UNIVERSITÀ
CATTOLICA
del Sacro Cuore

DIPARTIMENTO DI SCIENZE ECONOMICHE E SOCIALI

Persistent Product Innovation and Market-oriented Behaviour: the Impact on Firms' Performance

Eleonora Bartoloni
Maurizio Baussola

Quaderno n. 105/marzo 2015

VP VITA E PENSIERO

Università Cattolica del Sacro Cuore

DIPARTIMENTO DI SCIENZE ECONOMICHE E SOCIALI

Persistent Product Innovation and Market-oriented Behaviour: the Impact on Firms' Performance

Eleonora Bartoloni
Maurizio Baussola

Quaderno n. 105/marzo 2015

VP VITA E PENSIERO

Eleonora Bartoloni, ISTAT, Italian National Institute of Statistics, Via Porlezza, 12, Milano 20123

Maurizio Baussola, Dipartimento di Scienze Economiche e Sociali, Università Cattolica del Sacro Cuore, Piacenza

✉ bartolon@istat.it

✉ maurizio.baussola@unicatt.it

I quaderni possono essere richiesti a:
Dipartimento di Scienze Economiche e Sociali,
Università Cattolica del Sacro Cuore
Via Emilia Parmense 84 - 29122 Piacenza - Tel. 0523 599.342
http://dipartimenti.unicatt.it/dises

✉ dises-pc@unicatt.it

www.vitaepensiero.it

ISBN 978-88-343-2983-2

Abstract

This paper provides an empirical investigation of the impact of innovation on firms' economic performance pinpointing complementarities between product and marketing innovation during the period 1998-2008. Firms' profitability and productivity are simultaneously estimated, thus allowing for consistent and robust estimates of the relationship being tested. The conceptual framework in which we have developed the analysis bridges the gap between the management (organization) approach, from which we grasp the notion of a firm's market orientation to innovation, and the economics of innovation perspective. The results show that being a persistent product-innovating and market-oriented firm significantly affects profitability, although the estimated impact is relatively mild. The gain in productivity determined by investing in R&D is relatively small and in line with the corresponding gain attributable to investing in marketing and organizational innovations. Conversely, capital deepening—as measured by the capital-labor ratio—exerts a larger impact on productivity, thus underlining how knowledge capital plays a less relevant role. This result emphasizes a crucial weakness of Italian manufacturing firms, because knowledge investment is the key to future economic growth. The estimates we have presented cover a sufficiently long time interval, thus enabling us to perform different robustness tests.

JEL Classifications: L25, 030, 032, 033
Keywords: Product Innovation, Market Orientation, European Community Innovation Survey, Profitability, Productivity

1 Introduction[1]

The relationship between innovation and economic performance at the firm level has been largely analyzed within the tradition of industrial organization studies. Although it is well recognized that technological innovation is the main determinant of economic growth, there is no well-established understanding of the mechanisms by which industrial innovation affects firms' performance and, through this route, growth at the economy-wide level.

In the generation of new technologies, product innovation occupies a central role, first, because it is the most recognizable by customers among the different forms of technological change and, second, because the primary goal of innovation is enhancing firms' profitability and because successful innovation depends, ultimately, on consumers' choices. This view, which has crucially affected economic studies at the industry level since the early 1970s, is clearly stated in the Schumpeterian view of competition (Schumpeter, 1934), according to which firms engage in risky innovation efforts when they foresee prospects for gaining competitive advantages by creating products or services that are preferred by the market.

In recent years, which have been characterized by high competition in global marketplaces, firms have faced increasing complexities to develop new products that meet customers' requirements. In the product-development process, the ability to cope with customers' needs represents a core strategic issue within a firm's organizational context.

Furthermore, an increasing number of scholars have focused on the notion of "market orientation" with the aim of understanding its link with a firm's performance. Within the management science literature, marketing orientation has been defined as a form of organizational culture (Deshpande and Webster Jr, 1989; Narver and Slater, 1990; Day, 1994). In the definition of Narver and Slater (1990), a market-oriented firm is one that manifests a customer and a competitor orientation together with interfunctional coordination. It has been argued that market orientation, when combined with organizational capabilities and learning orientation, may increase a firm's ability to intercept

[1]This paper is a result of collaboration between the Italian National Institute of Statistics (ISTAT, Regional Office for Lombardy) and the Catholic University of the Sacred Heart (UCSC). We would like to thank Emanuele Baldacci, Manlio Calzaroni, Raffaele Malizia and Rosalia Coniglio of the Italian National Institute of Statistics (ISTAT) for providing access to the data. Needless to say, the usual disclaimers apply.

customers' needs and, thus, to successfully innovate (Hurley and Hult, 1998; Gatignon and Xuereb, 1997).

The strategic role of managerial competencies in enhancing a firm's profitability is also emphasized in the resource-based view of the firm (Penrose, 1959; Wernerfelt, 1984) and, more specifically, in the dynamic capabilities approach (Pisano et al., 1997). According to this latter view, the firm achieves competitive advantages on the basis of organizational improvements and learning processes in order to adapt to a continuously changing business environment. In the context of a firm's innovative behavior, this approach also reconciles with the *process view of innovation* proposed by Geroski et al. (1993), who argued that the bulk of superior competencies acquired over the years by innovative firms allows a firm's profitability to persist over time. Previous research suggests the existence of a causal link running from firm-efficiency characteristics, and any innovative propensity, to profitability (Geroski et al., 1993; Roberts, 1999; Cefis and Ciccarelli, 2005).

The aim of this study is to provide new evidence on the impact of innovation on firms' economic performance pinpointing complementarities between product and marketing innovation in a simultaneous equation framework. We consider productivity and profitability as the two measures of a firm's performance, and we set up a model in which these variables are simultaneously determined.

The proposed empirical investigation is based on a panel of manufacturing firms that links three waves of the Italian Community Innovation Survey with an administrative data source providing economic and financial information at the firm level during the period 1998-2008. The empirical model is built on an interpretative framework that is suitable for investigating the extent to which the innovation-performance relationship is also related to firm, industry or geographical characteristics. Additionally, the panel nature of the database enables us to incorporate information on a firm's innovative behavior over an adequate time span.

We aim to exploit the time-series potential of the data set; thus, we propose a new definition, i.e., a persistent market-oriented innovating firm. This definition refers to a firm that has continuously and successfully innovated in both the product and marketing domains during the observed time span. We suggest that being a market-oriented firm brings about an ability *"to deliver superior value to its customers continuously"* (Slater and Narver, 1994); thus, this attitude may also bring about higher innovation performance than i) being an occasional

product innovator or ii) being a persistent product innovator without a market orientation.

Additionally, in line with the relevant organization-oriented literature (Brown and Eisenhardt, 1995; Atuahene-Gima, 1996), our study examines two different outcomes of innovation. The first, process performance, is an intermediate measure of product success and is measured in terms of productivity; the second, the market success of a product, is a measure of economic success and is measured in terms of profitability.

The distinction between the effects of product-marketing complementarities and the analysis of their impact on a firm's productivity and profitability is a novelty among those empirical studies that have been based on innovation surveys. Therefore, this study may contribute by bridging the gap in the understanding of the determinants of firms' growth between economic and organization-oriented studies.

Studies appearing in the organization-oriented tradition have extensively analyzed the black box of the product-development process by focusing on the organizational characteristics, roles and processes that determine successful innovation (Brown and Eisenhardt (1995), Krishnan and Ulrich (2001) and Hauser et al. (2006)).

Many authors have tried to conceptualize and, then, test the role of market orientation for creating higher organizational performance. These studies are based on appropriate surveys and the use of ad hoc variables indicating organizational culture (Hurley and Hult, 1998) or, more specifically, marketing orientation (Narver and Slater, 1990; Slater and Narver, 1994; Atuahene-Gima, 1996; Han et al., 1998). Potential limitations of this stream of empirical research may be found in the extensive use of subjective measures, mainly on a cross sectional basis. These concerns are clearly recognized by the scholars in the field of organization studies. Slater and Narver (1994) recommend using different sources of data and the introduction of objective measures of firm performance.

In economic-oriented studies, an important contribution to the empirical debate is to be found in the growing amount of literature based on innovation survey micro-data, which have the advantage of providing information about inputs, outputs, organizational aspects and behavioral aspects of their innovative activities. Starting from the seminal work by Crépon et al. (1998) (CDM), different investigations have been performed in various countries using the CDM structural model approach. These investigations have shown that innovation output pos-

itively affects a firm's performance variously measured in terms of employment, labor productivity or sales margins. However, there is room to believe that the impact of innovation on a firm's performance is not well understood given the following: i) evidence from innovation survey micro-data—namely, the Community Innovation Survey (CIS)—is prevalently cross-sectional and fails to take adequate account of dynamic effects and firms' heterogeneity; ii) the CIS surveys' lack of economic and financial indicators at the firm level makes it arduous to relate successful innovation to the internal resources available to a firm and, ultimately, to its efficiency conditions; and iii) evidence of the impact of non-technological innovations (e.g., marketing and organizational innovation) on a firm's performance is scarce and does not offer a clear-cut picture.

This paper is structured as follows. Section 2 provides an overview of the literature by focusing on the role of both market orientation and the determinants of firms' performance. Section 3 presents the data set, while Section 4 describes the empirical model, which is based on a simultaneous equation specification. We discuss the estimates in Section 5, followed by robustness analyses discussed in Section 6. Finally, conclusions are presented in Section 7.

2 Literature review

The analysis of the benchmarking literature may be better described by taking into consideration, on the one hand, the specific impact of a firm's attitude towards market orientation on its economic performance, and, on the other hand, the more general role of other determinants. Thus, we first analyze the literature on the relationship between business success and market orientation, and then, we discuss the findings of the literature on the determinants of firm performance.

2.1 Market orientation and firm performance

Depending on the characteristics of the available information, the role of market orientation for business success has been variously investigated. In the organization and management science literature, Narver and Slater (1990), through the use of a sample of 140 strategic business units and ordinary least squares regressions, showed that market orientation and performance (as measured by relative return

on investments (ROA), are strongly related, thus suggesting that market orientation is the driver of a firm's competitive advantage strategy. The model controls for firm-specific characteristics (relative costs and relative size) and market-level factors (growth, concentration, entry barriers, buyer power, seller power, and technological change). Their original results have been further confirmed (Slater and Narver, 1994) insofar as market orientation does have a long-term impact on business performance, whereas environmental conditions (e.g., a competitive environment) have short-term effects.

These findings opened the way to other studies that have refined the original conceptual framework. In a later investigation, Olson et al. (1995) found a positive impact on a firm's performance of the availability of coordinated functional departments, by using data from 45 product development projects in 12 firms and multivariate tests of significance. This evidence implies marketing and R&D department integration.

Further support to the complementarity role of market orientation in the product-development process arises from the Han et al. (1998) study, which focused specifically on market orientation, according to the Narver and Slater (1990) definition. By using a sample of 225 banks and a three-stage least squares analysis, they found a positive and significant impact of market orientation i) on innovation (defined as technical and administrative innovations) and ii) on business performance (as measured in terms of income growth and return on assets), with this relationship being mediated by innovation, thus supporting the view that market orientation and innovation propensity should be combined in order to achieve superior performance.

