

# What kind of relationship between firm size and innovation? The case of Latium's high tech enterprises

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## Abstract

The role of small and medium enterprises in the innovation process has become a fundamental policy issue because of the understanding that innovation is the key to economic development for the most developed countries. The focus of the work is on a sample of 518 high tech enterprises of Latium, whose innovative behaviour has been monitored by an *ad hoc* questionnaire. The results are encouraging: the sampled enterprises realize the primary role of innovation to gain competitiveness in the markets. The business of micro, small and medium enterprises has to be fostered and safeguarded through specific reforms able to play an effective role in the spread of innovation, the sharing of best practices and the support to less developed and troubled enterprises.

*Keywords: innovation, firm size, high tech sectors, questionnaire, Latium.*

## 1 Introduction

The role of small and medium enterprises (SMEs) in the innovation process has become a fundamental policy issue at regional, national and European level (European Commission [1, 2]), because of the understanding that innovation is the key to economic development for the most developed countries: a huge number of empirical analysis have highlighted the remarkable and growing contribution of SMEs to total innovation output (Pavitt *et al.* [3], Acs and Audretsch [4], Wood [5], Nauwelaers and Wintjes [6], Hodgkinson and McPhee [7]).

In Europe, 99,8% of firms are SMEs: this paper focus the attention on a sample of 518 micro (1–9 employees), small (10–49), medium (50–249) and few



large (more than 250) Latium's high tech enterprises, whose innovative behaviour has been monitored by an *ad hoc* questionnaire. In particular, the performance of SMEs will be compared to the innovative attitude of large firms, considered as a benchmark.

The paper is organized as follows: firstly, a brief review of literature about small and large firm advantages in innovation; broadly speaking, the relative strength of large firms is due to a greater availability of resources, while that of small firms is in terms of behavioural characteristics. Secondly, data collected through the questionnaire will be presented in order to provide a first glance of the innovative attitude of Latium's high tech firms. Finally, some concluding remarks and policy guidelines will be drawn.

## 2 Relative advantages of small and large firms

According to the seminal works of Schumpeter ([8, 9]) large firms foster technological innovation more efficiently than small firms: large firms, especially the ones with monopoly profits, are better able to finance R&D from internal sources, exploit a larger output over which to realize the benefits of process innovations and can diversify the risks of performing R&D (Vossen [10]). Kamien and Schwartz [11] suggest that there may be scale economies in the R&D process, while according to Nootboom [12] and Rothwell and Dodgson [13] large firms advantages are in the deeper specialization both of people and equipment.

On the contrary, as reported in Table 1, small firms are more motivated (Scherer [14]), show a less bureaucratic organization (Mansfield [15], Mansfield *et al.* [16]), a more efficient communication and flexibility and are able to offer contracts that attract top talent and retain most creative individuals (Zenger [17]).

Table 1: Relative advantages of small and large firms.

	Small firms	Large firms
<b>Organizational</b>	Little bureaucracy	Formal management skills
	Faster decision chains	Able to control complex organizations
	Faster internal communication	Time and resources to establish internal and external comprehensive networks
<b>Labour</b>	Motivated labour	More specialized labour
<b>Market</b>	Faster reaction to changing market requirements	Comprehensive distribution and servicing facilities
	Can dominate market niches	High market power with existing products
	Ability for customisation of production	Ability for diversification of production
		Able to erect entry barriers
<b>R&amp;D</b>	Higher R&D efficiency	Economies of scale and scope in R&D
	Faster learning and adapting of routines and strategy	Faster absorption of new technology
		Larger R&D laboratory
<b>Financial</b>	Risk taking	Spreads risk over a portfolio of products
		Easier access to external capital

Source: adapted from Vossen [10].



