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NEW ECONOMY AND ICTs: MEASUREMENT PROBLEMS AND THE ITALIAN CASE

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1. Introduction

The so-called "new economy" has been defined as the association between high economic growth rates and low inflation rates, along with the computerization as well as the globalization of the world economy (Schreyer, 2000). It follows that the contribution of the Information and Communication Technology (ICT) in sustaining economic growth is a necessary condition, even though not a sufficient one, to explain the transition to a new economic order at international level.

Furthermore, the role of ICT has been the subject of a recent debate aimed at establishing whether and to what extent this technological change can be viewed as "horizontal" - that is, able to propagate growth in the overall economic system, thus representing a new "technological paradigm" – or, rather, if it is a more limited and sector-specific change. Yet, most studies reveal that ICT has not only shown an outstanding dynamic as a single industry but also a great capacity of promoting growth in other sectors, both traditional and technology-intensive (Gambardella and Torrisi, 2001)

Historical experience has shown that such technological revolutions and their effects on the economic system share some common characteristics. For example, the advent of railroads in the middle of the 19th century determined a new economic deal characterized by huge and sudden profits on the world stock markets that lasted until the beginning of the First World War. Likewise, the coming of the radio in the early twentieth century implied potential unlimited profit and growth opportunities associated with the marketing of the new technology thus entailing a deep change of investment behavior of firms. Besides, the effects of all-purpose technological revolutions on the economic system have generally occurred in the following (often overlapping) main stages: a raise in productivity growth in the innovating production sector, a significant capital deepening stimulated by the rapid fall of prices of goods embodying the new technologies and a considerable reorganization of production around those capital goods[1] Furthermore, most of the general-purpose technological revolution of the past have been associated with heated debates about the extraordinary economic growth rates and the deep transformations of the economic structure potentially induced by the introduction of new technologies (Bruland, 2000).[2] The Information Technology (IT) revolution is different from past technological revolution in the globalization of production, which has strengthened real and financial linkages across countries, but, on the other hand, it has largely followed the pattern of past technological revolutions being characterized by an initial phase of boom and bust in the stock prices of innovating firms, as well as in spending on goods embodying the new technology.

As outlined by the growing literature on IT and labor productivity two main issues have to be addressed: measurement problems and the contribution of IT to labor productivity growth. New goods and the rapidly falling prices of goods that embody the new technology, complicate the measurement of output. Moreover different countries use different statistical methodologies to adjust price indices for new goods and for the

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[1] IMF - World Economic Outlook, October 2001.

[2] Yet, in the "Business Cycles" Schumpeter himself identified some "waves" or cycles of economic growth drawn by the introduction of some fundamental technologies: the age of steam and textiles, the age of railways, the age of electricity.

improvements in the quality of existing goods and to aggregate the output of goods with large relative price changes.
The new technology can contribute to labor productivity growth increasing the levels of both Information Technology capital per worker and total factor productivity (TFP) growth in IT production. But the precise magnitude of these contributions is still a subject of debate. In particular, the main issue is whether IT has contributed to TFP growth more generally by increasing the efficiency of production, either through usage or knowledge spillovers from the production of IT goods.
Looking at the current debate our work aims at identifying the Italian position in the transition from the "old" to the "new economy". We start by placing Italy in the international context, comparing its relative situation with respect to the US and, particularly, to the other European countries. We then emphasize the growing complexity of national accounts estimates arising from the necessity to grasp elements such as the speed of change, the interdependence and the intangibility of economic and innovative processes. We subsequently focus our attention on the development and the diffusion of ICTs in Italy by providing an outline of both the relevance and the evolution of the national ICT market during the 1990s. It is worth to remind that the work currently in progress represents the necessary background for a more in-depth examination of the impact of ICTs on the overall Italian economic growth.

2. The development and the diffusion of ICTs: the international context

In spite of a relative delay shown in the last decade, today the ICT revolution has involved also Italy. According to the European Information Technology Observatory, in 1999 the Italian ICT expenditure as a percentage of GDP reached 5.0%, compared to 3.7% estimated in 1996 (EITO, 2000). Following the remarkable growth of the late 1990s (almost 15% per year), the weight of the Italian ICT market in Western Europe has reached 11%, being closer to the shares of the most technologically advanced European economies - Germany with 22%, the United Kingdom with 18% and France with 15% – than to the still modest shares of other Southern European countries (Spain with 6% and Greece with 1%).

[Table 1 here]

While in the United States – that, in the 1990s, witnessed the longest growth phase ever recorded - the relationship between ICT development and economic growth is relatively clear-cut, in other advanced countries this connection is not easily detectable. In Canada, the Netherlands and Spain, for instance, economic growth is mainly attributable to a set of structural reforms of national labor markets fostering employment growth. However, there are no sufficient elements to establish whether and to what extent ICT investments have contributed to a better economic performance. Ireland, Finland and Sweden, in turn, have recorded rates of growth of total factor productivity (TFP) much higher than the United States and hardly justifiable only by the ICT spread. According to a study carried out by the Federal Reserve, the latter could lead to an increase of TFP not higher than 1%.[4] In Finland and Sweden, for example, ICT goods represent nearly 4% of the output of each economy, much more than what occurs in other developed countries. By assuming that the growth rate of the industrial sector is the same of the United States, in these countries the ICT sector could contribute for 0.3% to productivity growth. However, the Swedish Ministry of Finance has estimated that, in the last few years, the productivity growth of Information Technology (IT)

[4] Federal Reserve Bulletin, October 2000.

industries has had an impact of 0.5% on the growth of labour productivity. This suggests that the rise of productivity in these countries need to be also ascribed to the development of other sectors.

Moreover, during the three-year period 1996-99, some countries recorded growth rates much higher than that of the United States. By taking into account only data on industrial firms[5], a gap emerges between the US and countries such as Ireland, Finland and Norway, and between the former and the rest of Europe. In fact, in the United States the average GDP growth rate was 4.8%, compared to 5.5% and 9.8% of Finland and Ireland respectively, and to 2.5% and 1.6% of France and Italy.

However, if ICT development and diffusion have played a driving role in promoting output growth as well as productivity growth in the United States, may we maintain that this will also happen (or has already been happening) in other countries? The answer is indeed positive, although it is difficult to foresee modes, scope and times of such changes. It is not immediate that the availability of new technologies will automatically turn into an enhanced productive performance. The structure of the economic system, its institutions and the regulation of markets influence the pace at which technological innovations are adopted as well as the way in which these improvements result in a higher efficiency. Furthermore, there are significant difficulties in measuring the output of the ICT industry and inputs it supplies to other economic sectors. As emerges from the following investigation, these difficulties are strictly related to the representation of the economic system through national accounts and they require a careful evaluation of the completeness and reliability of GDP estimates.

Following the remarkable growth of the late 1990s (almost 15% per year, see Chart 1), the weight of the Italian ICT market in Western Europe has reached 11%, becoming closer to the shares of the most technologically advanced European economies - 22% of Germany, 18% of the United Kingdom and 15% of France – than to the still modest weight of other Southern European countries (Spain with 6% and Greece with 1%).

