPUT-OUTPUT" APPROACH

by:
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Canada

Department of Communications of Canada
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FOREWORD

The goal of this research project on the information economy is to evaluate the importance of the information sector in the Canadian economy and to construct a satellite account of the information sector using Statistics Canada's Input-Output Table. Our purpose is to propose a classification of information activities; to evaluate the proportion of information labour, the information content of industries, and the relationship between information employment and productivity; and to conduct an intersectoral analysis of information-intensive industries.

This study is also aimed at evaluating the necessary inputs for the production of information and linking the information sector with other sectors of the economy. Finally, a few simulations are performed using the information satellite account.

We feel that this study has a very significant scientific contribution to make, since it will allow us to explore the dynamics of a new activity sector--the information sector--of strategic importance to the development of the Canadian economy. The originality of our approach makes it possible to reconsider the process while it is underway and to answer questions that the lack of statistical data has prevented us from addressing in the past.

This exploratory research project complements certain initiatives by the Organizational Research Directorate, such as the proceedings of a conference held in Toronto in June 1989, "Canada's Information Revolution."

We strongly hope that these publications will highlight the importance of pursuing analyses in this sector, allowing us to consider the changes occurring in our economy as computers play a constantly growing role in our lives.

Lucie Deschênes

RESEARCH TEAM

The author wishes to introduce and thank the researchers and assistants who helped to carry out this study.

Dominique Vachon worked as senior researcher, in charge of classifying information workers and defining production functions in information sectors. Abdellah El Manouar worked on the productivity of information workers and the simulations of the input-output model with a complete information sector, which were also analysed by Yves Létourneau.

Finally, Christine Lamarre and Lynda Paquin worked as research assistants.

Note also that this work was made possible by the Input-Output Division of Statistics Canada. Ronald Rioux and Aldo Diaz helped define information sectors, while René Durand and Director Claude Simard provided us with technical advice on defining the information sector.

We also wish to thank the three anonymous referees for their comments that allowed us to improve the quality of our study.

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INTRODUCTION

Our mandate was to establish an information satellite account in the intersectoral table of the Canadian economy. This involved:

- establishing a method for evaluating the information content of commodity production in Canada. This content must be established on the basis of sectors to be found in the Canada input-output table;

- developing a method for determining production functions in terms of input-output relating to the production of information; in other words, evaluating the inputs necessary for the production of information;

- combining all the production of information in the economy in a fictive information sector, and establishing links among this sector and other sectors of the economy through the production functions associated with the production of information.

Once the information satellite account had been defined, our objective was to conduct a number of simulations of the impact of a variation in final demand components, on both the production of information in the economy and the effects of the information sector on other economic sectors.

With the co-operation of Statistics Canada, we managed to create an operational information satellite account, which can now be used for many economic analyses.

In addition to this main achievement, our study allowed us to analyse various aspects of the information economy in Canada. Another aspect of our mandate was to classify information employment in Canada. To determine the information content of commodity production in Canada, we classified information employment and evaluated the value added produced by that labour. We compared our classification with the one prepared by CWARC, in keeping with our mandate. We were also able to establish the information content of production in each sector of the Canadian economy and then connect that content with the productivity of those sectors.

Using the data in the input-output table, we also examined the characteristics of certain sectors associated with the production of information or information-type goods.

Finally, we have managed to draw some overall conclusions from our study, using the various results obtained during the study and through simulations using the input-output table with an information sector.

1. MEASURING THE INFORMATION CONTENT OF PRODUCTION IN THE INTERINDUSTRIAL TABLE

1.1 Classification by sector

The phenomenon of information production and the use of information as an input in the economy are often analysed in the existing literature by identifying sectors producing commodities consisting mainly of information. Accordingly, four major economic sectors are generally defined:

- sectors producing information goods, such as computers;
- sectors producing information services, such as telecommunications and advertising;
- sectors producing non-information goods, such as mining and furniture manufacturing;
- sectors producing non-information services, such as hairdressing and dry cleaning.

Infrastructure

Sectors producing information goods have been described in various studies as infrastructure sectors for the information services industry, also called the information sector. This classification may be useful in analysing information industries and the structure of the economy, but it poses a number of problems when it comes to evaluating the **information content** of national and sectoral production. For example, while the main activity of information service industries is to produce information, the value added by these sectors does not consist solely of information. Similarly, sectors producing non-information goods and services nevertheless produce information, which in turn may represent an important proportion of the value added if the industry makes heavy use of computers and robots. This is the case for the motor vehicle industry; its purpose is not to produce information goods, but its production includes a high information component. Finally, the classification we have just described may also lead to confusion in conceptual terms. Manufacturing information-type goods such as computers is not in the same as producing information. A computer is used to

handle information, but is not itself information. Its production naturally requires a large amount of information, but the information content of information-type goods is not immediately evident, and the final result of production cannot be considered information.

Since the purpose of our study is to determine the information content of value added, on a sectoral basis, and to see how information is exchanged among sectors, we will not make direct use of this classification of sectors on the basis of their production. Instead, we will establish a method for evaluating the information content of all sectors of the economy.

1.2 Method of evaluating the information content of production

The various studies that have been done on the information content of production (including the wide-ranging study on the American economy by Porat) evaluate the information content of value added by analysing the occupations of employed workers. In fact, there are no other practical methods for estimating information content. Even if we were to conduct a statistical sway, it would be difficult to evaluate the information content in terms of the value added in the production of goods and services. Given the intangible nature of information, it would be possible to take an indirect approach, by subtracting inputs other than information from production. But an analysis of employment structure would be necessary to determine the contribution by labour to information content.

With the data available, the information content of production can be evaluated only by considering the employment structure. Accordingly, occupations must be classified in order to be able to list those occupations whose main task or activity is to produce, process, handle, store, retrieve, transmit or disseminate information. Once a list of information occupations has been drawn up, the next step is to establish the value added produced by those workers.

This approach leads to a number of problems. One difficulty arises from the fact that any occupation possesses a certain information component:

> *"Clearly, all human endeavor contains some component of information processing. Without information, all cognitive function would collapse and there would be no human activity."*[1]

In view of this difficulty in deciding whether an occupation can be classified as information-related, we can consider occupations the **main activity** of which is to produce, process, store, retrieve, transmit or disseminate information.

There is a relatively small number of occupations whose sole activity relates to information. These clear-cut cases do not represent the majority, hence any classification of information occupations is to some extent arbitrary. Two examples of occupations that do not easily lend themselves to classification are sales representatives and foremen/women. Naturally, foremen/women and sales representatives do not spend their entire days disseminating information received; but the information component of those tasks nevertheless represents a proportion sufficiently large for those activities to be classified as information occupations.

Thus if we consider that the entire value added produced by those two occupations consists of information, we will slightly **overestimate** the information content of their production, since they do not handle or transmit information exclusively. On the other hand, some occupations whose main activity is not considered to be information-related and which are excluded from the list of information occupations nevertheless handle or disseminate information. A worker assembling parts to produce equipment, for example, must decode information and use it in his or her work. Their exclusion from the list of information occupations tends to give an **underestimated** value of the information component of production. Such a method does not lead to highly accurate results, but rather to a reasonable estimate of the information component of production.

We should note at this point that as concerns the use of employment as a method of evaluating the information component of production, our criteria for classifying an occupation as an information occupation relate to the **worker's main task** and **not to the activity sector.** Accordingly, people who are employed in sectors producing information goods such as

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[1] *M.V. Porat, "The Information Economy: Definition and Measurement", U.S. Department of Commerce, May 1977.*

computers, televisions and telephones are not automatically classified as information workers. Those responsible for assembling computers and installing and repairing communications equipment are not considered information workers, since their main task is to **handle physical goods,** rather than information. Thus there is no immediate relationship between the type of activity sector and the information-related nature of an occupation. Sectors producing non-information goods may hire a large proportion of information workers and, inversely, sectors producing information commodities may employ a significant proportion of non-information workers.

In view of the importance of the classification of information occupations in determining the information component of production, the following chapter gives a detailed description of how we broke them down into information and non-information occupations.

1.3 Evaluating the value added by information workers and its application to the input-output table

Evaluating the value added by information workers

To analyse the occupations of employed workers in order to evaluate the information component of production, we must determine the value added by those information workers in the various activity sectors. Insofar as the labour market functions with relative efficiency, workers' wages reflect their marginal productivity. Wages represent a way of evaluating information workers' direct contribution to production. In addition, the other part of value added, consisting mainly of profits and other income, must also be attributed to information workers. The method we have used is to attribute to those workers the balance of the value added, in proportion to their wages, as compared with the total wages of each industry.

This method should give us, overall, a reasonable estimate of the total value added corresponding to the production of information, and in fact is the approach employed in previous studies on this question. Obviously, it may include certain biases from one sector to another, and we assume that there is no systematic upward or downward bias in all the activity

sectors. In some sectors where information workers use much more productive capital than non-information workers, attributing the balance of the value added on the basis of the proportion of information workers' wages may then result in underestimating the total value added by those workers. However, the use of highly productive capital should be reflected in the productivity of information workers, and hence in their wages, if the labour market functions efficiently. Inversely, if information workers use less efficient capital than non-information workers in a given sector, the value added attributable to the former may be underestimated. If wages have managed to adjust so as to reflect discrepancies in the productivity of capital, this bias should not be large. Nevertheless, as wages on the labour market adjust to the productivity of workers with a certain time lag when there are changes in the capital (e.g., generations of more-productive information capital replacing outdated information capital), there may be some biases in the estimated value added by information workers. Since our estimate deals with 1985, at a time when information capital was being replaced at a fairly rapid pace, it is possible that wages had not fully adjusted to the new levels of productivity (wage increases began accelerating in 1987). In such a case, our method would tend to somewhat underestimate the value added by information workers to the economy.

Application of the method to the Canada Input-Output Table

The basic data that we use to evaluate the information component of production in Canada are drawn from the Statistics Canada Input-Output Table. The data on employment by occupation were provided by the federal Department of Employment and Immigration[1] and come from the 1971, 1981 and 1986 censuses conducted by Statistics Canada. These time series data allowed us to examine the development of the structure of employment in Canada over a 15-year period, and are analysed in Chapter 2.

The data on employment by occupation are broken down by industry, on the basis of the 1971 Standard Industrial Classification for three-digit industries. We would have had to delay our research by several months to obtain a version with the new classification; and in practice, working with the former classification caused no major difficulties, since the Input-Output

[1] *We wish to thank George Jaromek, of that Department, for his valuable assistance in obtaining the data, and also Janet Smith of Ivation Data Systems, for her technical assistance in producing the data.*

Division had the necessary data available for adjusting the 1971 classification data to those in the input-output table.

In addition to the breakdown by industry, the employment data are broken down by occupation, on the basis of the four-digit Canadian Occupational Code. This gives a very large employment matrix with three-digit industries in columns and four-digit occupations in rows, allowing us to analyse the development of the occupational structure of employment by industry for the period concerned. The main results are given in the following chapter.

Since the 1986 census data actually refer to employment in 1985, we used the 1985 version of the input-output table to estimate the information component of production. We also obtained the census data on workers' wages by **occupation**, specially compiled by the Department of Employment and Immigration and its consultant, Ivation Data System. We were unable to obtain wages by occupation **and by industry**. Consequently, to evaluate the information value added from wages, we had to assume that the operation of the labour market is sufficiently efficient that there are no major wage disparities **between industries in a specific occupation.**

The link with the input-output table is made as follows:

- First of all, the data on employment by occupation by three-digit industry (1971 industrial classification) had to be reconciled with the 209 level W industries in the input-output table. In that way, employment by occupation was distributed among those 209 industries. It should be noted here that the data on the absolute values of employment by industry that we have used in this study are drawn from the input-output table. Thus the census data were used essentially to establish the **employment structure by occupation** by industry. The structure is defined as the **percentage distribution** of employment by occupation. In short, the absolute value of the jobs matches the data from the input-output table, but the employment structure by occupation is obtained using the census data.

- The figure for total wages of information workers by industry was arrived at by totalling the average wage rates, multiplied by the number of workers corresponding to each information occupation. Once again, we are basing ourselves on the census data, since the wage rates by occupation are drawn from the census. For us to be able to apply the value added per industry on the basis of the data in the input-output table, the wage data are used essentially only to determine the proportion of the value added attributable to information workers. The total wages of information workers as a proportion of the total wages of all workers (obtained by adding up average wages, multiplied by the workers of all occupations in an industry) are thus used to assign the value added from the input-output table by industry to information workers. The balance is assigned to non-information workers.

- For each industry in the input-output table, then, we know the jobs of information workers by occupation and those of non-information workers by occupation, from the data in the table. We also know the value added attributable to information workers and that attributable to other workers. The total value added by industry logically corresponds to that in the input-output table by industry. The total for the economy as a whole or for the major subsectors can be obtained by adding up the data by industry.

2. INFORMATION WORKERS IN CANADA

We evaluate the information component of production in Canada using an approach based on the occupational structure of employment. The purpose of this Chapter is to present a detailed classification of information occupations. We will then illustrate the results of this approach, by analysing the information labour component of certain sectors of the Canadian economy.

2.1 Classification by occupation

As noted in the previous chapter, our classification of information occupations is founded on the basic principle that the information worker's main activity must consist of producing, processing, storing, retrieving, transmitting or disseminating information. Applying this definition to the four-digit occupations defined in the Canadian Occupational Code was simple for a number of occupations whose main task is directly related to the production, processing and diffusion of information. That is the case for occupations such as teachers, copywriters, radio or television announcers and so on. In other cases, we had to examine the workers' tasks in greater detail, and consulted the literature available on the matter (see Bibliography).

In general, our classification conforms with the one described in the literature we examined. In cases that we considered somewhat more arbitrary, we took what we felt was a conservative approach, so as not to overestimate the number of information workers. In that way our approach differs in one important respect from the literature available; workers in the information goods producing sector, or in services relating to information equipment, are often considered information workers in that literature.

We consider that these workers in so-called information infrastructure industries, whose tasks are generally to handle, process, assemble or repair equipment, are not information workers. Thus we have excluded from our list of information occupations certain occupations such as assemblers, installers or repairers of electronic communication equipment, since their main task is not related to information production. On the other hand, communication equipment sales staff are considered information workers. This occupation is included in our list not because it involves the sale of communication equipment, but because it has to do with sales. We feel that the main activity of a sales representative is to disseminate information.

Finally, we must remind the reader that classifications of information workers vary somewhat from one study to another, and some arbitrariness cannot be avoided, given the relative complexity of human tasks.

2.2 General typology of information workers

We can group information workers into a few general large categories, as follows:

Table 1
General typology of information occupations

I- Organization of information

a) Clerical skills
b) Technical skills
c) Scientific and professional skills
d) Research and artistic creation

II- Decision-making and control

a) Management
b) Inspection
c) Supervision

III- Dissemination of information

a) Various information and news
b) Entertainment
c) Promotion and sales
d) Training

IV- Infrastructure of information

a) Office information and communication equipment operators
b) Occupations related to printing and photographic development
c) Occupations related to mail and messenger services

Using this general typology, we examined the job descriptions of each four-digit occupation provided in the Canadian Occupational Code, and attempted to distribute the various information occupations on this basis. The detailed breakdown of information occupations is given in Appendix I.

2.3 Application of definitions to census data

We obtained the census data on employment by occupation and by industry for 1971, 1981 and 1986. With our classifications of occupations, described in general above and in detail in Appendix I, we prepared a general table giving the relative extent of information occupations. Table 2 shows the proportion of information occupations as a percentage of the labour force, as well as the changes that occurred between 1971 and 1981.

The results for all information occupations for Canada are similar to those obtained by Rubin and Sapp[1]. On the basis of our classification, in 1971 information occupations represented 42.32% of the labour force and 50.36% in 1981, for a considerable increase of 19.0%. For their part, Rubin and Sapp obtain 41.0% for the United States in 1970. The different classifications of information occupations in our study and Rubin and Sapp's work may explain the slight discrepancy between the findings. In particular, Rubin and Sapp adopted a slightly more restrictive classification of information occupations, by excluding those such as social workers, inspectors and certain types of foremen/women, adult education teachers, etc. Thus the proportion of information workers in the total employment they obtained is somewhat lower than our figure.

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[1] *Rubin, M.R. and M.E. Sapp, "Selected Roles of Information Goods and Services in the U.S. National Economy," Information Processing and Management, 1981, Vol. 17, pp. 195-213.*

Table 2
Information workers in Canada: 1971-1981
By major information-processing categories
As a percentage of the labour force

		1971	1981
I-	**Organization of information**		
a)	Clerical skills	11,0	14,31
b)	Technical skills	0,64	0,81
c)	Scientific and professional skills	5,32	6,44
d)	Research and artistic creation	0,28	0,34
	Subtotal	**17,24**	**21,90**
II-	**Decision-making and control**		
a)	Management	2,46	4,85
b)	Inspection	1,01	1,08
c)	Supervision	8,73	7,83
	Subtotal	**12,20**	**13,76**
III-	**Dissemination of information**		
a)	Various information and news	0,64	0,96
b)	Entertainment	0,17	0,24
c)	Promotion and sales	5,79	6,27
d)	Training	3,9	4,25
	Subtotal	**10,5**	**11,72**
IV-	**Information infrastructure**		
a)	Office information and communication equipment operators	0,99	1,13
b)	Occupations related to printing and photographic development	0,61	0,63
c)	Occupations related to mail and messenger services	0,78	1,22
	Subtotal	**2,38**	**2,98**
	Total according to our classification	**42,32**	**50,36**

Appendix II contains a table giving a detailed breakdown of all information workers by category, i.e. the figures corresponding to the information on 1971 and 1981 in Appendix I.

Occupations responsible for the organization of information represented almost half of all information occupations, and 20% of the labour force. Within this category, occupations grouped under "clerical skills" accounted for **nearly 70% of all occupations responsible for the organization of information.** In addition, we should note the substantial increase in the proportion of clerical employees as a percentage of the labour force, i.e. 30.01%. There was also considerable growth in the proportion of the overall category of occupations related to the organization of information between 1971 and 1981, i.e. 27.03%.

The data in the second category, decision-making and control, which groups together the occupations of management, inspection and supervision, reveal an interesting phenomenon linked to the growth in information technologies. **Management** tasks almost **doubled** as a percentage of the labour force, while **supervisory** occupations lost ground. In overall terms, those occupations grew by 12.79%.

For the last two categories, namely dissemination of information and infrastructure of information, there were increases of 11.62% and 25.21%, respectively.

Information occupations thus totalled 50.36% of the labour force in Canada in 1981. Occupations related to clerical skills were the most important. Appendix II shows the relative size of each occupation in all categories as a percentage of the labour force.

2.4 Occupational structure by activity sector: a few examples

Given the considerable volume of manual calculations involved in evaluating the information labour component of employment by activity sector for 1971 and 1981 (only the 1986 data could be computer-processed, by Statistics Canada), we had to limit to a few examples the sectors for which the proportion of information workers in comparison with employment was calculated. To select those examples, we took the following factors into consideration:

- various studies consider that certain activity sectors, such as telecommunications, can automatically be grouped in the information sector. But since we **use occupational structure** as a **method for evaluating information production by sector,** it is appropriate to verify the information component of sectors that can automatically be considered information sectors. The information component may be considerably less than 100%, for various reasons relating to the sector's production functions;

- there are other sectors in which there is known to be a high information component, although the main activity of the sector is not the production of information. That is the case, in particular, for the banking sector. We therefore examined the information component of that type of sector;

- moreover, it is known that information technologies play a growing role in goods-producing sectors, but the information component of production in these industries is not very well known. For purposes of illustration, we chose three key sectors of the Canadian economy from all the goods-producing industries. First, the very important pulp and paper sector; then we examined another key sector that has undergone many changes in recent years, namely the motor vehicle sector; finally, we examined a promising high-technology sector, the aerospace industry;

- this exercise also allowed us to show the classification problems confronting us when we use census data by industry (on the basis of the 1970 industrial classification) for labour and data from the input-output table for evaluating value added and production functions. We illustrated the linkage problem using level W, that is the least aggregated level of the input-output table.

Finally, this exercise showed what changes have taken place in the information component of the industries we selected for the analysis.

A) Presentation of the linkage between the standard industrial classification (1970) and the classification used in the input-output table, for several industries

Standard Industrial Classification (1970) SIC		Equivalent Interindustrial classification in the input-output table (IOA), Level W	
543	Radio and television broadcasting	175 176	Radio and television broadcasting industry Cable television industry
701	Banks and other deposit-accepting establishments	184 185 186 187	Banks and other deposit-accepting institutions Trust/deposit-accepting mortgage corporations Credit unions Other finance & real-estate industries
861 863 864 866	Offices of accountants Offices of architects Engineering & scientific services Offices of lawyers & notaries	192	Professional business services
851 853 855	Employment agencies & personnel suppliers Computer services Security & investigation services	191 194	Computer & related services Miscellaneous business services

B) Presentation of the information component of several industries

In the following tables we show the industries at level W, the least aggregated in the input-output table, and at level L, the most aggregated. For all the sectors under study, the proportion of information occupations is summarized for 1971, 1981 and 1986 in Table 4. A more detailed breakdown appears for 1971 and 1981 for the service sectors in Tables 3.1 to 3.4. For the manufacturing sectors, we have given the results for 1971, 1981 and 1986, to better evaluate the most important sectoral changes in those industries.

