

# **The impact of innovation on economic performance in services<sup>1</sup>**

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## **Abstract**

This paper explores the two-ways relationships between innovation and economic performance in services at the firm level. The empirical analysis is based on a unique longitudinal firm-level data set, which matches CIS2 data (1993-95) and a set of economic variables provided by the Italian Production Survey (1993-98). In particular, the empirical analysis aims at disentangling: i) the impact of innovation on the economic performance of firms, in terms of productivity and growth; ii) the reverse casual effect, that is the impact of past economic performance on firms' innovation activities.

The results presented show that the high level of productivity and growth boost innovation. Further, innovation has a positive impact both on growth and productivity. In particular, the higher is the level of innovation expenditure in ICTs, the better is the economic performance of firms in terms of productivity.

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## 1. Introduction

It is widely acknowledged that technology change and innovation are major drivers of economic growth and lie at the very heart of the competitive process. Over the last few decades a large amount of literature has tried to empirically prove such a point.

A first stream of literature has evolved within the growth-accounting tradition. Since the pioneering study of Solow (1957) the contribution of technological change to economic growth has been estimated by an endless number of contributions aiming at squeezing the residual using additional production factors related to technological knowledge. In this stream of literature those contributions, which have explored (still within a production-function setting) the technology-productivity links at the firm and industry level, can also be included (see Griliches, 1998, for a review).

The relationship between technological change and economic performance has represented the research focus of another stream of literature in the neo-schumpeterian tradition. These relationships have been conceptualised in a out-of-equilibrium framework and empirically investigated using a wider spectrum of methodologies, indicators and a mix of qualitative and quantitative evidences (Silverberg and Soete, 1994; Freeman and Soete, 1997; Archibugi and Michie, 1998).

A common feature of both the streams of empirical literature sketched above is their explicit or implicit focus on the manufacturing sector. The role and impact of technological change in services has been largely neglected. Services have in fact been traditionally considered as technological backward, with innovation playing no role in explaining both the aggregate performance of this sector, for its internal dynamics as well as for the competitive strategies of firms. In line with this view, also the empirical evidence on the relevance, nature and economic impact of innovation in services has been rather poor.

Over the last few years the situation has considerably changed. Innovation in services has in fact become a topic of increasing interest among economists and scholars of technological change. Services have been increasingly covered by economic S&T statistics produced by national and international institutions such as the OECD and EUROSTAT (Sirilli, 1997). As far as R&D statistics are concerned, substantial steps ahead have been made in terms of actual coverage and collection of data. Data on the generation and use of ICTs are also becoming more detailed and exhaustive and services are usually well covered by such statistics (OECD, 2002). Last but not least, since the mid 90s innovation surveys have been extended to services (Djellal and Gallouj, 1999). The second Community Innovation Survey has in fact provided for the first time comparable firm-level data on innovation activities carried out in the service sectors of 15 European countries (EUROSTAT, 2001).

Thank to this new empirical evidence we have nowadays a rather detailed picture on the relevance and nature of innovation activities in services. OECD data show that service industries in the advanced countries perform up to one third of total business R&D (BERD) and account for more than 50% of the total R&D embodied in the intermediate inputs and capital equipment (OECD, 2000a). The results of CIS confirm that innovation activities do occur in services though to a different extent and in different forms across industries (Eurostat, 2001; Evangelista, 2000). ICTs data reveal that services are heavy

users of these technologies and that it is in the service sector where the economic impact of such technologies is more visible (OECD 2000a, 2002).

Despite we know more and more about the variegated universe of innovation in services, we have know much less about its actual economic impact. The literature in this field is in fact largely descriptive and dominated by a series of impressionistic views not supported by robust evidence. This is even more true when firm level evidence is considered. The limited number of firm-level studies is somewhat justified by the difficulties of getting access to micro-data, which is in the case of services even more severe than it is in the manufacturing industry. Data constraints and methodological problems arise also in relation to the availability of appropriate indicators to measure innovation activities in services. Those traditionally used in the manufacturing sector might be far from being appropriate in the case of services. The Community Innovation Survey has clearly shown that R&D play only a marginal role in services and patents are hardly used by service firms to protect their innovative output from imitation (EUROSTAT, 2001; Evangelista, 2000). This suggests that different and more comprehensive measures of firms' innovation activities have to be used in order to study the relationship between technological change and economic performance in services. CIS adopts this enlarged perspective on innovation and represents a fundamental data-source to expand research in this direction. Along with R&D other fundamental sources of innovation are taken into account by CIS such as activities related to the design of new services, software development, the acquisition of know-how, investment in new machinery (ICTs) and training (OECD-EUROSTAT, 1997). Despite the potentialities offered by this new information source, so far only very few studies have used CIS data for investigating the relationship between innovation and economic performances at the firm level, and most of them have remained confined to the manufacturing sector (Crepon, Duguet and Mairesse, 1998; Klomp and van Leeuwen, 1999).<sup>2</sup>