Finally, most empirical findings suggest the role of small firms as primary source of innovation in products, techniques and services (see, *inter alia*, Bolton [18] and Mueller [19]): the efficiency of R&D is higher with respect to large firms (Cooper [20], Scherer [21], Schmookler [22]), which may exploit, as Arrow [23] suggests, the organizational advantages of small firms purchasing innovations from them through acquisitions, joint ventures or other forms of cooperation.

### 3 The questionnaire

For the period 2000-2003, through an *ad hoc* questionnaire (see Osservatorio Fi.La.S. [24]) the innovative behaviour of a sample of 518 firms of the following high tech sectors (Table 2) has been monitored: advertising (ADV); audiovisual (AUD); biomedical (BIO); information & technology (IT); high tech manufacturing (MAN); publishing (PUB); business services (SER); telecommunications (TEL). As regards the choice of the sectors, not only producers but also users of advanced technological goods in the productive process have been considered as high tech.

Table 2: Composition of the sample: sectors and size.

Sector	Micro	Small	Medium	Large	Total
Advertising	12	11	0	0	23
Audiovisual	57	37	15	1	110
Biomedical	5	8	7	1	21
Information & Technology	80	62	14	0	156
High Tech Manufacturing	12	19	5	2	38
Publishing	35	15	3	0	53
Business Services	34	46	5	1	86
Telecommunications	7	16	7	1	31
<b>Total</b>	<b>242</b>	<b>214</b>	<b>56</b>	<b>6</b>	<b>518</b>

Source: Osservatorio Fi.La.S [24].

The remarkable presence in the sample of enterprises of audiovisual, information & technology and business services sectors mirrors the peculiar composition of the economy of Latium, one of the most innovative and economically advanced Italian regions. It is evident for the advertising firms a smaller size with respect to other sectors; on the contrary, for biomedical, business services and telecommunications micro size is not the most frequent size class observed.

#### 3.1 Product and process innovation

Product and process innovation is a *conditio sine qua non* for economic growth: introducing new, less expensive products of better quality is often the only way to cope with increasing, worldwide competition. Besides, this kind of innovation is fundamental for the economy as a whole, triggering leader-follower behaviours among enterprises of the same field and among different sectors.



Results for high tech firms of Latium are encouraging (Table 3): almost three-fourth of the surveyed enterprises introduced at least one product or process innovation; in particular, about 40% brought in both of them. As expected, almost all the large firms of the sample, characterized by a wider financial availability, introduced both of them.

Table 3: Process and product innovation by sector and firm size.

	None	Only Process	Only Product	Both	N
<b>Advertising</b>	34.8%	17.4%	13.0%	34.8%	<b>23</b>
<b>Audiovisual</b>	37.6%	16.5%	16.5%	29.4%	<b>109</b>
<b>Biomedical</b>	15.0%	5.0%	35.0%	45.0%	<b>20</b>
<b>Information &amp; Technology</b>	20.5%	5.8%	26.3%	47.4%	<b>156</b>
<b>High Tech Manufacturing</b>	27.8%	2.8%	22.2%	47.2%	<b>36</b>
<b>Publishing</b>	28.3%	15.1%	20.8%	35.8%	<b>53</b>
<b>Business Services</b>	29.4%	16.5%	15.3%	38.8%	<b>85</b>
<b>Telecommunications</b>	20.0%	0.0%	46.7%	33.3%	<b>30</b>
<b>All firms</b>	<b>27.3%</b>	<b>10.7%</b>	<b>22.5%</b>	<b>39.5%</b>	<b>518</b>
<b>Micro firms</b>	31.4%	10.3%	24.4%	33.9%	<b>242</b>
<b>Small firms</b>	25.2%	10.7%	19.6%	44.4%	<b>214</b>
<b>Medium firms</b>	17.9%	12.5%	25.0%	44.6%	<b>56</b>
<b>Large firms</b>	16.7%	0.0%	0.0%	83.3%	<b>6</b>

Source: Osservatorio Fi.La.S [24].