Table 3.1
Radio and Television Broadcasting

SIC classification	Interindustrial classification (IOA)	
	Level W	Level L
543: Radio and television broadcasting	**175:** Radio & television broadcasting industry **176:** Cable television industry	**129:** Telecommunications broadcasting industry

Main occupations in radio and television broadcasting (543)	1971		1981	
	Number	%	Number	%
3330: Producers and directors	2 390	10,2	4 605	11,2
3337: Radio and television announcers	2 340	10,0	5 240	12,7
4111: Secretaries and stenographers	1 290	5,2	N/A[1]	-
9551: Radio and television broadcasting equipment operators	1 475	6,3	2 265	5,5
Other	15 935	68,0	29 185	70,7
Total	23 430	100,0	41 295	100,0
Information occupations	**16 570**	**70,7**	**49 480**	**71,4**

[1] *Included with "Other occupations."*

Table 3.2
Banks and other deposit-accepting institutions

SIC classification	Interindustrial classification (IOA)	
	Level W	Level L
701: Banks and other deposit accepting establishments	**184:** Banks and other deposit-accepting institutions **185:** Trust/deposit-accepting mortgage corporations **186:** Credit unions **187:** Other finance & real estate industry	**137:** Banks, credit union & other deposit institutions **138:** Trust, other finance & real estate (partly)

Main occupations in banks and other deposit-accepting establishments (701)	1971 Number	1971 %	1981 Number	1981 %
1135: Financial management occupations	N/A	-	29 960	12,3
1171: Accountants, auditors and other financial officers	28 975	22,4	21 270	8,7
4111: Secretaries and stenographers	9 295	7,2	N/A	-
4131: Bookkeepers and accounting clerks	14 550	11,2	25 720	10,5
4133: Tellers and cashiers	28 975	22,4	61 390	25,1
4135: Insurance, bank and other finance clerks	12 730	9,8	28 895	11,8
Other	35 025	27,1	77 365	31,6
Total	129 550	100,0	244 595	100,0
Information occupations	**114 390**	**88,3**	**223 365**	**91,3**

Table 3.3
Professional business services

SIC classification	Interindustrial classification (IOA)	
	Level W	Level L
861, 863, 864, 865: Professional business services	**192:** Professional business services	**143:** Professional business services

Main occupations in industry 861	1971		1981	
	Number	**%**	**Number**	**%**
1171: Accountants, auditors and other financial officers	16 255	53,9	28 970	51,3
4111: Secretaries and stenographers	2 645	8,8	4 435	7,9
4113: Typists and clerk-typists	N/A	-	1 305	2,3
4131: Bookkeepers and accounting clerks	6 755	22,4	14 570	25,8
Other	4 490	14,9	7 195	12,7
Total	30 145	100,0	56 475	100,0
Information occupations	**28 595**	**94,9**	**54 240**	**96,1**

Main occupations in industry 863	1971		1981	
	Number	**%**	**Number**	**%**
2141: Architects	2 770	44,5	5 130	41,3
2163: Draughting occupations	1 345	21,6	2 855	23,0
2165: Arthitectural and engineering technologists and technicians	N/A	-	500	4,0
4111: Secretaries and stenographers	575	9,2	815	6,6
Other	1 540	24,7	3 110	25,1
Total	6 230	100,0	12 410	100,0
Information occupations	**5 820**	**93,4**	**11 760**	**94,7**

Table 3.3 (cont'd)
Professional business services

Main occupations in industry 864	1971 Number	1971 %	1981 Number	1981 %
2143: Civil engineers	5 345	11,4	10 350	10,3
2161: Surveyors	2 735	5,8	5 710	5,7
2163: Draughting occupations	5 575	11,9	11 265	11,3
4111: Secretaries and stenographers	2 990	6,4	5 760	5,7
Other	30 288	64,5	67 015	66,9
Total	46 966	100,0	100 100	100,0
Information occupations	**40 030**	**85,2**	**87 725**	**87,6**

Main occupations in industry 866	1971 Number	1971 %	1981 Number	1981 %
2343: Lawyers and notaries	13 645	37,3	27 915	39,0
2349: Occupations in law and jurisprudence, n.e.c.	2 075	5,7	4 420	6,2
4111: Secretaries and stenographers	14 120	38,6	26 440	36,9
4131: Bookkeepers and accounting clerks	1 330	3,6	3 165	4,4
Other	5 390	14,7	9 580	13,4
Total	36 560	100,0	71 520	100,0
Information occupations	**34 230**	**93,6**	**68 575**	**95,9**

Total professional business services W-192	**1971**	**1981**
Total employment:	**119 901**	**240 505**

	1971 Number	1971 %	1981 Number	1981 %
Information occupations	108 675	90,6	222 300	92,4

Table 3.4
Other business services industries

SIC classification	Interindustrial classification (IOA)	
	Level W	Level L
851, 853, 855: Other services to business management	**191:** Computer & related services **194:** Miscellaneous business services	**142:** Other business services industries

Main occupations in industry 851	1971 Number	1971 %	1981 Number	1981 %
1174: Personnel & related occupations	1 020	11,9	2 325	11,4
4111: Secretaries and stenographers	1 285	15,0	3 005	14,7
4131: Bookkeepers and accounting clerks	N/A	-	1 835	8,9
6115: Guards and related security occupations	1 165	13,6	1 255	6,2
Other	5 095	59,5	11 995	58,8
Total	8 565	100,0	20 415	100,0
Information occupations	**5 415**	**63,2**	**13 160**	**64,5**

Main occupations in industry 853	1971 Number	1971 %	1981 Number	1981 %
2183: Systems analysts, computer programmers & related occupations	1 155	26,2	9 890	32,9
4111: Secretaries and stenographers	215	4,9	1 115	3,7
4131: Bookkeepers and accounting clerks	N/A	-	1 015	3,4
4143: Electronic data-processing equipment operators	865	19,6	4 360	14,5
Other	2 170	49,3	13 695	45,5
Total	4 405	100,0	30 075	100,0
Information occupations	**3 740**	**84,9**	**25 720**	**85,5**

Table 3.4 (cont'd)
Other business services industries

Main occupations in industry 855	1971 Number	1971 %	1981 Number	1981 %
4111: Secretaries and stenographers	N/A	-	495	1,6
4131: Bookkeepers and accounting clerks	N/A	-	420	1,3
6113: Police agents and investigators, private	710	4,8	1 120	3,2
6115: Guards and related security occupations	10 815	73,0	23 875	75,1
9175: Truck drivers	315	2,1	480	1,5
Other	2 980	20,1	5 410	17,0
Total	14 820	100,0	31 800	100,0
Information occupations	**2 295**	**15,5**	**4 960**	**16,0**

851, 853, 855	**1971**	**1981**
Total employment:	**27 790**	**82 290**

	1971 Number	1971 %	1981 Number	1981 %
Information occupations	11 450	41,2	43 840	53,3

Table 3.5
Pulp and Paper Industry

SIC classification	Interindustrial classification (IOA)	
	Level W	Level L
271: Pulp and paper mills	**66:** Pulp industry **67:** Newsprint industry **68:** Paperboard, building board & other paper industries	**51:** Pulp & paper industries

Main occupations in the pulp and paper industry (271)	1971		1981		1986	
	Number	%	Number	%	Number	%
8258: Occupations in labouring and other elemental work, pulp and papermaking	7 390	9,3	11 115	11,8	4 730	5,6
8253: Papermaking and finishing occupations	6 070	7,7	8 815	9,4	7 610	9,0
8259: Pulp and paper-making and related occupations, n.e.c.	4 730	5,9	5 560	5,9	10 395	12,3
8284: Other workers	4 265	5,4	4 560	4,8	4 850	5,6
8251: Cellulose pulp preparing occupations	3 755	4,7	6 515	6,9	5 560	6,6
Other	26 209	33,1	57 540	61,1	51 240	60,7
Total	79 190	100,0	94 105	100,0	84 385	100,0
Information occupations	**20 505**	**25,9**	**26 400**	**28,1**	**26 735**	**31,7**

Table 3.6
Motor vehicle industries

SIC classification	Interindustrial classification (IOA)					
	Level W		Level L			
323: Motor vehicle manufacturers	100: Motor vehicle industries		76: Motor vehicle industry			
Main occupations in the motor vehicle industry (323)	**1971**		**1981**		**1986**	
	Number	**%**	**Number**	**%**	**Number**	**%**
8335: Welding and flame cutting occupations	3 715	4,3	3 140	3,1	20 955	34,6
8334: Metalworking-machine operators, n.e.c.	2 695	3,1	20 840	20,5	2 875	4,8
8581: Motor-vehicle mechanics and repairers	4 725	5,4	4 605	4,5	2 365	3,9
8513: Motor-vehicle fabricating and assembling occupations	14 735	16,9	3 330		2 180	3,6
8526: Inspecting and testing occupations, fabricating and assembling metal products, n.e.c.	3 370	3,9	2 150	2,1	1 750	2,9
Other	57 775	66,4	63 348	61,8	30 465	50,3
Total	87 015	100,0	102 413	100,0	60 590	100,0
Information occupations	**20 045**	**25,3**	**27 115**	**26,5**	**14 025**	**23,2**

Table 3.7
Aircraft and aircraft parts industries

SIC classification	Interindustrial classification (IOA)					
	Level W			Level L		
321: Aircraft and aircraft parts manufacturers	**99:** Aircraft and aircraft parts industries			**75:** Aircraft and aircraft parts industries		
Main occupations in the aircraft and aircraft parts industry (321)	**1971**		**1981**		**1986**	
	Number	**%**	**Number**	**%**	**Number**	**%**
8515: Aircraft fabricating & assembling	2 940	11,6	1 200	3,1	4 770	13,9
8313: Machinist & machine tool setting-up occupations	1 020	4,0	2 585	20,4	2 085	6,1
8582: Aircraft mechanics and repairmen	1 385	5,5	1 635	4,5	2 515	7,3
8526: Inspecting & testing occupations, fabricating & assembling metal products, n.e.c.	1 275	5,0	5 180	2,1	1 885	5,5
8315: Machine tool operating occupations	920	3,6	2 275		1 405	4,1
Other	17 885	70,4	24 420	64,5	21 715	63,2
Total	25 425	100,0	37 295	100,0	34 375	100,0
Information occupations	**9 870**	**38,8**	**15 225**	**40,8**	**16 015**	**46,6**

Table 4
Summary

	TOTAL EMPLOYMENT			INFORMATION EMPLOYMENT			SHARE OF INFO. EMPLOYMENT		
	1971	1981	%	1971	1981	%	1971 %	1981 %	1986 %
SIC 701 Banks and other deposit-accepting establishments W - 184,185,186,187 L - 137,138	129 550	244 595	88,8	114 390	223 365	95,3	88,3	91,3	88,4
SIC 543 Radio and television broadcasting W - 175,176; L - 129	23 430	41 295	76,3	16 570	29 480	77,9	70,7	71,4	81,9
SIC 861 Offices of accountants	30 145	56 475	87,3	28 595	54 240	89,7	94,9	96,1	98,1
SIC 863 Offices of architects	6 230	12 410	99,2	5 820	11 760	102,1	93,4	94,8	96,7
SIC 864 Engineering & scientific services	46 966	100 100	113,1	40 030	87 725	119,2	85,2	87,6	89,1
SIC 866 Offices of lawyers and notaries	36 560	71 520	95,6	34 230	68 575	100,3	93,6	95,9	97,6
TOTAL - Professional business services W - 192	**119 901**	**240 505**	**105,6**	**108 675**	**222 300**	**104,6**	**90,6**	**92,4**	**94,2**
SIC 851 Employment agencies & personnel suppliers	8 565	20 415	138,4	5 415	13 160	143,0	63,2	64,5	84,8
SIC 853 Computer services	4 405	30 075	582,7	3 740	25 720	587,7	84,9	85,5	93,0
SIC 855 Security and investigation services	14 820	31 800	114,6	2 295	4 960	116,1	15,5	16,0	35,4
TOTAL - Computer and related services, miscellaneous business services W - 191,194; L -142	**27 790**	**82 290**	**196,1**	**11 450**	**43 840**	**282,9**	**41,2**	**53,3**	**66,4**
SIC 271 Pulp and paper mills W - 66,67,68;L - 51	79 190	94 105	18,8	20 505	26 400	28,7	25,9	28,1	31,7
SIC 323 Motor vehicle manufacturers W - 100; L- 76	87 015	102 413	17,7	22 045	27 115	23,0	25,3	26,5	23,2
SIC 321 Aircraft and aircraft parts manufacturers W - 99; L - 76	25 425	37 295	49,7	9 870	15 225	54,3	38,8	40,8	46,6

C) *Some comments on the results*

First of all, it can be seen that in industries with a large information component--the component being defined here as the proportion of information workers compared with total employment in a sector[1]--there was no substantial variation in the **proportion** represented by information workers between 1971 and 1981. Thus, in the banking and financial institutions sector, the proportion of information workers rose from 88.3% to 91.3% over this period. On the other hand, employment in those sectors increased markedly over the same period. This increase is clearly greater than in the labour force, which points to strong growth in economic sectors related to information.

Furthermore, it is important to note that the radio and television broadcasting sector, which typologies generally include in the information sector, actually has a **lower information component** in labour terms than the banking sector, while that latter sector does not always appear in the information sector in typologies. In short, the information component of production in the banking sector, on the basis of these results, is higher than that of the radio and television broadcasting sector. This stems from the high number of technicians, electricians and other support workers not classified as information workers in the latter sector. Thus this calculation shows that if the information component of a sector is evaluated using the occupational structure of labour, a specific sector cannot automatically be classified as part of a "general information sector."

The information labour component is very high in professional business services sectors (W: 192), and generally exceeds 90% of the workforce in those sectors. Thus in those cases, these sectors can be considered totally information sectors. When drawing up the information satellite account presented later, the fact that the non-information component of production in these sectors has been left out is a calculation error that will not have significant effects on the overall results.

---

[1] *The information component according to the value added by information workers has been calculated only for 1985 (1986 census data and data from the 1985 input-output table). Because of difficulties relating to the availability of data and the high cost of obtaining them, we estimated the information component of production for the period 1971-1981 using the proportion of information employment in the economy.*

In the goods-producing sectors it can be seen that for the pulp and paper industry, the information component represents approximately 26% of production. It is somewhat surprising to find that this proportion changed little between 1971 and 1981. Modernization in the pulp and paper sector resulted in a rather substantial decrease (more than 10%) in employment between 1981 and 1986, and increased production, and also led to an increase in the proportion of information employment, which rose from 28% to 31.7%. In this case, technical progress reduced non-information employment and also implies a greater use of information capital, which in turn seems to have brought about a rise in the proportion of information employment.

In the motor vehicle sector, the share of information employment as a proportion of total employment changed little between 1971 and 1981, remaining at about one-quarter. However, modernization in the industry between 1981 and 1986 led to a great upheaval in production structures:

- total employment dropped by 40%, while production rose, suggesting considerable productivity growth;

- even more remarkably, the share of information employment dropped between 1981 and 1986, meaning that technological progress affected not only traditional labour, but also information workers. This corresponds to the idea expressed by C. Jonscher (1983), who felt that a second wave of technological progress is having an impact on information workers and will result in a reduction of the number of such workers and an increase in their quality in terms of human capital, as well as greater specialization to complement new information equipment.

The last example concerns a non-information industry, but one in the **high-technology** field, namely the aircraft and aircraft parts industry. First of all, it can be seen that the share of information occupations was already high in 1971, and grew to reach 40.8% in 1981. Technological progress thus resulted in a rise in the share of information employment. Between 1981 and 1986, modernization in this industry likewise produced a drop in employment. But unlike in the motor vehicle sector, it also brought about an additional increase in the proportion of information employment, to 46.6%. In this case, the rise in productivity reduced the number and proportion of traditional workers. On the other hand, more sophisticated production processes and **products sold** resulted in a greater proportion of information employment in the total number of jobs.

3. INFORMATION COMPONENT OF PRODUCTION, PRODUCTIVITY AND INTERSECTORIAL ANALYSIS OF INFORMATION INDUSTRIES

We use the data in the first step of building the input-output table with an information satellite sector to analyse the penetration by information technologies into various economic sectors and their effects on productivity. It must be clearly understood that this is complementary information that we have decided to present, and **not part** of the mandate of the study as such. Thus an exhaustive analysis of these data should not be expected. The above-mentioned data-processing constraints also limited the scope of the analysis.

In this section we estimate the extent of penetration by information technologies by comparing the proportion of information workers with total employment in a sector, or the ratio of value added by information workers to total value added. When the share of the value added by information workers largely exceeds that added by employment in general, that is an indication that information workers are more productive than their non-information counterparts. Consequently, in those sectors an increase in the proportion of information workers probably tends to increase productivity. This can generally be achieved through greater use of information capital and more reliance on information technologies. We also calculated productivity by sector, dividing total value added by total employment. This allows us to examine the possible correlation between the use of information technologies and productivity. If sectors that make greater use of information workers generally have higher productivity than those where the share of information employment is lower, this would indicate that reliance on information technologies tends to boost productivity.

It must be stressed, however, that this is a **simple test** that bears on a single snapshot of industries for 1985. We do not have time series data that would allow us to determine the development over time of the relationship between information workers and productivity. As we saw in the preceding chapter, this relationship may have changed over the years; in particular, the penetration of new technologies into some sectors has been accompanied by a **drop** in information employment. This is the result of the replacement of a generation of information workers by a new generation, less numerous but more productive, and new information capital. The data that we have do not enable us to examine this development. Furthermore, measuring the penetration of information technologies by means of information employment is obviously an incomplete and imperfect approach. For a more complete analysis, it would be desirable to have **other indicators** concerning the nature of the equipment and

technology used[1]. In our approach we make no distinctions regarding the composition and nature of information employment. Thus the same proportion of information workers may reflect different levels of technology. In one case, they may be first-generation workers operating with fairly old capital, while in another they may be workers of a new generation, using the most up-to-date capital. We use the share of the value added attributable to information workers in an attempt to take this phenomenon into account. The results that we present generally give valid indications of the penetration and impact of information technologies. However, those indications are incomplete, particularly when the analysis is carried to a less aggregated level. The use of complementary information is then desirable.

3.1 The relationship between information employment and productivity

The information component of production was calculated for the 154 industries at level L of the input-output table. We present the results in graphic form, showing "information employment over total employment" (Ni/N) and "information wages over total wages" (Wi/W) for the 154 industries (which, because of our method of estimating value added, represents the proportion of the value added by information workers in an industry), and productivity defined as total value added divided by total employment (GDP/N). The industry numbers are shown on the horizontal axis, the information employment/total employment and information value added/total value added ratios on the left-hand axis, with productivity on the right-hand vertical axis. The complete results are given in table form in Appendix III, along with the detailed list of industries.

Note that in many industries, a higher ratio of information employment to total employment is accompanied by greater-than-average productivity. In fact, the correlation coefficient between these two variables is on the order of 0.65. We consider here that reliance on information technologies, as measured by the proportion of information employment to total employment, affects productivity when the proportion of value added attributable to information workers in an industry exceeds the average of an activity sector and the productivity of that industry also exceeds the average in the sector. Obviously, it should be stressed here that the existence of

[1] *For example, for Quebec, see the work by L.A. Lefebvre et al. listed in the bibliography.*

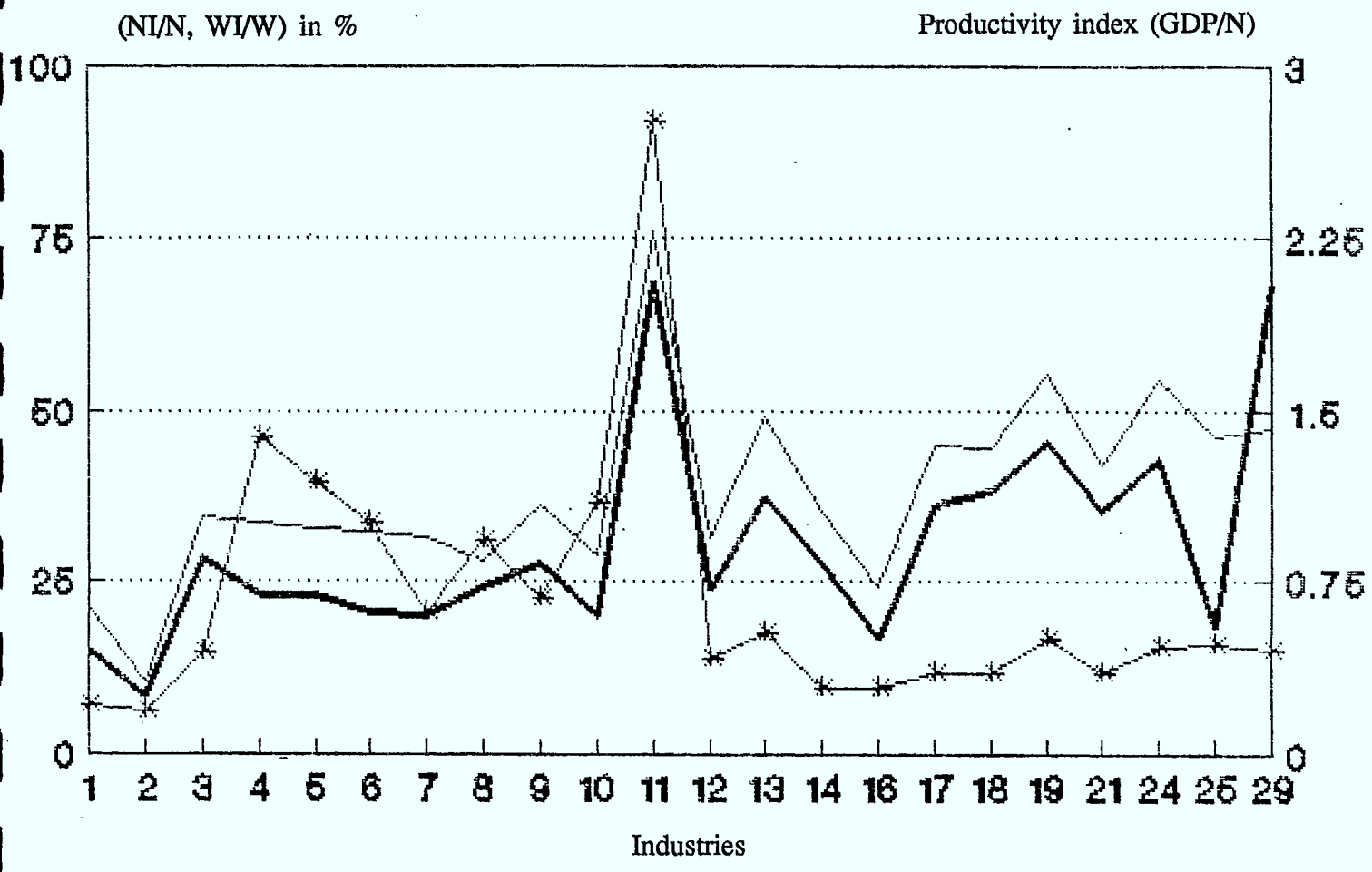
a positive correlation between the proportion of information employment and productivity is only one possible factor in explaining the level of productivity. All the other usual factors (management style, labour relations, etc.) that also affect productivity are not taken into account in our measurements. We have grouped the sectors into three major activity sectors:

- resources, raw materials and energy;
- semi-processed and processed products (this sector is more or less equivalent to the manufacturing sector);
- services.

