Trends In The Productivity Of The Information Sector In Canada

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Abstract

This study shows that almost half of the national employment and production in Canada are due to its vast information sector. However, it also shows that, even if labour productivity in this sector has been superior to the national productivity, its annual growth rate has decreased during the 1980's and, for the period 1990-95, a recovery of this productivity growth has been observed in this sector. These two trends reveal, therefore, as in the USA, a productivity paradox of information technology in the 80's and the end of this paradox in the 90's.

Sommaire

Cette étude montre que prés de la moitié de l'emploi national et de la production nationale au Canada sont dues à son vaste secteur de l'information. Par contre, l'étude montre que, même si la productivité du travail dans ce secteur a été supérieure à celle de la productivité nationale, le taux de croissance annuel de cette productivité a d'abord diminué dans les années 80 avant de se remettre à croître dans les années 90. Ces deux tendances révèlent donc, comme aux États-Unis, un paradoxe de la productivité des technologies de l'information dans les années 80 et la fin de ce paradoxe dans les années 90.

1.0 Issues

According to the Organization for Economic Co-operation and Development (OECD) [1], Canada is included in the group of the first ten countries having invested the most in information technology. The objective of this study is, therefore, to show whether this massive investment has been followed by significant productivity gains in the whole Canadian economy. This question is important if we consider that, during the last ten years, a large debate has been devoted to the examination and re-examination of the "productivity paradox" of information technology in the USA, Japan, France, Germany and England, in different studies, particularly those of Loveman [2], Dué [3], Brynjolfsson [4] and Dewan [5].

2.0 Research Methodology

This study concerns a large sector of the canadian economy called the information sector. Indeed, this sector regroups not only computer and telecommunications industries (components, hardware and software) but also traditional information industries existing prior the electronic revolution of the early 1980's (e.g. telephone, radio, television, editing, financial services, education, public administration industries, etc.) and those industries which utilize products and services for the production of non-information sector goods and services (e.g. automobile and aeronautical industries). All these industries utilize information sector employees classified by OECD [6] in four major categories: information producers, information processors, information distributors and information infrastructure occupations.

Based on this international classification, the productivity of these employees is evaluated as follows:

1. Contribution of information sector employment (IE) to national employment (NE) = IE/NE

2. Contribution of information sector production (IP) to national production Gross Domestic Product (GDP) = IP/GDP

$$= \left[\sum_{i=1}^{n} (N_i * E_i) + (C/L) \sum_{i=1}^{n} (N_i * E_i) \right] / (GDP) \qquad (1)$$

Where n: number of information sector occupations,

N_i: number of employees in the i^{th} information sector occupation,

E_i: average labour income of the i^{th} information sector occupation,

C/L: ratio of capital income share (C) divided by labour income share (L) in GDP. According to Statistics Canada (catalogue 15204) [7], the value of this ratio was 0.54 in 1980; 0.55 in 1985; 0.46 in 1990 and 0.51 in 1995.

3. Productivity of information sector employees = IP/IE

3.0 Results Of The Research

Table 1 shows that the information sector is the largest employment sector in Canada with 43% of national employment coming from this sector during the period 1980-1995. However, in terms of trend, this relative share remained stable during this period and its employment growth rate has even declined a bit (-0.2%) in the recent years (1990-95). This paradox of the new economy based precisely on information activities could be explained by the dynamics of employment in this information sector where the creation of new jobs has been neutralized by the destruction of traditional jobs as observed in national census for the occupations shown in Table 2.

Table 3 reveals that the information sector has been the largest sector of economic activity in Canada since 1980, accounting for almost half

Table 1: Contribution of information sector employment to national employment in Canada

	1980	1985	1990	1995	1980-85	1985-90	1990-95
INFORMATION SECTOR							
- Employment	5,372,360	5,793,073	6,564,362	6,498,850			
- Annual growth (%)	-	-	-	-	1.5	2.5	-0.2
- % of total economy	43.7	44.3	44	43.3			
TOTAL ECONOMY							
- Employment	12,273,255	13,074,460	14,905,395	14,996,390			
- Annual growth (%)	-	-	-	-	1.3	2.6	0.13

Table 2: Professions in decline or experiencing growth

Professions in decline	Professions experiencing growth
- Supervisors, inspectors and controllers	- Senior management occupations
- Bookkeepers	- Professional occupations in business and finance
- Typists and word processing operators	- Professionals in natural science, engineering, mathematics and computer science
- Telephone operators	- Teachers and professors
- Telecommunication line and cable workers	- Writers, editors and public relations professionals
- Library clerks and archivists	- Graphic designers
- Printing press operators.	- Receptionists, switchboard operators and customer service clerks

(48%) of national production (GDP). This relative share is higher than that of employment (43%) because the average labour income in this sector (26.292 $ in 1995) is higher than that of the whole economy (20.763 $). However, the annual growth rate of production in this sector has strongly declined from 1990 (2.8%) to 1995 (1.0%) as a result of reduction in the number of information sector employees and the economic recession in the beginning of 1990's.

Table 4 shows, as expected, that productivity in the information sector has exceeded that of the total economy from 1980 to 1995. It then follows that the information sector contributes to the improvement of productivity gains. In this sector, the category with highest productivity is, as expected, that of information producers which regroups among others professional occupations in natural sciences, engineering and mathematics. It is followed by the category of information distributors represented essentially by teachers and specialists in communication. The third rank of productivity in this sector concerns the category of information processors which includes chiefly administrative, managerial and clerical occupations. Finally, the category with the lowest productivity is that of information support comprising mainly information machine operators.