The view of a complementary role of market orientation and innovation characteristics is also supported by Atuahene-Gima (1996). Based on a sample of 275 firms from both the manufacturing and services sectors and on the application of a similar conceptual approach, he found that market orientation contributes to innovation performance only when combined with innovation characteristics. Innovation performance is measured both in terms of "market success" (self-reported measures of sales, market share and profits) and in terms of "project impact performance", which is a measure of cost efficiency. Interestingly, market orientation has a stronger effect on internal efficiency than on market success, even when the effects of innovation characteristics are taken into account, thus suggesting the need for extending the analysis to factors other than market orientation in order to fully

understand the innovation-performance link. This result seems to contrast with the analysis proposed by Baker and Sinkula (2009) on a small sample of 88 firms. The analysis, based on a structural equation modeling approach, provides support for a direct effect on profitability (in term of self-reported changes in sales revenues, profit and profit margins) by market orientation (via a modified version of the Narver and Slater's scale) but not by entrepreneurial orientation, which included firm's innovativeness as an input measure of innovation. They also found a positive and significant effect of a measure of successful innovation on profitability, thus indicating that an output rather than an input measure of innovation should be preferred. Gatignon and Xuereb (1997) include technological and organizational issues within the Narver and Slater approach. They emphasize how firms must be consumer- and technology-oriented in those markets characterized by high demand uncertainty in order to be able to market innovations (new products). Conversely, when markets are less turbulent and, thus, demand is relatively stable, a competitive orientation is more relevant for marketing innovation.

Within the stream of analysis of the economics of innovation, studies based on micro-data derived from innovation surveys have extensively analyzed the impact of technological innovation—i.e., product and process innovation—on firms' performance. More recently, a growing number of scholars have emphasized the complementarity between different aspects of innovation, i.e., technological and non-technological innovations. It is worth recalling that, according to the CIS definitions (OECD, 2005), non-technological innovation includes marketing and organizational innovations. A marketing innovation is defined as *"the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing"*. An organizational innovation refers to *"the implementation of a new organizational method in the firm's practices, workplace organization or external relations"*.

Schmidt and Rammer (2007) and Schubert (2010) used the German CIS to test whether marketing and organizational innovations are complements to or substitutes of product or process innovation. Schubert used data from the 2007 wave of the German CIS, whereas Schmidt and Rammer referred to the 2005 wave; thus, both analyses were performed on a cross-sectional basis.

In both cases, the authors found that when focusing on a large set of manufacturing and service firms participating in these surveys,

marketing and organizational innovation does complement technological innovation, thus suggesting that this may affect firms' performance. However, this impact crucially depends on the performance measure that is adopted. Indeed, Schubert found that the percentage of sales due to new products—as a measure of innovation success—increases and costs are reduced when marketing innovation is simultaneously introduced with product or process innovation. These findings confirm the previous investigation by Schmidt and Rammer (2007) in that they also found significant effects of both marketing and organizational innovation on innovative sales and cost reductions for those firms, which also introduced product and process innovation. Additionally, they test for an impact on profit margins—which is a measure of the economic success of a firm—by using estimates that are related to ordinal measures of the profit variable (i.e., ordered probit estimation). Using this approach, they find that the greatest effect on profit margins is attributable to technological innovation alone, thereby suggesting that having a market orientation in the development of technological innovation is not relevant for the economic success of a firm.

Battisti and Stoneman (2010) used the Fourth British CIS to explore the impact of the adoption of a range of innovative activities, including product, machinery, marketing, organization, management and strategic innovations. By using a clustering approach, they showed that there is a significant degree of complementarity between these innovation practices. They identified two major sets of innovations: on the one hand, marketing, organization, management and strategic innovations and, on the other, more traditional activities: machinery, process and product innovations. Wide (organizational) innovation was found to play a crucial role in the innovative activity of UK firms. They also found a positive impact of such activities on firms' performance; however, they did so by using a qualitative and subjective measure derived from firm respondents' judgments. Indeed, the impact on a firm's performance was measured by using a subjective estimate of the impact on future value added, and this may represent a limitation for the model validation, which was, however, unavoidable given the nature of the data set they used.

The relationships between marketing innovation and innovation performance are explored in a dynamic context by Lhuillery (2014), who used an unbalanced panel of manufacturing firms, which was obtained by matching four consecutive waves of the French CIS. Sales of new or improved products were used as an indicator of innovation success. He

found that marketing innovation had a short-term direct effect (contemporaneous effect) on innovation success, whereas the long-term effect (lagged effect) was not significant. In high-tech sectors, the short-term effect was not significant for incremental products. To test for the role of marketing in enhancing the persistence of innovation success, an interacted term between the lagged share of innovative sales and the lagged dummy for marketing innovation was introduced. The results support the view that innovation marketing does not raise the persistence of product innovation in low-tech industries. For high-tech industries, the results were more controversial, because the interacted coefficient was positive and significant for incremental innovation, whereas it was negative and significant for radical innovation.

These pieces of evidence suggest the need for further investigation of the specific role played by the marketing aspects of innovation in affecting a firm's performance. One of the drawbacks of the CIS Surveys is that many quantitative data are censored, i.e., they are available only for the subset of firms that declared their innovative status. Among these, the share of innovative sales—when used as a performance measure—may give rise to a selectivity bias issue. This problem is well known among the users of innovation surveys; hence, one proposed solution has been to merge innovation data with other sources—namely, accounting information—in order to gather economic information for all firms, including non-innovators (Mairesse and Mohnen, 2010).

2.2 Firms' performance, innovation, market structure and efficiency conditions

Since the mid-1980s, a growing amount of economic literature has focused on the relationship at the firm level between the adoption of new technology and productivity. Previous empirical studies have mainly explored the relationship between R&D and productivity. Most of these studies have demonstrated the existence of a significant positive relationship between these two variables (see Mairesse and Sassenou (1991) for a review of the literature) but have failed to describe the complex mechanisms by which these relationships work. More recent literature has increasingly focused attention on panel-data investigations (Rouvinen, 2002; Frantzen, 2003; Battisti et al., 2010) and has proved the existence of a causal link running from R&D to productivity. Despite a considerable number of studies having recorded this link, a relatively small number of econometric investigations have been performed on

the relationships between innovation and profitability (Griliches, 1986; Mairesse et al., 1999; Heshmati and Lööf, 2006). These studies, however, do not provide a clear-cut picture. This lack of conclusive evidence on empirical grounds may depend, on the one hand, on the extensive use of input measures of innovation and, on the other hand, on the variety of proxies for a firm's economic performance used in the model specifications.

Moreover, the Schumpeterian analysis of entre- preneurial profit recognizes the centrality of firm behavior in determining profitability in a competitive process that is essentially dynamic. Since the early 1970s, most of the empirical studies in the field of industrial organization have focused on the role of industry- or firm-specific effects. Two main arguments have dominated the industrial economics debate: according to the structure-conduct-performance (SCP) paradigm (Bain, 1956), a firm's performance is essentially determined by the structural characteristics of the industry; thus, the market structure—i.e., industry concentration—is the main determinant of firm performance; in contrast with this traditional view, the so-called firm efficiency view emphasizes the role of firm-specific characteristics—i.e., size and efficiency measures or market share—in determining a firm's performance and possibly market structure. The studies by Demsetz (1973), Peltzman (1977) and, more controversially, Clarke et al. (1984) show that efficient firms grow and capture large shares of the market. Thus, according to this view, a cost-reducing innovation may enable a firm to be more efficient and, eventually, to earn large profits. However, the debate on the robustness of the SCP paradigm has continued even more recently, with controversial results.

The studies by Allen (1983), Delorme Jr et al. (2002), and Slade (2004), despite using different methodological approaches, do find support for the SCP paradigm, therein establishing the role of market structure in determining a firm's profitability. From a different perspective, the management view of firms' profitability, the studies by Roberts (1999, 2001) and Hawawini et al. (2003) have specifically recognized the role of managerial abilities—e.g., product innovation—in determining profitability and its persistence. These studies refer to two seminal works by Schmalensee (1985) and Rumelt (1991), who both emphasize the fact that industry effects do not matter significantly in explaining a firm's performance. Bartoloni and Baussola (2009) note that the typical SCP mechanism driven by industry concentration was verified in a panel of Italian manufacturing firms covering the 1990s; however, its ef-

fect was found to be very small and less relevant than firms' innovative behavior, thus implying that dynamic competition through innovation may be more relevant than factors reflecting monopoly rents per se.

According to the SCP paradigm, financial aspects are strategic conduct-determining factors insofar as they can affect the cost of capital and, through this route, a firm's performance, thus suggesting a relationship running from an index of indebtedness to profitability. However, the sign of this relationship is controversial. On the one hand, it could be the case that highly leveraged firms incur increasing debt costs, as suggested by the agency-costs literature, thus implying a negative relationship. A possible negative relationship is also expected on the grounds that highly leveraged firms that do not invest in long-term growth opportunities will suffer declining innovativeness and long-term worsening profitability. On the other hand, a different theoretical approach (Jensen, 1986) emphasizes the role of debt in reducing the free cash flow under managers' control. Because seeking external financial resources exposes managers to increased monitoring, they are motivated to perform well. As a consequence, highly leveraged firms are expected to experience improved profitability and, thus, a positive relationship should be found.

Another important argument in understanding the determinants of firm performance is the role of technological adoption and technological spillover. The former aspect refers to the fact that innovation may provide a competitive advantage to innovating firms, thus allowing for an increase in their profitability that may even persist (Mueller and Cubbin, 2005). However, one should take into account that multiple innovations may be generated within a single firm and that firms may introduce innovations at different points in time, thus calling for the relevance of the diffusion process (Stoneman and Kwon, 1996). In addition, the distinction between older and more recent innovation has to be considered because the former may be exposed to greater competition—thus implying a milder impact on profitability—whereas the latter may give rise to a relative monopolistic power, thus enabling for possible extra-normal profits.

Technological spillover has been emphasized in a number of different studies, which have underlined the importance of R&D spillover in affecting firm productivity (Griliches, 1984, 1992; Mairesse and Sassenou, 1995; Los and Verspagen, 2000), but only a few studies have examined its impact on firm profitability. Previous studies have suggested the presence of a clear negative effect of technological spillover as mea-

sured by research inputs (Jaffe, 1986; Hanel and St-Pierre, 2002), and more controversial results when measured by research output (Geroski et al., 1993).

The effect of innovation on firm profitability may also be rationalized on the grounds that the innovation process affects the internal allocation and use of resources, thus enabling innovating firms to react and adapt quickly to exogenous demand or supply shocks (Geroski et al., 1993).

3 The data

3.1 Cis samples: panel properties

Our main source of information is represented by a panel data set that links four consecutive CIS surveys (CIS1, years 1998-2000; CIS2, years 2002-2004; CIS4 years 2006-2008; and CIS5, years 2008-2010). The data set provides information on 16,623 manufacturing firms that responded in at least one wave (Table 1). It is worthwhile to note that the last two waves partially overlap because the survey has taken place every two years since the 2008-2010 wave (CIS5). In addition, the use of consecutive waves gives rise to attrition and selection bias issues. Attrition is because the CIS survey has not been designed to be longitudinal; thus, we can note that the sample size decreases dramatically when consecutive waves are linked together. The number of firms responding to the CIS1 survey is approximately 7,000, dropping to fewer than 2,600 when we consider those firms that are present in at least the first two waves (see the second to fifth patterns in Table 1) and slumping to less than three hundred if one considers those firms that are present in all of the waves being considered (the third pattern in Table 1).