The relationship between information employment and productivity is particularly evident in the resources and energy sector. This is a capital-intensive sector dominated by very large companies, where the use of information technologies makes a major contribution to increased productivity. Those industries include:

10	Coal mines	103	Industrial chemicals
11	Petroleum, natural gas	127	Pipeline transport
91	Cement industry	132	Electric power systems
96	Refined petroleum	133	Gas distribution systems
97	Chemical and chemical products		

INFORMATION



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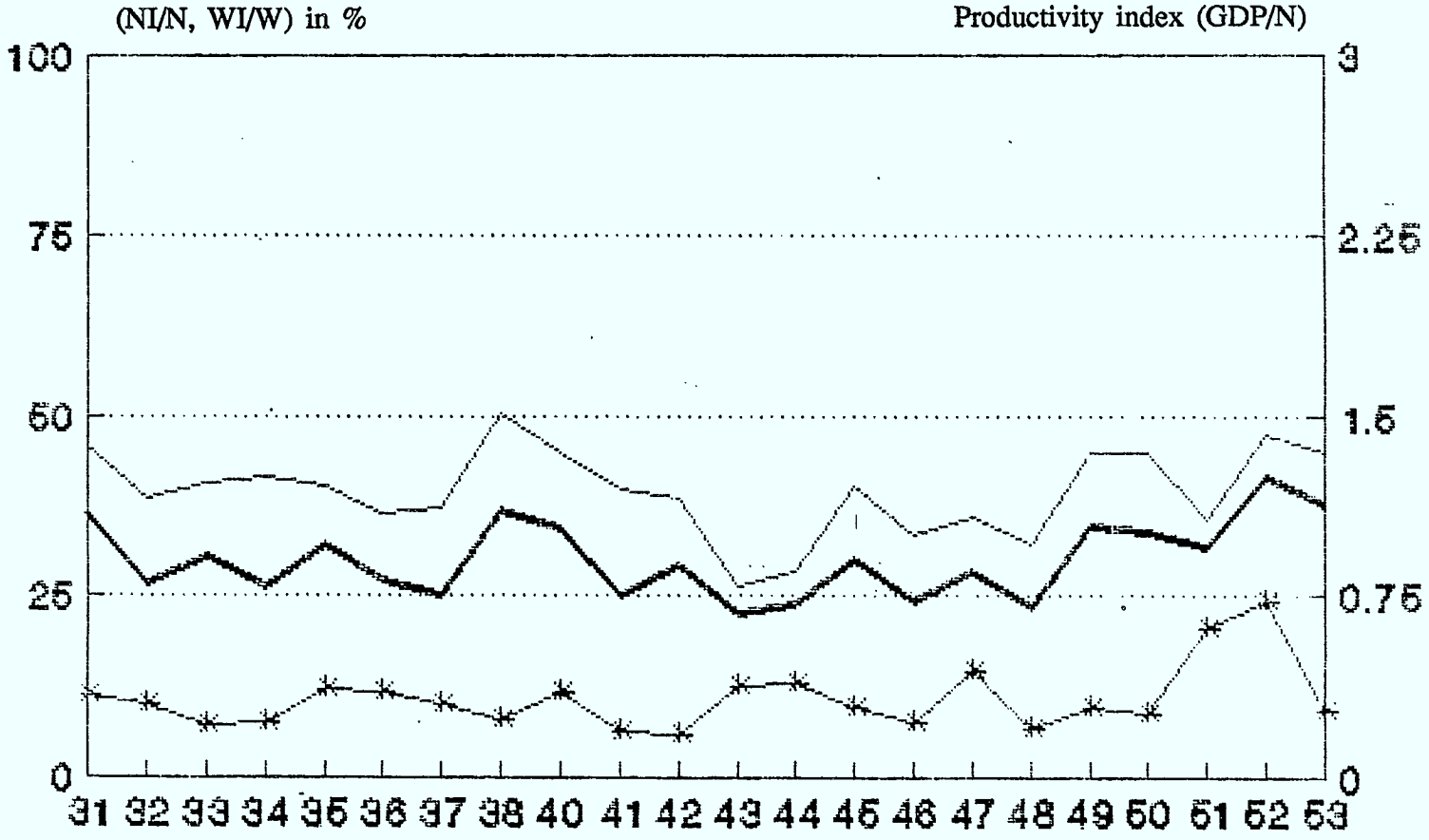

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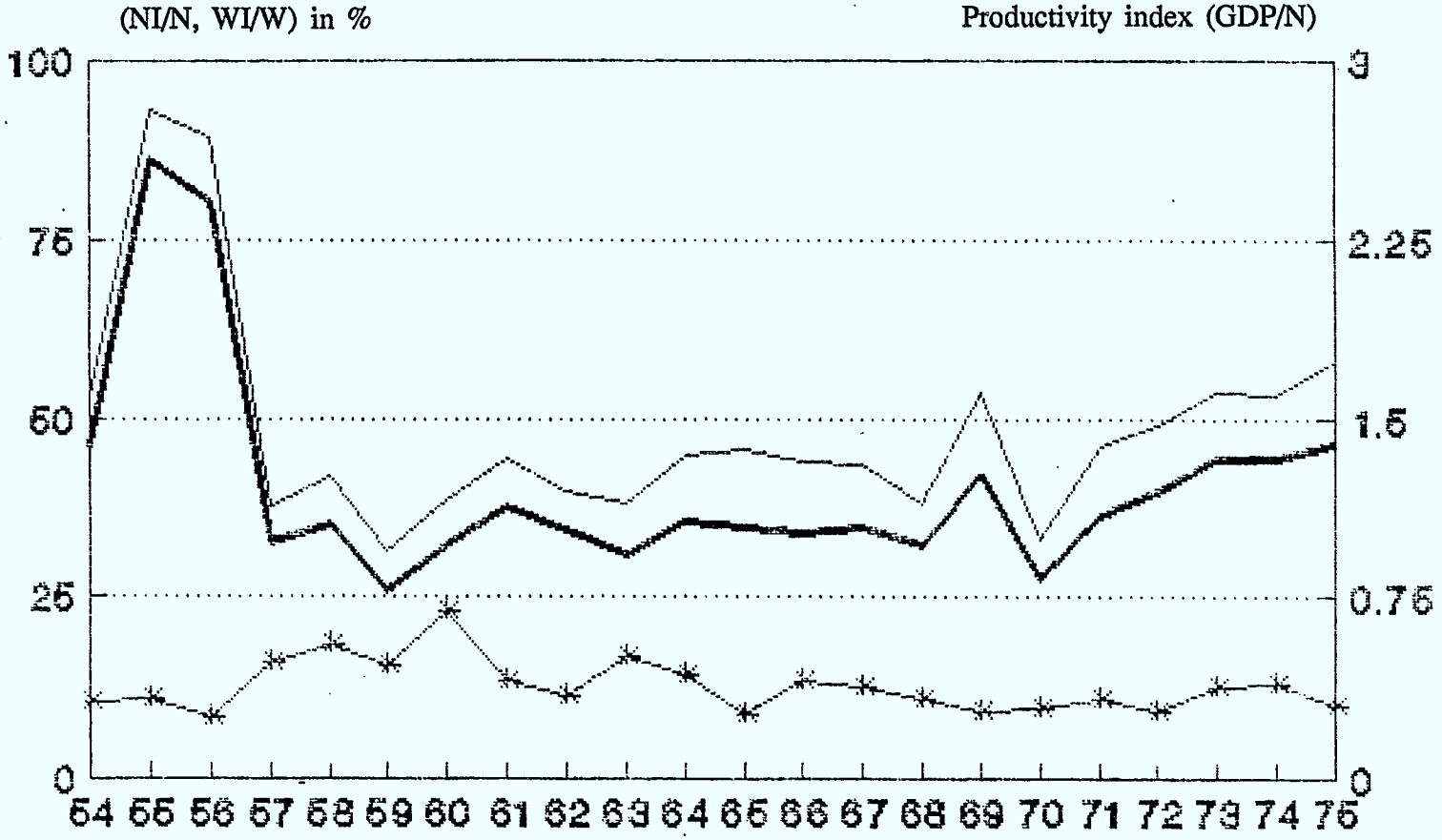

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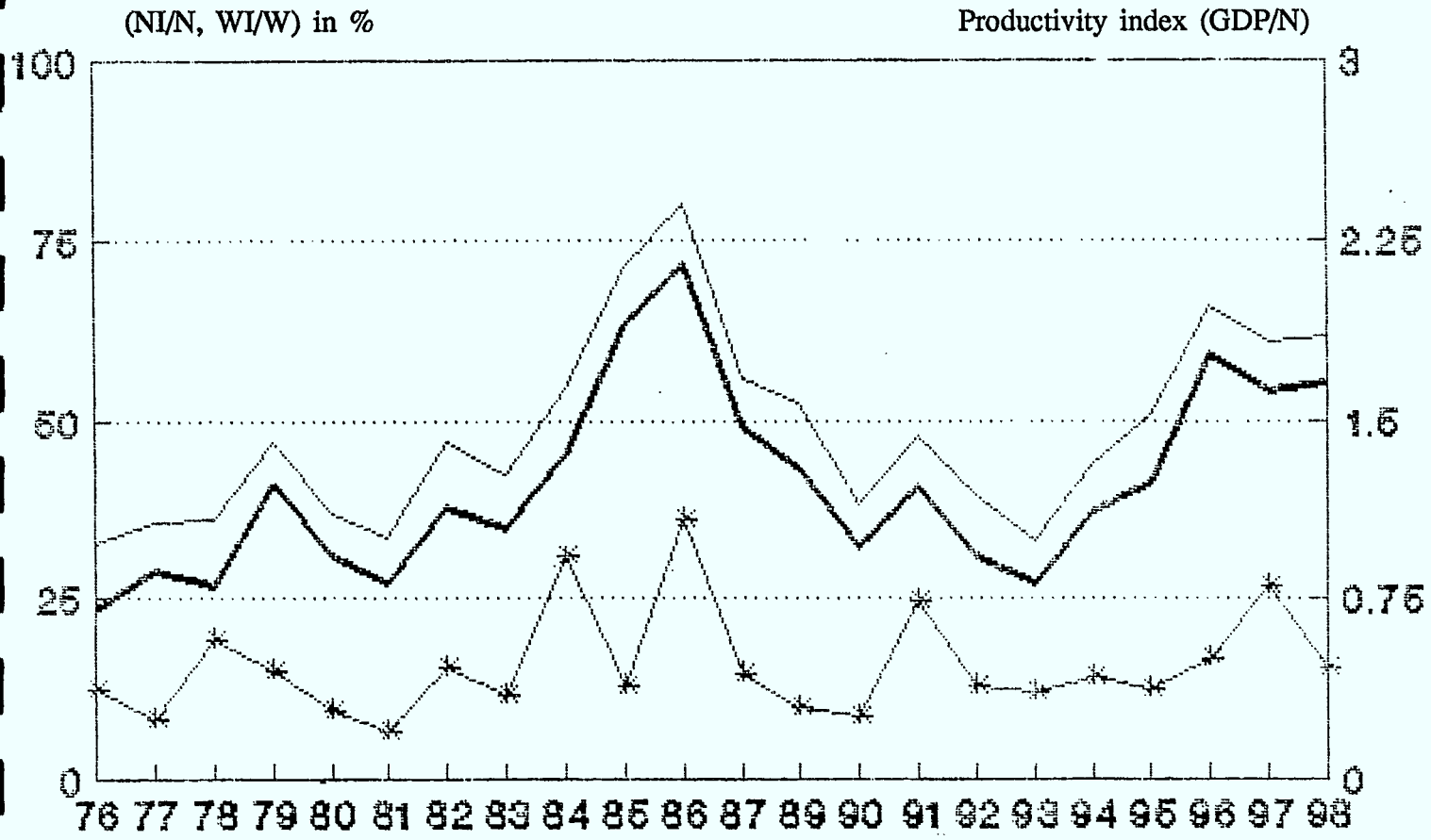

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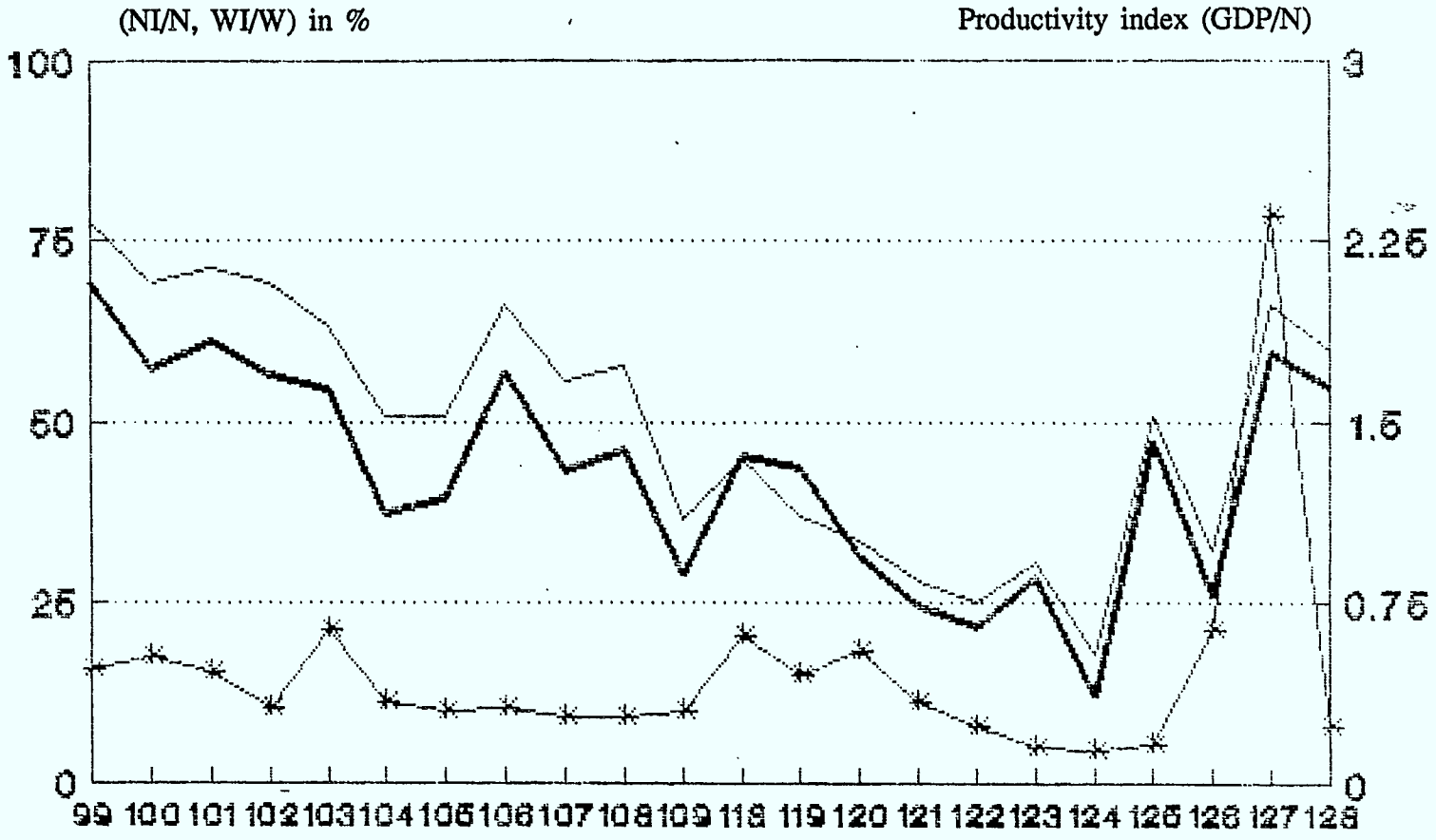

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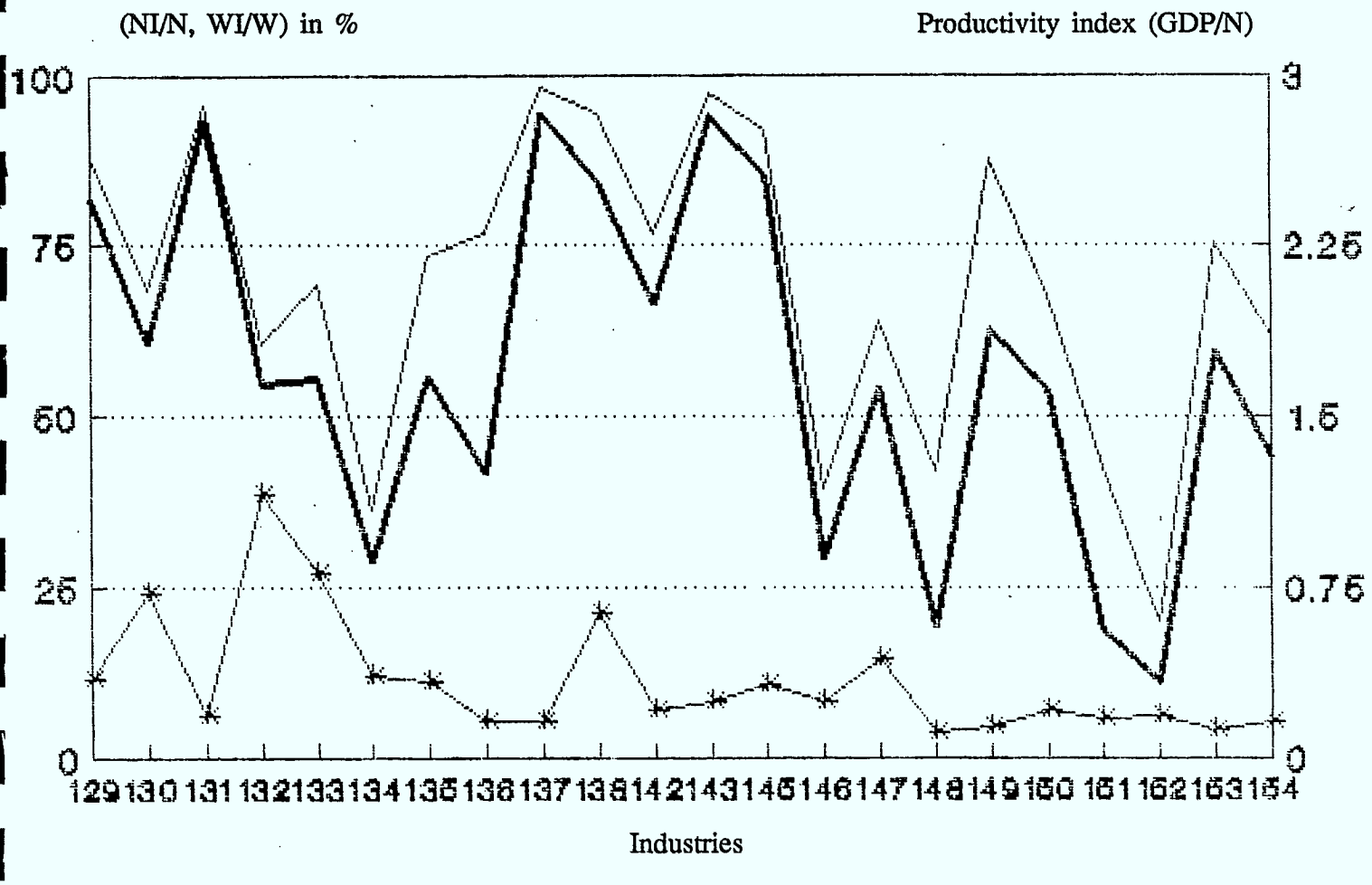

These are industries dominated by very large companies, where information technologies are prevalent throughout the companies' operations. There are also primary commodities manufactured on a large scale, where information capital is particularly productive. It should be noted here that many of the industries are related to the energy sector. Gas pipeline transport, for instance, is an industry where information technologies play a preponderant role in the production process; nearly 60% of employees are information workers, and productivity is very high.

In the manufacturing sector, there is also a link between information workers and productivity, albeit a less systematic one. The penetration of information technologies varies (Statistics Canada, 1987) in the manufacturing sector, and even within a given industry the use of these technologies may differ considerably from one company to another. The use of information technologies is more generalized in large firms, and affects many of the company's operations. Among small and medium-sized companies, the use of information technologies may vary significantly from one company to another and, where small companies are concerned, tends to be limited to fairly simple operations. Moreover, the data at our disposal are industrial average, where the variance may be fairly high. We can expect to see a more obvious link between the proportion of information workers and productivity in sectors dominated by large companies. That is the case, as we have seen, in the transportation equipment sectors. In the manufacturing sector, the link between productivity and the proportion of information workers is noticeable in the following industries:

40	Carpet, mat and rug industry	66	Stamped, pressed and coated metals
47	Other wood industries	73	Commercial refrigeration equipment
50	Other furniture & fixture ind.	74	Other machinery & equipment ind.
52	Asphalt roofing industry	78	Motor vehicle parts & accessories
58	Steel pipe & tube industry	84	Record players, radio & TV receivers
60	Non-ferrous smelting & refining ind.	85	Electronic equipment industries
63	Other metal rolling, casting, etc.	86	Office, store & business machines

This list includes producers of partially processed goods, such as metals or other raw materials. Those industries are generally dominated by large companies, and the use of information

technologies augments their productivity. The other group of industries produces **high information-content processed goods.** That is the case, in particular, for industries 84 to 86, which constitute the "infrastructure sectors" of the information economy. Productivity is quite high in those industries, and information technologies play a major role. In those sectors, **the size of companies is not as important a factor** as in the raw materials sectors for evaluating the penetration of information technologies and their impact on productivity. In sectors producing goods with a high information content, there are medium-sized companies where the use of information technologies makes it possible to obtain high productivity without having to depend on major economies of scale. Information technologies make it possible to use more flexible manufacturing processes, perform very exacting work (through robotics and other, similar, techniques), exercise better product quality control and so on.

