
NOTES D'ÉTUDES

ET DE RECHERCHE

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Indirect ICT Investment

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Abstract

Numerous economic studies have highlighted that ICT investment expenditure appears to be greater in the field of services, and above all in certain activities such as financial services and wholesale trade, than in industry. This analysis examines whether the investment data compiled by national accountants underestimate productive ICT expenditure, and whether this is more pronounced in the case of industry than for services. For that purpose, we propose an assessment of the size of ICT inputs (termed “Indirect ICT Investment”) in non-ICT investment expenditure for France in 2000.

The main result of our analysis is that the amount of “indirect ICT investment” appears to be small, compared with “direct ICT investment”, suggesting that the biggest investors in ICT remain services, regardless of whether we consider “direct” or “direct” plus “ indirect investment”.

Keywords: ICT, investment, intermediate consumption, technical coefficients

JEL classification: E22 O33

Résumé

Une abondante littérature économique a souligné, sur les dernières années, que les dépenses d’investissements en TIC seraient plus importantes dans les services, et tout particulièrement certaines activités comme les services financiers et le commerce de gros, que dans l’industrie. La présente analyse étudie si les données d’investissements en TIC élaborées par les comptes nationaux minorent les dépenses productives en TIC, et ceci de façon plus importante dans l’industrie que dans les services. En effet, les dépenses en TIC ne sont considérées comme des investissements que lorsque les produits correspondants sont physiquement isolés. Aussi, les TIC intégrés à des investissements productifs ne sont pas comptabilisés comme des investissements en TIC mais comme des consommations intermédiaires des entreprises produisant ces biens d’équipements, cette source de minoration des dépenses en TIC concernant davantage l’industrie que les services.

Une évaluation de l’importance des intrants TIC (appelés « investissements indirects en TIC ») dans les dépenses d’investissements en produits non TIC est proposée, sur la France, pour la seule année 2000 qui est celle de la nouvelle base dans laquelle les comptes nationaux sont maintenant disponibles. Cette évaluation est réalisée à partir des matrices croisant branches et produits de consommations intermédiaires et d’investissements à un niveau détaillé de nomenclature.

Le principal résultat de l’analyse est que l’ampleur des « investissements indirects en TIC » apparaît faible par rapport aux « investissements directs en TIC » habituellement commentés dans la littérature. Ce sont les branches de services qui investissent le plus en TIC, de manière tant « directe qu’indirecte ».

Mots clefs : TIC, investissements, consommations intermédiaires, coefficients techniques

Codes JEL : E22 O33

1. Introduction

A wealth of economic literature has been devoted , over the last few years, to the spread of information and communication technology (ICT) and to the impact of this spread on productivity growth and, as a result, on the GDP of industrialised countries (for a review of the literature, see for example OECD, 2004, or Cette, 2004). These analyses generally find a substantial impact on productivity growth of the spread of ICT, which, at first sight, contrasts with apparently low ICT investment rates.

Cette, Mairesse and Kocoglu (2000) put forward the hypothesis that the ICT investment data compiled by national accountants underestimate productive spending on ICT. Indeed, spending on ICT is regarded as investment only when the corresponding products are physically isolated. Therefore, generally speaking, ICT that is included in productive investment (for example machine tools or robots) is not counted as ICT investment but as intermediate consumption of companies producing these capital goods. According to Cette, Mairesse and Kocoglu (2000), this might help to explain why IT investment in the national accounts appears particularly concentrated in services activities, where it generally takes the form of specific goods (large IT systems or PCs). Thus, in France in 2000, services activities accounted for more than 72% of ICT investment. Within services, industrialised countries have been recording particularly high ICT investment expenditure in financial services and wholesale trade (see. for example, OECD, 2003, van Ark, Inklaar and McGuckin, 2003, and Sharpe, 2005).

The aim of the present study is to propose an assessment of the size of ICT inputs in non-ICT investment expenditure . This assessment is proposed for France for the year 2000 only, which is the new base year for which the national accounts are now available.

After briefly recalling what is covered by the concept of ICT, as well as the main branches that invest "directly" in these products, we present the methodology adopted to estimate "indirect ICT investment".. We then set out the results, before ending with some concluding remarks.

2. Direct and indirect ICT investment

Drawing on Lequiller (2000), the definition of ICT chosen here includes three sets of products¹ (see table 1):

- IT products, which include office equipment and computer hardware, as well as software (products GE 31 and GN 21 of the TES (input-output matrix) classification comprising 118 branches);
- Telecommunications products, including broadcasting and transmission equipment (product GE 33);
- Electronic products, which include electronic components, measuring and monitoring instruments, and sound and image receiving, recording and reproducing apparatus (products GF 62, GE 35 and GC 45).

This field of ICT products excludes the so-called “content” products (printing industry, films, etc.) as well as certain intangible services, such as telecommunications.

¹ The product codes indicated are those of the French classification.