[Chart 1 here]

Besides, it should be noted that, according to the estimates carried out by the Italian National Association of Producers of Technologies and Services for Information and Communication (ASSINFORM)[6], in the year 2000 the Italian ICT market recorded a 12.8% growth with respect to the previous year, reaching a GDP share of 5.5%. The driving forces leading to such a growth have been the massive investment in telecommunications and the expenditure on ITs that reached 12.6% of the total (two percentage points higher than that of Europe and the United States). Therefore, Italy is now making up for the delay of the early 1990s, strengthening its position in the ICT world market.

A possible way to assess the role of the new technologies in promoting economic growth is to analyse the relationship between ICT diffusion and the increase in labour productivity.[7] There are different channels through which technological innovations determine productivity gains. The first is the contribution given by industries producing ICT goods to the total productivity of the economic system. In fact, such a contribution may increase more than that of other sectors if the rapid growth of ICT industries is due to considerable increases in their own productivity. In other terms, even if these sectors constitute a rather limited share of total production, they substantially contribute to productivity growth at macroeconomic level. Oliner and Sichel (2000), for instance, estimate that, in the period 1996-1999, the sectors producing computers and semiconductors were responsible for half of the increase of the growth of American multifactorial productivity estimated for the same period, although they accounted only for 2.5% of US industrial production. It should be noted that, according to OECD estimates, the production of ICT

[5] Data concerning the US come from BLS, while figures for the other countries come from OECD.
[6] Press release by ASSINFORM, 6 March 2001.
[7] Schreyer (2000) and Bassanini, Scarpetta and Visco (2000).

industries represents between 2.5% and 4.5% of gross domestic product at current prices, depending on the country and on the ICT definition adopted (OECD, 2000).

Other two channels can determine an increase in productivity and they are related to the utilisation of ICTs in other sectors of the economic system. Investments in IT goods tend to spur labour productivity, as they result in an increase in the capital-labour ratio (*capital deepening*). Other things being equal, with a given level of technology the capital deepening enables workers to be more efficient. Recently, IT investments have been greatly increasing compared to those in other categories of capital goods, due to the price decline brought about by the rapid evolution of the new technologies.

Ultimately, as widely known, the adoption of ICTs has indeed positive externalities, giving rise to benefits that go beyond those accruing to investors. For instance, a major gain coming from Internet is that, in a network of firms, each new investment in a connection is profitable both for the investor and the other partners. In other words, being part of the network entails an increase in the firm productivity, which turns into an increase in productivity at macroeconomic level.

Turning again to the international context, it should be pointed out that, whilst in the United States the massive investment in ICTs has boosted productivity through the above mentioned mechanisms, this has not so far occurred in other countries. That is mainly due to the fact that the latter have invested in ITs to a lesser extent than the United States and, therefore, the increase in productivity growth rates might not be visible yet. Schreyer (2000), for instance, estimated that, up to 1996, the portion of IT goods in the capital stock ranged from 2% to 3% in France, Western Germany, Italy and Japan, while it was nearly 5% in Canada and the United Kingdom and 7.5% in the United States. Hence, it is evident that, with such a high investment, the weight of this sector on the total American production is much more considerable than in Europe.[8] An analysis carried out by the Federal Reserve - whose object was the relationship existing between the growth rate of multifactorial productivity and the number of Internet hosts and secure servers for a group of OECD countries in the periods 1981-95 and 1996-98 - showed that in Norway, Canada, the United States and Sweden a substantial rise in multifactorial productivity has been followed by a strong development of ITs, while in Japan, France and Italy the decline in multifactor productivity has been related to a limited diffusion of such technologies.

At present, there are many and various reasons to put forward in order to explain the considerable gap between the American and the European economic growth. However, it does not seem possible yet to give definite answers to such a crucial issue. We can only claim that the remarkable productivity growth recorded in the United States in the second half of the 1990s was undoubtedly the result of the rapid ICT progress, of the adoption of these technologies in other economic sectors, but also of the extremely positive business cycle of the US economy. Yet, the positive impact of ICT development and diffusion on the growth of the American productivity is the result of the massive investment in ICT-intensive goods undertaken since 1993. Hence, we might expect that those countries which have started investing in "new economy" goods in the second half of the 1990s will witness an acceleration of growth at the beginning of the new millennium.

Europe, that in the 1990s displayed a persistent slowdown with drastic repercussions on employment levels, has recorded a good increase in ICT investments since 1997. In Western Europe the expenditure on ICTs as a share of GDP, which was equal to 4.6% in 1996, became 5.8% in 1999.[9] According to the estimates carried out by the European Information Technology Observatory (EITO), in 1999 the European ICT market rose of 12% and it was expected to attest around 10.6% in 2000. Indeed, the consolidation of the European macroeconomic context, supported by a considerable rise of exports, is

[8] Yet, it has to be pointed out that the analysis carried out by Schreyer underestimated the influence of IT on the economic growth of all countries, because of a narrower definition of this sector (which excludes software).

[9] Data source EITO (2000).

fostering such a high growth. Even the stabilization of the unemployment rate of the Euro area around 10%, associated with rather limited inflation rates in most European countries, has contributed to the creation of a positive context for ICT investments.

3. Measurement issues

The ICT phenomenon is a deep and fast technological transformation, comparable to those induced by the industrial revolution[10]. A major drawback of such a change has been the growing complexity of the national accounts estimate arising from the necessity to grasp elements such as the speed of change, the interdependence and the intangibility of economic and innovative processes (Iammarino et al., 2001). Nonetheless, progress has been made since the adoption, at the EU level, of the new System of National Accounts (SEC95), allowing for the resolution of some of the problems faced in the estimation of intangible activities. For example, software has been reclassified as capital good, advance has been made in the harmonization of estimates at constant prices and, in particular for Italy, a new statistical file of productive units is now available, together with both a system for statistical surveys on the accounts of enterprises encompassing all economic activities and the first results of a few specific surveys on the most innovative sectors. Yet, it should be born in mind that the National Accounts are virtually more suitable to measure an economy with a relatively stable composition and whose output is univocally measurable through largely widespread and approved methodologies. On the other hand, greater difficulties emerge when measuring those economic activities that are generally indicated as a part of services, but actually involve also some manufacturing activities (for instance, all sectors related to electronics) whose production measurement is less obvious or whose elaboration of a specific deflator is more complex.
Given that, the following aspects arise as sensitive in terms of statistical measurement:[11]

- classifications;
- available sources for current price estimations;
- constant price evaluations.

It has been argued that the present classifications of economic activities do not represent the most recent aspects of the economy. Some assert that it is necessary to implement a radically new classification of economic activities in order to discern between goods, services and information.[12] Although we do not agree on such an extreme standpoint, we are aware that some of the main new economy activities have not yet been included in the NACE Rev.1 classification. For instance, group 64.2 of ATECO91[13] includes activities of " *transmission of sound, image, data or other information via cables, broadcasting systems, ripetors or satellites*", therefore denying a distinction between a website and a pay-tv or a telecom provider. Hence, even though network firms are detected by the statistical surveys and can be found in the files of the National Institute of Statistics (Istat), they cannot be individually identified. Although this does not have any impact on the estimate of the total value of production, costs or remuneration of group 64.2., it undoubtedly covers potentially different economic behaviours, preventing also from achieving a definition of the usual characteristic relationships.