In the service sector, the link between information workers and productivity is less significant. Information technologies have only just begun to penetrate a number of industries, and productivity gains have yet to come. In other industries, there may be many information workers but they are still involved in fairly simple tasks related to data processing. Those workers are not equipped with highly sophisticated information capital, and lack highly developed skills in the use of telematics. That is the case, for example, in the banking and retail sales sectors, where the many information workers handle basic data-processing tasks. But the quick-paced development of information technologies suggests that those sectors will experience an increase in their productivity in the near future; already some of them are posting higher-than-average productivity levels. The link between productivity and the proportion of information workers is strongest in the following service industries:

118 Air transport
130 Telecommunication carriers
138 Trust, other finance and real estate
147 Other health services

For trust companies, where productivity is four times greater than in the banking sector, it can be assumed that more extensive use of information technologies has led to appreciable productivity gains. The banking sector may benefit from such gains in future, in the wake of

the experience of other financial industries. However, the high number of bank branches hampers increased productivity (see III.4). Finally, generally speaking, it can be seen that there is only a limited number of industries where a higher than average proportion of information workers leads to greater than average productivity.

Judging from the above summary results, it appears that the service sector has yet to benefit from the penetration of information technologies, in terms of productivity measured by the value added per job.

3.2 Some results from statistical tests

Using cross-sectional data of the 154 industries in the input-output table, we first calculated a simple production function linking production to information employment, non-information employment, and capital. The objective was not to empirically test production functions, but rather to gain additional indications of the productivity of information workers.[1] The data on capital per industry were provided by the Input-Output Division of Statistics Canada. We specified a Cobb-Douglas type production function, which in its logarithmic form is as follows:

$$\log GDP = B_0 + B_1 \log NI + B_2 \log NNI + B_3 \log K + u \qquad (1)$$

where:

GDP = value added or production
NI = information employment
NNI = non-information employment
K = capital

[1] *For an analysis of production functions and information activities, see: G. Warskett, "The Role of Information Activities in Total Canadian Manufacturing: Separability and Substitutability", Applied Economics, Volume 16, 1984.*

We lack the data necessary to perform a distribution between information and non-information capital. The only distinction that the Input-Output Division of Statistics Canada makes in this regard is limited to non-residential construction and machinery and equipment.

New definitions are necessary in the investigation into investments to obtain data on information capital. Moreover, the estimate involves some bias, since it was impossible to separate information capital from the conventional variety.

The cross-sectional results for 1985 are as follows (tests, "t", appear in parentheses):

$$\log GDP = \underset{(17.9)}{7.51} + \underset{(9.6)}{0.38} \log NI + \underset{(6.2)}{0.24} \log NNI + \underset{(13.1)}{0.35} K \qquad (1')$$

$$R^2 = 93.3$$

All estimated coefficients are significant. The elasticity of production using information workers is thus 0.38, and 0.24 for non-information workers. This reflects the higher value added by information workers as compared with non-information workers. An increase of 1% in information workers in the economy increases production by more than a 1% increase in non-information jobs.

The second test dealt with the link between the proportion of information employment in relation to non-information jobs and productivity. We calculated, for the resources, raw materials and energy sector, the manufacturing sector and the service sector, the following relationship:

$$\log \frac{GDP}{N} = B_0 + B1 \log \frac{NI}{NNI} + u \qquad (2)$$

The results confirm our analysis from the previous section. For the resources sector, this regression gives good results (the coefficients are significant):

$$\log \frac{GDP}{N} = 7.7 + 1.1 \log \frac{NI}{NNI} \qquad (2')$$

(7.2) (3.2)

$R^2 = 0.5$

An increase in information employment in relation to conventional employment boosts productivity significantly.

For the manufacturing sector, the variance in results is greater and the regression gives statistically weaker results:

$$\log \frac{GDP}{N} = 9.2 + 0.4 \log \frac{NI}{NNI} \qquad (2'')$$

(22.2) (3.2)

$R^2 = 0.12$

An increase in the proportion of information employment in the manufacturing sector has a much smaller effect on productivity than in the resources sector; furthermore, the relationship is not as close as in the resources sector. That is what we observed in our qualitative analysis of the data. This result was attributed to the widely varying sizes of companies in this sector and the unequal penetration of information technologies.

This relationship is no more statistically significant for the service sector. Once again, this confirms our study of data in the previous section.

Finally, we ran a regression where the total productivity of labour (GDP/N) is broken down into its information (GDP^{I}/NI) and non-information (GDP^{NI}/NNI) components. This is a statistical breakdown of total productivity to confirm the results described above, which suggest that the value added attributable to information workers is, on average, higher than that attributable to conventional workers. The results are as follows:

$$\log (GDP/N) = \underset{(1.37)}{0.27} + \underset{(14.2)}{0.6 \log \frac{GDPI}{NI}} + \underset{(10.7)}{0.38 \log \frac{GDPNI}{NNI}} \qquad (3)$$

$R^2 = 0.96$

As expected, the sum of the elasticities is approximately equal to one, and that applying to GDPI/NI is much higher than that applying to GDPNI/NNI.

3.3 Intersectoral analysis of some high-information-content industries

In the first chapter we noted that our approach to the information economy was to measure the information content of the production of each sector, rather than identify information industries by the type of goods and services they produce. Appendix III shows the information content of each of the 154 industries at level L in the input-output table. Using the method described in the first chapter, we determined the value added by industry attributable to information workers, and this value added as a proportion of the total value added of the industry represents the information content of the production of that industry.

In that connection we note that the activities described as "information industries" on the basis of the nature of their production generally have a very high information content, as measured by the value added by information workers, in many cases exceeding 90%. There are some exceptions, such as the telecommunication carrier industry, where the information content is high (68%), but lower than that of other information industries. This specific case clearly illustrates the difference between our approach and that based on the nature of the services produced. This industry would be classified as an information industry, on the basis of its type of activity. With a sectoral approach, in fact, the entire production of industry 130 is information. But a considerable part of the value added of this industry, 30%, is not really information, if our approach is applied. A number of workers in the industry are not considered information workers, and perform tasks associated with the handling of physical objects. This industry in fact includes professions such as installer, repair technician,

electrician, and so on, whose main task is to handle physical goods. Thus we estimate, using our method, that about 70% of the production of industry 130 is information.

We have chosen a number of industries that, on the basis of the nature of their activities, are considered information industries, so as to analyse their relationships with other industries in the economy. They are as follows:

	Industries	**Information content**[1]
55	Printing and publishing	93.3%
129	Telecommunications broadcasting	88.0%
130	Telecommunication carriers	68.2%
137	Banks, credit unions	98.3%
138	Trust, other finance	94.2%
143	Professional business services	97.4%
144	Advertising services[2]	97.0%

1 Value added by information workers as a percentage of total value added.

2 At level L of the input-output table, this industry is included with sector 143 (professional business services) for reasons of confidentiality.

The input-output table allows us to determine, for an industry, the extent of purchases of inputs from other industries in the economy, and the destination of its production. The production of an industry may be used as input for other industries, or to meet final demand.

Final demand may be broken down into two major categories: domestic demand (consumption, investments and governments) and exports. The results of this analysis appear in Table 5.

compatible among institutions. This results in lost economies of scale in terms of the performance of computer systems, and makes transactions among institutions more costly.

Another interesting hypothesis explaining information technologies' lack of impact on productivity in the service sector relates to the effects of competition: a company may use telematics as a strategy (particularly for advertising purposes) to increase its share of sales on a market. In that case, technology leads to a **redistribution of sales among companies** in an industry, but does not contribute directly to increasing those companies' productivity. In the resources, energy and manufacturing sector, new technologies **are generally more closely related to production processes** and thus would have a more immediate effect on productivity.

Another, more familiar, hypothesis concerns the accumulation of information brought about by telematics, without a corresponding increase in the ability to use that information; this phenomenon affects the service sector in particular, where there is a large bureaucracy that produces and accumulates information. Finally, in the service sector, but also in other industries, information technologies may **improve working conditions** with no formal impact on the productivity measured. Productivity gains are then "consumed" by workers in the form of better working conditions. For example, one has only to think of office automation as compared with working conditions of ten or fifteen years ago. These technologies may lead to formal productivity gains, but a substantial proportion of the new technologies may simplify work and make it more pleasant or less stressful for employees; this could indirectly increase their productivity, since they would be prepared to work harder in return for better conditions. But this effect would not apply to the new generations of information workers, who consider the working conditions stemming from the new technologies "normal." All in all, it is probable that a considerable proportion of the gains brought about by new technologies is consumed by workers, and so cannot be measured with the data generally used to quantify productivity.

In the service sector, appreciable productivity gains have been recorded in the United States in a few specific industries--in fact, those in which we found a link between information jobs and productivity. They are the telecommunications industries, where there have been major investments in information technologies.

Table 5

High information-content industries: inputs and production

Industries	Inputs: purchases of goods and services (1)	Value added (2)	Gross production (1) + (2)	Use of gross production Total: 100%			
				Intermed. demand	Final demand domestic (1)	Final demand exports (2)	Final demand total 1 + 2
55 Printing and publishing	49,1%	50,9%	100%	79,0%	14,9%	6,1%	21,0%
129 Telecommunications broadcasting	54,9%	45,1%	100%	66,4%	31,9%	1,7%	33,6%
130 Telecommunication carriers	15,7%	84,3%	100%	52,5%	43,8%	3,7%	47,5%
137 Banks, credit unions and other	25,8%	74,2%	100%	46,4%	53,4%	0,2%	53,6%
138 Trust, other finance	34,1%	65,9%	100%	44,2%	55,0%	0,8%	55,8%
143 Professional business services	21,7%	78,3%	100%	82,7%	3,7%	13,6%	17,3%
144 Advertising services	32,8%	67,2%	100%	N/A			

We note, first of all, that information industries in Canada, with the exception of business services, **export very little.** For the latter, approximately 14% of production is exported. The purchase of inputs varies considerably from one sector to another, and reflects the nature of the industry. In printing and publishing, nearly 50% of gross production consists of inputs. The purchase of paper, ink and other similar supplies is important for this industry. At the other extreme, the business services industry purchases relatively few inputs (22% of gross production), with production made up mostly of intellectual services produced by professionals from all disciplines.

If banking and financial services are excluded, it can be seen that a very large proportion of information production is sold to other companies as input. In the printing sector 79% of production goes to meet intermediate demand and, for business services, this proportion rises to nearly 83%. The production of information is thus widely used in the economy as an intermediate input.

3.4 Comparison with the U.S. economy and hypotheses for explaining differences in behaviour between economic sectors

The results we have presented in this and the previous chapters bear some similarity to the findings of certain studies conducted in the United States.

A recent study[1] using time series data noted that in the United States there was some acceleration in productivity growth between 1979 and 1987, at a time when the use of information technology was expanding. But this acceleration was very unequally distributed among the sectors. As in Canada, penetration was uneven on a sectoral basis, and its impact also varied substantially from one industry to another. There were considerable productivity gains in sectors comparable with those identified in the previous chapter for Canada. In those sectors, there was a **second wave in the telematics revolution**. Those industries, such as machinery or transport equipment production, are in the manufacturing sector.

The study noted a **slowdown** in productivity in various industries in the U.S. service sector. This result is compatible, in general terms, with our observations. The learning and penetration period for new technologies in the service sector is not over. In the banking and finance sector, some more-specific factors may explain the stagnating productivity. For instance, with strong competition among branches, banks forego economies of scale by serving multiple points of sale, while in sectors such as resources and energy, information technologies have accentuated the productivity gains associated with economies of scale. Moreover, computer systems have been developed that are specific to a given financial institution, rather than

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[1] *See M.N. Baily and R.J. Gordon, "The Productivity Slowdown Measurement Issues, and the Explosion of Computer Power", Brookings Paper of Economic Activity, Volume 2, 1988, The Brookings Institute.*

Moreover, it can be seen in both Canada and the United States that information production in a sector such as business services is used mainly as input for other companies. One factor that explains these exchanges of information services in the economy is the fact that many firms **lease rather than buy** computer equipment, a process that includes the sale of professional services to help use telematics equipment, develop computer systems and so on. However, the growth of microcomputers is changing this situation, and many companies are buying their computer equipment because of its low cost and assigning their own employees to handle the user-friendly equipment. In fact, we saw that many industries in all sectors of the economy produce a large information value added even if their main activities have nothing to do with information. But although companies produce more information with microcomputers, the fact remains that the input-output data show that a large volume of information services is being exchanged, as inputs, among industries.

4.1 General presentation

The purpose of this step is to create an information industry in the input-output table, one that conducts transactions with other industries. In this way we wish to determine the importance of information as an economic commodity, how it circulates in the economy, and its impact on other activity sectors when the production of information varies.

The economy's production of information or, in other words, the value added by the information sector, consists of the **sum of the value added** associated with the production of information **in every industry in the economy.** For a specific industry, information production is estimated using the method explained in the first chapter. We will briefly summarize that method: through a classification of information occupations, we determine information employment by industry. Then, using data on wages by occupation, we determine total wages. This is then used to determine the proportion of value added produced by information workers, which represents the production of information by industry.

The production or value added by the information industry that we are adding as an industry in the input-output table thus comprises the sum of all value added corresponding to the production of information in each of the industries of the economy. In this way we create what is referred to as a "fictive" information industry. This industry is not to be found as such in the economy, since its production corresponds to the production of information by each industry in the economy. In that sense, it is "fictive". However, the production attributed to the information industry is real, and thus there is a **transfer of value added** in the input-output table; each industry's production is reduced by an amount corresponding to its information production, and this production is shifted to the information industry. There is a re-arrangement of production in the interindustrial model, but the overall value added in the economy remains unchanged.

An example using a specific industry will illustrate this transfer. The production of information in the motor vehicle industry represents 32.5% of the entire production of that sector. The value added attributable to the motor vehicle industry represents 67.5% of the value added shown in the input-output table, prior to the addition of an information sector. In the table including the information industry, the balance of 32.5%, representing the production of

information by the motor vehicle industry, is moved to the fictive information industry. The motor vehicle industry, in this new intersectoral model, will purchase information it needs for its activities from the fictive information industry. The amount purchased is equal to 32.5% of the initial value added. Thus each industry's production will be reduced by an amount equal to its information production, and that production will be purchased from the new information industry.

Once the value added by the new information industry has been determined, the next step is to develop a method to establish the **input structure** of that industry. These inputs will consist of purchases of goods and services from other industries in the economy. In the end, the goal is to devise a production function for this fictive information industry. These purchases of inputs will constitute the **intersectoral link** between the production of information and the other industries in the economy.

When the estimate of the purchases of inputs by the information industry is completed, we will then have a complete interindustrial model with an information sector, and can carry out various simulations using shocks on final demand. We can examine the information content of our exports, or analyse the implications of an increase in some of our exports resulting from a Canadian strategy on the international market.

4.2 Estimating production functions for the information sector

A) General principle

Production functions were estimated on the basis of **inputs used by information workers.** We identified those inputs in two ways: first, we examined the list of commodities in the input-output table (a total of 602 inputs used by all industries) and selected those used almost solely by information workers. Second, for industries where information workers represent almost 100% of occupations, we selected all the inputs for that industry. These lists of inputs then become inputs for the fictive information industry. The value of the inputs selected is then divided by wages **to determine the coefficients of inputs by labour cost** for various

information occupations. We in fact used the **average by information occupation of input coefficients** by labour cost for all industries. Accordingly, the use of inputs by an information occupation in the fictive information industry will correspond to that obtained with the average coefficients by labour cost.

B) The abridged list of occupations

In Chapter 2 we found that 251 out of 497 occupations are information occupations. Determining the production functions for 251 occupations would have involved extensive calculations, and the overall results would have been difficult to comprehend. Accordingly, to make this step feasible and simplify the calculations, we grouped the information occupations together, to arrive at an abridged list of 75 information occupations. The lexicon of those occupations appears in table form in appendix IV.

Two criteria were used in preparing the abridged list:

- the similarity of information occupations;

- but also the nature of the inputs associated with an information occupation in a given industry.

Thus, as an example, the occupations of bookkeepers and bookkeeper supervisors were placed in a single occupational group, since the two have similar functions and tasks. The tasks of a trade such as a foreman/woman may be similar from one sector to another (supervision, transmitting information, management, etc.), but the inputs in industries in which they are employed may vary considerably from one to the next, depending on production processes. Grouping all foremen/women into a single occupational group would result in the loss of many details relating to the use of inputs. Consequently, in such cases, we preferred to make a distinction among different categories of foremen/women. This approach allowed us to reduce the number of information occupations from 251 to 75, which we will refer to as **occupation groups.**

C) Determining inputs for each information occupation, by industry

To determine the input vector for the information industry, we examined the 602 goods used as inputs by the 161 industries. Those data constitute the USE matrix of the input-output table.

On the basis of our classification of 75 information occupation groups, we identified a vector for goods used mainly by information workers (office supplies, communication equipment, etc.). The list of goods selected is as follows:[1]

[ ] = 543, 544, 545, 552, 554, 555,556,
561, 564, 566, 567, 572, 573,
575, 576, 581, 584, 585, 586.

This series of inputs is selected for each industry, and identified in the text hereafter with the notation [ ]. This vector can be used to calculate the use coefficients of these inputs, by industry, in relation to the wages of information workers. In the fictive information industry, by grouping together all information workers, we end up using an average of the use coefficients of these inputs.

This identification of inputs has the benefit of specifying the production function of those information workers whom we know do not use only inputs specific to information workers. For example, foremen/women, sorters and plant operation auditors are considered information workers, although not all their activities are related only to information. But the inputs that we have identified **concern only that part of their activities related to information.** The other inputs they may use are not then considered inputs for the information industry.

On the other hand, in industries where information workers represent nearly 100% of occupations, we then select **all the inputs.** This is the case, in particular, for the banking sector. Furthermore, those industries allow us to establish use coefficients for inputs that cannot be directly attributed to information workers in certain sectors. That is the case for the following inputs:

[1] *See Appendix V for a detailed list of inputs according to the classification in the input-output table.*

( ) =
- 539 - Taxicab transportation
- 546 - Electric power
- 549 - Water and other utilities
- 551 - Repair service
- 562 - Hospital services
- 563 - Health services
- 565 - Other recreational services
- 574 - Services to bldgs. & dwellings
- 577 - Rental of automobiles & trucks

This list will be identified hereafter with the notation ( ). Thus electricity or any other input appearing in ( ) will be used by information workers in a given industry **in the same proportion as that observed in the banking sector,** where the information production is equivalent to nearly 100% of the value added by the industry.

For industries in which all inputs have been selected, the value of those inputs divided by the wages of information workers allows us to determine the use coefficients of inputs by labour cost.

Finally, aside from these more general cases, we identified, **industry by industry,** more specific inputs related to the particular nature of the work of various information occupations. To identify those inputs, we also considered the relative importance of those occupations in the total of information occupations in an industry. In the summary table that follows, we have shown the specific inputs by industry and the particular occupations with which we have associated those inputs. An example of such inputs would be scientific measuring devices used by engineers in an industry where there are laboratories and research is conducted.

The detailed calculation of input coefficients by labour cost is done as follows. We first divide the inputs in the [ ] and ( ) groups by the labour costs of the 75 information occupations for each industry (all 75 categories are not usually to be found in a given industry, but rather a sub-set of those occupations). The average input coefficients by category of information occupation are obtained by calculating an average for all the industries. Thus the use of inputs

by an information occupation in the fictive information industry will correspond to that obtained using average coefficients by labour cost.

The **complete inputs** to be found in the few industries where all inputs have been selected are **divided by the labour costs** of the various information occupation categories of the industries in question. This time we obtain **average coefficients for the industry** for which we have decided to select all inputs.[1] The use of these inputs by the 75 categories of information occupations in the fictive information industry corresponds in this case to their use in the industries for which all inputs were selected.

Finally, the other specific inputs are divided by the labour costs of the specifically identified occupations. The average coefficients of inputs by category of information occupation are obtained by taking the average of the coefficients for the entire set of industries. But in this case, "the entire set of industries" may amount to a single industry, owing to the specific nature of inputs and occupations.

The result of this detailed work to specify the production functions of the fictive information industry is summarized in the following table. This table represents the essential step that allowed us to create the satellite information sector in the input-output table. It may be interpreted as a three-dimensional matrix: industries, occupations and inputs.

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[1] *In calculating input coefficients for an industry, we have removed inputs belonging to the ( ) group, since in this case the average is calculated on all the industries. The average of coefficients in the [ ] group is established in industries where all inputs were selected.*

Table 6

Summary table of links between the fictive information industry and other industries in the economy

INDUSTRIES		GENERAL INPUTS		SPECIFIC INPUTS[1]	INFORMATION OCCUPATIONS ASSOCIATED WITH SPECIFIC INPUTS[2]
Level W	Level L	for all information workers	by the proportion in industries 184-186-187-188 (W) or 137-139 (L)		
1- 71	1- 54	[ ]	( )	--	--
72- 75	55- 56	All inputs including [ ] and ( )		--	--
76-116	57- 84	[ ]	( )		
117-121	85- 86	[ ]	( )	329,357,358, 359,360,497, 498	
122-136 138	87- 98	[ ]	( )	--	
139-140	99-100	[ ]	( )	5,15,63,488	
141-144 137	101-103 108	[ ]	( )	—	
145	108	[ ]	( )	499,500,502	2165,2183,4143
146-148	104-105	[ ]	( )	—	
149	106	[ ]	( )	135,231,241, 264,367,409, 515	3113,3114
150	107	[ ]	( )	—	—
151-152	108	[ ]	( )	231,305,362, 404	2165,2183,4143
153-174	109-128	[ ]	( )	—	—
175-176	129	[ ]	( )	357,362,503, 520	2183,3315,3330, 337,3339,3351
177	130	[ ]	( )	358,359,370	2144,2183

[1] *The numbers refer to the coding of inputs in the input-output table. A dash means that there is no input or occupation specific to this industry.*

[2] *The numbers refer to the 1971 Canadian Classification and Dictionary of Occupations.*

Table 6 (cont'd)
Summary table of links between the fictive information industry and other industries in the economy

INDUSTRIES		GENERAL INPUTS		SPECIFIC INPUTS[1]	INFORMATION OCCUPATIONS ASSOCIATED WITH SPECIFIC INPUTS[2]
Level W	Level L	for all information workers	by the proportion in industries 184-186-187-188 (W) or 137-139 (L)		
178	131	All inputs including [ ] and ( )		--	--
179	132	[ ]	( )	33,37,39, 396,540	2165,2183,4143
180	133	[ ]	( )	39,540	2165,2183,4143
181-183	134-136	[ ]	( )	221,395	5130,5131,5133
184-188	137-139	All inputs including [ ] and ( )		--	--
189-191 194	140-142	[ ]	( )	--	--
192-193	143-145	All inputs including [ ] and ( )		--	--
196-198	146-147	[ ]	( )	--	--
199-200	148	[ ]	( )	565	all information occupations
201-202	149	[ ]	( )	503,231	3315,3330,3335, 3339,3351
203-204	150	[ ]	( )	396,508,231	2792,3330,3332, 3335,3339,3360, 3370
205-206	151-152	[ ]	( )	--	--
207	153	All inputs including [ ] and ( )		--	--
208-209	154	[ ]	( )	--	--

[1] *The numbers refer to the coding of inputs in the input-output table. A dash means that there is no input or occupation specific to this industry.*

[2] *The numbers refer to the 1971 Canadian Classification and Dictionary of Occupations.*

4.3 Presentation of the fictive information sector in the input-output table

A) Relationship with the input-output table

The fictive information sector is handled in the same way as the other fictive sectors in the input-output model.[1] All industries that need information to produce goods and services purchase the composite information product, product 587, for use as an input. To produce product 587, the input structure was designed using the method described in the previous section.