- Table 4 reveals also an important observation in terms of productivity trends in the canadian information sector: During the 1980's, annual growth rate of this productivity has diminished from 1.1% in 1980-85 to 0.3% in 1985-90 and this decline in productivity growth is also seen in the whole economy (1.3% to -0.1%). This result confirms the productivity paradox observed also in the United States [3],
- In the first half of the 90's, we see a new trend with a recovery in the productivity growth, as observed also in United States by [4] and [5]. This new trend could be the end of the productivity paradox of information technology.

Table 3: Contribution of information sector production to national production in Canada

	1980	1985	1990	1995	1980-85	1985-90	1990-95
INFORMATION SECTOR							
- Total employment income (constant $million)	121,112	137,358	167,718	170,870			
- Average employment income (constant $)	22,543	23,711	25,550	26,292			
- % of national employment income	52.8	54.7	55.5	54.8			
- Production (constant $million)	168,513	212,905	244,869	258,014			
- Production as % of GDP	48.2	48.3	48.9	48.3			
- Annual growth (%) of production	-	-	-	-	2.6	2.8	1.0
TOTAL ECONOMY							
- Total employment income (constant $million)	229,232	250,689	306,019	311,378			
- Average employment income (constant $)	18,677	19,174	20,530	20,763			
- GDP (constant $million)	387,149	440,917	500,257	534,263			
- Annual growth (%) of GDP	-	-	-	-	2.6	2.5	1.3

Table 4: Evolution of productivity in the information sector and in the whole Canadian economy

	Productivity (constant $)				Annual growth (%)		
	1980	1985	1990	1995	1980-85	1985-90	1990-95
INFORMATION SECTOR	34,717	36,752	37,303	39,702	1.14	0.30	1.25
- Information producers	47,860	49,704	49,792	52,570	0.80	0.04	1.10
- Information processors	31,564	33,356	33,908	35,780	1.10	0.30	1.00
- Information distributors	38,342	39,626	41,377	43,287	0.60	0.80	0.90
- Information infrastructure occupations	27,087	29,739	27,577	28,646	1.80	-1.50	0.70
TOTAL ECONOMY	31,544	33,723	33,562	35,626	1.34	-0.1	1.2

4.0 References

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About the author

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The BEAM/WCRG Millennium Robot Games

Southern Alberta Institute of Technology, Calgary, Alberta. June 9-11, 2000

Terrance Malkinson and Craig Maynard

IEEE Canada

The BEAM/WCRG Millennium Robot Games held at the Southern Alberta Institute of Technology, Calgary, Alberta, June 9-11, 2000 represented the coming together of two world-class robot events. These were the International BEAM robotic games and the Western Canadian Robotic Games (WCRG). This three-day gathering brought together 80 competitors of all ages and skill levels who participated in more than 14 events with over 160 unique robots. The essential element of the games was creative thinking, i.e. thinking “outside the box” using ingenuity and craftsmanship to create an original robot that moves by itself and accomplishes the mission for which it was designed. Bizarre and strange ideas were encouraged.

The Western Canadian Robotic Games is one of the longest-running (10 years) annual robot events in N. America. The mandate of the WCRG is to encourage interest in science and technology using personal robotics as the channel. This annual competition allows robot designers of all ages and skill levels to demonstrate, showcase, and compete for prizes in a variety of competitions.

Today's workplace requires individuals who are creative, innovative, resourceful, competitive and self-motivated. Participation in an event such as this provides young and old the opportunity to develop and display these attributes as well as to have fun. A number of IEEE members from the Southern Alberta Section were involved in this gathering as mentors of students and as volunteers.

This year the 8th International BEAM Robot games were held concurrently with the WCRG. BEAM is an acronym for the Biology, Electronics, Aesthetics, and Mechanics style of robotics invented by Mark W. Tilden while at the University of Waterloo (Ontario, Canada). This is a philosophy building self-contained robotics that “live” for years and years, are built from recycled goods, and that begin as simple designs that evolve to become more complex over time.

A partial list of competitive events includes autonomous and remote Sumo, Atomic Hockey, Fire Extinguisher, Solaroller race, Aquarobotics, Legged Race, Micromouse, and Innovation Machines. Enthusiasm, innovation, and craftsmanship are the key to these competitions. It is not even necessary to complete in an event. Many participants simply brought their robots to the venue simply to “show-off” their device and engage in discussion with other enthusiasts.

In addition to the competition, lectures and workshops provided both the beginner and experienced robotic enthusiast with the opportunity to share ideas and advance their knowledge. Mark Tilden of the Los Alamos National Laboratories presented a number of lectures on a diversity of subjects including the future of robotics and chaotic control for robotic systems. He emphasized the importance of designing these devices to be only as complex as they need to be to achieve their objective and not to be constrained by assumptions. Mark Hillier of HVW Technologies discussed tips for novices including important pitfalls to avoid. Jeff de Boer of the Alberta College of Art and Design led a fascinating discussion on interfacing robotics with our society and a futuristic vision of the design of robots. Other lectures and workshops discussed circuit design, an educator's course on robotics in the classroom, and building robots.

The Alberta Government through its ministry of science and innovation was one of many sponsors of this event. Alberta Innovation and Science is very supportive of providing an infrastructure supportive of creativity and innovation in the technologies.

A volunteer managed event such as this is an extremely valuable asset to our society. It provides us with the rewards of sharing our knowledge and experience with the future leaders of science and technology. Gatherings such as these provides opportunities for young people to meet together focusing upon a constructive activity of importance for developing interpersonal and technical skills that will serve them well in the future.