Table 1

ICT products and "direct" ICT investment in France - 2000

Code product (classification comprising 118 items)	Category	On all the branches ...		
		...Capital expenditure (billion €)	...Investment rate (%)	...Share of total investment (%)
GE 31	Office and IT equipment	10.4	0.8	3.7
GE 33	Broadcasting and transmission equipment	6.8	0.5	2.4
GN 21	Software	22.7	1.8	8.1
GE 35	Measuring and monitoring instruments	1.9	0.2	0.7
GF 62	Electronic components	ε	E	ε
GC 45	Sound and image receiving, recording and reproducing apparatus	1.3	0.1	0.5
Total		43.1	3.4	15.4

Taking the classification comprising 16 branches, the biggest investors in ICT products are business services and finance and insurance (these two sectors represent one-third and 12% of total ICT investment respectively). The activities in which ICT represents the highest proportion of total GFCF are capital goods (55%), business services (50%) and finance and insurance (42%). At a more detailed level of classification (118 items), the branches that invest the most in ICT are financial intermediation, IT activities and public administration. These figures thus seem to bear out the idea that service activities invest the most in ICT.

Our purpose being to isolate ICT components in the intermediate consumption of branches producing capital goods, it was first of all necessary to determine the ICT content of the production of equipment branches. This allows us to establish an ICT technical coefficients matrix. Then, by multiplying this matrix by the non-ICT investment matrix of all of the branches, we obtain a new matrix called "indirect ICT investment" which gives us information about the ICT content of the ICT investment made indirectly by the 118 branches. The detail of the matrix writing of this methodology is given in the box below.

3. Results

"Indirect ICT investment" accounts for 1.6% of total GFCF. Regarding it as ICT investment results in the share of ICT in total investment rising from 15.4% to 17.0%. The "indirect component" of ICT investment therefore corresponds overall to 10.4% of the direct component. In value terms, it represents EUR 4.5 billion whereas "direct ICT investment expenditure" represents EUR 43 billion, out of a total EUR 280 billion of investment expenditure. We can observe that this "indirect ICT investment" mainly concerns investment in measuring and monitoring instruments, electronic components and above all in software (ranging from EUR 1 billion to EUR 1.5 billion for each of these three products).

Taking the classification comprising 118 items, indirect investment exceeds EUR 100 million in seven branches: railway transport, real estate rental, agriculture and hunting, handling and storing, telecommunications and post office, rental without operator, and public administration. These seven branches, which are not industry-related, alone represent almost one-half of total "indirect ICT investment expenditure".

BOX

Methodological Aspects

Investment (or gross fixed capital formation) consists of ICT products and non-ICT products. The ICT part of investment is called "direct ICT investment". In the non-ICT part of investment, we try to isolate the ICT component that corresponds to intermediate consumption of ICT by branches that have produced these capital goods. This ICT component included in capital goods is called "indirect ICT investment", the residual component being called "indirect investment in non-ICT products". The sum of both direct and indirect components of ICT investment is called "total ICT investment".

Subsequently, the indices i and j denote product i and branch j respectively. The six ICT products are indicated by k . X_{ij} corresponds to the matrix of investment in products i from branches j , and it contains 38 lines (because only 38 products are concerned by investment) and 111 columns, 5 branches having been grouped together with the others to avoid the presence of negative investment, while 2 "correction branches" do not concern investment. Finally we denote, for any matrix M_{ij} , $M_{.j}$ the vector lines as: $M_{.j} = \sum_i M_{ij}$. So, $X_{.j}$ represents total investment (all products) of branch j .

"Direct ICT investment"

The "direct ICT investment" of each branch j is directly informed by lines k of the matrix X_{ij} . We denote as $K_{.j}$ the line vector of this direct ICT investment, with
$$K_{.j} = \sum_{i=k} X_{ij}$$

"Indirect ICT investment"

We denote as V_{ij} the non-ICT investment matrix, which contains 32 lines (the 38 products concerned by investment, from which we removed 6 ICT products) and 111 columns. We denote as Y_{kj} the "indirect ICT investment" matrix, in other words, the matrix of the component in products k of non-ICT investment from branches j .

The matrix Y_{kj} results from the matrix product of:

- . the technical coefficients matrix A_{kj} , the ratio between the intermediate consumption in products k and the total production of the different branches j , at market price. A_{kj} is thus a matrix of 6 lines and 32 columns, because we exclude the intra-consumption of the 6 ICT products. This technical coefficients matrix can be interpreted as follows: to produce EUR 1, branch j needs to have EUR a_{kj} of intermediate consumption of product k , the term a_{kj} denoting the intersection of line k and of column j within matrix A_{kj} .
- . and the non-ICT investment matrix V_{ij} .

We thus have: $Y_{kj} = A_{kj} \times V_{ij}$; Y_{kj} being a matrix of 6 lines and 111 columns.