The dramatic decrease of information is only partially due to firms' demographic dynamics during the observed time interval. The specific nature of the CIS's sampling design gives rise to potential selection bias when using a balanced panel. Indeed, firms with fewer than 250 employees are randomly selected with equal probability within each stratum, and this sampling mechanism may negatively affect the probability of being a firm selected in consecutive surveys; on the contrary, large firms (more than 250 employees) are selected on a census basis; thus, they should "theoretically" always be present. Hence, we can observe, for example, that the mean size of firms from the CIS4 wave is 171 employees,

Table 1: Umbalanced panel of Italian manifacturing firms responding to the CIS survey. Patterns' analysis (CIS1, 1998-2000; CIS2, 2002-2004; CIS4, 2006-2008; CIS5, 2008-2010)

	Presence		Product innovation		Incremental product inn.		Radical product inn.	
pattern	number of firms	size	number of firms	size	number of firms	size	number of firms	size
0000	-	-	41	291	194	694	63	445
1100	1,853	75	336	125	26	137	230	164
1111	289	526	91	769	1	76	58	939
1110	239	231	67	342	3	886	37	362
1101	188	165	42	408	3	1,154	22	430
0011	659	230	291	253	39	288	231	296
0010	3,272	53	1,425	40	489	84	1,074	70
0001	2,230	70	1,078	52	367	73	840	68
0100	2,748	61	842	62	439	84	601	82
0111	228	438	90	881	4	610	63	695
0110	270	159	92	186	26	215	49	236
0101	215	112	55	153	10	1,924	43	365
1000	4,017	75	1,780	44	415	73	1,558	53
1011	112	539	74	705	1	697	58	732
1010	138	213	67	290	5	471	59	287
1001	165	167	85	155	7	623	59	178
in at least one wave	**16,623**	**52**	**6,415**	**103**	**1,835**	**104**	**4,982**	**118**
Cis 1998-2000	**7,001**	**131**	**2,542**	**208**	**461**	**179**	**2,081**	**214**
Cis 2002-2004	**6,030**	**139**	**1,615**	**275**	**512**	**203**	**1,103**	**309**
Cis 2006-2008	**5,207**	**171**	**2,197**	**271**	**568**	**179**	**1,629**	**302**
Cis 2008-2010	**4,086**	**203**	**1,806**	**305**	**432**	**235**	**1,374**	**327**

	Process innovation		Marketing innovation		Product and marketing inn.	
pattern	number of firms	size	number of firms	size	number of firms	size
0000	0	-	50	430	205	263
1100	329	118	356	102	159	219
1111	74	819	54	782	27	706
1110	55	359	52	443	29	484
1101	43	360	41	496	20	358
0011	300	259	195	305	153	382
0010	1,568	41	1,199	34	831	80
0001	1,030	55	937	48	656	82
0100	1,298	41	833	42	411	106
0111	90	883	38	930	31	841
0110	134	176	52	174	40	205
0101	75	193	38	139	25	205
1000	1,700	41	2,921	47	1,509	64
1011	70	974	53	1,025	42	1,103
1010	78	279	101	528	61	473
1001	75	166	111	225	63	171
in at least one wave	**6,919**	**97**	**6,981**	**89**	**4,057**	**128**
Cis 1998-2000	**2,424**	**206**	**3,689**	**174**	**1,910**	**223**
Cis 2002-2004	**2,098**	**220**	**1,464**	**210**	**742**	**306**
Cis 2006-2008	**2,369**	**266**	**1,744**	**274**	**1,214**	**327**
Cis 2008-2010	**1,757**	**326**	**1,467**	**294**	**1,017**	**332**

Notes. Variable *Patterns* indicate i) absence (0) or presence (1), during the four consecutive innovation surveys (Presence) or ii) being innovative (1) or not (0) depending on the specific innovation output reported in the head of the table. Size refers to the average number of employees over the up-to-four time observations divided the number of firms in the specific pattern.
Product innovation: the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses.
Process innovation: the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
Marketing innovation: the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
Organizational innovation: the implementation of a new organizational method in the firm's practices, workplace organization or external relations.

but the size increases to 526 employees when the balanced sample of firms present in all four waves is considered.

Table 1 reports frequencies and the average firm size for each specific pattern and for each CIS wave relative to various outcomes of a firm's innovative activity. These descriptive statistics are reported for product innovation and process innovation (technological innovation), marketing innovation and the combination of product and marketing innovation. Organizational innovation is also considered but not reported in the table. Descriptions of these different innovative activities, which are derived from the general guidelines of the so-called Oslo Manual (Oecd-Eurostat, 2005), are reported in the notes to Table 1. The distinction between radical and incremental product innovation refers to the fact that a firm may introduce into the market a new or improved good or service before its competitors (radical innovation for the market in which the firm operates) and/or may introduce a product innovation that is new only for the firm despite already being available to the competitors (incremental innovation). It is worth noting that almost five thousand firms have introduced at least a radical innovation during the observed time span. With reference to the single waves, the share of radical innovators is quite high and ranges from 68% during the period 2002-2004 to 82% during the period 1998-2000. These results signal the prevalence of radical vs. incremental innovators within our sample of firms[2].

In addition to the descriptive statistics discussed above, patterns of persistence in the innovation status over the entire period are also considered in Table 2, where t, $t+1$, $t+2$ and $t+3$ indicate, for the sake of simplicity, the first and the subsequent three periods analyzed. Thus, one can consider the number of innovative firms in each period and the relative persistence rates in the subsequent periods. In particular, persistence rates along the diagonal cells indicate persistence rates after one period for each starting sample, whereas the off-diagonal cells indicate persistence rates after more than one period. A characteristic that merits attention is that the persistence rates may be over-estimated when two consecutive waves are partially overlapped. Our evidence supports this view, because one can note that persistence rates after one period are systematically higher when moving from $t+2$ to $t+3$ (i.e., when they are partially overlapped). In addition, with reference

[2]However, one has to take into account that this indicator reflects a subjective measure that is derived from a firm's perception of its relevant market, i.e., regional vs. global (see also: Schmoch et al. (2006), p. 123).

to each starting sample of firms, persistence remains quite stable when moving from $t+2$ to $t+3$ after the considerable decrease moving from $t+1$ to $t+2$ (which are not overlapped).

Given this evidence, we decided to retain a balanced panel of 528 firms that were respondents to the first three waves. This decision is also reinforced by the consideration that extending to a four-period balanced panel yields a further substantial decrease in the number of observations, reducing the final sample to fewer than three hundred firms.

A final consideration concerns the fact that, by using a balanced panel, we do not control for entry, exit and, in general, corporate restructuring. However, it has to be emphasized that entry/exit and M&A deserve to be analyzed in an ad hoc framework because these phenomena are important components of the industrial dynamics, which may affect the variables under investigation without any specific relation with the theoretical framework that has been explored.

3.2 Accounting information and other firm specific variables

Firm balance sheets and profit-and-loss accounts, available from administrative sources, provide financial and economic information for the period 1998-2008. Linking the CIS data with accounting information allows for the use of a wider set of economic indicators typically not considered in the innovation survey micro-data; therefore, this link enables us to better explore the relationships between innovation and economic performance, which otherwise would not have been possible. One should note that the full samples of firms from the CIS surveys also include small individual firms for which balance-sheet information is not available from the Italian public register; thus, our analysis excludes these firms. We have compared the final sample of firms for which there is complete accounting information to the starting samples in the CIS surveys and then have concluded that the loss of sampling units due to the use of out-of-sample information is acceptable concerning a possible problem of size-bias.[3].

[3]If one compares the CIS sample distribution by size-class relative to the period 2006-2008 with the distribution obtained when firm-level accounting information is added, the results show a reduction from 64% to 56% of firms in the first class (firms with fewer than 50 employees) and, accordingly, increases in both the 2nd class (firms with between 50 and 250 employees; + 5 percentage points) and the 3rd class (medium-large firms with more than 250 employees; +3 percentage points).

Table 2: Persistence in innovative status

product innovation					incremental product innovation				
	t	t+1	t+2	t+3		t	t+1	t+2	t+3
t	2,542	536	299	292	t	461	33	10	12
t+1		1,615	340	278	t+1		512	34	18
t+2			2,197	546	t+2			568	45
Persistence rates					*Persistence rates*				
t		21%	12%	11%	t		7%	2%	3%
t+1			21%	17%	t+1			7%	4%
t+2				25%	t+2				8%
radical product innovation					process innovation				
	t	t+1	t+2	t+3		t	t+1	t+2	t+3
t	2,081	347	212	197	t	2,424	501	277	262
t+1		1,103	207	186	t+1		2,098	353	282
t+2			1,629	410	t+2			2,369	534
Persistence rates					*Persistence rates*				
t		17%	10%	9%	t		21%	11%	11%
t+1			19%	17%	t+1			17%	13%
t+2				25%	t+2				23%
marketing innovation					product and marketing innovation				
	t	t+1	t+2	t+3		t	t+1	t+2	t+3
t	3,689	503	260	259	t	1,910	235	159	152
t+1		1,464	196	171	t+1		742	127	103
t+2			1,744	340	t+2			1,214	253
Persistence rates					*Persistence rates*				
t		14%	7%	7%	t		12%	8%	8%
t+1			13%	12%	t+1			17%	14%
t+2				19%	t+2				21%

Notes. t: years 1998-2000; $t+1$: years 2002-2004; $t+2$: years 2006-2008; $t+3$: years 2008-2010. In the diagonal grey cells is reported the number of firms in each innovative status relative to each CIS wave. In the adjacent cells on the right is reported the number of firms which remain in the same innovative status during the subsequent periods. Persistence rates along the diagonal cells indicate persistency rates after one period for each starting sample, while off-diagonal cells indicate persistence rates after more than one period.

Economic performance. We use a measure of operating profitability, return on sales (*ros*), that is appropriate for investigating the profitability generated by the core business of a manufacturing firm and a measure of labor productivity (y), which is given by the value added per employee ratio and which may be considered an intermediate measure of a firm's innovation success.

Financial efficiency indexes. Financial efficiency can be considered by using a measure of a firm's exposure to external financing sources (*lev*), which is given by the ratio of shareholders' funding to total debts, thus reflecting the extent to which a firm uses internal resources instead of borrowing to finance its activity.

Capital deepening. The role of physical capital is taken into account by considering the *kl* ratio (tangible fixed assets per employee). It measures the extent of capital deepening in fostering productivity. Typically, the impact of this variable on labor productivity may be derived from growth-accounting exercises, together with the impact that may be exerted by Total Factor Productivity (TFP). Instead, we test its impact by using an econometric approach, which enables us to also consider other possible determinants related in particular to a firm's innovative effort. One should also note that capital deepening may incorporate process innovation; this latter determinant typically implies the acquisition of new machinery.

Innovative effort As previously mentioned, together with physical capital, a firm's innovative effort should be considered when describing the core determinants of labor productivity. The proxy we use, R&D investment (*R&D_exp*) and marketing investment (*mrk_exp*) expenditures, may also be thought of as a proxy for knowledge capital, which can contribute directly to labor productivity growth as well as exert a positive influence through TFP growth. Because we refer to the entire sample of innovative and non-innovative firms, the aforementioned expenditures are not available for this latter group of firms. Therefore, we use two dummy variables indicating whether a firm has undertaken R&D investment and marketing investment, respectively[4]. In addition,

[4]Otherwise a different modeling strategy should have been applied, i.e., focusing only on innovative firms or using a Tobit model with a selection equation. This approach, however, is beyond the scope of our investigation, which aims to pinpoint the different behavior and performance of innovative and non-innovative firms.

we can include networking within the innovation input group of variables because cooperation agreements in the process of innovation may produce positive effects on a firm's performance and, particularly, on its productivity. Therefore, we consider a dummy variable that signals whether the firm has cooperated on innovation with other firms or institutions during the reference period (*co*).