Summing up, the empirical literature on the relationship between technological change and economic performance is very limited in the case of services and such a *vacuum* is particularly severe as far as firm level evidence is concerned. Despite the overwhelming importance of services and the growing awareness of the importance of innovation in such a sector we know very little about the economic role that innovation plays in this section of the economy. The following questions need still to be properly answered on the basis of robust empirical evidence:

- a) If, and the extent to which, innovation plays a role for explaining the economic performances of firms in services;
- b) which are the innovation strategies which exert the greatest impact on firm's economic performance;
- c) if, and the extent to which, past economic performances spur innovation.

This paper aims at answering these questions using a unique longitudinal firm-level data set, which matches Italian CIS II data for services and a set of economic indicators provided by the System of the Enterprise Accounts. The resulting sample is made of more than 700 service firms, for which a rich set of innovation data (1993-1995) and a selected number of economic performance indicators (1993-1998) are available. The time span of our data set allows us to explore the "two-ways" causal relationship between innovation and economic performance, as synthesised in a), b) and c) above. In particular, the

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<sup>2</sup> An exception is van der Wiel, 2001.

empirical analysis will aim at disentangling i) the impact of innovation on the economic performance of firms, in terms of growth of value added, sales and productivity; ii) the reverse causal effect, that is the contribution of economic growth to the innovative performance of firms.

The paper is organised as follows. The next section contains a description of the main characteristics of the data-set and of the variables used in the empirical analysis along with some preliminary descriptive statistics. The regression model used to estimate 1), 2) and 3) above and the results of the empirical analysis are presented in section 3 and 4 respectively. The concluding section synthesises the empirical findings.

## **2. The data-set**

The empirical analysis carried out in this work is based on a new longitudinal firm-level data set built up by matching two different statistical sources: the Italian CIS II data for services and the System of the Enterprise Accounts (also known as SCI). The resulting sample of this statistical integration process consists of 735 service firms with 20 or more employees for which a wide set of innovative data for the period 1993-1995 and a restricted number of economic performance indicators for the period 1993-1998 are available. Data from CIS allows us to measure innovation activities and performance in services in a broad sense, and investigate the economic impact of different types of firm strategies, whereas data from SCI provides us microeconomic structural information at firm level such as sales, value added, the number of employees used for calculating economic performance indicators.

[Tables 3.1 and 4.1 about here]

In order to assess the statistical representativeness of our selected sample, a comparison between the CIS population and this sample is shown in Table 3.1. The analysis of this evidence shows that our sample closely resembled to that of its reference population both in terms of number of firms and overall structure. The only exception is represented by Trade. Moreover, it should be noted that our sample shows a modest bias towards innovative firms.

The variables used in our empirical exercise are listed and described in Table 4.1. These variables are grouped in four different categories: (i) sectoral dummies; (ii) size dummies; (iii) innovative performance indicators; and (iv) economic performance indicators. Great care has been taken in constructing sectoral dummies in the attempt to capture the strong sectoral heterogeneity of this section of the economy.

Finally, Table 4.2a and 4.2b report some descriptive statistics on innovative performance and economic performance indicators.

[Tables 4.2a and 4.2b about here]

In particular, the analysis of the correlation structure among these indicators shows that a strong correlation generally exists among the economic performance indicators of different periods of time when they are measured in levels: for example, the average level of labour productivity measured by sale for employees shows a correlation of 0.941 between the period 1993-1995 and the period 1996-1998. On the contrary, when these indicators are measured by rates of growth they show a low correlation. A significant linear dependence

can also be detected among the innovative performance indicators. This latter information which concerns only a sub-sample of our set of innovating firms implies that the innovative activity for these firms is a multidimensional process involving different levels of the firm's organisation.

### 3. The empirical results

#### 3.1 The descriptive evidence

#### 3.2 The econometric results

Two different types of relationships between innovation and economic performance can be envisaged, both from a conceptual and empirical point of view.

First, innovation activities are likely to enhance economic performance in the following period.

The second relationship relates to the potential effects of past economic performance on the presence and intensity of current innovative activities.