The above considerations, together with the new characteristics of many economic activities – i.e. intangibility and volatility -, might suggest that the sources traditionally used by Statistical Institutes could have partially lost their power of measuring the economic system or, in other terms, that the efforts made in

[10] Gordon (2000).
[11] United Nations (1997).
[12] North American Industrial Classification System (NAICS).
[13] Italian version of NACERev1.

collecting data and identifying sources have not kept up with the rapid changes brought about by the technological revolution.

Indeed, the 1995 System of National Accounts (SEC95) has included software among capital goods, stressing that the problems faced in the estimation of intangibles emerged since a long time. However, it should be noticed that National Accounts are virtually more suitable to measure an economy with a relatively stable composition and whose production is univocally measurable through largely widespread and approved methodologies. On the other hand, we are facing greater difficulties when measuring those economic activities that are generally indicated as a part of services,[14] but actually involve also some manufacturing activities[15] whose production measurement is less obvious or whose elaboration of a specific defltor is more complex. Yet, since the contribution of the latter economic activities to GDP formation has been gradually rising over time, in the second half of the '90 Eurostat and Istat made several efforts to improve the quality of available sources:

- since 1995 surveys on enterprises have been extended to all economic activities of market services[16];
- surveys have been carried out upon specific service activities which needed a closer examination (i.e., IT, audiovisual services);
- a pilot survey on telecommunications is currently in progress;
- a survey on costs structure of service firms is now being launched.

Yet, problems of classifications and utilization of sources have little impact on the estimate of aggregates at current prices.[17] Moreover, the national account estimate of GDP, based on the balancing of production side estimates with independent demand side estimates, allows to measure even the most tricky statistical phenomena and to make up for the possible delays which can occur when updating the business files.

The complications implied by constant price estimates are more difficult to be sorted out. This mainly concerns investments and, more generally, the production of some economic activities and/or the determination of an economically significant deflator. Even in such a case, the problems related to the estimate of proper output price indexes have been known for a long time and the Statistical Institutes of the main industrialized countries as well as international organizations are currently engaged in the discussion of both theoretical and practical possibilities of constructing more suitable indexes. Since 1998, Eurostat has launched a specific research programme for the measurement of prices and quantities. The outcomes of this research have been published in a manual collecting the results achieved by nine research groups, each analysing a particular economic sector among those considered as the most problematic in terms of constant price measurement.[18] Beyond the specific features of each sector, the manual, aimed at improving constant price estimates, addresses in particular the following topics:

1. the substitution of fixed base indexes with chain indexes;
2. major use of hedonic price indexes.

Therefore, it is important to distinguish the different aspects of the "new economy", as in many cases constant price estimates are not more complex than those analyzed by Eurostat's research groups,[19] thus not requiring alternative methodologies but only the application of the recommendations provided by the manual.

[14] In particular, health care, education, financial services and personal services are those traditionally most difficult to measure.

[15] Especially all sectors related to electronics.

[16] Financial and insurance activities excluded.

[17] Cf. Puggioni (2000) and Pisani (2000).

[18] Among others: Postal and Telecommunications Services, Education, Financial Intermediation, Services for Enterprises, Constructions.

[19] For instance, it is well known that computer deflators are difficult to estimate.

However, ICT goods having the following characteristics[20] call for a substantial improvement of statistical research:

- structural variability;
- absence of a direct contact among economic operators;
- values based upon intangible qualities;
- easy reproduction and sharing;
- property rights.

In these cases, in fact, the price paid for does not represent neither the quantity nor the value of what is bought, but only the generic access to a product or a service.

The direct consequence of the problems linked to the measurement of production and investments at constant prices is the uncertain validity of productivity measures, as those mainly used in the most recent literature[22] for assessing the impact of ICTs on economic growth.

4. New economy and ICT in Italy: the investment behavior of firms.

During the 1990s there has been a substantial transformation of products and production processes in Italian firms, which - in spite of the significant delay with respect to the European average - have gradually adapted to the new technological and market conditions created by the ICT revolution also through a diversification of their investment behavior.

Information technology has rapidly become an input in other economic activities, although a clear division between hardware and software producers has not been achieved yet (SMAU, 2000). The software sector has seen particularly fast rates of development, which have allowed new functions such as the connection with the global IT networks, interactivity, multimediality and virtuality. Particularly since 1994, a new phase of expansion and intense technological innovation has started for the national ICT sector, after the deep crisis of the beginning of the 1990s which affected especially Italy. The following five years, 1995-1999, saw the gradual "convergence" among ITs, telecommunications and media. At the same time, the striking affirmation of mobile phones communication networks took place and was, for some respects, unique in the world scenario. Mobile phones have recently recorded an outstanding increase in the share of turnover deriving from data transmission and on-line services to the detriment of "voice" services. At present, the main challenges for Italian firms concern infrastructures and services related to telecommunications, networking, Internet for E-business and E-commerce, Broadcasting. Furthermore, the on-going revolution in the field of communications is likely to undergo further changes following the introduction of UMTS (Universal Mobile Telecommunication System) technologies, that is real "terminals" for information management, able to modify economic behaviours in all sectors of activity.

The investment strategies of enterprises and the actual pervasiveness of ICT technologies are investigated both on the supply side – i.e. ICT firms producing capital goods – and on the demand side – all firms buying ICT capital goods. The analysis has been carried out on the basis of a 20x101 matrix at current prices for the period 1992-1999,[3] where rows represent the economic activities (ATECO91) producing capital goods (Appendix 2), and columns contain investments by branch of owner (Appendix 3).

The twenty ATECO producing ICT capital goods were selected from the 151 ATECO producing capital goods, on the basis of the ICT definition given by the OECD (2000) according to the ISIC

[20] Carter and Postner (1996).

[22] Among others see Jorgenson and Stiroh (2000).

[3] See Bracci, Costanzo, Jona-Lasinio (1999) for the sources and methods of estimate of these matrixes and, more generally, of gross fixed capital formation in the National Accounts.

classification (International Standard Industrial Classification, Rev.3). This classification identifies the ICT sectors by dividing them into three subgroups: manufacturing activities, goods-related services and intangible services (Appendix 1). On the production side, this implied the exclusion of the second subgroup and that of telecommunications (included in the third subgroup), given that they do not produce capital goods.[4] On the demand side, instead, all economic activities (including the three ICT subgroups) are considered (101 branches).

On the supply side, it turns out that the average growth rates of the production of ICT capital goods in the last decade has been much higher (5.8% per year) than that of non-ICT commodities (2.9%). The evolution of the share on the total confirms the gradual increase of the weight of the "new economy" in national investments: the ICT share rose from 12.5% in 1992 to 15.2% in 1999. The percentage change on the previous year of the two aggregates is shown in Chart 2. After a sudden decline in 1993 - where the ICT production was even more significantly affected by the negative economic cycle (in 1993 the negative variation of the whole production of capital goods was -7.2%, compared to -11.9% of the ICT sector) - the growth was higher than that of non-ICT goods for almost the whole period considered (only in 1998 the ICT products recorded 5.5%, whilst the production of "traditional" capital goods grew of 6.1% compared to 1997). Yet, the sharp drop of ICT investments occurred in coincidence with the negative economic cycle of the early 1990s might suggest a more pronounced reactivity to short-term trends for such a type of goods.