The total "indirect investment in ICT products" of the different branches j thus corresponds to the line vector $Y_{.j}$.

"Indirect investment in non-ICT products"

"Indirect investment in non-ICT products" for branches j is the line vector $W_{.j}$ (1 line and 111 columns) calculated as the difference between total investment and the "direct and indirect components of ICT investment".

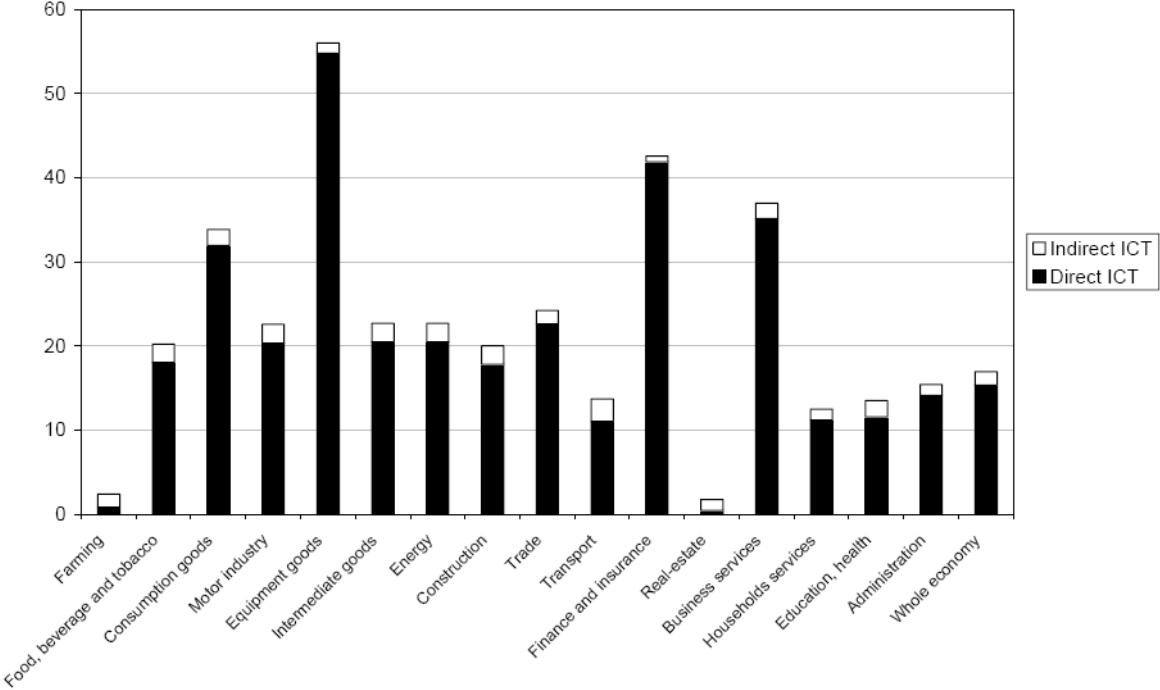
We thus have: $W_{.j} = X_{.j} - K_{.j} - Y_{.j}$.

"Total investment in ICT products"

"Total investment in ICT products" is the sum of the "direct and indirect components" of ICT investment from the various branches. They correspond to the vector line $Z_{.j}$ with: $Z_{.j} = K_{.j} + Y_{.j}$

Taking the classification comprising 16 items, real estate, business services and transport branches have the highest "indirect ICT investment expenditure" in value terms (EUR 1.1, EUR 0.7 and EUR 0.4 billion respectively). Taking industry as a whole, "indirect ICT investment expenditure" amounts to approximately EUR 0.9 billion and is mainly found in intermediate goods. As a proportion of total investment, the transport, automotive industry, intermediate goods, energy and business services branches have the highest "indirect ICT investment expenditure", namely between 2% and 3% (see Graph). In terms of investment rate, "indirect ICT investment expenditure" appears to be the highest in the transport, motor industry and real estate branches: between 0.7% and 0.9%. Also in terms of investment rate, the "indirect ICT" component generally seems similar for all industrial and services branches: approximately 0.4% of their value added. Overall, the branches that "directly" and "indirectly" invest the most in ICT are the very ones that register the greatest "direct ICT investment", namely business services (29.7% of the total) and finance and insurance (10.4%), with trade ranking fourth (6.7%), behind capital goods (7.4%).

Graph
Share of "direct and indirect ICT investment" in total capital expenditure (as a %)



4. Concluding remarks

Despite the inevitable difficulties encountered by national accountants in compiling tables of intermediate consumption and investment that cross-classify branches and products at a detailed level, the results obtained here seem clear-cut enough to be robust to the associated statistical uncertainties. Our study thus brings new confirmation of the fact that, *regardless of whether we consider "direct" or "direct" plus "indirect investment"*, ICT investment is greater in services, and particularly in financial intermediation and wholesale trade, than in industry.

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