Accordingly, to calculate the elements of the input structure for the fictive information industry, we use the breakdown of employment by occupation and industry (matrix E) and the breakdown of inputs associated with an occupation by employee (matrix P). The product PE gives us the inputs used by the information industry. Those inputs are subtracted from non-information industries, and hence added to the fictive information sector. The intermediate and primary use matrices (Y and U, respectively) are thus divided into two sectors: the non-information industries sector (NI) and the information industries sector (I):

$$\begin{bmatrix} U \\ Y \end{bmatrix} = \begin{bmatrix} UNI: & UI \\ YNI: & YI \end{bmatrix}$$

Two important observations on the structure of the information and non-information sectors should be made at this point:

- First of all, after the production of information and the associated input structure are removed from the various industries in the economy, the intermediate (YNI) and primary (UNI) use matrices still have **the same matrix dimensions.** All non-information industries continue to produce the same goods and services and purchase their information from the new fictive sector.

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[1] *For a more detailed description of fictive sectors, see the Statistics Canada publication on the input-output table, No. 15-510, pp 37 ff.*

- To produce its **unique** composite product, the satellite information sector has a technology that combines all the technologies used in all the industries of the economy that produce information. This is in fact a **combination** that is **weighted** by the information employment in each industry. In short, the information sector does not have a specific technology, but rather reflects the weighted value of the various technologies at the disposal of the entire economy for producing information. In this respect, a technological change in an industry affecting the production or use of information will affect the information sector in a proportion equivalent to the ratio of employment in this industry to total information employment in the economy.

  Furthermore, to balance purchases and sales in the input-output table, the inputs subtracted from non-information industries are replaced by a fictive intermediate product, composite product 587 (B_{587}), or the "information" product:

  $$B_{587} = 1'PE \qquad (2)$$

  where 1 is the summation vector and PE constitutes the structure of inputs for the information sector.

  In terms of value added, equilibrium is assured by the transfer of value added toward the fictive information sector in a proportion equal to the wages of information workers as a proportion of total wages. The total value added in the input-output table remains equal to the value added in the non-information sector and the value added of the fictive information sector.

B) Quantified results

To check the consistency of our calculations and ensure that the information sector functions properly, we conducted a first simulation, consisting of a purchase of $10 million of composite product 587.

The simulation of a purchase of $10 million of the information product allows us to evaluate, in terms of value added and employment, the direct effects on the information sector and also the indirect effects stemming from the **interaction** between the information sector and other industries in the economy. In fact, it is possible, in terms of employment, to obtain the **direct** employment matrix by occupation corresponding to the demand for an information product. The occupation/industry employment matrix can also be obtained, which shows what **direct and indirect** use (i.e., taking account of the interaction between activity sectors) had to be made of a given information occupation to satisfy the demand for the information product by other industries. This is the presentation format that we will be using to analyse the results of the simulations presented in the following chapter.

For a demand of $10 million of the composite information product, we obtain the main results below:

1.	**Production and expenditures**		**Direct and indirect effects**
a)	Information sector		
	1) Value added (at factor cost)	=	$7.9 million
	2) Purchases of inputs	=	$3.2 million
b)	Non-information sectors		
	1) Value added (at factor cost)	=	$1.2 million
	2) Purchases of inputs	=	$0.5 million
c)	Total value added at market prices:		
	a)1)+b)2)+net taxes	=	$9.5 million
	Total transactions	=	$13.2 million
	Total imports	=	$0.4 million
2.	**Employment**		**Direct and indirect effects**
a)	Information sector	=	260
b)	Non-information sectors	=	42
	Total employment		302
3.	**Productivity (value added/employment)**		**Direct and indirect effects**
a)	Information sector	=	$30,385.00
b)	Non-information sectors	=	$28,571.00

It should be noted, first of all, that the results are consistent and match our expectations. The solution resulting from a demand shock of $10 million on the information sector agreed, with negligible discrepancies, with the accounting equations of the input-output table, making it possible to verify the consistency of the solution. The satellite information account thus functions satisfactorily, and allows us to calculate various impacts relating to the input-output table.

The main conclusions to be drawn from the results are as follows:

- Information production is integrated into all the various economic sectors, since inputs of more than $3 million are purchased to meet a demand of $10 million. Out of 302 jobs created, approximately 15% are mainly in the sectors supplying inputs for the information sector.

- Information production involves very few imports, since out of total transactions of about $13 million, only $0.4 million represents imports. The increase in the **production of information** stimulates mostly production and employment in Canada, since the import coefficient is low. But it should be stressed that here we are dealing with **current production of information, rather than investments in information technology.** If we were looking at investments in these technologies, the results would certainly be different, since we know, in particular, that the proportion of imports in investments in machinery and equipment for Canadian companies is high. We also know that Canada is an importer of information-producing equipment, such as computers and other scientific devices. But once this equipment has been installed in Canada, economic agents here can produce information with a minimum of imports.

- Information workers, according to the results already analysed, are generally more productive than non-information workers. The results show that in this case information workers have 6.5% greater productivity than non-information workers. But this result conceals much greater discrepancies for certain occupations. The presence of a sizeable information bureaucracy in the information sector, which makes relatively basic use of information, particularly in the service industries, **reduces average productivity** in the sector.

5. RESULTS OF VARIOUS SIMULATIONS USING THE INFORMATION SATELLITE ACCOUNT

5.1 Presentation of simulations

To illustrate the operation of the information sector in the economy, and to show the role of information in the Canadian economy as both an input and an end-use product by consumers, companies, governments and non-residents, we conducted various simulations using the input-output table with a complete information sector. Each simulation corresponds to a shock on a final demand factor. The shocks fall into four categories:

- a variation in the demand for exports;
- a variation in the demand for consumer goods;
- a variation in the demand by companies for investments in construction, machinery and equipment;
- a variation in the demand by governments.

Part of the results is presented in the form of value added stemming from the production of information necessary to meet the needs of various non-information industries. The results have been aggregated for the entire information sector, and are broken down by user industry. The model also allows us to obtain a breakdown of employment by information occupation (the 75 groups from our occupation lexicon). The results of activities in the information sector have been reproduced in the tables in Appendix VI in the form of direct and indirect jobs by occupation, which are broken down by industry using the information product. Thus, for example, employment in occupation i for industry j shows what employment is necessary in the information sector for occupation i to be able to meet the information needs of industry j. The production needs of industry j are determined by the shock on the final demand. We have not shown all the jobs by occupation, since that would require 75 lines in each table. Instead, we show employment in the **main occupations** and group the other jobs under "other occupations". In addition, the results in terms of industries have been aggregated to give a total of 13 overall industries, since it would be near-impossible to analyse the overall results for the 154 industries

in the input-output table.[1] The grouping of industries in the most aggregated version of the input-output table is as follows:

Number	Industry definition
1	Agriculture & related industries
2	Fishing, trapping and other industries
3	Logging, forestry and related industries
4	Mining, quarrying & oil wells
5	Manufacturing
6	Construction
7	Transportation & storage
8	Communication
9	Public utilities
10	Wholesale trade
11	Retail trade
12	Finance, insurance & real estate
13	Business and personal services

Thus the figures shown on the line for the users of the information product refer to the industries defined above. The figures indicating occupations, in columns, refer to the mini-lexicon of combined occupations. In the last column of the table, we have given the structure of employment in information occupations necessary to meet the shock on final demand, in percentage form. We have also shown the non-information employment required, and have determined the distribution between information and non-information jobs.

Finally, the last lines in the tables show the value added associated with the jobs. We have aggregated the value added by information workers, which is broken down by industry using the information product. The value added is a measurement of the production of information in the economy, and we can see what industries use that production. The non-information

[1] *The results in the form of a matrix of employment for 75 information occupations, broken down into 154 industries, can be obtained from Statistics Canada.*

value added is also shown, as well as the total value added. In addition, a percentage distribution between information production and non-information production appears in the table.

5.2 Presentation and analysis of the simulations

In this section we will show the results of 15 simulations. We were obliged to restrict the number of simulations, owing to insufficient resources. Since the model is now operational, we can use the results presented here to devise many other simulations responding to various problem situations. One of the objectives of these simulations is to illustrate the operation of the input-output model including a satellite information sector. Another goal is to examine the information production component necessary to satisfy various aspects of final demand by economic agents in Canada and abroad. Finally, the simulations allow us to identify the main industries that consume information and the main information occupations involved in the production created by a shock on final demand.

A) Exports

We chose six groups of export products and exported services, which we feel give a relatively representative range of the various categories of export products. It must be stressed, however, that transportation equipment and aeronautics were excluded, since those sectors were examined in greater detail in the second chapter. The groups of export products are as follows:

- raw materials and semi-processed products;
- textiles, clothing, other related products and food (non-durable and semi-durable goods);
- metal products;
- machinery, equipment and other related products;
- petrochemical and chemical products;
- communications equipment, scientific devices and related products.

Raw materials

Canada remains a major exporter of raw materials. We have seen that in those sectors, the use of information technologies is associated with high productivity. The data from simulation No. 1 confirm this result. Exporting raw materials calls for many information workers. In fact, 38% of jobs created directly and indirectly by exports are information workers. It should be noted here that the business services sector is a major user of the information product. This sector acts as a supplier of services to sectors producing raw materials.

The information component represents approximately 25% of the initial expenditure. We then find that the total value added to the cost of the factors is approximately $7 million, if direct and indirect effects are taken into account. The information component of this value added is 51%; this result can be explained by the fact that information workers have high productivity in this case, since 30% of workers are responsible for 51% of the value added. **The information component of exports of raw materials from Canada is high.** In such a competitive market it can be assumed that a high information component in these products gives an exporting country a competitive advantage.

Durable and non-durable goods

The composition of information employment differs considerably from that in the previous case, but the proportion of such workers in total employment remains fairly high, at nearly 42%. Since imports represent more than 30% of the initial expenditure, total production at factor cost in this case reaches $6.3 million. Canada imports a large part of its inputs in sectors such as clothing and related products. The productivity of information workers is slightly higher than that of other workers, with the result that the information content of value added reaches 45%. Although information technologies do not have as important an effect on productivity as in the previous case, the fact remains that the information component of these exports is high.

Metal products

Once again, there is a change in the composition of information employment. This export category requires a smaller variety of information workers, although their share of total employment is high, at over 45%.

Many inputs are imported for metal production, and account for more than 45% of the expenditure of $10 million. In addition, indirect effects generate a fairly high import component, so that the value added at factor cost produced in Canada reaches about $5 million. Although these sectors are generally dominated by large companies, information workers are no more productive than other workers, with the result that the information component is equal to 45% of production.

Machinery and equipment

These are activity sectors where it is to be expected that the information component of production is fairly high. But we also know that Canada imports a substantial proportion of the components for these products, so that the value added generated in Canada is likely to be small.

We note that the information component of employment in fact reaches 51%, and that since those workers have higher-than-average productivity, information production accounts for close to 55% of value added. Furthermore, only a small proportion of the value added remains in Canada, in relation to export expenditure. The total value added actually reaches only $1.1 million and imports represent over 80% of the initial expenditure. Thus, in this sector where information plays an important role, Canada is mainly a re-exporter, and the information content of the goods exported largely comes from other countries. A specialization strategy in this sector and import substitution would make it possible to increase the value added generated in Canada and thus the number of high-productivity information jobs.

Chemical products

We saw that the industries relating to chemical products are among those where information technologies play an important part, and are associated with high productivity. The simulation confirmed this result, since the direct and indirect use of information labour represents almost 52% of the employment generated by this export shock. The information content of the value added reaches nearly 58%.

The import content is still fairly high, and represents about 40% of the initial expenditure. The total value added is approximately $5.5 million.

Scientific equipment and related products

This type of products does not yet represent a major export category for Canada, as do raw materials or transportation equipment. Since the early '80s, however, there has been a diversification of exports, and communication and measuring equipment have increasingly risen in the list of Canadian exports. It is to be expected that the information content of these exports is high, manly because of the **nature** of the products, rather than because of the use of information technologies as a means of boosting the productivity of the manufacturing process (as is the case for raw materials or chemical products). But a relatively high import content can also be expected, since various components of this equipment are imported.

The results of the simulation show that information employment accounts for 56% of all jobs associated with this export shock. The information content of this production **is 61%**. In this case, we can say that Canada exports its information technologies on the world market. But the proportion of imports is high, and reaches 75% of the initial expenditure. This proportion may vary, depending on the equipment concerned. Because of the high import content, the value added is slightly less than $2 million. A policy of encouraging specialization in the best-integrated niches in the Canadian economy would make it possible to increase the value added per dollar exported.

Services

As anticipated, the information content of exported services is high, and information workers represent 60% of employment created directly and indirectly. It must be stressed, as shown in the occupations column for information occupations in the table for simulation No. 7, that exporting services calls for a wider variety of information workers than in the previous cases. In particular, there are occupations associated with the export of business services, such as architects, lawyers, administrators and computer programmers.

The information content of production reaches over 61%. Consequently, the **information component of exports of services is similar to that observed in the export of information equipment.** In one case, it is the skills of information workers that are directly exported, while in the other, the expertise is sent by way of the products sold. In the case of services, however, the import content is fairly low (12% of the initial expenditure), meaning that exports result in the creation of value added of about $8 million in Canada. Thus it would clearly be to Canada's advantage to encourage its exports of services on the world market.

B) Consumer expenditures

We simulated an increase in the expenditures of households in the usual four major consumption categories:

- durable goods
- semi-durable goods
- non-durable goods
- services

It was to be expected that the information content would be higher for services and less so for non-durable goods. In the case of durable goods, consumers purchase commodities to **produce** information (such as radios or televisions); but the **information content** of such goods, while it varies considerably from one product to another, should be fairly high owing to the nature of the products. Moreover, the production **processes** for motor vehicles, which, as we saw,

require information technology, should give the goods purchased a fairly high information content.

However, in the case of durable goods, a significant share of information production is likely to lie outside the Canadian economy, given the fairly high import content associated with those goods.

The results are shown in the tables for simulations Nos 8 to 11. As anticipated, the information content for durable goods purchased by Canadian households **represents nearly 67% of the value added;** the proportion of information jobs to manufacture these goods in total employment is similar, and so the productivity of all workers is also similar. As was the case for many categories of exports with high information content, the information component of purchases is high and represents over 40% of the initial expenditure. Thus the direct and indirect value added at factor cost gives a total of approximately $4.3 million.

The information content of semi-durable goods is **also high and represents 65% of value added.** However, since these are less technologically sophisticated goods, we noted that less is lost to imports, as they make up 27% of the initial expenditure. The less sophisticated nature of semi-durable products is reflected in the **composition of information occupations** necessary to provide the information commodity for the industries using it. In this case there are occupations relating to the information bureaucracy (office clerks, production clerks, stenographers, other clerical employees, receptionists, etc.) created by the first wave of information technologies. In fact, we noted that when the information content is produced by these workers in the first generation of the information economy, the **import component is smaller.** A large proportion of information production in Canada, then, is still associated with the traditional information bureaucracy.

The information content of non-durable goods consumed is slightly greater than expected, at nearly 60%. This can be explained in part by the entire process of **marketing** food products by wholesalers and retailers, which calls for many information workers. There are also occupations more specific to food production, such as agricultural operations managers. Finally,

the import component is about 20%, so that the value added is fairly high in proportion to the initial expenditure.

The information component of the services consumed by households is no higher (65%) than for purchases of durable goods. However, the composition of information labour used to produce services is different. In the case of durable goods, the information content can be attributed to production technology, and also to the sometimes complex nature of the good sold. In the case of services, it is above all the very nature of production that explains its information component, although information technologies play an increasing role in the production of services and also explain the high information content of the services sold to households. It must be noted that information workers are much more productive than non-information workers involved in the production of services for households: information workers represent just over 52.4% of employment, while their value added accounts for 65% of total production (direct and indirect).

The industries involved in producing services for households employ a wide variety of information workers; there is the usual bureaucracy associated with information production, but also workers related to housing services, artists, performing arts technicians and various other occupations associated with personal services.

C) Business expenditures

There are two types of business expenditures: investments in machinery and equipment, and construction of infrastructures (non-residential construction).

Expenditures on machinery and equipment constitute a special case, since those are investments that generally **incorporate** the most recent technology. It should be expected that the information content of such expenditures would be high. However, if a country imports a high proportion of its equipment, the information component may then be lower and, in particular, less attractive in terms of technological strategy. When equipment is mostly imported, the Canadian information component is generally limited to sales, supervision of installation, processing of financing operations and so on.

The results of simulation No. 12 tend to confirm our expectations concerning expenditures on machinery and equipment. The information component of production to meet the demand by companies is about 60%, lower than the information content of durable goods purchased by consumers. In addition, the value added produced in Canada on expenditures of $10 million is only $3.4 million, whereas the proportion of imports reaches 55% of the initial expenditure. Canada is an importer of machinery and equipment, and hence of foreign technology. With regard to the production of information in Canada, it can be seen that the occupations concerned are particularly involved in commercial operations (sales, etc.) and other traditional occupations relating to the information bureaucracy. The Canadian part of the information component of these capital expenditures is not concentrated in incorporating recent information technologies.

The information content of production, to satisfy the demand for non-residential construction, is 52% of the total value added. In addition to the traditional information bureaucracy, there are occupations related to the construction sector, such as construction operations managers, site superintendents, building foremen/women and so on. The import component is low (14% of the initial expenditure), which corresponds to the nature of construction activities (high labour content and work done locally).

D) Government expenditures

This takes in all levels of government in Canada, excluding educational and health institutions. The first simulation concerns purchases of goods and services by governments.

The information employment necessary to meet the demand for goods and services represents 62% of the total employment required, and the information component of production is 65% of the total value added. As expected, government current expenditure in Canada has a high information content. In this case, the import content is low, about 15% of the initial demand, so the ratio of Canadian value added to expenditure is high. Moreover, the information content of demand by governments is among the most sophisticated of those observed in the various simulations, insofar as the information component is evaluated in terms of the **composition** of information employment. The occupations called upon to meet the demands of various

industries include, in addition to those associated with the normal information bureaucracy, mathematicians and computer programmers, teachers, health professionals, applied science professionals, high-level managers and so on. In addition to the expenditures by governments in the health and education fields,[1] the demand by governments in the business services sector (communications services, computer programming, research in pure and applied sciences, social sciences and humanities, etc.) is largely responsible for the more sophisticated information content. In that respect, only exports of services that include business services had as advanced an information content.

The second simulation concerns expenses related to national defence. Various countries, including the United States, have often used expenditure programs to stimulate research and development, and to influence the industrial make-up of the national economy. Canada has a number of research programs related to national defence, but a large proportion of expenditures goes to operating the armed forces and military bases. Furthermore, Canada is an importer of military technology, although we are trying, by means of purchase contracts, to transfer part of the technological know-how here.

It is obviously impossible to draw conclusions on the general impact of defence expenditures from a simulation conducted for a structure of demand corresponding to a specific year. But inasmuch as that structure does not change very quickly over time, it should be noted that the information content of production in Canada to satisfy defence demand does not appear sophisticated, if it is evaluated in terms of the information component of employment. Information employment, which represents approximately 5.6% of total employment, and whose value added accounts for 61% of total production, is mainly made up of the traditional bureaucracy in the information sector. It must also be stressed that the high import content of defence expenditures produces fairly little value added in Canada in proportion to the initial expenditure. This seems to confirm our expectations concerning the nature of defence expenditures.

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[1] *These are expenditures by various government departments, rather than the expenditures associated with the operation of health and education institutions funded by governments, which are separate sectors.*

Finally, we conducted a number of other simulations, which we will not report on here, since we do not feel that they add a great deal to our understanding of the information sector in Canada. In particular, education and health expenditures produce a value added consisting almost entirely of the wages paid directly to professionals in those sectors. Information production for those sectors has little effect on the rest of the economy. This can be explained by the high labour level of production in those sectors. The structure of information occupations to produce information in those sectors corresponds essentially to the composition of occupations there (teachers, managers, health professionals and support bureaucracy).

5.3 Some conclusions drawn from the simulations

As the simulations concern the structure of the economy for a given year, and provide us with no indications of historical trends, we must limit the scope of the conclusions drawn from the results. However, the combination of these results with those in the preceding chapters allows us to come to some conclusions on the role of information in the Canadian economy.

The main conclusions may be summarized as follows:

- With the exception of raw materials and natural resources, where Canada is largely self-sufficient, it can be seen that the production of goods with a high information content is accompanied by a **high level of imports**. In the case of natural resources, we note that Canadian exports have a high information content, while the value added associated with these exports is mainly produced in Canada. In the case of other **goods** with high information content, the value added produced in Canada is often **fairly low** in proportion to the expenditure, because of the high import content. Given the structure of the information occupations necessary to produce the **information component of the Canadian value added,** we note that the production of information in Canada in macro-economic terms corresponds **mainly** to that associated with the **traditional information bureaucracy**. This is what may be defined as the first generation of information workers, who process information at a relatively basic level and have no need for highly sophisticated information capital. In summary, the second wave of the telematics

revolution that we mentioned in Chapter 2 in a number of sectors does not yet seem to have extended to a more macro-economic level. Instead, Canada **imports** the information component of goods that require more-sophisticated workers and information capital using the most recent and most advanced technologies.