[Chart 2 here]

During the overall period, the contribution of each sector to the total production of ICT capital goods remained substantially stable. As it turns out from Chart 3, the most significant shares in 1999 are those of "Manufacture of apparatus for line telephony and line telegraphy" (ATECO 32202), with 28.9%, "Software consultancy and supply" (ATECO 72200), from 16.9% in 1992 to 20.2% in 1999, and "Manufacture of computing machinery" (ATECO 30020), with a slightly smaller share (14.8%) than that recorded in 1992 (15.1%).[5] An increase of more than two percentage points was recorded in "Manufacture of television and radio transmitters" (ATECO 32201), from 5.2% in 1992 to 7.4% in 1999, whilst a decrease is found in "Manufacture of industrial process control equipment" (ATECO 33300), from 8.8% to 6.7% of the total production of ICT capital goods in 1999. Such a reduction is largely attributable to the substitution of the traditional methods of production process control with CAM (Computer Assisted Manufacturing), CAD (Computer Assisted Design) and CAD/CAM techniques: this clearly corresponds to the remarkable increase of the sector "Software consultancy and supply".

[Chart 3 here]

The evolution of the shares is confirmed by looking at the annual average growth of the production of ICT capital goods in the eight years considered (Chart 4). Given the increase of 5.8% for the ICT sector as a whole, the highest growth rates are found in "Manufacture of television and radio transmitters" (ATECO 32201), amounting to 10.5% per year, and in "Software consultancy and supply" (ATECO 72200), with a 8.2% annual growth rate. On the other hand, the sector "Manufacture of industrial process control equipment" (ATECO 33300) shows an annual increase of 2.3%, thus much lower than the average of the overall aggregate, while the substantial stability of the share of "Manufacture of apparatus for line

[4] It should be noted that sector 3130 is the only one belonging to the "ICT manufacturing" which does not appear among the sectors producing capital goods, since it produces intermediate goods, and is excluded from the supply side analysis as well as most ICT services.

[5] The following ATECO producing ICT goods have been aggregated in the category "Other": 32100, 32203, 33203, 33204, 33205, 72300, 72400, 72601 and 72602. The sectors to be aggregated were chosen on the basis of their production shares, which in all cases were less than 1% of the total (twenty ICT ATECO) both in the former and in the latter years here considered.

telephony and line telegraphy" (ATECO 32202) comes from a growth rate corresponding exactly to that of the sectoral average.

[Chart 4 here]

On the demand side, software was again the most dynamic IT sector, representing more than 20% of the entire ICT market in 1999, with high and positive rates of change throughout 1992-99. On the other hand, the hardware average growth rate was lower than that of the overall ICT industry: however, it constituted nearly 15% of the investment expenditure in 1999, mainly because of the relevance of purchases of Personal Computers (PCs) and new NT Servers (SMAU, 2000). Conversely, there was a sharp decline in the expenditure on the so-called office hardware: in this case, the corresponding sector is "Manufacture of office and accounting machinery" (ATECO 30010) that, especially in the last two years considered, shows extremely low variation rates. With respect to the CT segment, telecommunication systems and networks represent the most considerable share of expenditure on investment goods. These systems can be distinguished into "private telecommunications" (nearly 70% of CT market) and "infrastructural investments" or public networks, whose development in Italy is likely to experience a considerable expansion in the next few years, mainly as a consequence of the liberalisation of the national market (SMAU, 2000).

The 101 buying branches were grouped into 11 categories including all manufacturing and service activities (Chart 5). The largest contribution to total expenditure for ICT investments comes from Manufacturing, whose share, however, has considerably decreased in the observed period - from 40% in 1992 to 33.7% in 1999. Although in the next few years a further erosion is very likely, Manufacturing will continue to be the main buyer of ICT products, due to the computerization processes related to competitiveness restructuring undertaken not only by large enterprises but also, and to an even greater extent, by SMEs. The expenditure share of Wholesale and retailing trade has been growing from 8.3% to 13.4%, while that of Public Administration and other services has risen from 22.4% to 23.6%. Indeed, the latter category of activity has been recently characterised by a remarkable upgrading of technological endowments and by a substantial Internet-driven transformation of the supply of public services. Communications, Transports and Hotels, instead, record very modest increases, less than 1%, while the shares of the other categories are stable or undergo slight reductions, as in the case of the null share of Renting (whose rate was anyhow negligible even in 1992, when it represented only 0.6% of total expenditure).

[Chart 5 here]

Such a picture is supported by the annual average expenditure for ICT capital goods for each purchasing category (Chart 6). As expected, the highest growth is that of Wholesale and retailing trade (12.4%), followed by Hotels, Transports and Communications. Although even Agriculture shows an annual growth rate higher than the average (8% against 5.8%), its contribution is negligible in the period of reference. Credit, on the contrary, records a growth rate slightly lower than the average, maintaining its initial share on the total (4.3% both in 1992 and 1999).

[Chart 6 here]

Although the above mentioned aggregates allow an easier interpretation of available data, in order to give a more detailed outline of ICT investments made in Italy during the 1990s it is interesting to look at the trend of some particular purchasing branches and, among the 101, especially those producing ICT capital goods.[6] Through these branches it is therefore possible to grasp the intra-ICT dimension of national

[6] The group of ICT manufacturing (cf. Appendix 1) is included in branches 43, 45-49, while the two subgroups of ICT services belong to branches 67, 81, 87 and 88. Moreover, branches 45, 67, 81 and 87 include those ICT activities that do not produce capital goods and, therefore, are only identifiable on the demand side.

investment, even though with a certain degree of approximation due to the level of aggregation that does not permit to "isolate" ICT sectors from the others included in the same branch.

As far as Manufacturing is concerned, the highest growth rates are recorded by some traditional branches, such as "Fish, oils and fats and other food products" and "Dairy products" (branches 11 and 13), "Spinning, weaving of textiles and clothing" (branches 18-20) - the latter together representing a rather large share of the total expenditure on ICT capital goods of Manufacturing (nearly 11% in 1999) - and "Leather" and "Footwear" (branches 21 and 22). Also "Paper, publishing and printing" (branches 24 and 25), "Plastic" and "Glass Products" (branches 32 and 33) and, above all, "Machinery for industrial use" (branch 40) record high growth rates, together with remarkable shares on total expenditure: in 1999 "Machinery for industrial use" represented 14% of the total expenditure on ICT goods of Manufacturing.

Overall, in line with the recent empirical literature, the «*made in Italy*» sectors turn out to be among the main contributors to ICT investments in the country. In fact, such sectors have been greatly affected by the pressure of international and global competition and therefore obliged to react through innovative strategies aimed at preserving their competitive positions.

Always with reference to Manufacturing, the six branches including the sectors producing ICT investment goods (43 and 45-49) represent together nearly 24% of total expenditure in 1999, thus confirming the importance of intra-ICT investments. Yet, it should be noted that in 1992 the same share amounted to 38%, with the main contribution coming from "Office, accounting and computing machinery" (branch 43). However, in the period considered, the latter branch shows a strongly negative growth rate (-12.3%), as well as almost all other ICT branches except for "Electric machinery and apparatus" (branch 45) and "Electronic components" (branch 46). The latter in particular is the only one among the six branches that records a high annual growth rate (+12.1%) and experiences an increase in its contribution to the overall expenditure on ICT capital goods of Manufacturing, with a share rising from 4.4% in 1992 to 8.2% in 1999.