Innovation output Our investigation aims to underline the role of product innovation and market orientation in determining firm performance. Indeed, these attitudes are crucial in determining the ability of a firm to compete in global markets. Process innovation is implicitly taken into account given the previous consideration of the capital-labor ratio. Thus, we consider a proxy of a firm's attitude to adopt product and marketing innovations persistently, i.e., continuously over the entire time interval taken into consideration (variable *pers_pd_mkt*). This means that a firm ought to have adopted product and marketing innovations in each wave of the CIS survey considered. This variable represents an innovation output that directly affects a firm's competitive advantage and, through this mechanism, its operating profits.

Other firm-specific characteristics. Firms' *age* (years) may positively impact their growth; thus, firm age exerts an indirect impact on profitability[5]. Moreover, we consider other variables—available from the CIS survey—that reflect a firm's propensity to internationalize. Thus, we use two dummy variables: the first indicates whether a firm belongs to an international group (*gp_int*), and the second indicates whether a firm sells its products in the international market (*intern*). The first variable may affect a firm's efficiency, whereas the latter is closely related to the ability to expand internationally and thus increase turnover.

Sectoral structure and localization. Industry-specific characteristics are taken into account by considering two sectoral dummies that, in line with the Pavitt taxonomy, identify the high and medium-high technology sectors (*pavitt_mh*) and the low and medium-low technology sectors (*pavitt_ml*). Geographical characteristics are captured by four regional

[5]This variable is available from the Statistical Register of Active Businesses (ASIA). This archive is the most relevant administrative register used by the Italian National Institute of Statistics (ISTAT) as the pillar for many sample surveys and even census investigations.

dummies (*nwest, neast, centre, south*) reflecting a firm's location in the north-west, north-east, central or southern regions of Italy. Additionally, we consider the *cr5* ratio to capture the SCP mechanism described in section 2 and the ratio of the sectoral number of product-innovating firms to the total number of firms in that sector (*sect_inpd*). This latter variable captures two alternative mechanisms. The first may exert a positive effect on profitability because a significant number of sectoral innovating firms increase the overall industry's technological opportunities. The second effect may be negative as long as the increase in the sectoral number of innovating firms reduces a firm's opportunity to exploit gains from innovation.

It is worth emphasizing that balance-sheet information is provided on a yearly basis, whereas the qualitative variables derived from the CIS survey are defined on a three-year time span. To tackle the problem of different timing of information, we averaged accounting information over a three-year period; thus, the economic and financial indexes are provided as average values over the reference CIS time span. Descriptive statistics are reported in Appendix 1.

4 Model specification

We model the impact of innovation on firms' economic performance by using a simultaneous equation framework. This approach is indeed relevant because it enables us to take into consideration both the simultaneity bias issue and other possible interactions that are accounted for by considering the correlation between the two equations' error component.

Thus, we specify a model in which productivity (y), as measured by per capita (employee) value added, is treated as an endogenous variable, which in turn is determined by physical capital, a proxy of knowledge capital and a set of control variables that are described later. The other endogenous variable is operating profitability (ros), as measured by the ratio of operating margins to sale, which depends on the mechanisms described in Section 2.2, according to the SCP mechanism, to the mechanism represented by the innovation process view or by internal firms' efficiency conditions.

Following the description of variables in Section 3, the explanatory variables in the profitability equations are the following:

- a measure of persistent product and marketing innovation (*pers_pd_mkt*);

- financial efficiency (*lev*);
- productivity (*y*);
- ability to sell products on international markets (*intern*);
- market structure (*cr5*);
- technological spill-over (*sect_inpd*).

The productivity equation includes as explanatory variables:

- a proxy of knowledge capital (*r&d_exp* and *mrk_exp*);
- networking (*co*);
- organizational innovation (*innorg*);
- physical capital deepening (*kl*);
- sectoral innovation characteristics (*pavitt_mh* and *pavitt_ml*);
- localization (*nwest*, *neast*, *centre* and *south*) and other firm specific characteristics (*age* and *gp_int*).

The empirical specification includes, therefore, two equations, one for a firm's profitability and one for productivity, as follows:

$$\begin{aligned} ros_{it} =& \alpha_0 + \alpha_1 pers\_pd\_mkt_{it} + \alpha_2 y_{it} + \alpha_3 cr5_{it} + \alpha_4 lev_{it} + \alpha_5 intern_{it} \\ &+ \alpha_6 sect\_inpd_{it} + u_{it} \end{aligned} \tag{1}$$

$$\begin{aligned} y_{it} =& \beta_0 + \beta_1 pavitt\_mh_i + \beta_2 innorg_{it} + \beta_3 r\&d\_exp_{it} + \beta_4 mrk\_exp_{it} \\ &+ \beta_5 gp\_int_{it} + \beta_6 co_{it} + \beta_7 kl_{it} + \beta_8 age_{it} + \beta_9 nwest_i \\ &+ \beta_{10} neast_i + \beta_{11} centre_i + \beta_{12} T_t + v_{it} \end{aligned} \tag{2}$$

where the subscripts i and t identify, respectively, firms and the time. T_t is a time dummy common to every firm and refers to a three-year time span. Because productivity is endogenous to our specification, we estimate the equations by using 2SLS and 3SLS in order to account for simultaneity and correlation between errors. We provide such estimates

for three separate periods (1998-2000; 2002-2004; 2006-2008) and for the average long-run values of the variables over the entire sample time span (1998-2008). In addition, a 2SLS random effect (RE) estimate for panel data is presented with the following assumptions about the error term:

$$u_{it} = \mu_i + \epsilon_{it} \tag{3}$$

which is a one-way error component model where:

$$\mu_i \sim IID(0, \sigma_u^2) \qquad \text{and} \qquad \epsilon_{it} \sim IID(0, \sigma_\epsilon^2) \tag{4}$$

are independent of each other and themselves. In addition, the error term ϵ_{it} is assumed to be white noise, that is:

$$E(\epsilon_{it}, \epsilon_{is}) = 0 \qquad \text{for} \qquad t \neq s \tag{5}$$

Finally, the results for both the OLS and the RE (not instrumented) specifications are also presented for comparative purposes.

5 Empirical investigation

5.1 Results—general

Our panel of firms covers a ten-year time span (1998-2008); thus, it is suitable for investigating short- and long-run effects in the model. Given the characteristics of our data, in order to separate short and long-run relationships, we decided to estimate two different specifications. The first is described by the system of equations presented in the previous section, where the time variable refers to a three-year time span, according to the CIS time interval. By using this specification, we are not able to explore lagged effects, for example, in the innovation-profitability relationship, given that this would determine a substantial drop in the number of observations available for econometric investigation. Contemporaneous relationships are instead analyzed taking into account, however, that (i) the measures of innovation used here refer to adoption decisions which may have occurred during a three-year period without knowing, however, the precise year and that, (ii) in order to address this issue, we use a three-year average of the economic information derived from balance sheets. The second specification refers to a long-term model in which all of the hypothesized relationships are es-

timated using a ten-year average of the quantitative variables, whereas qualitative variables for innovation are used to capture occasional or persistent behavior, as will be explained hereafter.

Table 3: Determinants of firm economic performance: panel estimates over the period 1998-2008

	OLS		2SLS	3SLS		Random effects		2SLS RE
variables	ros	y	ros	ros	y	ros	y	ros
y	0.0800***		0.0547***	0.0609***		0.116***		0.0851***
	[0.00477]		[0.00715]	[0.00705]		[0.00370]		[0.00806]
pers_pd_mkt	0.0124**		0.0157***	0.0132**		0,0111		0.0142**
	[0.00532]		[0.00525]	[0.00516]		[0.00828]		[0.00711]
cr5	0.0731***		0.0842***	0.0723***		0.0407*		0.0680***
	[0.0249]		[0.0200]	[0.0196]		[0.0231]		[0.0220]
sect_inpd	-0.0246**		-0.0220*	-0,0188		-0.0490***		-0.0428***
	[0.0113]		[0.0118]	[0.0117]		[0.00969]		[0.0103]
lev	0.0200***		0.0230***	0.0202***		0.00990***		0.0138***
	[0.00237]		[0.00198]	[0.00194]		[0.00173]		[0.00187]
intern	-0.0127***		-0.0105**	-0.0105**		-0.00617*		-0.00679*
	[0.00486]		[0.00431]	[0.00424]		[0.00352]		[0.00377]
age		0.0455**			0.0455***		0.0533**	
		[0.0187]			[0.0175]		[0.0238]	
pavitt_mh		0.0685**			0.0644***		0.105**	
		[0.0274]			[0.0236]		[0.0420]	
innorg		0.0363*			0.0375*		0.0298**	
		[0.0217]			[0.0219]		[0.0149]	
r&d_exp		0,0343			0,0355		0.0479**	
		[0.0289]			[0.0246]		[0.0200]	
mrk_exp		0.0562*			0.0563**		-0,00574	
		[0.0289]			[0.0260]		[0.0197]	
gp_int		0.169***			0.181***		0.0675**	
		[0.0303]			[0.0266]		[0.0335]	
co		0.0746***			0.0665**		0,0123	
		[0.0287]			[0.0279]		[0.0227]	
kl		0.199***			0.198***		0.142***	
		[0.0142]			[0.0107]		[0.0186]	
nwest		0.175***			0.195***		0.181***	
		[0.0368]			[0.0329]		[0.0586]	
neast		0.179***			0.191***		0.184***	
		[0.0347]			[0.0328]		[0.0544]	
centre		0.241***			0.250***		0.247***	
		[0.0424]			[0.0419]		[0.0702]	
d2000		0.0816***			0.0524**		0.0708***	
		[0.0256]			[0.0257]		[0.0171]	
d2004		0.0406			0.0199		0.0382***	
		[0.0263]			[0.0247]		[0.0128]	
Constant	-0.783***	8.492***	-0.510***	-0.576***	8.506***	-1.160***	9.105***	-0.829***
	[0.0504]	[0.167]	[0.0776]	[0.0765]	[0.128]	[0.0410]	[0.225]	[0.0880]
Observations	1,533	1,536	1,531	1,531	1,531	1,533	1,536	1,531
RMSE	0.06059	0.3939	0.06135	0.06096	0.3916	0.0341	0.202	0.03185
R-squared	0.367	0.273				0.3398	0.257	
within						0.5005	0.038	
beetween						0.3134	0.257	

Notes. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. The variables y, age and kl are in log values.

We present empirical results for the panel over the period 1998-2008.

In Table 3, we show, together with the standard OLS estimates, 2SLS and 3SLS estimates. These latter are preferred because they represent a system method that, together with the endogeneity issue, also takes into account the correlation between each equation error term. The coefficient on the productivity variable (in log value) is positive and significant for all of the specifications presented. Estimates range from 0.116 in the RE specification to 0.054 in the 2SLS specification. In addition, coefficient estimates when y is not instrumented are higher than in the IV specifications, thus signaling a possible upward bias incurred by using both OLS and RE estimations. A more precise measure of the average impacts in the system by using a 3SLS specification is reported in Table 4 where marginal effects for selected variables are reported. Thus, a ten-percent increase in productivity determines, on average, a 0.6 percentage points increase in profitability.