In order to empirically test these two causal relationships, we estimate the following two single-equation models:

$$[1] \quad X_{i,t} = a_0 + a_1 \cdot Y_{i,t-1} + \mathbf{a}'_1 \cdot \mathbf{i} + \mathbf{a}'_2 \cdot \mathbf{s} + u_{i,1}$$

$$[2] \quad Y_{i,t} = b_0 + b_1 \cdot X_{i,t-1} + \mathbf{b}'_1 \cdot \mathbf{i} + \mathbf{b}'_2 \cdot \mathbf{s} + u_{i,2}$$

where  $X_{i,t}$  is the economic performance indicators for firm  $i$  in period  $t$ ,  $\mathbf{i}$  is a vector of sector dummies,  $\mathbf{s}$  is a vector of size dummies,  $\mathbf{a}'_j$  ( $j=1,2$ ) and  $\mathbf{b}'_j$  ( $j=1,2$ ) are vectors of unknown coefficients. Finally,  $u_{i,j}$  (with  $j=1,2$ ) are random error terms with the usual assumptions.

The econometric analysis have been carried out on several specifications for each equation, including the list of variables illustrated in Table 2.

The impact of innovation on the economic performance of the following period is formalised by equation [1]. The causal direction between innovative and economic performance is in line with the traditional Schumpeterian literature on innovation seen as a major driver behind economic growth and competitiveness. As already mentioned, much of the empirical literature has so far revolved around the impact of innovation on the economic performance in the manufacturing sector. Here we argue that the presence of a direct link between innovation and economic performance might as well occur in services.

The underlining hypothesis behind equation [2] is that better performing firms in terms of sales growth and productivity levels tend to be more innovative in the following period. Innovative performance can be measured both in terms of propensity to introduce innovations and of amount of resources devoted to innovation. A positive effect of total sales growth of firms' innovativeness might configure the demand-pull hypothesis set forward by Schmookler (1966). Firms tend in fact to be more innovative when market demand 's growth is sustained and able to pull innovation.

A positive economic performance might also affect the future propensity of firms to innovate through a “cash-flow effect”. Firms relying on large financial resources might easily invest in innovation along with other type of investments. Overall, equation [1] aims at testing whether growth and /or productivity differentials among firms are associated to differentials in the propensity to innovate and intensity of innovation activity.

The presence of industry and size dummy variables captures the fixed effects as far as the level of innovation is concerned due to sector and size specificities.

### *3.2.1. The effects of innovation on economic performance*

The effects of innovation on the economic performance of service firms (equation [1]) have been tested, using different econometric specification. The results are reported in Tables 4.5 and 4.6.

[Tables 4.5 and 4.6 about here]

In Table 4.5 the dependent variable is the average growth rate of employment (1995-1998).

The specifications from [a] to [e] refer respectively to the use of different explanatory variables: the introduction of innovation, the total innovation expenditure per employee, and the different types of innovation expenditure. Among the latter, the only one which shows a positive impact on the growth of firms is the dichotomic variable indicating the presence of innovation. This suggests that the variance between the two groups of innovative and not innovative firms is high enough to produce a statistically significant difference as far as the growth of employment is concerned.

The picture provided by Table 4.6 re-establish the importance of innovation as a key factor behind the economic performance of firms. The estimates results shown in Table 4.6 show in fact that innovation activities undertaken in 1995 do have a strong impact on the productivity levels in the following three years. The level of innovative activities seems therefore not to be a necessary condition for firms to grow. On the contrary, the (long-run) productivity differentials emerge as being affected by the innovative efforts of firms. Particularly strong is the impact of ICT expenditure on the productivity level.

### *3.2.2. The effects of economic performance on innovation*

Table 4.3 reports the results of a set of ‘robust’ Logit estimates relating to the impact of economic performance respectively on the probability of introducing an innovation [2], of introducing a process [2] and service [3] innovation. Each specification in turn considers the effects of the average growth rate of sales over 1993-1995 [a] and the average level of labour productivity relating to the same period [b] on the probability of introducing a (service/process) innovation. The logit models include as well the whole set of sectoral and size dummies.

[Tables 4.3 and 4.4 about here]

Table 4.3 shows that past economic performance has a positive and statistically significant effect on the propensity to introduce innovations. Such an effect is confined to process innovations. Further, past growth has a stronger effect on the probability of introducing innovation as compared to the average level of productivity. It can therefore be inferred that firms with a sustained growth rate are most likely to be innovative in the following period.