As far as the category of services in general is concerned, it is worth mentioning the shares of ICT goods purchases on the total expenditure of the 101 branches, in particular those of "Financial intermediation" (branch 82), with 3.4% in 1999; "Other business activities" (branch 90), with 6%, doubled compared to the first year considered; "Public administartion" (branch 92), whose contribution to total expenditure rose from 3% to 5.2% in the eight years of reference. Conversely, the share of "Recreational cultural and sporting activities" (branch 99) drops substantially, due to an average growth rate of –13.3%.

As far as intra-ICT in services is concerned, the buying branches (i.e. those including ICT sectors) showing the highest shares on the total expenditure on ICT goods are "Wholesale trade " (branch 67), with 8.4%, and "Telecommunications" (branch 81), whose contribution to total investments in the "new economy" goods is definitely the highest among the 101 branches, both at the beginning (16.1%) and at the end of the reference period (17.2%). Yet, this trend corresponds to the exceptional development of on-line services and mobile lines. Suffice it to consider that it has been estimated that between 1998-1999 the increase of the expenditure for Internet connections was more than 70% (SMAU, 2000). As to the other two branches including ICT sectors, "Renting of machinery and equipment" (branch 87) displays an extremely negative growth rate, leading to a reduction in its expenditure share (0.4% of the total in 1999) already small in 1992; "Computer and related activities" (branch 88) - that is, the only branch of services producing ICT capital goods - shows an unchanged contribution to the total over time (5.2%), with extremely high growth rates, above the average of ICT investments, particularly in the last two years considered.

In order to observe the expenditure breakdown by type of product, we have analysed more in detail the purchasing branches that represented, as a whole, more than 50% of total expenditure on ICTs in 1999 (in 1992 the same branches represented 40% of the total). Three of these branches, that is

"Wholesale trade" (67), "Telecommunications" (81) and "Computer and related activities" (88) include ICT sectors.

[Chart 7 here]

Chart 7 reports the seven branches selected (i.e. the top buyers) and the percentage breakdown of their investments by ATECO producing ICT goods in 1999. Considering all ATECO producing intangible capital goods[7] - corresponding to some IT activities and identifiable by the first two digits 72 -, they represent a considerable proportion of the expenditure of all purchasing branches observed. This is particularly the case of "Software consultancy and supply" (ATECO 72200), constituting even 79% for "Financial intermediation"(branch 82) (in 1992 the same share was 56%). It should be highlighted also the high proportion of software expenditure for the computer branch (47.3%): as already pointed out, in such a branch (88) the same sector producing intangible capital goods (ATECO 72000) is included as a buyer. This allows to estimate the substantial share of "intra-branch" investments, which has considerably increased with respect to 1992, when the share of expenditure on software was 31.5%. Yet, it is interesting to notice that, apart from the growth of the shares of software expenditure assessed in the two previous cases, all other branches here reported register a rather sharp decline in the expenditure for this type of goods, which turns out rather clearly especially for "Public administration" (branch 92) - from 58% in 1992 to 31.2% in 1999. "Machinery for industrial use" (branch 40) is obviously the only branch among the seven selected largely buying from "Manufacture of industrial process control equipment" (ATECO 33300) and from "Manufacture of gas water and other liquids meters for measuring, checking, testing" (ATECO 33202), whose shares on the branch total ICT investments (10.3% and 23.8% respectively) have remarkably risen over time. "Manufacture of apparatus for line telephony and line telegraphy" (ATECO 32202) has also considerable shares and accounts for more than 80% of the expenditure of "Telecommunications" (branch 81). A large part of the "new economy" investments of "Wholesale trade" (branch 67) is in "Manufacture of television and radio transmitters" (ATECO 32201), amounting to 42.5% in 1999: it should be noted that the same share was only 9.5% in 1992. The two branches of "Other business activities" (branch 90) and "Public administration" (branch 92), that, as already highlighted, register the highest growth rates of ICT investments among all branches considered, buy largely from "Manufacture of computing machinery" (ATECO 30020). In 1992 the investments in this type of products represented 12.9% and 4.7% respectively of the ICT expenditure of the two branches, while in 1999 they reach approximately 37% in both cases. Instead, the proportion of expenditure on this type of investment goods substantially decreases for all other branches reported in Chart 7: in some cases, they have been nearly halved and in others, as for branch 82, they have even decreased to zero.

5. Conclusions

The descriptive analysis carried out in this paper has shown that Italy has been involved in the transition from the "old" to the "new economy. Since the second half of the 1990s, Italian firms have been gradually undertaking a process of adjustment to the new technological and market conditions created by the development and diffusion of ICTs. Although, compared to the other European partners, the Italian the business sector is a bit in late in the process of diversification of investment choices that allows the reorganization even of the most traditional economic activities. Yet, the sectors of «*made in Italy*» turn out to be among the main contributors to ICT expenditure in the country, proving to have been greatly affected

[7] The economic activities identified by code 72 (cf. Appendix 2) are classified as producers of intangible capital goods according to the new European accounts system SEC95. However, in accordance to the OECD definition of ICT sectors they were identified as intangible services (cf. Appendix 1).

by the international competition that stimulated the adoption of innovative strategies aimed at preserving their competitive positions.

The present analysis has provided some preliminary support to the fact that both inter- and intra-sector ICT exchanges contribute, "horizontally" as well as "vertically", to the diffusion of the new technologies in the economic system. Yet, it is not easy to establish what role ICTs are and will be playing in the future Italian GDP growth. The main problem concerns the difficulties of measuring the output of the ICT industry and the inputs it provides to the other economic activities. Nonetheless, some progress has been made since the adoption of the 1995 European System of Accounts (ESA95): for example, software has been reclassified as capital good, and, in particular, in Italy are available new statistical files of productive units and a comprehensive system of surveys on business units accounts which covers all economic activities and finally, the first results of a few specific surveys on the most innovative sectors are now accessible.

The work currently in progress represents the necessary background for a more in-depth examination of the impact of ICTs on the overall Italian economic growth. As it is widely known, the net-economy and the information society have indeed positive externalities for firms, giving rise to benefits that go beyond those accruing to investors and that are likely to turn into increases in productivity at the macroeconomic level. On the other hand, the growing availability of statistical information on technology and innovation, along with the research programs established at the EU level, will allow a more precise identification of new economic activities thus fostering methodological improvements for constructing data on production, investment and input-output linkages in ICT-related sectors within a framework coherent with GDP estimates. The Italian GDP growth, though fairly small throughout the 1990s, has recently shown signs of recovery, i.e. with 2.9% of growth in 2000 with respect to 1999 a further exploration of the role played by ICTs in such a process is therefore urgently required.

Table 1 – Expenditure on ICT as a percentage of GDP

countries	1996	1997	1998	1999
Italy	3.7	4.0	4.5	5.0
Western Europe	4.6	5.0	5.4	5.8
United States	7.1	7.4	7.1	7.3
Norway	4.8	4.9	5.3	5.6
Sweden	6.0	6.5	7.3	7.7
Finland	5.0	5.5	5.8	6.2
Ireland	5.6	5.7	5.5	5.4

Source: EITO (2000)[8]

[8] Da notare che i dati di fonte EITO non tengono conto della revisione dei Conti Nazionali Italiani effettuata nel febbraio 2001.