Table 4: Marginal effects on performance for selected variables: panel estimates over the period 1998-2008 - 3SLS estimates

effects on profitability	
y (+10%)	+0.6 p.p.
lev (+10 p.p.)	+0.2 p.p.
pers_pd_mkt (=1)	+1.3 p.p.
effects on productivity	
innorg (=1)	+3.7%
r&d_exp (=1)	+3.5%
mrk_exp (=1)	+5.6%
gp_int (=1)	+18.1%
co (=1)	+6.6%
kl (+10%)	+2%
nwest (=1)	+19.5%
neast (=1)	+19.1%
centre (=1)	+25%

Note. Recall that profitability (ros) is a ratio, whereas productivity (y) is expressed in log values and thus impacts are calculated accordingly.

The impact of being persistently innovative in both product and

marketing (*pers_pd_mkt*) is positive and significant in both the 2SLS and 3SLS specifications and the size of the coefficients is similar: our estimates show that being a persistent product innovator with market orientation determines an increase in profitability that ranges from 1.3 to 1.6 percentage points.

Market structure, as proxied by the $cr5$ index, does positively affect profitability, and its impact (10 percentage points increase) ranges from 0.7 to 0.8 percentage points according to the 3SLS and 2SLS, respectively. It is also interesting to note the negative sign of the coefficient on the sectoral number of product innovators (*sect_inpd*), although it is not significant at the conventional levels. It suggests that positive effects of technological spillovers generated by the introduction of product innovations within the sectors tend to be offset by the competitive mechanism that reduces a firm's profitability as the number of product innovators increases. In other words, this variable reflects two contrasting mechanisms. On the one hand, it may reflect the information (epidemic) effect—as the number of innovators increases, a firm's probability of introducing an innovation increases accordingly—and, therefore, through this mechanism, it may positively affect its profit margins. On the other hand, this variable may reflect the so-called stock effect (Karshenas and Stoneman, 1993), in that the increase in the number of adopters may reduce profit margins. The prevailing mechanism determines the sign of the coefficient, which in our case is negative, although significant at the 0.1 significance level.

Among the firm-specific characteristics included in the profitability equation, it is worth emphasizing the positive and significant effect of a firm's financial efficiency as proxied by variable *lev*. The results from the 3SLS specification show that a 10 percentage-point increase in the ratio of shareholders' funding to total debts increases profitability by 0.2 p.p. This result suggests that profitability is positively affected by the extent to which a firm decides to finance its activity by using internal resources instead of borrowing. Although our leverage index does not allow one to distinguish between different categories of debt or the typology of lender (banks or other financial institutions), we believe this indicator may adequately describe the financial choices of our panel of firms, which operate in a context where the bank system traditionally occupies great relevance within the Italian industry.

The *intern* dummy, as a proxy of a firm's internationalization propensity, presents a negative and significant coefficient. This result is at first sight controversial because one would expect a positive sign, in

that selling products on international markets may increase turnover and profitability. However, one has to consider that operating on international markets brings about additional costs that may be not fully compensated by revenue increases. This effect seems to prevail in our panel of manufacturing firms and is also confirmed by simple descriptive statistics that show that returns on sales for firms that operate in international markets are slightly less than the correspondent returns of firms which base their business mainly on domestic markets[6]. This result is plausible within the Italian manufacturing industry, which is dominated by a relatively high number of small-sized firms, which therefore face possible diseconomies when they approach international markets.

Our results suggest that, when a firm within our panel decides to sell abroad its products, it may incur lower profits (-1 p.p. in the 2SLS and 3SLS estimates).

In the productivity equation, results indicate that, on average, a positive and significant productivity gain (+ 6.4% in the 3SLS specification) characterizes firms operating in the medium-high technology sectors compared with firms operating in the medium-low technology sectors. Variables reflecting product innovation inputs present with the expected signs. The propensity to undertake marketing investments, to introduce organizational improvements and to co-operate for innovation with other firms or institutions may determine positive and significant improvement on a firm's productivity (see Table 4 for a more accurate measure of the impacts, based on the 3SLS specification). The impact of the *r&d_exp* dummy is positive although not significant at conventional significance levels. This may be justified on the grounds that the regional dummies included in the model, which are positive and significant (reference area: south Italy), also pick up the effect of the R&D propensity, giving the existence of significant regional gaps which are generally recognized as stylized facts of the Italian industrial sector.

Firms' *age* (log value) show a positive and significant coefficient, thus signaling that well-established firms may increase their productivity compared with younger or less-established firms. In addition, firms' productivity is positively and significantly affected by other structural characteristics, such as group membership (*gp_int*) and physical capital deepening (*kl*): our estimates, based on the 3SLS specification, show

[6]The whole set of descriptive statistics dealing with the panel data set (Micro-Manu.Istat 2000-2010) used for the present econometric estimation may be downloaded from http:// www.istat.it/archivio/111638.

that a firm that belongs to an international group may increase its productivity by 18.1% and that the effect of a 10% increase in the tangible fixed assets per employee ratio is +2%.

The capital-labor ratio reflects the role of physical capital on productivity, and it exhibits an impact that is greater than the effect of R&D and marketing expenditures, which can be thought of as proxies of knowledge-capital expenditures. We are aware of the fact that these results are not strictly comparable as they refer to two different types of variables, as R&D and marketing expenditures are two dummy variables. Moreover, we are aware that knowledge is also incorporated into physical capital, following, for example, the stream of research generated by endogenous growth theories (Rebelo, 1991). Nonetheless, given these considerations, per capita physical capital does show a significant and robust impact, which contrasts with the milder effect of the proposed proxies of knowledge capital.

This evidence is coherent with the stylized facts of the Italian economy and, particularly, manufacturing, in that labor productivity has shown a significant decreasing trend since the mid-1990s. During this period, knowledge investment (in particular R&D) has also been decreasing, thus suggesting that Italian firms have been unable to grasp the technological opportunities prevailing at that time. Simple growth-accounting exercises (ISTAT, 2008) show that the contribution of TFP to labor productivity growth has been significant and higher than the contribution of capital deepening until the mid-1990s; afterwards, labor productivity has been sharply decreasing, mainly because of the decline in the TFP growth rate.

The estimates based on ten-year averages reported in Table 5 capture long-run relationships instead of the effects that are evident within a three-year time span, which have previously been discussed. In the long-run specification, the variables reflecting innovation inputs (*r&d_exp* and *mrk_exp*) and other variables taken from the CIS survey (*co*, *innorg* and *gp_int*) have been included in the productivity equation in order to capture a general propensity to innovate in at least one period during the entire 10-year span. Their effect is not significant in this specification, and this result may be explained by considering that these variables reflect only an occasional innovative behavior, which therefore may not have an impact on a firm's productivity. In addition, these variables do not show strong variability—instead, the majority of firms may be classified as occasional innovators. Other variables, conversely, exhibit significant impacts on productivity. Taking

Table 5: Determinants of firm economic performance: long-run estimates over the period 1998-2008

	OLS estimates		2SLS	3SLS	
variables	ros	y	ros	ros	y
y	0.0656***		0.0524***	0.0526***	
	[0.00581]		[0.0111]	[0.0111]	
pers_pd_mkt	0.0148*		0.0163**	0.0151*	
	[0.00804]		[0.00810]	[0.00805]	
cr5	0.0744**		0.0792**	0.0727**	
	[0.0340]		[0.0341]	[0.0339]	
sect_inpd	-0,0185		-0,0159	-0,013	
	[0.0217]		[0.0217]	[0.0217]	
lev	0.0232***		0.0250***	0.0234***	
	[0.00316]		[0.00338]	[0.00337]	
intern	-0.0223**		-0.0218**	-0.0215**	
	[0.00877]		[0.00876]	[0.00872]	
age		0.0596*			0.0619**
		[0.0306]			[0.0301]
pavitt_mh		0.0836**			0.0819**
		[0.0388]			[0.0383]
innorg		-0,00271			0,00329
		[0.0528]			[0.0522]
r&d_exp		0,00932			0,0126
		[0.0438]			[0.0432]
mrk_exp		0,045			0,0445
		[0.0400]			[0.0394]
gp_int		0.126***			0.134***
		[0.0406]			[0.0399]
co		0.104***			0.0984**
		[0.0393]			[0.0387]
kl		0.204***			0.202***
		[0.0185]			[0.0182]
nwest		0.169***			0.177***
		[0.0543]			[0.0534]
neast		0.169***			0.172***
		[0.0542]			[0.0533]
centre		0.238***			0.239***
		[0.0692]			[0.0684]
Constant	-0.620***	8.442***	-0.478***	-0.479***	8.446***
	[0.0638]	[0.219]	[0.120]	[0.120]	[0.216]
Observations	524	525	524	524	524
RMSE	0.05543	0.37169	0.05533	0.05534	0.36772
R-squared	0.346	0.293			

Notes. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. The variables y, age and kl are in log values. The dummy variables $innorg$, $r\&d\_exp$, mrk_exp, $intern$, gp_int and co indicate the presence of the relative characteristic in at least one sub-period.

part in an international group and having cooperated for innovation on at least one occasion during the ten-year period 1998-2008 positively and significantly affect a firm's long-run productivity.

As concerns long-run profitability, with the only exception being the variable reflecting technological spillovers within the sectors, all of the relationships that have been found significant within the short-run horizon continue to be significant in the long-run specification. In particular, it is worth emphasizing that the role of persistent product innovation in marketing-oriented firms, as proxied by variable $pers\_pd\_mkt$, continues to be relevant even in the long-run, thus indicating a positive impact on the long-run profitability, which is also coherent with the impacts derived from the panel estimates (Table 3).

5.2 Innovation success: marketing complementarities, persistence patterns, and radical vs. incremental innovation

The results described in the previous section point out that product innovation, when performed persistently and in conjunction with marketing activities, is a key success element because it significantly increases a firm's profitability. A step forward in the analysis of the profit-innovation relationship is represented by a more accurate comparison of the profit margins that are earned by firms when different innovative behaviors are conducted together with the adoption of a product innovation. We suggest this additional comparison in order to provide empirical support to the issue we have raised before—i.e., being a persistent innovator with a market orientation enables firms to earn higher profits compared with firms that are only occasionally innovators or, even more interestingly, compared with firms which, although persistently innovating during the entire time period, do not exhibit strong market orientation.

Thus, in order to explore thoroughly the innovative behavior of our panel of firms, we present in Table 6 the results from the 3SLS specification for a firm's profitability, where variable INN has been alternatively defined in order to represent i) product innovation that has been introduced occasionally (i.e., in at least one survey) or persistently (i.e., in all three consecutive survey occasions); ii) marketing innovation introduced on an occasional or persistent basis; and iii) conjunct product-marketing innovation that may be introduced occasionally or persistently during the three consecutive time spans.