The coefficients of the sectoral dummies reveal the presence of strong differences across industries in the average propensity of firms to innovate. As expected, the ICT industry (DINF) and the S&T-based business services (D1RDTEC) show positive and much higher coefficients as compared to more traditional sectors (Hotel and restaurants, transports, other business), though such differences mainly refer to service innovation. Large firms are more innovative than small firms, though such higher propensity again refers on process innovations.

Table 4.4 reports the ‘robust’ OLS estimation as to account for the impact of past economic performance on firms’ innovation expenditure. In particular, the following innovation indicators have been considered as dependent variables: the total innovation expenditure per employee [1]; R&D, design and know-how expenditure per employee [2]; ICT expenditure per employee [3]; investments per employee [4]. The parameters of the independent variables, which are expressed in natural logarithms, can be interpreted in terms of elasticity coefficients. The past levels of labour productivity are positively related to all innovation intensity indicators. On the contrary, the past rates of growth show a positive impact only on innovative investments. This latter result is consistent with the logit estimates presented in table 4.3 and in particular on the link between growth performances and process innovation. As far as the relationship between innovation and productivity is concerned a comparison among the different elasticity coefficients in table 4.4 reveals that highly productive firms are more likely to reinvest first and foremost their profits in ICTs.

To sum up, past economic performance do affect the propensity to innovate as well as the amount of resources put into the innovation process and ICT hardware. More in particular, high levels of productivity are associated to process innovation linked to the adoption of ICTs. Not necessarily such innovation strategies aim at mere cost-cutting objectives. Both process innovation and ICTs could be used to pursue quality-enhancing strategies.

#### **4. Summary of the findings**

The present paper empirically disentangles the complex relationship between innovation and economic performance in service firms.

The value added of our analysis is twofold. Firstly, both the impact of current innovation on future economic performance as well as the reversal relationship linking past economic performance on current innovation activity have been explored. Such relationships have been empirically tested using a unique longitudinal (1993-1998) data set, which matches the CIS II and the Italian System of the Enterprise Accounts data. The results of the empirical analysis have been illustrated in Section 3 and hereby summarised.

From a theoretical point of view, a positive impact of innovation on the economic performance is expected. The empirical results actually reveal that innovation does positively affect economic performance. Such an effect is confined to productivity level, while much a weaker impact on growth performance is found. Investment in ICTs emerge as being a major driving factor for productivity performance.

As far as the reversal causal relationship is concerned, better performing firms have been found to be more prone to innovate as well as to devote resources to innovation. In particular, highly productive and faster growing firms concentrate their innovative effort towards process innovation and ICT investments.



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(CAPOVERSO DA RISISTEMARE EVENTUALMENTE IN INTRODUZIONE)

As mentioned above, the most severe vacuum in the empirical literature on innovation in services lies in the analysis of its economic consequence. Since the empirical literature on technological innovation has been extended to service industries, the main focus has lied on the characteristics of innovation activities in services as compared to the manufacturing industries. The review proposed in Drejer (2002) and Coombs and Miles (2000) illustrate the different approaches so far adopted in tackling innovation in services. Very briefly, the state of the art embraces an “assimilation approach” (references), which tackle innovation in services through the same conceptual and measurement tools used for the manufacturing sector. Such approach is typically technology-centred and focussed on the dichotomy between product and process innovation. As opposed to this, the “demarcation approach” rather claims the specificity of service activity, which would imply the need of using specific concepts and measurement tools in accounting for innovation in services (references). In order to build up a bridge between the two approaches and contribute to the enlargement of the conceptual and methodological tools to tackling innovation both in manufacturing and in services, the author recalls the Schumpeterian heritage. This latter, in fact, “is rich enough to encompass also service specificity” and, mostly important, allows to strengthening from a conceptual point of view the analysis of innovation in services. The so-called “demarcation approach” risks in fact to “stretching the innovation concept too far and thus moving too far away from the original economic meaning of innovation”.

We do not intend here to get into the debate on the different approaches to the analysis of innovation in services. Rather, we intend to refocus the debate on the economic meaning and consequences of innovation in services. In line with this view, it is intended here to move a step forward with respect to the recently flourished literature on innovation in services, mainly focussed on the characteristics of innovation in these sectors, and account for the economic consequences of innovation in services.

The relationship has been empirically tested on the total innovation expenditure per employee and different types of innovation investments. Accordingly, different specifications of equation [1] have been empirically tested, using different endogenous and explanatory variables, as reported in Table 2. In particular, past economic performance has been proxied both as the average annual growth rate of sales over 1993-1995 and the average level of labour productivity (sales per employee) over the same period.