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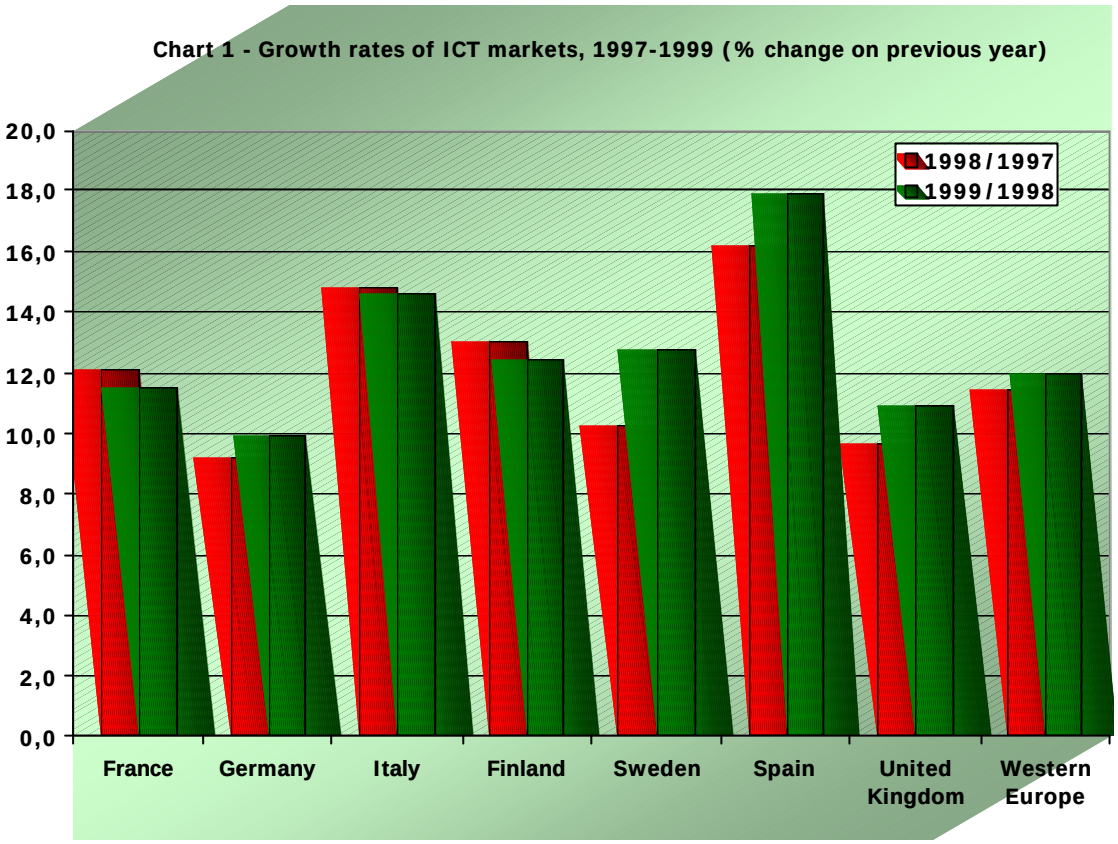

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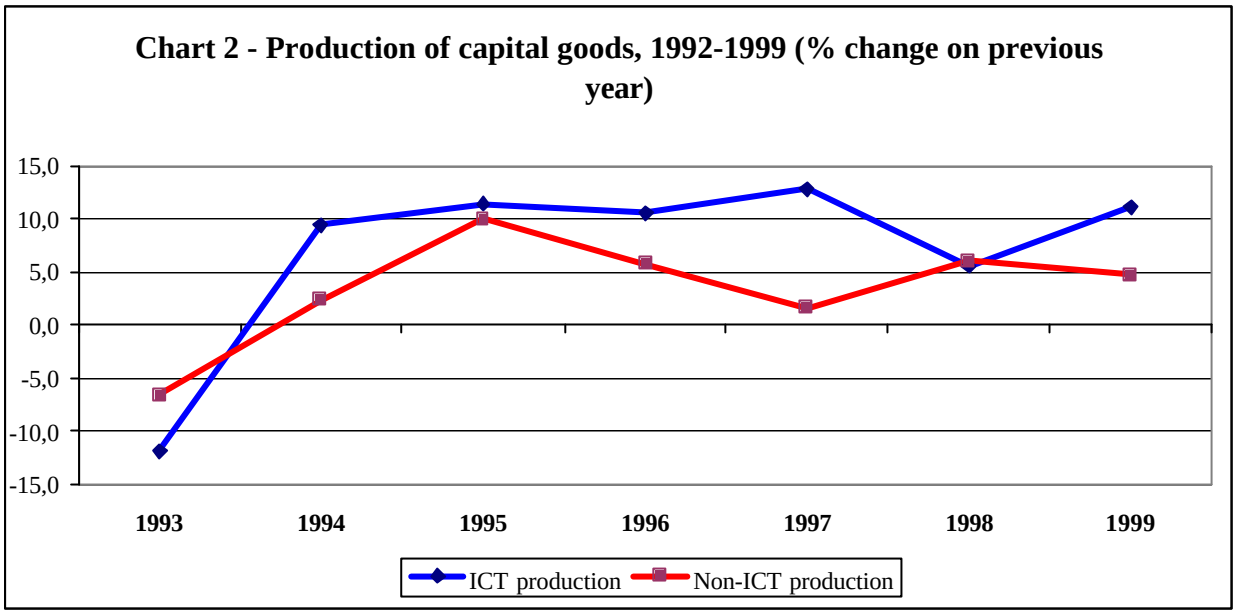

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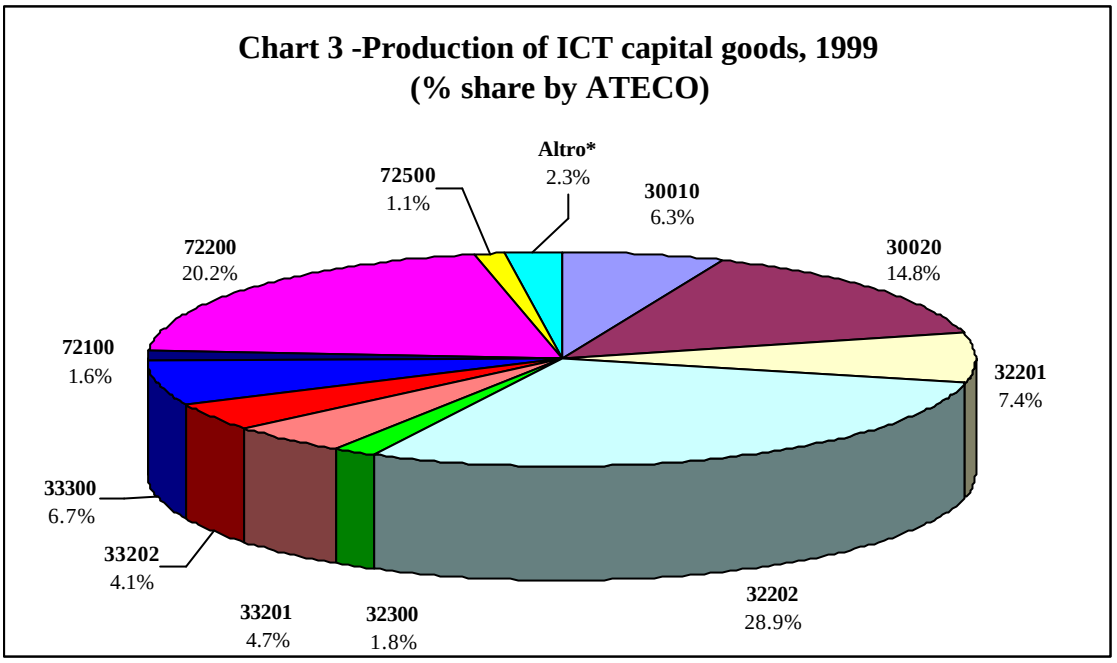