Table 6: Impact of innovation on firm profitability: panel estimates over the period 1998-2008 - 3SLS estimates

	product innovation					
	occasional			persistent		
	(1)	(2)	(3)	(4)	(5)	(6)
variables	all	new-to-the-market	new-to-the-firm	all	new-to-the-market	new-to-the-firm
INN	0.00630*	0.00817**	-0,00441	0.00929**	0.00913**	-0,0253
	[0.00342]	[0.00338]	[0.00494]	[0.00410]	[0.00421]	[0.0175]
y	0.0620***	0.0598***	0.0626***	0.0618***	0.0618***	0.0624***
	[0.00698]	[0.00704]	[0.00699]	[0.00697]	[0.00700]	[0.00698]
cr5	0.0737***	0.0753***	0.0748***	0.0695***	0.0742***	0.0730***
	[0.0197]	[0.0197]	[0.0197]	[0.0197]	[0.0196]	[0.0197]
sect_inpd	-0.0163	-0.0229*	-0,0163	-0.0198*	-0.0212*	-0,0156
	[0.0117]	[0.0120]	[0.0116]	[0.0117]	[0.0118]	[0.0116]
lev	0.0205***	0.0204***	0.0205***	0.0204***	0.0203***	0.0204***
	[0.00195]	[0.00195]	[0.00195]	[0.00195]	[0.00194]	[0.00195]
intern	-0.0101**	-0.0112***	-0.00975**	-0.0112***	-0.0106**	-0.00999**
	[0.00426]	[0.00427]	[0.00426]	[0.00427]	[0.00424]	[0.00424]
Constant	-0.588***	-0.563***	-0.595***	-0.585***	-0.584***	-0.593***
	[0.0757]	[0.0764]	[0.0758]	[0.0756]	[0.0760]	[0.0757]
Observations	1,531	1,531	1,531	1,531	1,531	1,531
RMSE	0.06117	0.06110	0.06101	0.06099	0.06096	0.06100

	marketing innovation		conjunct product-marketing		
	occasional	persistent	occasional	persistent	persistent
	(7)	(8)	(9)	(10)	(11)
variables			all	all	new-to-the-market
INN	0,00458	0,00633	0.00581*	0.0132**	0.0224***
	[0.00315]	[0.00390]	[0.00343]	[0.00516]	[0.00641]
y	0.0634***	0.0616***	0.0604***	0.0609***	0.0609***
	[0.00709]	[0.00703]	[0.00707]	[0.00705]	[0.00702]
cr5	0.0739***	0.0739***	0.0751***	0.0723***	0.0760***
	[0.0197]	[0.0197]	[0.0197]	[0.0196]	[0.0196]
sect_inpd	-0,017	-0,0163	-0,0192	-0,0188	-0.0210*
	[0.0116]	[0.0116]	[0.0118]	[0.0117]	[0.0117]
lev	0.0213***	0.0204***	0.0204***	0.0202***	0.0202***
	[0.00195]	[0.00195]	[0.00195]	[0.00194]	[0.00194]
intern	-0.00957**	-0.0107**	-0.0107**	-0.0105**	-0.00998**
	[0.00426]	[0.00426]	[0.00426]	[0.00424]	[0.00423]
Constant	-0.582***	-0.585***	-0.571***	-0.576***	-0.576***
	[0.0761]	[0.0762]	[0.0767]	[0.0765]	[0.0762]
Observations	1,531	1,531	1,531	1,531	1,531
RMSE	0.06075	0.06101	0.06111	0.06097	0.06083

Notes. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. The variable y, is in log values. The dummy variable INN indicates, alternatively, the introduction of an innovation with different characteristics according to the descriptions in the head of the table. *Occasional*: in at least one sub-period; *Persistent*: in all the three sub-periods.

Table 7: Impact of innovation on firm profitability: long-run estimates over the period 1998-2008 - 3SLS estimates

	product innovation					
	occasional			persistent		
	(1)	(2)	(3)	(4)	(5)	(6)
variables	all	new-to-the-market	new-to-the-firm	all	new-to-the-market	new-to-the-firm
INN	-0.00362	0,00554	0,000822	0.00856	0,0105	-0,0237
	[0.00800]	[0.00555]	[0.00548]	[0.00642]	[0.00660]	[0.0277]
y	0.0539***	0.0512***	0.0535***	0.0530***	0.0531***	0.0539***
	[0.0110]	[0.0112]	[0.0110]	[0.0110]	[0.0110]	[0.0110]
cr5	0.0724**	0.0743**	0.0726**	0.0707**	0.0758**	0.0720**
	[0.0340]	[0.0340]	[0.0341]	[0.0340]	[0.0340]	[0.0340]
sect_inpd	-0.00772	-0,0132	-0,00842	-0.0135	-0,0166	-0,00788
	[0.0217]	[0.0222]	[0.0217]	[0.0219]	[0.0221]	[0.0216]
lev	0.0237***	0.0239***	0.0238***	0.0237***	0.0236***	0.0237***
	[0.00339]	[0.00339]	[0.00338]	[0.00338]	[0.00337]	[0.00338]
intern	-0.0205**	-0.0217**	-0.0207**	-0.0214**	-0.0212**	-0.0204**
	[0.00874]	[0.00882]	[0.00879]	[0.00875]	[0.00872]	[0.00873]
Constant	-0.495***	-0.466***	-0.491***	-0.484***	-0.485***	-0.495***
	[0.119]	[0.121]	[0.119]	[0.119]	[0.120]	[0.119]
Observations	524	524	524	524	524	524
RMSE	0.05549	0.05558	0.05552	0.05545	0.05537	0.05546

	marketing innovation		conjunct product-marketing		
	occasional	persistent	occasional	persistent	
	(7)	(8)	(9)	(10)	(11)
variables			all	all	new-to-the-market
INN	0,000951	0,00836	0,00258	0.0151*	0.0250**
	[0.00570]	[0.00612]	[0.00510]	[0.00805]	[0.0100]
y	0.0534***	0.0533***	0.0528***	0.0526***	0.0526***
	[0.0110]	[0.0110]	[0.0111]	[0.0111]	[0.0110]
cr5	0.0732**	0.0735**	0.0734**	0.0727**	0.0774**
	[0.0340]	[0.0339]	[0.0340]	[0.0339]	[0.0339]
sect_inpd	-0,00874	-0,00918	-0,00998	-0,013	-0,0156
	[0.0217]	[0.0216]	[0.0218]	[0.0217]	[0.0216]
lev	0.0238***	0.0237***	0.0238***	0.0234***	0.0234***
	[0.00338]	[0.00337]	[0.00338]	[0.00337]	[0.00336]
intern	-0.0207**	-0.0219**	-0.0210**	-0.0215**	-0.0212**
	[0.00880]	[0.00877]	[0.00878]	[0.00872]	[0.00869]
Constant	-0.491***	-0.489***	-0.484***	-0.479***	-0.479***
	[0.119]	[0.120]	[0.120]	[0.120]	[0.120]
Observations	524	524	524	524	524
RMSE	0.05552	0.05540	0.05554	0.05534	0.05517

Notes. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. The variable y, is in log values. The dummy *intern* indicates that the firm has sold its products in the international market in at least one sub-period The dummy variable INN indicates, alternatively, the introduction of an innovation with different characteristics according to the descriptions in the head of the table. *Occasional*: in at least one sub-period; *Persistent*: in all the three sub-periods.

In addition, in order to capture possible differential impacts on profitability of radical (new-to-the-market) vs. incremental (new-to-the-firm) product innovation, we have reported separate estimations for these two measures of innovation. In Table 7, cross-sectional estimates based on time averages across the 1998-2008 period are reported in order to discuss the long-run impacts.

It is worth noting that, although estimates reported in the penultimate columns of Tables 6 and 7 are equivalent to those already commented upon in the previous section, in the last column, we want to specifically investigate the effect of being a persistent radical innovator with a market orientation.

Product innovation, when performed on an occasional basis, has a positive, albeit not highly significant impact on a firm's profitability (Table 6, column 1). One can also note a similar positive impact when product and marketing innovation are jointly and occasionally introduced (column 9). Additionally, the effect of occasional product innovation is increased with a higher level of significance when a radical innovation is introduced (column 2), whereas the introduction of an incremental innovation does not significantly affect profit levels (column 3).

The positive impact on profit margins is significantly increased if firms are persistent product innovators. Our estimates suggest that the impact on a firm's profitability is 0.9 percentage points (column 4) and that this increase is significantly explained by radical innovations (column 5); conversely, incremental product innovation, even when performed on a persistent basis, continues to be non-significant in explaining profit margins (column 6).

The attitude towards market orientation is captured in our panel by the dummy variable, which indicates whether the firm has performed both product and marketing innovation persistently during the entire time horizon, i.e., during each of the three-year time spans considered in the sample. The results in column 10 suggest that firms with strong market orientations are able to increase profitability by 1.3 percentage points compared with firms that do not exhibit this characteristic. This result implies that firms with strong market orientation not only perform better than those that have occasionally introduced joint product and marketing innovation but also, more interestingly, are able to increase profitability with respect to persistent product innovators without a market orientation (see column 4).

Moreover, if one considers the results shown in the last column,

where a strong market orientation is combined with having continuously and successfully generated radical innovations, one can note that the impact on profitability is even greater (2.2 percentage points).

The critical role of a firm's marketing orientation combined with persistent product innovation is better clarified in the long-run specification. The results reported in Table 7 suggest the absence of any significant effect on long-run profitability generated by both occasional innovative behavior and persistent behavior when product innovation is not joined with marketing innovation. Conversely, the long-run profitability of persistent product innovators together with strong market orientation is significantly increased compared to firms that do not exhibit these characteristics: our estimates indicate a 1.5-percentage-point increase (column 10), which is even higher than the increase we have registered by considering contemporaneous effects (panel estimations). Furthermore, pursuing radical innovations persistently in conjunction with a strong market orientation is even more relevant in the long run: the effect on long-run profitability is equal to a 2.5-percentage increase (column 11), which is one percent higher than what we register for product innovation taken as a whole (column 10) and higher than the value we observed in the panel estimates.

6 Robustness

Our investigation is based on a balanced panel of firms derived from three non-overlapping waves of the Italian CIS survey. The robustness of the results may be evaluated, first, in terms of the coefficients' sizes, signs and significance values, which are associated with the various model specifications we have proposed. Moreover, it may also be addressed in terms of short-run and long-run relationships in that we can verify whether a relationship is significant and relevant when panel estimates (Table3) or long-run averages (Table5) are considered. These issues have been widely discussed in the previous sections, where we also have emphasized the fact that the hypothesized relationships are robust to model specifications and the time horizon used in each regression.

Robustness may also be evaluated when focusing on alternative innovative behavior established by firms; thus, we can conclude that, by changing the INN variable in order to capture different aspects of a firm's innovative propensity (Table 6 and Table 7), the overall strength

of our model holds, although the impacts of innovation on firms' profitability are differentiated, as expected, depending on the time horizon being considered for the estimates and the degree of persistence introduced in the empirical investigation.

Finally, robustness may be checked by comparing results obtained from our panel with those one could derive from the original CIS samples eventually linked to the economic and financial information derived from the balance sheets. Thus, in order to test for the sensitivity of our results to different sample characteristics, we have reported in Appendices 2a-c the regression estimates based on each of the three cross-sections of firms that are relative, respectively, to the 1998-2000, 2002-2004 and 2006-2008 periods. The relevance of this comparison lies in the possibility of ascertaining the role played by selectivity bias, which is, however, unavoidable when two or more CIS waves are linked together in order to derive longitudinal data sets. This additional test allows us to confirm the robustness of the estimated relationships. It is worth emphasizing that the effect of the dummy variable (*conj_inpd_mkt*) could not be directly compared with that which we observed in the panel specification, where we intended to capture persistence patterns in conjunct product-marketing innovation that are not possible to capture in the cross-sectional specification.

This clarification is important because the impact of occasional conjunct product-marketing innovation on a firm's profitability does not appear to be clearly defined in all of the three time spans analyzed. This controversial result may further highlight the need for panel-data investigations to better understand the profit-innovation relationship at the firm level.