- With regard to the production and export of scientific communication and measuring devices, excluding telecommunications devices that we examined in our intersectoral analysis at a rather micro-economic level, it can be seen that the import content of these devices is very high, and that Canada retains relatively little value added from these exports. Canada again imports many components, whose information content is presumably high. This result, concerning the production of goods in general other than raw materials or natural resources, is entirely compatible with our observations in Chapter 3 at a more macro-economic level. In fact, we found that the penetration of information technologies appeared to be rather uneven in the manufacturing sector. Our simulations suggest that recent information technologies have not yet penetrated **throughout the Canadian manufacturing sector**, and that components with a high information content must be imported.

- Moreover, with regard to the production and **export of services**, particularly business services, the information content is very high, and the share of Canadian value added is also high in proportion to the value of exports. The composition of information workers required for this production suggests that the information content is sophisticated and that information workers use information capital incorporating the most recent technology.

- Insofar as a sophisticated information component in the production of services may **affect the penetration of information technologies**, or the development in Canada of information technologies in the widest sense of the term (including the design of software and computer systems), we can then say that **public expenditures on goods and services by all levels of government** in Canada and **exports of services** appear to be the components of global demand that would make it possible to encourage the penetration or development of made-in-Canada technologies.

- Contrary to the situation in other countries such as the United States or some European countries, national defence expenditure programs do not appear to lead to extensive production of high information-content goods and services in Canada. Those expenditures instead appear to support production associated with a traditional information bureaucracy. Canada seems to be obliged to import goods and services with more-sophisticated information content, and efforts to transfer more-advanced technology to Canada through defence equipment purchasing programs appear to have little success, at least in macro-economic terms.

6.1 Size of the information economy, and recent trends

We have shown, in this study, that information plays a key role in the Canadian economy. Using a detailed classification of information workers, we determined that in 1971, approximately 42% of job-holders in Canada could be considered information workers. There was a fairly substantial increase in such employment between 1971 and 1981, and the proportion of information workers exceeded the 50% mark in 1981. Since the value added and produced by information workers is on average **greater** than that of non-information workers, it can be concluded that **information now accounts for over 50% of Canada's GDP.** This result corresponds to those obtained for other OECD countries. The "information economy" revolution has thus had clear repercussions in Canada, although the economic accounts of Canada and other OECD countries unfortunately provide no details on the nature and extent of the phenomenon at present.

The importance of information workers generally **continued to rise in Canada between 1981 and 1986.** In micro-economic terms, the growing use of information workers has been accompanied by major productivity gains in certain strategic sectors of the Canadian economy. In sectors such as aeronautics and pulp and paper, growth in the proportion of information workers has kept pace with the modernization of capital and increased use of information technologies. This in turn has resulted in appreciably greater productivity at work. In the motor vehicle industry, modernization programs have resulted in the wholesale overhaul of production structures. Not only were there substantial productivity gains between 1981 and 1986, but the proportion of information employment **dropped** over that same period, a new phenomenon. This means that technological progress has affected both traditional and information labour, and that a second wave of technological progress **is affecting information workers** in some industries, such as the motor vehicle sector. The corollary of this movement will be a **reduction in this type of labour** and an **increase in its quality** in terms of human capital, as well as **greater specialization** for more efficient use of new information equipment. What all this means is that we are seeing one generation of information workers being replaced in various industries by a new generation, less numerous but more productive, and which uses new information capital. The proportion of highly qualified workers in the jobs created in recent years in Canada tends to back up this assertion.

6.2 Relationship between information workers and productivity

Throughout the economy, it can be seen that a higher ratio of information employment to total employment is generally accompanied by greater-than-average productivity. However, this relationship varies considerably among major activity sectors. The connection between information employment and productivity is particularly evident in the resources and energy sector. In this capital-intensive sector dominated by very large companies, the use of information technology makes an important contribution to increased productivity.

In the manufacturing sector, the link between information workers and productivity is also visible, but less systematic. Information technology has penetrated the sector to differing degrees, and may vary considerably even within a single industry. The use of information technologies is more widespread in large firms, and affects many of the company's functions. In small and medium-sized firms, the use of information technology may vary significantly from one to another, and the data from our study show fairly substantial differences between the results of different industries. The relationship between information workers and productivity is actually clearer in industries dominated by large companies. The link is also more evident among industries that produce high-information-content goods (in particular the "infrastructure sectors" of the information economy), where the size of the company is not so important a factor in the relationship between information technology and productivity.

The link between information workers and productivity becomes even more explicit in the service sector. The penetration of information technology in a number of industries is still at an early stage, and productivity gains are still to come. In other industries, there is sometimes a very large number of information workers, but who are still carrying out fairly basic data-processing tasks. Those workers are not equipped with very sophisticated information capital, and lack highly developed skills in the use of telematics technology. However, the rapid evolution of information technologies suggests that those sectors should experience considerable productivity growth in the near future.

All these results are confirmed by various statistical tests carried out with data from the 1985 input-output table.

6.3 Analysis of information industries

Our study uses the value added by information workers to evaluate the information content of an industry. With this objective method, we do not automatically consider some industries information industries.

Nevertheless, we conducted an intersectoral analysis using the input-output tables of a certain number of industries that are considered "information industries" in the literature (telecommunications, business services [data processing, etc.], advertising, financial services and so on). First of all, we found that with the exception of business services, information industries in Canada **export little.** If banking services are excluded, it can be seen that a substantial proportion of information production is sold to other businesses, as an input. Information production in Canada, then, is widely used as an input by companies.

6.4 Comparison with the U.S. economy and other conclusions

We found that there was a certain acceleration in productivity growth in the United States between 1979 and 1987, with increasing reliance on information technology. But that acceleration was very uneven from one sector to the next. As in Canada, information technology penetrated different sectors to varying degrees, and within those sectors its impact differed considerably from one industry to another. In some sectors we also found that there was a second wave in the information revolution occurring (production of machinery, transport equipment, and others). Finally, there was no improvement in productivity in the service sector; in fact there was a deterioration in some industries. Those results are very similar to our own.

Different hypotheses are possible for explaining the weak link between information technologies and productivity gains in the service sector. Banks, for instance, with fierce competition at the branch level, forego economies of scale in an effort to serve multiple points of sale; while in sectors such as resources and energy, information technologies have added to the productivity gains associated with economies of scale. There is also a loss of economies of scale owing to the great variety of computer systems used by financial and related institutions.

The small impact of information technologies on productivity in the service sector may also be attributed to the workings of competition: a company may use telematics as a strategy (e.g., for advertising purposes) to increase **its share** of sales. The technology **then results in a redistribution of sales among companies**, but makes little difference in productivity. Furthermore, information technologies increase the quality of the product or service.

The other, more familiar, hypothesis concerns the accumulation of information resulting from telematics with no corresponding growth in the ability to use that information. Lastly, in the service sector but also in other industries, information technologies may **improve working conditions** without being clearly reflected in the productivity measured. Productivity gains are then "internalized" by workers in the form of better working conditions.

Finally, it can also be seen in the United States that a large proportion of information production is used as input by other companies. One explanation of these exchanges of information services is the fact that many companies rent, rather than buy, computer equipment, a process accompanied by the sale of professional services. The development of microcomputers is currently changing that situation, however.

6.5 Designing an information sector for the input-output table

The main objective of our study was to establish an information industry in the input-output table, one that conducts transactions with other industries, to show the importance of information as an economic commodity, how it circulates in the economy and its impact on other activity sectors when information production varies.

Information production in the economy or, in other words, the value added by the information sector, consists of the **sum of value added** associated with the production of information **in each industry of the economy**. For a specific industry, the information production content is estimated with the following method: using the classification of information occupations, we determine the information employment by industry. Then, using wage data by occupation, we determine the total wages of information workers, and total wages. The proportion of wages of information workers to total wages is then used to calculate the proportion of value added

produced by information workers, and that value added represents information production by industry.

The production or value added by the information industry that we add as an industry in the input-output table, then, comprises the total value added corresponding to information production in each industry of the economy. In this way we create what is termed a "fictive" information industry. That industry is fictive in that it is not to be found as such anywhere in the economy, since its production corresponds to the information production of each industry in the economy. Nevertheless, the production attributed to the information industry is real, and there is thus a **transfer of value added** in the input-output table; each industry's production is reduced by an amount equal to its information production, and that production is shifted to the information industry. Thus there is a re-arrangement of production in the inter-industrial model, but the total value added in the economy remains unchanged.

Once the value added by the new information industry had been determined, we devised a method allowing us to establish the **input structure** for that industry. Those inputs are made up of purchases of goods and services from other industries in the economy. The aim here is to estimate a production function for the fictive information industry. Those purchases of inputs represent the **intersectoral link** between information production and the other industries in the economy.

Once the purchases of inputs from the information industry have been estimated, we then have a complete inter-industrial model with an information sector, and can carry out various simulations using shocks on final demand.

6.6 Estimating the production function of the information industry

Production functions were estimated on the basis of **inputs used by information workers.** We identified those inputs in two ways: first, we examined the list of commodities in the input-output table (a total of 602 inputs used by all industries) and selected those used almost solely by information workers. Second, for industries where information workers represent almost 100% of occupations, we selected all the inputs for that industry. These lists of inputs then

become inputs for the fictive information industry. The value of the inputs selected is then divided by wages **to determine the input coefficients by labour cost** for various information occupations. We in fact used the **average by information occupation of input coefficients** by labour cost for all industries. Accordingly, the use of inputs by an information occupation in the fictive information occupation will correspond to that obtained with the average coefficients by labour cost.

In practice, this method was fairly complex to use, and had to be applied in stages. In particular, we had to group occupations together for the method to be practicable. That approach allowed us to build a **satellite information sector in the input-output table.** The latter may be considered a three-dimensional matrix, comprising industries, occupations and input. This satellite information sector, or "fictive" information sector, is now **operational**, and can be used to conduct general equilibrium simulations in which the effect of a final demand shock can be calculated on information production in the economy.

To check that the information sector was operating properly, we carried out a simulation, consisting in a purchase of $10 million of the "information" commodity. First of all, it can be seen that the production of information is **integrated** in the whole of various sectors of the Canadian economy. For example, out of a total of 3,000 jobs created to supply the units for this purchase of information, approximately 15% are in sectors providing inputs for the information sector. Furthermore, the production of information **involves very few imports.** It should be noted at this point that we are speaking of **current production of information,** and not the purchase of information equipment or investments in information technology. The results also confirm that information workers are more productive than non-information workers.

6.7 Results of simulations

To illustrate the operation of the information sector in the economy, and to show the role of information in the Canadian economy as both an input and an end-use product by consumers, companies, governments and non-residents, we conducted various simulations using the input-output table with a complete information sector. Each simulation corresponds to a shock on a final demand factor. The shocks fall into four categories:

- a variation in the demand for exports;
- a variation in the demand for consumer goods;
- a variation in the demand by companies for investments in construction, machinery and equipment;
- a variation in the demand by governments.

The results are shown in the form of detailed tables giving employment by information occupation, non-information employment, the information value added (production), and non-information value added. The results include the **direct** and **indirect** effects in terms of general equilibrium.

As the simulations concern the structure of the economy for a given year, and provide us with no indications of historical trends, we must limit the scope of the conclusions drawn from the results. However, the combination of these results with those in the preceding chapters allows us to come to some conclusions on the role of information in the Canadian economy.

The main conclusions may be summarized as follows:

- With the exception of raw materials and natural resources, where Canada is largely self-sufficient, it can be seen that the production of goods with a high information content is accompanied by a **high level of imports**. In the case of natural resources, we note that Canadian exports have a high information content, while the value added associated with these exports is mainly produced in Canada. In the case of other **goods** with high information content, the value added produced in Canada is often **fairly low** in proportion to the expenditure, because of the high import content. Given the structure of the information occupations necessary to produce the **information component of the Canadian value added**, we note that the production of information in Canada in macro-economic terms corresponds **mainly** to that associated with the **traditional information bureaucracy**. This is what may be defined as the first generation of information workers, who process information at a relatively basic level and have no need for highly

sophisticated information capital. In summary, the second wave of the telematics revolution that we mentioned in Chapter 2 in a number of sectors does not yet seem to have extended to a more macro-economic level. Instead, Canada **imports** the information component of goods that require more-sophisticated workers and information capital using the most recent and most advanced technologies.

- With regard to the production and export of scientific communication and measuring devices, excluding telecommunications devices that we examined in our intersectoral analysis at a more micro-economic level, it can be seen that the import content of these devices is very high, and that Canada retains relatively little value added from these exports. Canada again imports many components, whose information content is presumably high. This result, concerning the production of **goods** in general other than raw materials or natural resources, is entirely compatible with our observations in Chapter 3 at a more macro-economic level. In fact, we found that the penetration of information technologies appeared to be rather uneven in the manufacturing sector. Our simulations suggest that recent information technologies have not yet penetrated **throughout the Canadian manufacturing sector**, and that components with a high information content must be imported.

- Moreover, with regard to the production and **export of services**, particularly business services, the information content is very high, and the share of Canadian value added is also high in proportion to the value of exports. The composition of information workers required for this production suggests that the information content is sophisticated and that information workers use information capital incorporating the most recent technology.

- Insofar as a sophisticated information component in the production of services may **affect the penetration of information technologies**, or the development in Canada of information technologies in the widest sense of the term (including the design of software and computer systems), we can then say that **public expenditures on goods and services by all levels of government** in Canada and **exports of services** appear to be the components of global demand that would make it possible to encourage the penetration or development of made-in-Canada technologies.

- Contrary to the situation in other countries such as the United States or some European countries, national defence expenditure programs do not appear to lead to extensive production of high information-content goods and services in Canada. Those expenditures instead appear to support production associated with a traditional information bureaucracy. Canada seems to be obliged to import goods and services with more-sophisticated information content, and efforts to transfer more-advanced technology to Canada through defence equipment purchasing programs, in the year on which our simulations are based, appear to have little success, at least in macro-economic terms.

6.8 Future research

In this study we developed an operational satellite account for the information sector in Canada. The model may be used to conduct many other simulations and calculations in future research projects.

A matrix of information output multipliers could be developed, which would be useful in a study of economic strategies. Simulations combining **various assumptions** in terms of economic policies may be considered. For example, the effect of an increase in the **information content** of the production of various commodities in Canada could be examined, assuming a drop in import coefficients. A number of different scenarios could be considered with regard to free trade with the United States. In addition, the impact of increased specialization in the Canadian economy on various export niches is another possible subject for study, involving information goods or high-information-content goods.

The input-output model with an information sector is a flexible tool that can be used to analyse various strategies available to Canada in the next decade.

APPENDIX 1

Detailed breakdown of information occupations by occupation code

I) Organization of information

a) Clerical skills

Occupation codes:

4111	4137	4157	4192
4113	4139	4159	4193
4131	4151	4161	4195
4133	4153	4169	4197
4135	4155	4191	4199

b) Technical skills

Occupation codes:

2161	2349
2163	2353
2164	3152
2331	

c) Scientific and professional skills

Occupation codes:

1171	2131	2189	2511-9
1173	2133	2311	3111
1174	2135	2313	3119
1175	2139	2315	3136
2111	2141	2319	3151
2112	2142 to 2159	2333	3153
2113	2165	2339	3156
2114	2169	2343	3158
2117	2181	2351	
2119	2183	2359	

d) Artistic creation and research

Occupation codes:

3311	3331
3313	3334
3314	3351
3319	

II) Decision-making and control

a) Management

Occupation codes:

1111 all codes 113 and 114	
1113	1179
1115	2341
1119	3330

b) Inspection

Occupation codes:

1116	8236	8536
1176	8256	8546
6113	8276	8566
7196	8296	8576
7516	8316	8596
8116	8336	8686
8146	8356	8736
8156	8376	8796
8176	8396	9916
8226	8526	

c) Supervision

Occupation codes:

2160	5190	8250	8710
2350	6120	8260	8730
3130	6130	8290	8780
3360	6160	8310	9110
3371	6190	8350	9130
4110	7180	8370	9170
4130	7510	8390	9190
4140	7710	8510	9310
4150	8110	8530	9510
4160	8130	8540	9530
4170	8150	8550	9550
4190	8160	8570	9590
5130	8210	8580	9910
5170	8230	8590	

III) Information dissemination

a) Miscellaneous information and news

Occupation codes:

3337
3355
3359
4171
4194

b) Entertainment

Occupation codes:

3332	3339
3333	3373
3335	6144

c) Sales promotion

Occupation codes:

5131	5171
5133	5172
5135	5173
5141	5174
5143	5177
5149	5179

d) Training

Occupation codes:

2391	2791
2399	2792
2711	2793
2719	2795
2731	2797
2733	2799
2739	3370

IV) Information infrastructure

a) Operators of office information and communication equipment

Occupation codes:

4141	9553
4143	9555
4175	9557
9551	9559

b) Occupations related to printing and photographic development

Occupation codes:

3315	9515
9511	9517
9512	9518
9513	9519
9514	9591

c) Occupations related to mail and messenger services

Occupation codes:

4172
4173
4177
4178
4179

APPENDIX II

Detailed breakdown of information occupations by census data (1971 and 1981) and the Canadian Occupational Code (as a % of the labour force)

I. Organization of information

Occupation Code	1971	1981	Occupation code	1971	1981
a) Clerical skills			**b) Technical skills**		
4111	2,79	3,03	2161	0,12	0,15
4113	1,01	0,86	2163	0,31	0,35
4131	2,29	3,31	2164		
4133	1,29	2,02	2331	0,13	0,25
4135	0,23	0,34	2349	0,04	0,06
4137	0,08	0,08	2353	0,02	0,03
4139	0,05	0,05	3152	0,02	0,03
4151	0,14	0,15		**0,64**	**0,81**
4153	0,75	0,77			
4155	0,64	0,83			
4157	0,05	0,04			
4159	0,04	0,07			
4161	0,37	0,38			
4169	0,02	0,02			
4191	0,05	0,09			
4192	0,07	0,08			
4193	0,13	0,20			
4195	0,03	0,07			
4197	1,45	1,17			
4199	0,81	0,75			
	11,00	**14,31**			

I. Organization of information (cont'd)

Occupation Code	1971	1981
c) Scientific and professional skills		
1171	1,17	1,22
1173		
1174	0,28	0,26
1175	0,13	0,14
2111	0,08	0,08
2112	0,05	0,06
2113	0,01	0,01
2114	0,01	0,0076
2117	0,2	0,16
2119	0,035	0,013
2131	0,07	0,07
2133	0,03	0,06
2135	0,097	0,086
2139	0,019	0,016
2141	0,05	0,06
2142 to 2159	0,87	1,10
2165	0,27	0,40
2169	0,10	0,045
2181	0,04	0,05
2183	0,26	0,50
2189	0,0012	0,009
2311	0,06	0,10
2313	0,0049	0,01
2315	0,04	0,07
2319	0,02	0,04
2333	0,20	0,37
2339	0,0096	0,05
2343	0,19	0,28
2351	0,08	0,13
2359	0,0066	0,02
2511-9	0,28	0,26
3111	0,32	0,33
3119	0,015	0,03
3136		
3151	0,11	0,11
3153	0,017	0,016
3156	0,20	0,27
3158	--	--
	5,32	**6,44**
d) Artistic research and creation		
3311	0,026	0,018
3313	0,15	0,17
3314	0,094	0,15
3319	0,0055	0,0055
3331	--	--
3334	--	--
3351	--	--
	0,28	**0,34**
Subtotal I	**17,24**	**21,90**

II. Decision-making and control

Occupation Code	1971	1981
a) Management		
1111	0,013	0,019
1113	0,16	0,19
1115	0,065	0,048
1119	0,017	0,064
113/4	1,64	4,00
1179	0,51	0,43
2341	0,014	0,016
3330	0,044	0,08
	2,46	**4,85**
b) Inspection		
1116	0,19	0,22
1176	0,04	0,055
6113	0,04	0,036
7196	--	--
7516	0,02	0,02
8116	0,0016	0,004
8146	0,015	0,031
8156	0,024	0,015
8176	0,022	0,035
8226	0,053	0,075
8236	0,045	0,046
8256	0,028	0,029
8276	0,037	0,04
8296	0,009	0,011
8316	0,025	0,018
8336	0,011	0,019
8356	0,0005	0,0016
8376	0,0028	0,006
8396	0,0022	0,002

Occupation code	1971	1981
b) Inspection (cont'd)		
8526	0,09	0,10
8536	0,062	0,074
8546	0,001	0,005
8566	0,029	0,048
8576	0,019	0,022
8686	0,024	0,024
8596	0,02	0,017
8736	0,033	0,039
8796	0,05	0,05
9916	0,11	0,03
	1,01	**1,08**
c) Supervision		
2160	0,033	0,069
2350	0,013	0,018
3130	0,17	0,17
3360	--	--
3371	0,0025	0,0054
4110	0,030	0,037
4130	0,14	0,26
4140	0,044	0,064
4150	0,16	0,15
4160	0,012	0,018
4170	0,093	0,084
4190	0,56	0,27
5130	2,84	2,26
5170	0,28	0,18
5190	0,02	0,021
6120	0,46	0,58
6130	0,50	0,40

II. Decision-making and control (cont'd)

Occupation Code	1971	1981	Occupation code	1971	1981
c) Supervision (cont'd)			**c) Supervision (cont'd)**		
6160	0,06	0,04	8540	0,029	0,074
6190	0,13	0,15	8550	0,07	0,073
7180	0,05	0,073	8570	0,03	0,036
7510	0,079	0,068	8580	0,32	0,33
7710	0,12	0,12	8590	0,08	0,06
8110	0,011	0,0088	8710	0,21	0,14
8130	0,072	0,076	8730	0,18	0,19
8150	0,026	0,022	8780	0,64	0,66
8160	0,060	0,056	9110	0,015	0,016
8210	0,14	0,11	9130	0,061	0,047
8230	0,044	0,045	9170	0,14	0,14
8250	0,044	0,045	9190	0,011	0,0086
8260	0,041	0,032	9310	0,18	0,11
8290	0,0073	0,005	9510	0,076	0,063
8310	0,093	0,065	9530	0,08	0,065
8350	0,012	0,0073	9550	0,013	0,011
8370	0,0075	0,0097	9590	0,0087	0,009
8390	0,0047	0,004	9910	0,15	0,099
8510	0,078	0,097		**8,73**	**7,83**
8530	0,09	0,081			
			Subtotal II	**12,20**	**13,76**