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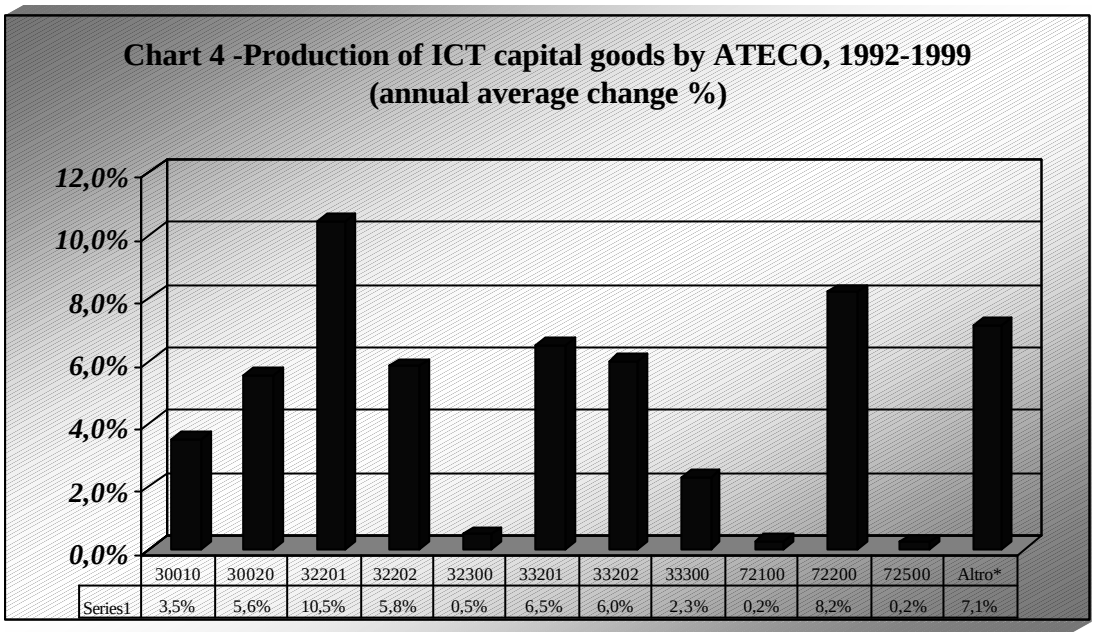

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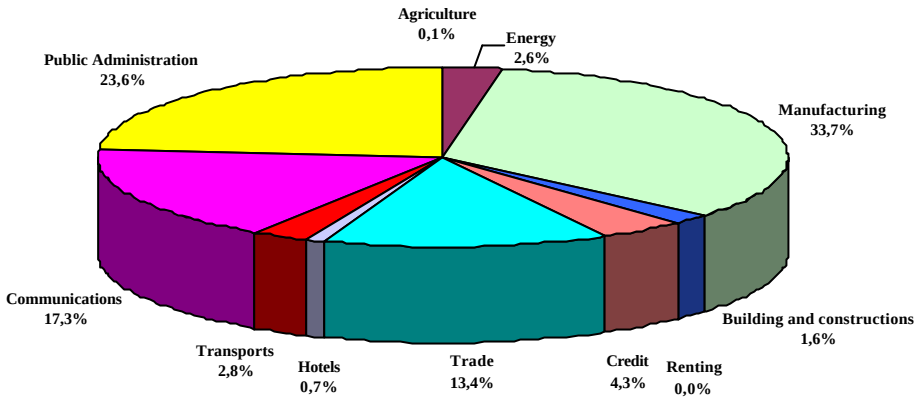
Chart 5 -Expenditure on ICT capital goods by sector, 1999
(% shares)



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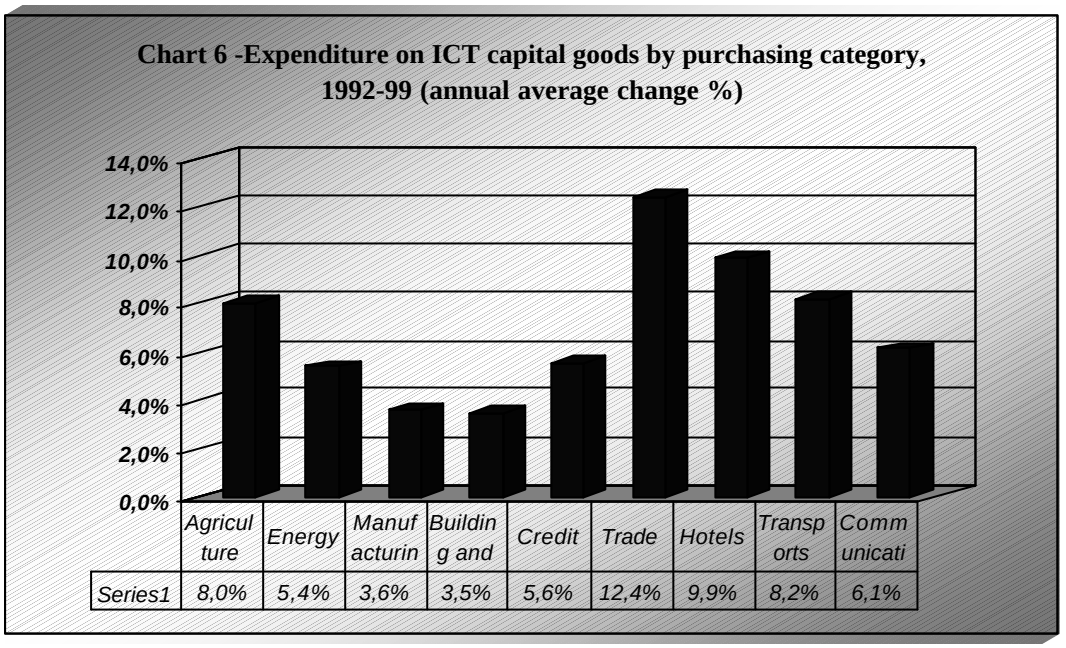