7 Conclusions

We have presented an empirical model in which firms' profitability and productivity are simultaneously estimated, thus enabling us to provide consistent and robust estimates of the relationship being tested. The conceptual framework in which we have developed the analysis bridges the gap between the management (organization) approach to innovation and the economics of innovation perspective. In particular, we grasp from the first approach the notion of a firm's market orientation, whereas we derive from the second approach the general view of the determinants of firm performance. We have therefore set up an

empirical model that incorporates such complementary views.

The estimates presented in this study show that productivity is affected by a combination of different mechanisms that are related to innovation efforts (knowledge capital), physical capital (capital deepening), networking and other controls (firm age and localization). The impact of such mechanisms has been estimated, providing cross-sectional, panel and long-run averages values, thus enabling us to verify that the results are robust to different specifications.

Ultimately, we aimed to test the impact of the so-called process of innovation on productivity in comparison with other determinants. Such an impact is relatively small for Italian manufacturing firms, reinforcing the evidence derived from macro growth-accounting exercises. The gain in productivity determined by investing in R&D is relatively small and in line with the corresponding gain attributable to investing in marketing and organizational innovations. Conversely, capital deepening—as measured by the capital-labor ratio—exerts a larger impact on productivity, thus highlighting how knowledge capital plays a less relevant role in the Italian manufacturing industry. This evidence may help to explain the decrease in competitiveness faced by Italian manufacturing firms. Indeed, they have focused more on process than product innovation, and this fact may explain the stronger impact of capital deepening, because process innovation is strictly related to the acquisition of new capital goods.

The fact that being part of an international group has a significant impact on productivity, which is in line with the corresponding impact of the capital-labor ratio, further underscores the structural problem previously emphasized—i.e., the non-satisfactory innovative effort of the Italian manufacturing firms. This consideration is reinforced even more by the fact that a broad measure of networking, which includes both national and international co-operation—has only a mild impact on productivity. Moreover, structural regional differences are still operational and significant insofar as southern manufacturing firms do show a lesser productivity level.

As concerns profitability, we have emphasized the role of being a persistent product-innovating and market-oriented firm. Such a firm's attitude—which is an innovation output measure—is significant in affecting profitability, although its impact is relatively mild. This result is consistent with those obtained for productivity, in that the innovation effort is positive and significant but mild. Productivity is endogenous and enters the profitability equation with a significant and

non-negligible impact. Given the previous considerations about the relative impacts of the determinants of firm productivity, this impact is mainly driven by capital deepening. This implies that knowledge capital should be fostered among Italian manufacturing firms to increase their profitability in the future.

We have also controlled for financial efficiency, as measured by a leverage index, which shows a mild significant impact on profitability. This result is not yet affected by the deepening of the recession after 2010, and this evidence may explain the relative mild impact of this variable on profitability.

The estimates we have presented cover a long time interval, which enables us to perform different estimations suitable for robustness testing. We have performed cross-sectional, panel and long-run average estimations that confirm the robustness of the results and therefore underscore the key role played by each single variable in determining firm performance over the short- and long-run.

Appendix 1 - Variables' definition and summary statistics

		period 1998-2000							*period 2002-2004*						
variable	**type**	**mean**	**st.dev.**	**p25**	**p50**	**p75**	**min**	**max**	**mean**	**st.dev.**	**p25**	**p50**	**p75**	**min**	**max**
age	years	27	17	17	25	32	1	135	31	17	21	29	36	5	139
ros	c	0.12	0.08	0.07	0.11	0.16	-0.10	0.43	0.11	0.08	0.07	0.10	0.15	-0.23	0.45
kl	c	67,769	72,541	26,070	45,104	84,843	1,310	711,634	62,977	64,141	25,431	44,182	79,260	916	571,693
lev	c	0.78	0.87	0.24	0.48	0.98	-0.13	7.21	0.82	0.87	0.27	0.53	1.03	-0.18	6.97
y	c	75,064	36,352	50,988	65,828	90,125	21,552	258,509	72,429	36,215	48,880	63,830	85,677	579	272,950
nwest	0/1	0.40	0.49				0	1	0.40	0.49				0	1
neast	0/1	0.36	0.48				0	1	0.36	0.48				0	1
centre	0/1	0.10	0.30				0	1	0.10	0.30				0	1
south	0/1	0.14	0.34				0	1	0.14	0.34				0	1
pavitt_ml	0/1	0.69	0.46				0	1	0.69	0.46				0	1
pavitt_mh	0/1	0.31	0.46				0	1	0.31	0.46				0	1
co	0/1	0.17	0.38				0	1	0.16	0.37				0	1
intern	0/1	0.84	0.37				0	1	0.81	0.39				0	1
gp_int	0/1	0.16	0.37				0	1	0.19	0.39				0	1
mrk_exp	0/1	0.18	0.38				0	1	0.34	0.47				0	1
r&d_exp	0/1	0.44	0.50				0	1	0.52	0.50				0	1
		period 2006-08							*Total panel*						
variable	**type**	**mean**	**st.dev.**	**p25**	**p50**	**p75**	**min**	**max**	**mean**	**st.dev.**	**p25**	**p50**	**p75**	**min**	**max**
age	c	35	17	25	33	40	9	143	31	17	20	29	37	1	143
ros	c	0.09	0.07	0.05	0.08	0.13	-0.35	0.41	0.11	0.08	0.06	0.10	0.15	-0.35	0.45
kl	c	71,745	76,535	28,830	49,688	88,206	1,690	737,594	67,550	71,377	26,928	46,476	83,798	916	737,594
lev	c	0.85	0.88	0.27	0.55	1.06	-0.05	6.23	0.82	0.88	0.26	0.52	1.03	-0.18	7.21
y	c	72,232	37,116	47,484	63,971	86,627	276	255,862	73,237	36,568	49,056	64,391	87,734	276	272,950
nwest	0/1	0.40	0.49				0	1	0.40	0.49				0	1
neast	0/1	0.36	0.48				0	1	0.36	0.48				0	1
centre	0/1	0.10	0.30				0	1	0.10	0.30				0	1
south	0/1	0.14	0.34				0	1	0.14	0.34				0	1
pavitt_ml	0/1	0.69	0.46				0	1	0.69	0.46				0	1
pavitt_mh	0/1	0.31	0.46				0	1	0.31	0.46				0	1
co	0/1	0.24	0.43				0	1	0.19	0.39				0	1
intern	0/1	0.84	0.36				0	1	0.83	0.38				0	1
gp_int	0/1	0.20	0.40				0	1	0.18	0.39				0	1
mrk_exp	0/1	0.25	0.43				0	1	0.26	0.44				0	1
r&d_exp	0/1	0.58	0.49				0	1	0.51	0.50				0	1

Notes. age: firm's age (years); ros: return on sales, the ratio between gross operating profits and sales; kl: tangible fixed assets per employee (euros); lev: the ratio of shareholders' funding to total debts; y: value added per employee (euros); $nwest$: 1 if the firm is localized in the North-West; $neast$: 1 if the firm is localized in the North-East; $centre$: 1 if the firm is localized in the Centre; $south$: 1 if the firm is localized in the South; $pavitt\_ml$: 1 if the low and medium-low technology sectors; $pavitt\_mh$: 1 if the high and medium-hight technology sectors; co: 1 if the firm firm has cooperated on innovation with other firms or institutions during the reference period; $intern$: 1 if the firm sells its products in the international market; gp_int: 1 if the firm belongs to an international group; mrk_exp: 1 if the firm has undertaken marketing investments; $r\&d\_exp$: 1 if the firm has undertaken R&D investments. c indicates a continuous variable. Continuous variables are defined as average values over the reference CIS time span.

Appendix 2a - Determinants of firm economic performance: cross-section estimates over the period 1998-2000

	OLS		2SLS	3SLS	
variables	ros	y	ros	ros	y
y	0.0795***		0.0544***	0.0567***	
	[0.00173]		[0.00558]	[0.00558]	
conj_inpd_mkt	-0.00518***		-0.00679***	-0.00614***	
	[0.00196]		[0.00234]	[0.00230]	
cr5	0.155*		0.285***	0,162	
	[0.0917]		[0.111]	[0.109]	
sect_inpd	-0,00579		-0,0189	-0,00965	
	[0.0111]		[0.0144]	[0.0143]	
lev	0.0244***		0.0301***	0.0258***	
	[0.00103]		[0.00164]	[0.00161]	
intern	-0.0187***		-0.0124***	-0.0155***	
	[0.00185]		[0.00299]	[0.00293]	
age		0.0418***			0.0440***
		[0.00978]			[0.00948]
pavitt_mh		0.0856***			0.0771***
		[0.0153]			[0.0151]
innorg		0,00388			0,0158
		[0.0164]			[0.0159]
r&d_exp		0.0395**			0.0382**
		[0.0156]			[0.0151]
mrk_exp		0.0753***			0.0785***
		[0.0175]			[0.0169]
gp_int		0.231***			0.258***
		[0.0240]			[0.0232]
co		0.0764***			0.0791***
		[0.0201]			[0.0194]
kl		0.176***			0.166***
		[0.00699]			[0.00688]
nwest		0.269***			0.274***
		[0.0238]			[0.0232]
neast		0.230***			0.234***
		[0.0237]			[0.0231]
centre		0.180***			0.179***
		[0.0270]			[0.0262]
Constant	-0.757***	8.707***	-0.485***	-0.507***	8.790***
	[0.0185]	[0.0809]	[0.0598]	[0.0597]	[0.0796]
Observations	6,506	3,226	3,216	3,216	3,216
RMSE	0.06736	0.39917	0.06458	0.06450	0.39451
R-squared	0.343	0.255			

Notes. Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1; the variables y, age and kl are in log values.

Appendix 2b - Determinants of firm economic performance: cross-section estimates over the period 2002-2004

	OLS		2SLS	3SLS	
variables	ros	y	ros	ros	y
y	0.0742***		0.0515***	0.0531***	
	[0.00175]		[0.00575]	[0.00574]	
conj_inpd_mkt	-0,0025		-0,0021	-0,00275	
	[0.00268]		[0.00280]	[0.00273]	
cr5	0,105		0.225**	0,153	
	[0.0847]		[0.109]	[0.106]	
sect_inpd	-0,00986		0,00776	0,0148	
	[0.0127]		[0.0170]	[0.0168]	
lev	0.0225***		0.0275***	0.0243***	
	[0.00103]		[0.00167]	[0.00163]	
intern	-0.0200***		-0.0202***	-0.0217***	
	[0.00185]		[0.00305]	[0.00297]	
age		0.0517***			0.0509***
		[0.0108]			[0.0105]
pavitt_mh		0.0870***			0.0820***
		[0.0183]			[0.0182]
innorg		0,0231			0,0278
		[0.0175]			[0.0170]
r&d_exp		0.0514**			0.0603***
		[0.0207]			[0.0200]
mrk_exp		0,00339			-0,00465
		[0.0187]			[0.0181]
gp_int		0.259***			0.275***
		[0.0267]			[0.0260]
co		0,0331			0.0468**
		[0.0223]			[0.0216]
kl		0.175***			0.167***
		[0.00802]			[0.00790]
nwest		0.294***			0.324***
		[0.0288]			[0.0280]
neast		0.262***			0.288***
		[0.0290]			[0.0282]
centre		0.232***			0.251***
		[0.0331]			[0.0322]
Constant	-0.702***	8.629***	-0.464***	-0.479***	8.672***
	[0.0186]	[0.0930]	[0.0616]	[0.0614]	[0.0920]
Observations	5,629	2,510	2,500	2,500	2,500
RMSE	0.06499	0.41850	0.06206	0.06197	0.41635
R-squared	0.337	0.248			

Notes. Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1; the variables y, age and kl are in log values.