III. Dissemination of information

Occupation Code	1971	1981	Occupation code	1971	1981
a) Miscellaneous information & news			**d) Training**		
3337	0,029	0,048	2391	0,051	0,048
3355	0,023	0,051	2399	0,015	0,044
3359	0,003	0,0058	2711	0,27	0,27
4171	0,52	0,77	2719	0,034	0,090
4194	0,067	0,09	2731	1,66	1,42
	0,64	**0,96**	2733	1,26	1,13
			2739	0,17	0,25
b) Entertainment			2791	0,10	0,25
			2792	0,16	0,15
3332	0,10	0,12	2793	0,12	0,053
3333	0,0042	0,0083	2795	0,06	0,16
3335	0,12	0,023	2797	0,065	0,12
3339	0,018	0,036	2799	0,069	0,11
3373	0,008	0,008	3370	0,10	0,16
6144	0,032	0,041		**3,9**	**4,25**
	0,17	**0,24**			
c) Promotion and sales			**Subtotal III**	**10,50**	**11,72**
5131	0,068	0,093			
5133	0,62	0,86			
5135	3,6	4,02			
5141	0,10	0.12			
5143	0,09	0,06			
5149	0,07	0,074			
5171	0,38	0,43			
5172	0,25	0,46			
5173	0,088	0,084			
5174	0,050	0,07			
5177	0,028	0,041			
5179	0,034	0,024			
	5,79	**6,27**			

IV. Infrastructure of information

Occupation Code	1971	1981	Occupation code	1971	1981
a) Operators of office information and communication equipment			**b) Occupations related to printing and photographic development**		
4141	0,24	0,12	3315	0,062	0,073
4143	0,31	0,63	9511	0,15	0,11
4175	0,36	0,30	9512	0,13	0,16
9551	0,04	0,034	9513	0,005	0,001
9553	0,019	0,013	9514	0,035	0,029
9555	0,004	0,017	9515	0,016	0,021
9557	0,017	0,015	9517	0,078	0,082
9559	0,002	0,004	9518	0,020	0,034
	0,99	**1,13**	9519	0,065	0,083
			9591	0,054	0,039
				0,61	**0,63**
			c) Occupations related to mail and messenger services		
			4172	0,20	0,21
			4173	0,36	0,36
			4177-9	0,22	0,65
				0,78	**1,22**
			Subtotal IV	**2,38**	**2,98**

APPENDIX III

Employment and value added and information productivity by sector in Canada

APPENDIX III

No (1)	Industry (2)	Industry name (3)	Employment (Ni/N) % (4)	Va (Wi/W) % (5)	(Wi/W)-(Ni/N) (6)	Total employment (7)	GDP/N (8)
1	AGRIC	Agricultural & related services ind.	14.902	21.122	6.220	513394	0.021
2	FISHI	Fishing & trapping industries	8.161	10.448	2.287	34119	0.019
3	LOGGI	Logging & forestry industries	28.254	34.207	5.953	57237	0.044
4	GOLD	Gold mines	23.034	33.441	10.407	6690	0.138
5	OTHER	Other metal mines	23.034	32.644	9.610	29018	0.118
6	IRON	Iron mines	20.531	32.303	11.772	6215	0.100
7	ASBES	Asbestos mines	20.033	31.322	11.289	3199	0.062
8	NON-M	Non-metal mines exc. coal & asbestos	24.012	28.137	4.125	7681	0.093
9	SALT	Salt mines	27.600	36.191	8.591	1551	0.067
10	COAL	Coal mines	20.162	28.832	8.670	8684	0.110
11	CRUDE	Crude petroleum & natural gas	68.770	75.883	7.113	43603	0.275
12	QUARR	Quarry & sand pit industries	23.683	31.185	7.502	8928	0.041
13	SERVI	Service related to mineral extract.	37.087	49.073	11.986	41010	0.052
14	MEAT	Meat & meat prod. (exc. poultry)	27.438	35.217	7.779	31443	0.029
16	FISH	Fish products industry	16.731	24.172	7.441	26581	0.029
17	FRUIT	Fruit and vegetable industries	36.149	44.936	8.787	17228	0.035
18	DAIRY	Dairy products industries	38.122	44.214	6.092	25435	0.035
19	FEED	Feed industry	45.243	55.198	9.955	9387	0.050
21	BISCU	Biscuit industry	34.969	41.742	6.773	6369	0.035
24	MISC.	Misc. food products industries	42.775	54.370	11.595	39610	0.047
25	SOFT	Soft drink industry	18.303	45.997	27.694	12380	0.047
29	TOBAC	Tobacco products industries	68.543	47.383	-21.160	7097	0.046
31	PLAST	Plastic products industries	36.491	45.731	9.240	38213	0.033
32	LEATH	Leather tanneries	26.757	38.430	11.673	2157	0.029
33	FOOTW	Footwear industry	30.387	40.527	10.140	16450	0.021
34	MISC.	Misc. leather & allied prod. ind.	26.310	41.551	15.241	4320	0.023
35	MAN-M	Man-made fibre yarn & woven cloth	32.127	40.228	8.101	19555	0.036
36	WOOL	Wool yarn & woven cloth industry	27.249	36.374	9.125	4051	0.035
37	BROAD	Broad knitted fabric industry	25.178	37.261	12.083	2994	0.089
38	MICS.	Misc. textile products industries	36.731	50.411	13.680	22808	0.024
40	CARPE	Carpet, mat & rug industry	34.488	44.765	10.277	5348	0.035
41	CLOTH	Clothing industries exc. hosiery	25.076	39.828	14.752	105781	0.018
42	HOSIE	Hosiery industry	29.393	38.342	8.949	5410	0.018
43	SAWMI	Sawmills, planing & shingle mills	32.501	26.450	3.949	60861	0.038
44	VENEE	Veneer and plywood industries	23.815	28.308	4.493	9019	0.039
45	SASH	Sash, door & other millwork ind.	30.074	40.272	10.198	26213	0.028
46	WOODE	Wooden box & coffin industries	24.297	33.639	9.342	3581	0.022
47	OTHER	Other wood industries	28.612	36.174	7.562	7850	0.043
48	HOUSE	Household furniture industries	23.172	32.068	8.896	24627	0.020
49	OFFIC	Office furniture industries	34.539	44.956	10.417	10477	0.029
50	OTHER	Other furniture & fixture ind.	34.036	45.018	10.982	15015	0.026
51	PULP	Pulp & paper industries	31.700	35.421	3.721	76801	0.062
52	ASPHA	Asphalt roofing industry	41.546	47.402	5.856	1562	0.072
53	PAPER	Paper box & bag industries	37.737	44.696	6.959	19099	0.027
54	OTHER	Other converted paper products ind.	46.169	52.858	6.689	15857	0.081

No	Industry	Industry name	Employment (Ni/N) %	Va (Wi/W) %	(Wi/W)-(Ni/N)	Total employment	GDP/N
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
55	PRINT	Printing & publishing ind.	86.371	93.297	6.926	102228	0.032
56	PLATE	Platemaking, typesetting & bindery	80.445	89.462	9.017	15495	0.025
57	PRIMA	Primary steel industries	32.805	37.800	4.995	47503	0.047
58	STEEL	Steel pipe & tube industry	35.351	41.825	6.474	5978	0.055
59	IRON	Iron foundries	25.861	31.464	5.603	7620	0.046
60	NON-F	Non-ferrous smelting & refining ind.	32.099	38.565	6.466	29585	0.068
61	ALUMI	Aluminum rolling casting, extruding	37.697	44.399	6.702	6177	0.040
62	COPPE	Copper rolling casting & extruding	34.464	39.828	5.364	3008	0.034
63	OTHER	Other metal rolling, casting etc.	30.894	37.944	7.050	5620	0.050
64	POWER	Power boiler & struct. metal ind.	35.553	44.725	9.172	22458	0.043
65	ORNAM	Ornamental & arch. metal prod. ind.	34.629	45.587	10.958	15689	0.026
66	STAMP	Stamped, pressed & coated metals	33.871	43.821	9.950	30838	0.040
67	WIRE	Wire and wire products industries	34.325	43.557	8.732	15363	0.038
68	HARDW	Hardware, tool & cutlery industries	32.349	37.914	5.565	19384	0.082
69	HEATI	Heating equipment industry	42.203	53.540	11.337	5617	0.027
70	MACHI	Machine shops industry	27.478	33.186	5.708	15600	0.029
71	OTHER	Other metal fabricating industries	36.495	46.029	9.534	14955	0.032
72	AGRIC	Agriculture implement industry	39.926	49.049	9.123	9118	0.088
73	COMME	Commercial refrigeration equipment	44.499	53.726	9.227	3698	0.037
74	OTHER	Other machinery & equipment ind.	44.591	53.262	8.571	61677	0.056
75	AIRCR	Aircraft & aircraft parts industry	46.633	58.136	11.503	33815	0.030
76	MOTOR	Motor vehicle industry	23.164	32.502	9.338	56866	0.037
77	TRUCK	Truck, bus body & trailer industry	28.697	35.488	6.791	11298	0.025
78	MOTOR	Motor vehicle parts & accessories	26.904	35.904	9.000	84388	0.057
79	RAILR	Railroad rolling stock industry	40.862	46.957	6.095	7562	0.045
80	SHIPB	Shipbuilding and repair industry	30.928	36.900	5.972	10990	0.029
81	MISC.	Misc. transportation equipment ind.	27.148	33.622	6.474	5975	0.019
82	SMALL	Small electrical appliance industry	37.831	46.721	8.890	5788	0.047
83	MAJOR	Major appliances (elec. & non-elec.)	34.884	42.449	7.565	9369	0.035
84	RECOR	Record players, radio & TV receivers	45.368	54.602	9.234	3007	0.093
85	ELECT	Electronic equipment industries	63.393	71.087	7.694	51620	0.036
86	OFFIC	Office, store & business machines	71.517	80.158	8.641	18586	0.108
87	COMMU	Communic., energy wire & cable	49.148	55.643	6.495	8155	0.044
89	OTHER	Other elect. & electronic products	43.218	52.490	9.272	37717	0.030
90	CLAY	Clay products industry	32.293	38.081	5.788	2749	0.027
91	CEMON	Cement industry	40.796	47.866	7.070	3533	0.074
92	CONCR	Concrete products industry	30.977	39.412	8.425	8376	0.038
93	READY	Ready-mix concrete industry	27.017	33.125	6.108	8966	0.036
94	GLASS	Glass & glass products industries	37.331	43.775	5.444	12886	0.042
95	NON-M	Non-metallic mineral products n.e.c.	40.854	50.689	9.785	13988	0.038
96	REFIN	Refined petroleum & coal products	59.278	65.834	6.556	15647	0.050
97	INDUS	Industrial chemicals industries n.e.c.	54.119	60.892	6.773	19204	0.080
98	PLAST	Plastic & synthetic resin industry	55.232	61.521	6.289	5794	0.046
99	PHARM	Pharmaceutical & medicine industry	69.134	77.568	8.434	16656	0.048
100	PAINT	Paint and varnish industry	57.533	69.219	11.686	6605	0.052

No (1)	Industry (2)	Industry name (3)	Employment (Ni/N) % (4)	Va (Wi/W) % (5)	(Wi/W)-(Ni/N) (6)	Total employment (7)	GDP/N (8)
101	SOAP	Soap & cleaning compounds ind.	61.104	71.489	10.385	8275	0.047
102	TOILE	Toilet preparations industry	56.416	69.274	12.858	8943	0.032
103	CHEMI	Chemical & chemical products n.e.c.	54.492	68.158	8.666	20469	0.064
104	JEWEL	Jewellery & precious metal ind.	37.044	50.689	13.645	5690	0.034
105	SPORT	Sporting goods & toy industries	39.371	59.896	11.525	10689	0.030
106	SING	Sign and display industry	57.188	66.357	9.169	7940	0.051
107	FLOOR	Floor tile, linoleum, coated fabric	43.243	55.547	12.304	1755	0.027
108	OTHER	Other manufacturing ind. n.e.c.	46.095	57.784	11.689	40997	0.028
109	REPAI	Repair construction	28.970	36.219	7.249	136252	0.030
118	AIR T	Air transport & services incidental	45.405	44.695	-0.710	40336	0.016
119	RAILW	Railway transport & rel. services	43.615	36.877	-6.739	70571	0.045
120	WATER	Water transport & rel. services	31.303	33.429	2.126	25718	0.055
121	TRUCK	Truck transport industries	24.450	23.062	3.602	144516	0.033
122	URBAN	Urban transit system industry	21.888	25.140	3.252	32575	0.023
123	INTER	Interurban & rural transit systems	28.419	30.487	2.068	8367	0.015
124	TAXIC	Taxicab industry	11.969	17.868	5.899	38159	0.013
125	OTHER	Other transport & serv. to transp.	47.275	50.623	3.348	61939	0.016
126	HIGHW	Highway & bridge maint. ind.	26.089	32.078	5.989	1140	0.063
127	PIPEL	Pipeline transport industries	59.524	66.436	6.912	6361	0.235
128	STORA	Storage and warehousing ind.	54.757	59.843	5.086	20210	0.024
129	TELEC	Telecommun. broadcasting ind.	81.950	87.931	5.981	36743	0.035
130	TELEC	Telecommunication carriers & other	60.491	68.169	7.678	98021	0.073
131	POATA	Postal service industry	93.677	95.486	1.809	73158	0.019
132	ELECT	Electric power systems industry	54.514	60.351	5.837	78056	0.116
133	GAS D	Gas distribution systems industry	55.467	69.033	13.566	13511	0.081
134	OTHER	Other utility industries n.e.c.	28.909	36.606	7.697	7253	0.035
135	WHOLE	Wholesale trade industries	55.649	73.354	17.705	545301	0.033
136	RETAI	Retail trade industries	41.629	76.586	34.957	1403554	0.016
137	BANKS	Banks, credit union & other. dep. inst.	94.615	98.324	3.709	242587	0.016
138	TRUST	Trust, other finance & real estate	84.200	94.218	10.018	267851	0.064
142	OTHER	Other business service industries	66.415	76.798	10.383	274313	0.020
143	PROFE	Professional business services	94.159	97.391	3.232	250139	0.024
145	EDUCA	Educational service industries	84.980	91.737	6.757	22773	0.032
146	HOSPI	Hospitals	29.369	39.171	9.802	5119	0.025
147	OTHER	Other health services	53.916	63.687	9.771	138592	0.043
148	ACCOM	Accommodation & food serv. ind.	19.077	41.840	22.763	672369	0.011
149	MOTIO	Motion picture & video industries	62.395	87.603	25.208	21396	0.013
150	OTHER	Other amusement & recreational serv.	53.786	67.472	13.686	84575	0.021
151	LAUND	Laundries & cleaners	18.639	42.492	23.853	37892	0.017
152	OTHER	Other personal services	11.081	19.895	8.814	124004	0.018
153	PHOTO	Photographers	59.551	75.558	16.007	15771	0.012
154	MISC.	Misc. service industries	44.119	61.446	17.327	246312	0.016

APPENDIX IV

Mini-lexicon of combined occupations

1. Members of legislative bodies
2. Government administrators
3. Postal managers
4. Government inspectors
5. Government administrators and senior officials
6. General managers and other senior officials
7. Personnel management
8. Purchasing management
9. Services management
10. Production management
11. Construction operations management
12. Agricultural operations management
13. Transport and communications operations management
14. Other managers and administrators
15. Agriculturalists, biologists
17. Architects, surveyors, technical and other draughting
18. Chemical engineers
19 Civil engineers
20. Electrical engineers
21. Industrial engineers
22. Agricultural engineers
23. Mechanical engineers
24. Metallurgical engineers
25. Mining engineers
26. Petroleum engineers
27. Aerospace engineers
28. Nuclear engineers
29. Urban planners
30. Other engineers and technicians
31. Mathematicians, statisticians and computer programmers
32. Social science workers
33. Social and related workers

34. Library, museum and archival science workers
35. Ministers of religion
36. University teachers
37. Health professionals
38. Performing arts professionals
39. Artists and performing arts technicians
40. Sports
41. Stenographers
42. Bookkeepers
43. Office clerks, supervisors and officers
44. Office machine operators
45. General production clerks
46. Library employees
47. Receptionists, telephone operators, messengers
48. Postal employees
49. Other office employees
50. Sales representatives and others
51. Police agents and private detectives
52. Guides
53. Printing and similar occupations
54. Communication equipment operators
55. Radio and television announcers
56. Supervisors: food and beverage
57. Supervisors: lodging and related sectors
58. Supervisors: laundering
59. Supervisors: other services
60. Foremen/women and inspectors: agriculture and forestry
61. Foremen/women and inspectors: metal processing
62. Foremen/women and inspectors: clay, glass and stone processing
63. Foremen/women and inspectors: chemicals, plastics
64. Foremen/women and inspectors: wood and paper pulp
65. Foremen/women and inspectors: textile

66. Foremen/women and inspectors: other processing
67. Foremen/women and inspectors: wood machining
68. Foremen/women and inspectors: electrical, electronic equipment
69. Foremen/women and inspectors: textile repair
70. Foremen/women and inspectors: mechanics
71. Foremen/women and inspectors: construction
72. Foremen/women and inspectors: air transport
73. Foremen/women and inspectors: other transport
74. Foremen/women and inspectors: other
75. Occupations in law and jurisprudence[1]

[1] Not available.

Aggregation of information occupations

1	[111]	42	[4230, 4131]
2	[1113]	43	[1135, 1171, 1173, 4133, 4135, 4137, 4139]
3	[1115]		
4	[1116]	44	[4140, 4141, 4143]
5	[1119]	45	[4150, 4151, 4153, 4155, 4157, 4159]
6	[1130, 1179]	46	[4160, 4161, 4169]
7	[1136, 1174, 1176]	47	[4170, 4171, 4175, 4177, 4179, 4194]
8	[1141, 1175]	48	[4172, 4173]
9	[1142]	49	[4190, 4191, 4192, 4193, 4195, 4197, 4199]
10	[1143]		
11	[1145]	50	[1137, 5130, 5131, 5133, 5135, 5141, 5143, 5149, 5170, 5171, 5172, 5173, 5174, 5177, 4179, 5190]
12	[1146]		
13	[1147]		
14	[1149]	51	[6113]
15	[2111, 2112, 2113, 2114, 2117, 2119]	52	[6144]
16	[2131, 2133, 2135, 2139]	53	[9510, 9511, 9512, 9513, 9514, 9515, 9517, 9518, 9519]
17	[2141, 2161, 2163, 2164]		
18	[2142]	54	[3315, 9550, 9551, 9553, 9555, 9557, 9559]
19	[2143]		
20	[2144]	55	[3337]
21	[2145]	56	[6120, 8210, 8226]
22	[2146]	57	[6130]
23	[2147]	58	[6160]
24	[2151]	59	[6190]
25	[2153]	60	[7180, 7196, 7510, 7516]
26	[2154]	61	[7710, 8110, 8116, 8146, 8310, 8316, 8320, 8330, 8336, 8390, 8396, 8510, 8526]
27	[2155]		
28	[2156]		
29	[2156]	62	[8150, 8156, 8370, 8376]
30	[1131, 2159, 2165, 2169, 2160]	63	[8160, 8176, 8570, 8576]
31	[2181, 2183, 2189]	64	[8230, 8236, 8250, 8256, 8540, 8546]
32	[1132, 2311, 2313, 2319, 2399]	65	[8260, 8276]
33	[2331, 2333, 2339, 2315, 2391]	66	[8290, 8296]
34	[2350, 2351, 2353, 3559]	67	[8350, 8356]
35	[2511, 2513, 2519]	68	[8550, 8556, 8730, 8736]
36	[1133, 2711, 2719, 2731, 2733, 2739, 2791, 2793, 2795, 2797, 2799]	69	[8550, 8566]
		70	[8580, 8586, 8590, 8596, 9530, 9590]
37	[1134, 3111, 3119, 3136, 3151, 3152, 3153, 3156, 3158, 3130]	71	[8710, 8780, 8796]
		72	[9110]
38	[2792, 3311, 3313, 3314, 3319]	73	[9130, 9770, 9190, 9310]
39	[3330, 3331, 3332, 3333, 3334, 3335, 3339, 3351, 3355, 3359]	74	[9910, 9916]
		75	[2341, 2343, 2349]
40	[3360, 3370, 3371, 3373]		
41	[4110, 4111, 4113]		**Total: 75 production functions**

The data refer to the 1971 standard occupational classification.