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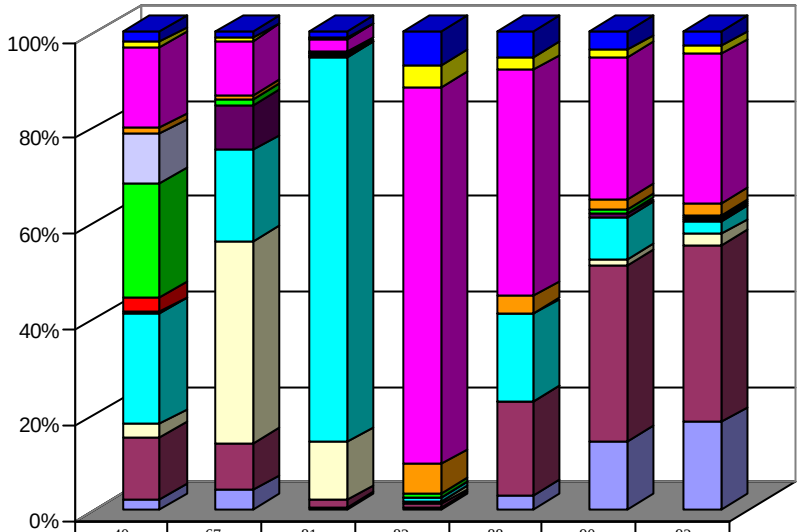
Chart 7 - Expenditure on ICT capital goods by branch of owner, 1999
(% shares by producing ATECO)



	40	67	81	82	88	90	92
Altro*	2,2	1,2	1,3	7,2	5,3	3,9	2,9
72500	0,9	0,6	0,2	4,3	2,5	1,6	1,7
72200	16,9	11,4	2,8	79,0	47,3	29,5	31,2
72100	1,3	0,9	0,2	6,1	3,7	2,3	2,4
33300	10,3	0,0	0,0	0,0	0,0	0,0	0,0
33202	23,8	1,2	0,1	0,9	0,3	0,8	0,7
33201	3,1	0,0	0,3	0,0	0,0	0,1	0,2
32300	0,4	9,4	0,3	0,2	0,2	0,6	0,4
32202	23,1	19,0	80,9	0,7	18,1	8,9	2,9
32201	2,9	42,5	12,2	0,4	0,1	1,3	2,2
30020	13,0	9,8	1,4	0,9	19,5	36,5	37,0
30010	2,1	4,0	0,4	0,4	3,0	14,5	18,3

Source: Istat

APPENDIX 1

Manufacturing

3000 Manufacture of office accounting and computing machinery

3130 Manufacture of insulated wires and cable

3210 Manufacture of electronic valves and tubes and other electronic components

3220 Manufacture of television and radio trasmitters and apparatus for line telephony and line telegraphy

3230 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods

3312 Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment

3313 Manufacture of industrial process control equipment

Services: goods-related

5150 Wholesale of machinery, equipment and supplies

7123 Renting of office machinery and equipment (including computers)

Intangible services

6420 Telecommunications

7200 Computer and related activities

APPENDIX 2

ATECO91 – SECTORS PRODUCING ICTs INVESTMENT GOODS

30010 Manufacture of office and accounting machinery

30020 Manufacture of computing machinery

32100 Manufacture of electronic valves and tubes and other electronic components

32201 Manufacture of television and radio trasmitters

32202 Manufacture of apparatus for line telephony and line telegraphy

32203 Repairing of television and radio trasmitters and apparatus for line telephony and line telegraphy

32300 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods

32201 Manufacture of instruments and appliances for measuring

33202 Manufacture of gas water and other liquids meters for measuring, checking, testing

33203 Manufacture of navigational aids, hydrological, geophysical and meteorology instruments

33204 Manufacture of instruments and appliances for other purposes, except industrial process control equipment

33205 Repairing of scientific and precision instruments (optical ones excluded)

33300 Manufacture of industrial process control equipment

72100 Hardware consultancy

72200 Software consultancy and supply

72300 Data processing

72400 Data base activities

72500 Maintenance and repair of office, accounting and computing machinery

72601 Services of telematics, robotics, computer graphics

72602 Other computer related activities

APPENDIX 3

BRANCHES OF ECONOMIC ACTIVITY

1 Agriculture and related service activities
2 Hunting and related service activities
3 Forestry, logging and related service activities
4 Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
5 Mining of coal and lignite; extraction of peat
6 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
7 Mining of metal ores
8 Other mining and quarrying
Minerals for basic chemistry
Production, processing and preservation of meat
Production, processing and preservation of fish, oils and fats and manufacture of other food products
Processing and preservation fruit, and vegetables
Manufacture of dairy products
Manufacture of grain mill products
Manufacture of prepared animal feeds
Manufacture of tobacco products
Manufacture of beverages
Spinning, weaving and finishing of textiles
Manufacture of other textiles, manufacture of knitted and crocheted fabrics and articles
Manufacture of wearing apparel; dressing and dyeing of fur
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness
Manufacture of footwear
Manufacture of wood and of products of wood and cork, except furniture
Manufacture of paper and paper products
Publishing, printing and reproduction of recorded media
Manufacture of coke, refined petroleum products and nuclear fuel
Manufacture of basic chemicals
Manufacture of pesticides and other agro-chemical products, paints, varnishes and similar coatings
Manufacture of pharmaceuticals, medicinal ,soap, detergents, and other chemical products n.e.c.
Manufacture of man-made fibres
Manufacture of rubber products
Manufacture of plastic products
Manufacture of glass and glass products
Manufacture of refractory ceramic products
Manufacture of cement, lime and plaster
Manufacture of other non-metallic mineral products n.e.c.
Manufacture of basic metals
Manufacture of structural metal products, tanks, reservoirs and steam generators
Manufacture of other fabricated metal products, metal working service activities
Manufacture of machinery for industrial uses
Manufacture of agricultural and forestry machinery
Manufacture of domestic appliances n.e.c.
Manufacture of office, accounting and computing machinery
Manufacture of electric motors, generators and transformers
Manufacture of electrical machinery and apparatus n.e.c.
Manufacture of electronic valves and tubes and other electronic components
Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
Manufacture of television and radio receivers, sound or video recording reproducing apparatus
Manufacture of medical instruments,
Manufacture of precision and optical instruments,
Manufacture of motor vehicles, trailers and semi-trailers
Manufacture of other transport equipment

Building and repairing of ships and boats
Manufacture of railway and tramway locomotives and rolling stock
Manufacture of aircraft and spacecraft
Manufacture of furniture and musical instruments
Manufacture of jewellery and related articles
Manufacturing n.e.c.
Recycling
Electricity, steam and hot water supply
Gas supply
Collection, purification and distribution of water
Constructions
Sale of motor vehicles, maintenance and repair of motorcycles, retail sale of automotive fuel
Maintenance and repair of motor vehicles
Commission trade
Wholesale trade
Non-specialized retail trade in stores
Retail sale of food, beverages and tobacco in specialized stores
Other retail trade and repair of personal and household goods
Hotels; camping sites and other provision of short-stay accommodation
Restaurants, bars and canteens
Transport via railways
Land transport; transport via pipelines
Passenger land transport
Water transport
Air transport
Activities of travel agencies
Supporting and auxiliary transport activities
Post and courier activities
Telecommunications
Financial intermediation
Insurance and pension funding
Activities auxiliary to financial intermediation

Dwelling location

Real estate activities
Renting of machinery and equipment without operator and of personal and household goods
Computer and related activities
Research and development
Other business activities
Building-cleaning activities
Public administration and defence, compulsory social security
Education
Hospital activities
Medical and dental practice activities
Social work activities
Sewage and refuse disposal, sanitation and similar activities
Activities of membership organizations n.e.c.
Recreational, cultural and sporting activities
Other service activities
Private households with employed persons