Appendix 2c - Determinants of firm economic performance: cross-section estimates over the period 2006-2008

	OLS		2SLS	3SLS	
variables	ros	y	ros	ros	y
y	0.0741***		0.0420***	0.0417***	
	[0.00184]		[0.00391]	[0.00388]	
conj_inpd_mkt	-0.00422**		-0,00127	0,0000427	
	[0.00214]		[0.00222]	[0.00216]	
cr5	0.127***		0.139***	0.102**	
	[0.0413]		[0.0426]	[0.0411]	
sect_inpd	-0.0324***		-0,0184	-0,01	
	[0.0109]		[0.0114]	[0.0112]	
lev	0.0191***		0.0229***	0.0196***	
	[0.000979]		[0.00109]	[0.00105]	
intern	-0.0276***		-0.0206***	-0.0234***	
	[0.00200]		[0.00221]	[0.00213]	
age		0.0656***			0.0658***
		[0.00847]			[0.00811]
pavitt_mh		0.122***			0.117***
		[0.0158]			[0.0157]
innorg		0.0447***			0.0462***
		[0.0138]			[0.0132]
r&d_exp		0.0797***			0.0834***
		[0.0154]			[0.0148]
mrk_exp		0.0462**			0.0455***
		[0.0181]			[0.0174]
gp_int		0.218***			0.240***
		[0.0204]			[0.0196]
co		0.0769***			0.0772***
		[0.0200]			[0.0191]
kl		0.152***			0.147***
		[0.00506]			[0.00493]
nwest		0.268***			0.277***
		[0.0207]			[0.0199]
neast		0.198***			0.206***
		[0.0211]			[0.0202]
centre		0.190***			0.200***
		[0.0250]			[0.0240]
Constant	-0.693***	8.806***	-0.357***	-0.353***	8.842***
	[0.0196]	[0.0562]	[0.0409]	[0.0406]	[0.0552]
Observations	5,063	5,046	5,026	5,026	5,026
RMSE	0.06243	0.43240	0.06421	0.06434	0.42923
R-squared	0.334	0.289			

Notes. Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1; the variables y, age and kl are in log values.

References

Allen, R. F. (1983). Efficiency, market power, and profitability in american manufacturing. *Southern Economic Journal*, pages 933–940.

Atuahene-Gima, K. (1996). Market orientation and innovation. *Journal of Business Research*, 35(2):93–103.

Bain, J. S. (1956). *Barriers to new competition: their character and consequences in manufacturing industries*, volume 3. Harvard University Press Cambridge, MA.

Baker, W. E. and Sinkula, J. M. (2009). The complementary effects of market orientation and entrepreneurial orientation on profitability in small businesses*. *Journal of Small Business Management*, 47(4):443–464.

Bartoloni, E. and Baussola, M. (2009). The persistence of profits, sectoral heterogeneity and firms' characteristics. *International Journal of the Economics of Business*, 16(1):87–111.

Battisti, G., Mourani, A.-G., and Stoneman, P. (2010). Causality and a firm-level innovation scoreboard. *Economics of Innovation and New Technology*, 19(1):7–26.

Battisti, G. and Stoneman, P. (2010). How innovative are UK firms? evidence from the fourth UK community innovation survey on synergies between technological and organizational innovations. *British Journal of Management*, 21(1):187–206.

Brown, S. L. and Eisenhardt, K. M. (1995). Product development: past research, present findings, and future directions. *Academy of Management Review*, 20(2):343–378.

Cefis, E. and Ciccarelli, M. (2005). Profit differentials and innovation. *Economics of Innovation and New Technology*, 14(1-2):43–61.

Clarke, R., Davies, S., and Waterson, M. (1984). The profitability-concentration relation: market power or efficiency? *The Journal of Industrial Economics*, 32(4):435–450.

Crépon, B., Duguet, E., and Mairessec, J. (1998). Research, innovation and productivity: An econometric analysis at the firm level. *Economics of Innovation and new Technology*, 7(2):115–158.

Day, G. S. (1994). The capabilities of market-driven organizations. *the Journal of Marketing*, 58(4):37–52.

Delorme Jr, C. D., Kamerschen, D. R., Klein, P. G., and Voeks, L. F. (2002). Structure, conduct and performance: a simultaneous equations approach. *Applied economics*, 34(17):2135–2141.

Demsetz, H. (1973). Industry structure, market rivalry, and public policy. *Journal of Law and economics*, 16:1–9.

Deshpande, R. and Webster Jr, F. E. (1989). Organizational culture and marketing: defining the research agenda. *The Journal of Marketing*, 53(1):3–15.

Frantzen, D. (2003). The causality between R&D and productivity in manufacturing: an international disaggregate panel data study. *International Review of Applied Economics*, 17(2):125–146.

Gatignon, H. and Xuereb, J.-M. (1997). Strategic orientation of the firm and new product performance. *Journal of marketing research*, pages 77–90.

Geroski, P. A., Machin, S., and Van Reenen, J. (1993). The profitability of innovative firms. *RAND Journal of Economics*, 24:198–211.

Griliches, Z. (1984). *R&D Patents and Productivity*. University of Chicago Press.

Griliches, Z. (1986). Productivity, research-and-development, and basic research at the firm level in the 1970s. *American Economic Review*, 76(1):141–154.

Griliches, Z. (1992). The search for R&D spillovers. *The Scandinavian Journal of Economics*, 94(1):S29–S47.

Han, J. K., Kim, N., and Srivastava, R. K. (1998). Market orientation and organizational performance: is innovation a missing link? *The Journal of marketing*, 62(4):30–45.

Hanel, P. and St-Pierre, A. (2002). Effects of R&D spillovers on the profitability of firms. *Review of Industrial Organization*, 20(4):305–322.

Hauser, J., Tellis, G. J., and Griffin, A. (2006). Research on innovation: A review and agenda for marketing science. *Marketing science*, 25(6):687–717.

Hawawini, G., Subramanian, V., and Verdin, P. (2003). Is performance driven by industry-or firm-specific factors? a new look at the evidence. *Strategic management journal*, 24(1):1–16.

Heshmati, A. and Lööf, H. (2006). Sources of finance, R&D investment and productivity: correlation or causality? *ICFAI Journal of Industrial Economics*, 3(4):43–59.

Hurley, R. F. and Hult, G. T. M. (1998). Innovation, market orientation, and organizational learning: an integration and empirical examination. *The Journal of Marketing*, 62(3):42–54.

ISTAT (2008). Misure di produttività. Statistiche in breve, Italian National Institute of Statistics.

Jaffe, A. B. (1986). Technological opportunity and spillovers of R&D: Evidence from firms' patents, profits, and market value. *The American Economic Review*, 76(5):984–1001.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *The American economic review*, 76(2):323–329.

Karshenas, M. and Stoneman, P. L. (1993). Rank, stock, order, and epidemic effects in the diffusion of new process technologies: An empirical model. *The RAND Journal of Economics*, 24(4):503–528.

Krishnan, V. and Ulrich, K. T. (2001). Product development decisions: A review of the literature. *Management science*, 47(1):1–21.

Lhuillery, S. (2014). Marketing and persistent innovation success. *Economics of Innovation and New Technology*, 23(5-6):517–543.

Los, B. and Verspagen, B. (2000). R&D spillovers and productivity: evidence from US manufacturing microdata. *Empirical economics*, 25(1):127–148.

Mairesse, J., Hall, B., Branstetter, L., and Crepon, B. (1999). Does cash flow cause investment and R&D? an exploration using panel data for french, japanese, and united states scientific firms. In Audretsch, D. B. and Thurik, R., editors, *Innovation, Industry Evolution and Employment*, pages 129–156. Cambridge University Press.

Mairesse, J. and Mohnen, P. (2010). Using innovations surveys for econometric analysis. In Hall, B. H. and Rosenberg, N., editors, *Handbook of the Economics of Innovation*, pages 1130–1155. Elsevier, Amsterdam.

Mairesse, J. and Sassenou, M. (1991). R&D productivity: A survey of econometric studies at the firm level. Working Paper 3666, National Bureau of Economic Research.

Mairesse, J. and Sassenou, M. (1995). R&D and productivity: a survey of the econometric literature. Working paper, Institut National de la Statistique et des Etudes Economiques (INSEE), Paris.

Mueller, D. C. and Cubbin, J. (2005). *The dynamics of company profits*. Cambridge University Press.

Narver, J. C. and Slater, S. F. (1990). The effect of a market orientation on business profitability. *The Journal of Marketing*, 54(4):20–35.

OECD, E. (2005). The measurement of scientific and technological activities. *Oslo Manual. Guidelines for Collecting and Interpreting Innovation Data*.

Olson, E. M., Walker Jr, O. C., and Ruekert, R. W. (1995). Organizing for effective new product development: the moderating role of product innovativeness. *The Journal of Marketing*, 59(1):48–62.

Peltzman, S. (1977). The gains an losses from industrial concentration. *Journal of Law and Economics*, 20(2):229–263.

Penrose, E. (1959). *The Theory of the Growth of the Firm, Basil*. London, Blackwell.

Pisano, G., Shuen, A., and Teece, D. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7):509–533.

Rebelo, S. (1991). Long-run policy analysis and long-run growth. *Journal of Political Economy*, 99(3):500–521.

Roberts, P. W. (1999). Product innovation, product-market competition and persistent profitability in the US pharmaceutical industry. *Strategic Management Journal*, 20(7):655–670.

Roberts, P. W. (2001). Innovation and firm-level persistent profitability: a schumpeterian framework. *Managerial and Decision Economics*, 22(4-5):239–250.

Rouvinen, P. (2002). R&D-productivity dynamics: Causality, lags, and 'dry holes'. *Journal of Applied Economics*, 5(1):123–156.

Rumelt, R. P. (1991). How much does industry matter? *Strategic management journal*, 12(3):167–185.

Schmalensee, R. (1985). Do markets differ much? *The American Economic Review*, 75(3):341–351.

Schmidt, T. and Rammer, C. (2007). Non-technological and technological innovation: strange bedfellows? Working Paper 07–052, ZEW, Centre for European Economic Research.

Schmoch, U., Rammer, C., and Legler, H. (2006). *National Systems of Innovation in Comparison: Structure and Performance Indicators for Knowledge Societies*. Springer.

Schubert, T. (2010). Marketing and organisational innovations in entrepreneurial innovation processes and their relation to market structure and firm characteristics. *Review of Industrial Organization*, 36(2):189–212.

Schumpeter, J. A. (1934). *The Theory of Economic Development*. Harvard University Press, Cambridge, MA.

Slade, M. E. (2004). Competing models of firm profitability. *International Journal of Industrial Organization*, 22(3):289–308.

Slater, S. F. and Narver, J. C. (1994). Market orientation, customer value, and superior performance. *Business horizons*, 37(2):22–28.

Stoneman, P. and Kwon, M. J. (1996). Technology adoption and firm profitability. *The Economic Journal*, 106(437):952–962.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic management journal*, 5(2):171–180.

Printed by
Gi&Gi srl - Triuggio (MB)
March 2015

ISBN 978-88-343-2983-2