APPENDIX V

List of inputs

543 Radio and television broadcasting
544 Telephone & telegraph
545 Postal services
552 Rental of office equipment
554 Banking services
555 Real estate services
556 Insurance
561 Education services
564 Motion picture entertainment
566 Services to business management
567 Advertising services
572 Miscellaneous services
573 Photographic services
575 Data processing equipment services
576 Other services to businesses
581 Office supplies
584 Laboratory equipment and supplies
585 Travel services
586 Advertising and promotion

APPENDIX VI

Simulations 1 to 15

SIMULATION 1 : EXPORTS OF RAW MATERIALS ($ MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS				OTHER USERS					PROPORTION IN%	
	1	4	5	13	10	11	12	Other	Total	Infor.	Total
50.	0,330	0,158	0,665	0,485	1,224	1,442	1,354	0,183	5,841	14,5%	
12.	3,881	--	--	--	--	--	--	--	3,881	9,66%	
42.	0,957	0,536	0,440	0,506	--	--	--	0,920	3,359	8,36%	
41.	0,208	0,565	0,360	0,842	--	--	--	0,768	2,743	6,82%	
63.	0,102	0,424	0,681	0,613	--	0,332	--	0,483	2,635	6,55%	
Other occupations	1,952	5,55	3,771	4,749	--	--	--	--	21,716	54,00%	
Total information employment	7,430	7,233	5,917	7,195				12,400	40,175	100,00%	37,8%
Total non-infor. employment	40,236	7,577	5,114	3,300				9,936	66,163		62,2%
Total employment	47,669	14,810	11,031	10,495				22,336	106,338		100,0%
1.B Value added ($000)[1,2]											
Information	213,6	2161,0	336,8	209,6				951,9	3872,9	51%	
Non-information	798,0	1082,1	260,3	70,2				736,3	2946,9	49%	
Total	1011,7	3243,1	597,1	279,8				1688,1	6819,8	100%	

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 2 : EXPORTS OF NON-DURABLE AND SEMI-DURABLE GOODS (FOOD, TEXTILES, CLOTHING) (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS			OTHER USERS					PROPORTION IN%	
	3	5	13	10	11	12	Other	Total	Infor.	Total
50.	0,061	2,662	0,636	1,998	1,877	1,584	0,325	9,143	15,5%	
42.	0,351	1,390	0,002				1,502	4,389	7,4%	
64.	--	3,964	0,002				0,099	4,065	6,8%	
41.	0,197	1,440	1,071				1,116	3,824	6,4%	
45.	0,080	2,221	0,102				0,890	3,293	5,5%	
43.	0,095	0,985	0,765				1,117	2,962	5,0%	
6.	0,127	1,312	0,580				0,729	2,748	4,6%	
49.	0,102	0,843	0,386				1,037	2,368	4,0%	
Other occupations	2,903	12,129	5,019				6,102	26,153	44,3%	
Total information employment	3,916	27,446	9,207				18,376	58,945	100,0%	41,6%
Total non-infor. employment	9,483	50,199	4,370				18,601	82,653		58,4%
Total employment	13,399	77,645	13,577				36,977	141,597		100,0%
1.B Value added ($000)[1,2]										
Information	24,8	1457,5	265,6				1170,7	2918,6		45,3%
Non-information	11,41	2176,9	91,6				1011,4	3394,0		54,7%
Total	138,9	3634,5	357,3				2182,1	6312,6		100,0%

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 3 : EXPORTS OF METAL PRODUCTS (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS			OTHER USERS					PROPORTION IN%	
	4	5	13	10	11	12	Other	Total	Infor.	Total
50.	0,099	1,316	0,415	1,691	1,005	1,041	0,112	5,679	14,1%	
61.	0,787	3,612	0,016				0,032	4,447	11,04%	
42.	0,220	1,096	0,424				0,930	2,670	6,63%	
41.	0,199	1,003	0,704				0,739	2,645	6,56%	
45.	0,160	1,662	0,067				0,621	2,510	6,23%	
Other occupations	2,134	10,196	4,416				5,568	22,314	55,41%	
Total information employment	3,599	18,885	6,042				11,739	40,265	100,0%	45,2%
Total non-infor. employment	7,691	30,768	2,837				7,372	48,668		54,7%
Total employment	11,290	49,653	8,879				19,111	88,933		100,0%
1.B Value added ($000)[1,2]										
Information	412,0	112,4	174,8				554,1	2253,3		45,5%
Non-information	648,0	1589,4	59,7				340,3	2637,4		54,5%
Total	1060,0	2710,9	234,5				894,4	4890,7		100,0%

1. Totals do not always match because of rounding-off errors.

2. At factor cost.

SIMULATION 4 : EXPORTS OF MACHINERY (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS					PROPORTION IN%	
	5	10	13	Other	Total	Infor.	Total
50.	0,646	0,035	0,065	0,903	1,649	14,19%	
45.	0,650	0,085	0,018	0,051	0,804	6,92%	
61.	0,731	0,003	0,004	0,016	0,754	6,49%	
41.	0,372	0,049	0,186	0,135	0,742	6,38%	
42.	0,401	0,080	0,112	0,133	0,726	6,25%	
Other occupations	4,302	0,585	1,214	0,838	6,939	59,7%	
Total information employment	7,102	0,837	1,599	2,076	11,614	100,0%	51,2%
Total non-infor. employment	8,772	0,324	0,748	1,261	11,105		48,8%
Total employment	15,874	1,161	2,847	3,337	22,719		100,0%
1.B Value added ($000)[1,2]							
Information	376,0	31,7	46,5	125,3	579,5		54,5%
Non-information	397,5	11,9	15,7	72,0	497,1		45,5%
Total	773,5	43,6	62,3	197,3	1076,6		100,0%

1. Totals do not always match because of rounding-off errors.

2. At factor cost.

SIMULATION 5 : EXPORTS OF CHEMICAL PRODUCTS (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS			OTHER USERS					PROPORTION IN%	
	1	5	13	10	11	12	Other	Total	Infor.	Total
50.	0,115	2,671	0,613	1,579	1,331	1,610	4,783	8,182	17,0%	
41.	0,073	1,248	1,059				1,146	3,526	7,34%	
42.	0,335	1,088	0,637				1,279	3,339	6,95%	
43.	0,036	0,676	0,319				1,509	2,540	5,28%	
6.	0,025	1,051	0,558				0,780	2,414	5,02%	
45.	0,025	1,284	0,100				0,719	2,128	4,43%	
Other specifics professions			--							
Other occupations	1,995	11,105	5,769				11,121	25,889	53,9%	
Total information employment	2,604	19,122	9,055				21,337	48,018	100,0%	51,5%
Total non-infor. employment	14,098	14,822	4,169				12,109	45,198		48,5%
Total employment	16,702	33,994	13,224				33,446	93,216		100,0%
1.B Value added ($000)[1,2]										
Information	74,8	1335,5	263,6				1650,6	3324,4		57,4%
Non-information	279,6	856,7	88,6				941,5	2166,4		42,6%
Total	354,4	2192,3	352,2				2591,9	5490,8		100,0%

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 6 : EXPORTS OF SCIENTIFIC EQUIPMENT (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS			OTHER USERS				PROPORTION IN%	
	5	10	13	11	12	Other	Total	Infor.	Total
50.	2,306	0,689	0,199	0,373	0,602	0,050	4,219	15,9%	
41.	1,500	0,095	0,349			0,225	2,169	8,2%	
42.	1,379	0,154	0,210			0,205	1,948	7,3%	
45.	1,422	0,162	0,033			0,074	1,691	6,3%	
6.	1,191	0,09	0,181			0,116	1,578	5,9%	
Other occupations	10,768	0,418	2,005			3,032	14,840	56,11%	
Total information employment	18,566	1,608	2,977			3,702	26,445	100,0%	56,0%
Total non-infor. employment	17,035	0,622	1,350			1,741	20,748		44,0%
Total employment	35,601	2,230	4,327			5,443	47,193		100,0%
1.B Value added ($000)[1,2]									
Information	713,1	61,0	87,1			188,2	1049,4		60,8%
Non-information	562,2	22,9	28,9			88,3	666,3		39,2%
Total	1239,4	83,9	116,0			276,5	1715,7		100,0%

1. Totals do not always match because of rounding-off errors.

2. At factor cost.

SIMULATION 7 : EXPORTS OF SERVICES (IN MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS					OTHER USERS			PROPORTION IN%	
	5	7	10	12	13	8,11*	Other	Total	Infor.	Total
50.	0,078	1,089	11,888	4,037	2,039	1,768*	0,300	21,329	19,4%	
41.	0,293	1,391	1,637	0,991	4,855		0,562	9,729	8,6%	
42.	0,332	2,277	2,659	0,578	2,762		0,769	9,377	8,3%	
43.	0,185	0,727	0,966	0,802	3,643		0,714	7,037	6.2%	
6.	0,287	0,954	1,554	0,389	1,913		0,426	5,522	4.9%	
45.	0,384	1,530	2,804	0,034	0,318		0,358	5,428	4,8%	
14.	0,144	0,741	0,869	0,311	0,873		0,271	3,209	2,8%	
73.	0,021	2,850	0,217	0,001	0,067		0,022	3,178	2,8%	
44.	0,128	0,620	0,628	0,262	1,199		0,277	3,114	2,7%	
47.	0,103	0,405	0,664	0,210	1,139	0,475	0,110	3,106	2,7%	
75.	0,004	0,032	0,005	0,020	2,867		0,015	2,943	2,6%	
81.	0,114	0,416	0,277	0,221	1,591		0,272	2,891	2,5%	
17.	0,055	0,117	0,049	0,013	1,870		0.174	2,278	2,0%	
48.	0,014	0,032	0,026	0,030	0,093	1,981	0,016	2,192	1,9%	
Other occupations	2,655	7,234	3,511	1,271	10,857			30,309	27,0%	
Total information employment	5,427	20,415	27,754	9,107	36,086		13,290	112,142	100,0%	60%
Total non-infor. employment	5,078	38,255	10,740	1,082	10,021		8,505	73,681		40%
Total employment	10,505	58,670	38,494	10,252	46,107		21,795	185,823		100%
1.B Value added ($000)[1,2]										
Information	282,1	1016,5	1053,2	430,1	1066,8		1141,5	4990,2		61,2%
Non-information	214,6	1615,2	395,9	42,5	206,8		676,1	3151,5		38,8%
Total	496,7	2631,7	1449,1	472,6	1273,7		1817,6	8141,3		100,0%

1. Totals do not always match because of rounding-off errors.

2. At factor cost.

SIMULATION 8 : CONSUMPTION OF DURABLE GOODS (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS				OTHER USERS			PROPORTION IN%	
	5	10	11	13	Other Specifics	Other	Total	Infor.	Total
50.	1,268	5,010	40,290	0,750	1,502		48,969	46,8%	
43.	0,293	0,407	9,289	0,679			11,070	10,5%	
42.	0,681	1,120	3,500	0,644			6,433	6,1%	
45.	0,908	1,182	3,475	0,113			5,830	5,5%	
41.	0,549	0,690	1,193	1,036			4,025	3,8%	
49.	0,327	0,482	1,645	0,455			3,463	3,3%	
6.	0,571	0,655	1,039	0,686			3,233	3,09%	
Other occupations	5,104	2,149	6,335	5,087			21,551	20,6%	
Total information employment	9,701	11,695	66,766	9,450		6,962	104,574	100,0%	67,3%
Total non-infor. employment	14,884	4,526	21,081	5,387		5,985	50,863		32,7%
Total employment	24,585	16,221	87,847	14,837		11,947	155,437		100,0%
1.B Value added ($000)[1,2]									
Information	445,5	443,8	1249,3	254,3		466,1	2859.0		66,5%
Non-information	515,3	166,8	386,2	103,2		242,3	1413,8		33,5%
Total	960,9	610,6	1635,6	357,6		708,1	4272,8		100,0%

1. Totals do not always match because of rounding-off errors.

2. At factor cost.

SIMULATION 9 : CONSUMPTION OF SEMI-DURABLE GOODS (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS				OTHER USERS			PROPORTION IN%	
	5	10	11	13	Other Specifics	Other	Total	Infor.	Total
50.	3,396	3,624	53,805	0,696	2,08	0,211	63,812	44,4%	
43.	0,661	0,294	12,405	0,822		0,560	14,742	10,2%	
42.	1,763	0,811	4,674	0,686		0,681	8,615	6,0%	
45.	2,433	0,855	4,638	0,111		0,201	8,238	5,7%	
41.	1,240	0,499	1,593	1,103		0,778	5,213	3,6%	
49.	0,888	0,349	2,196	0,398		0,781	4,612	3,2%	
6.	1,482	0,474	1,388	0,595		0,400	4,339	3,0%	
53.	2,921	0,021	0,090	0,032		0,009	3,073	2,1%	
47.	0,537	0,202	0,980	0,423		0,359	2,501	1,7%	
69.	2,379	0,005	0,086	0,008		--	2,488	1,7%	
14.	0,630	0,265	0,784	0,278		0,296	2,253	1,5%	
38.	0,917	0,029	0,889	0,328		0,018	2,181	1,5%	
70.	0,180	0,087	1,639	0,018		0,082	2,006	1,3%	
Other occupations	6,816	0,947	3,996	4,298		3,321	19,378	13,5%	
Total information employment	26,243	8,462	89,163	9,807		9,776	143,451	100,0%	62%
Total non-infor. employment	41,544	3,274	28,153	6,550		7,037	86,558		38%
Total employment	67,787	11,736	117,316	16,357		16,813	230,009		100%
1.B Value added ($000)[1,2]									
Information	1036,0	321,1	1668,4	254,9		623,0	3933,4		65%
Non-information	983,0	120,7	515,8	134,5		327,8	2081,8		38%
Total	2019,1	441,8	2184,2	419,5		950,6	6015,2		100%

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 10 : CONSUMPTION OF NON-DURABLE GOODS (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS					OTHER USERS			PROPORTION IN%	
	1	5	10	11	13		Other	Total	Infor.	Total
50.	0,201	2,645	4,226	27,616	0,554	1,693	0,298	37,233	38,3%	
43.	0,062	1,474	0,343	6,367	0,684		0,661	9,591	9.8%	
42.	0,582	1,194	0,945	2,399	0,563		0,924	6,607	6,8%	
45.	0,043	1,232	0,997	2,380	0,091		0,334	5,077	5,2%	
41.	0,126	1,135	0,583	0,818	0,926		1,940	4,527	4,6%	
49.	0,059	0,539	0,407	1,127	0,330		1,097	3,559	3,6%	
6.	0,043	0,830	0,552	0,712	0,494		0,552	3,183	3,0%	
12.	2,361	--	--	--	--		--	2,361	2,4%	
Other occupations	1,046	8,269	1,814	4,345	4,401		4,973	24,848	25,6%	
Total information employment	4,523	16,318	9,866	45,764	8,043		12,473	96,986	100,0%	57,3%
Total non-infor. employment	24,483	15,952	3,818	14,449	3,879		9,544	75,125		42,7%
Total employment	29,006	32,270	13,684	60,213	11,922		22,017	169,111		100,0%
1.B Value added ($000)[1,2]										
Information	130,0	917,9	374,4	856,3	232,8		1418,6	3930,0		59%
Non-information	485,6	777,0	140,7	264,7	81,0		801,9	2550,9		41%
Total	615,6	1695,0	515,1	1121,0	313,9		2220,3	6480,9		100%

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 11 : CONSUMPTION OF SERVICES (IN $10 MILLIONS)

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS			OTHER USERS			PROPORTION IN%	
	7	12	13	Other Specifics	Other	Total	Infor.	Total
50.	0,150	9,766	2,660	2,768	1,593	16,937	21,0%	
43.	0,133	1,941	3,485	--	1,151	6,710	8,3%	
41.	0,178	2,397	2,246	--	0,797	5,618	7,0%	
42.	0,252	1,399	2,014	--	1,131	4,796	5,9%	
49.	0,901	1,213	1,015	--	0,966	4,095	5,1%	
9.	0,008	0,062	3,439	--	0,019	3,528	4,4%	
47.	0,102	0,509	1,986	0,656	0,212	3,465	4,3%	
6.	0,138	0,940	1,497	--	0,639	3,214	4,0%	
56.	0,009	0,008	2,911	--	0,078	3,006	3,7%	
57.	--	0,707	1,570	--	--	2,277	2,8%	
39.	0,007	0,049	1,565	0,319	0,128	2,068	2,5%	
Other occupations	1,394	3,194	11,773		8,095	24,456	30,0%	
Total information employment	3,263	22,617	36,161		18,561	80,170	100,0%	52,4%
Total non-infor. employment	6,304	2,617	51,697		11,942	72,560		47,6%
Total employment	9,567	24,802	87,858		30,503	152,730		100,0%
1.B Value added ($000)[1,2]								
Information	132,5	1220,0	1046,7		906,3	3305,5		65,0%
Non-information	233,3	120,6	905,4		510,1	1769,5		35,0%
Total	365,8	1340,6	1952,2		1416,5	5075,0		

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 12 : INVESTMENT IN MACHINERY AND EQUIPMENT BY BUSINESSES

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS		OTHER USERS				PROPORTION IN%	
	5	10	Other specifics		Other	Total	Infor.	Total
50.	1,916	6,554	3,611	0,925	0,489	13,495	27,6%	
42.	1,106	1,466	--		1,063	3,635	7,4%	
45.	1,568	1,546	--		0,515	3,629	7,4%	
41.	0,959	0,903	--		1,095	2,957	6,0%	
43.	0,535	0,532	0,832		0,700	2,599	5,3%	
6.	1,044	0,856	--		0,629	2,529	5,1%	
49.	0,544	0,631	--		0,849	2,024	4,1%	
Other occupations	9,391	2,813	--		8,996	17,928	36,7%	
Total information employment	17,063	15,301			16,432	48,796	100,0%	57,9%
Total non-infor. employment	20,560	5,921			8,927	35,408		42,1%
Total employment	37,623	21,222			25,359	84,204		100,0%
1.B Value added ($000)[1,2]								
Information	838,0	580,6			615,2	2033,8		59,9%
Non-information	822,0	218,2			316,5	1356,7		41,1%
Total	1660,0	798,8			931,7	3390,5		100,0%

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 13 : NON-RESIDENTIAL CONSTRUCTION BY BUSINESSES

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS					OTHER USERS			PROPORTION IN%	
	5	6	10	12	13	Other specifics	Other	Total	Infor.	Total
50.	1,646	1,349	3,608	5,509	0,757	1,951	0,375	15,195	18,4%	
71.	0,158	7,752	0,015	0,027	0,032		0,105	8,089	9,8%	
42.	0,982	2,850	0,807	0,879	0,775		0,841	7,044	8,5%	
41.	0,736	2,135	0,497	1,352	1,285		0,615	6,620	8,0%	
43.	0,436	1,126	0,293	1,095	0,926		0,698	4,574	5,5%	
6.	0,794	1,268	0,472	0,530	0,691		0,471	4,226	5,1%	
49.	0,424	0,760	0,347	0,684	0,461		0,698	3,374	4,1%	
45.	1,099	0,293	0,851	0,046	0,122		0,407	2,818	3,4%	
14.	0,365	0,635	0,264	0,425	0,317		0,377	2,383	2,8%	
11.	0,037	1,976	0,005	0,027	0,019		0,037	2,101	2,5%	
Other occupations	6,649	5,250	1,264	2,030	5,667		6,971	25,831	31,4%	
Total information employment	13,326	25,394	8,423	12,514	11,052		11,546	82,255	100,0%	46,3%
Total non-infor. employment	18,858	55,270	3,260	1,477	5,242		11,217	95,324		53,7%
Total employment	32,184	80,664	11,683	13,991	16,294		22,763	177,579		100,0%
1.B Value added ($000)[1,2]										
Information	661,1	1158,1	319,6	673,7	319,2		717,8	3849,5		50,5%
Non-information	752,8	2044,0	120,1	66,6	109,7		610,7	3703,9		49,5%
Total	1414,0	3202,2	439,8	740,3	429,0		1328,1	7553,4		100,0%

1. Totals do not always match because of rounding-off errors.

2. At factor cost.

SIMULATION 14 : GOVERNMENT EXPENDITURES ON GOODS AND SERVICES

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS				OTHER USERS			PROPORTION IN%	
	5	11	12	13	Other Specifics	Other	Total	Infor.	Total
50.	1,137	6,988	4,956	3,193	2,081	0,580	18,935	17,2%	
41.	0,448	0,207	1,217	6,214		1,068	9,154	8,4%	
43.	0,312	1,611	0,985	3,756		0,594	7,258	6,5%	
42.	0,480	0,607	0,710	3,582		1,533	6,912	6,2%	
6.	0,384	0,180	0,477	3,253		0,820	5,114	4,6%	
33.	0,005	0,001	0,021	4,865		0,007	4,899	4,4%	
49.	0,293	0,285	0,615	2,219		1,413	4,825	4,3%	
47.	0,170	0,127	0,258	2,752		0,949	4,256	3,8%	
37.	0,096	0,149	0,013	3,845		0,013	4,116	3,7%	
36.	0,014	0,007	0,016	3,488		0,067	3,592	3,2%	
31.	0,137	0,030	0,272	2,668		0,328	3,435	3,1%	
48.	0,034	0,014	0,037	0,144	2,604	0,017	2,850	2,5%	
14.	0,220	0,102	0,382	1,612		0,497	2,813	2,5%	
44.	0,197	0,069	0,322	1,794		0,410	2,792	2,5%	
45.	0,459	0,602	0,041	0,602		0,850	2,554	2,3%	
Other occupations	3,856	0,601	0,937	15,275		5,923	26,592	24,1%	
Total information employment	8,242	11,580	11,259	59,262		19,917	110,060	100,0%	62,1%
Total non-infor. employment	4,860	3,656	1,328	36,892		20,240	66,976		37,9%
Total employment	13,102	15,236	12,587	96,154		40,157	177,036		100,0%
1.B Value added ($000)[1,2]									
Information	420,2	216,6	629,4	2251,9		1259,3	4777,4		64,8%
Non-information	211,6	66,9	62,2	1232,4		938,4	2511,5		35,2%
Total	631,9	283,6	691,6	3484,3		2197,5	7288,9		100,0%

1. Totals do not always match because of rounding-off errors.
2. At factor cost.

SIMULATION 15 : NATIONAL DEFENCE EXPENDITURES

1.A Measured by employment
1.B Measured by value added

DIRECT AND INDIRECT USE OF INFORMATION PRODUCTS BY INDUSTRY

Major industrial groups 1.A Employment by main information occupations	MAIN USERS		OTHER USERS					PROPORTION IN%	
	5	13	Other specifics			Other	Total	Infor.	Total
50.	0,746	0,779	1,681	1,483	0,729	0,223	5,591	17,2%	
41.	0,533	1,077				0,747	2,357	7,2%	
42.	0,494	0,684				1,013	2,191	6,7%	
43.	0,351	0,851				0,787	1,989	6,1%	
Other occupations	7,020	7,028				6,240	20,288	62,5%	
Total information employment	9,144	10,419				12,853	32,416	100,0%	55,8%
Total non-infor. employment	9,195	6,453				9,998	25,646		44,1%
Total employment	18,399	16,872				22,851	58,062		100,0%
1.B Value added ($000)[1,2]									
Information	463,8	279,3				699,6	1442,7		60,9%
Non-information	372,6	113,9				437,2	923,7		39,1%
Total	836,4	393,2				1136,8	2366,4		100,0%

1. Totals do not always match because of rounding-off errors.

2. At factor cost.

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