However, there are substantial sectoral differences: firms belonging to biomedical, I&T and high tech manufacturing sectors are much more active in terms of both process and product innovation than the average; on the contrary, audiovisual firms are far below the average. Advertising and audiovisual sectors show the highest percentage of firms without any kind of innovation, while for firms belonging to biomedical, I&T and telecommunications fields the opposite situation has been observed. In particular, in the telecommunications sector the innovation is concentrated above all on product.

### 3.2 Organizational innovation

The importance, both theoretical and practical, of the introduction of new forms of management is not at all new (Freeman and Perez [25]): quality control, diversification and flexibility are key elements to gain competitive advantages in the new international division of labour (Nielsen and Lundvall [26]).

As a consequence of process and/or product changes, slightly more than 40% of the responding firms have introduced significant innovations in their organization (Columns 2 and 3 of Table 4): firms of high tech manufacturing, advertising and above all telecommunications sectors show the best propensity to management innovations; on the contrary, audiovisual and publishing sectors seem to be the less engaged in organizational changes.

Consistently with stylized facts, the correlation between organizational innovation and firm size is evident: 37% of micro firms introduced during the considered period at least one innovation in their management; the share rises up to 42% for small ones and up to 50% as regards medium and large ones.



Concerning the role played by technology in the organizational order of the firms (Columns 4 and 5 of Table 4), its impact is particularly evident in the advertising and biomedical sector, while for high tech manufacturing the opposite situation was observed.

Table 4: Organizational innovation by sector and firm size.

	Due to prod/proc innovation		Due to new technologies		N
	No	Yes	No	Yes	
<b>Advertising</b>	47.8%	52.2%	30.4%	69.6%	<b>23</b>
<b>Audiovisual</b>	66.1%	33.9%	43.1%	56.9%	<b>109</b>
<b>Biomedical</b>	55.0%	45.0%	20.0%	80.0%	<b>20</b>
<b>Information &amp; Technology</b>	60.9%	39.1%	41.7%	58.3%	<b>156</b>
<b>High Tech Manufacturing</b>	52.8%	47.2%	47.2%	52.8%	<b>36</b>
<b>Publishing</b>	67.9%	32.1%	41.5%	58.5%	<b>53</b>
<b>Business Services</b>	55.3%	44.7%	38.8%	61.2%	<b>85</b>
<b>Telecommunications</b>	43.3%	56.7%	40.0%	60.0%	<b>30</b>
<b>All firms</b>	<b>59.4%</b>	<b>40.6%</b>	<b>40.4%</b>	<b>59.6%</b>	<b>518</b>
<b>Micro firms</b>	62.8%	37.2%	38.4%	61.6%	<b>242</b>
<b>Small firms</b>	57.9%	42.1%	40.2%	59.8%	<b>214</b>
<b>Medium firms</b>	50.0%	50.0%	50.0%	50.0%	<b>56</b>
<b>Large firms</b>	50.0%	50.0%	33.3%	66.6%	<b>6</b>

Source: Osservatorio Fi.La.S [24].

### 3.3 Internal and external innovative activities

Process, product and/or organizational changes are only the tip of the iceberg, the result of a long, complex and unpredictable path. Recalling a wider meaning of the concept of innovation, for a comprehensive analysis of its level in the surveyed firms, all the performed internal and external innovative activities have to be considered, because they represent the potential basis for future (further) innovations.

Concerning the internal activities, technological licences purchase, activity of R&D within the firm, marketing and analysis of products of competitive firms were considered; as regards external ones, research activity performed by private or public corporations on behalf of the firm and research project in association with other firms or Universities were taken into account.

Table 5 shows that R&D within the firm and technological licences purchase are the innovative actions usually implemented by firms; at sectoral level, telecommunications, advertising and, above all, I&T sectors are the most active. On the contrary, external innovative activities are scarcely considered by firms, with the only exception of the research projects in association with other firms, in particular for business services, advertising and biomedical sectors.

### 3.4 Technological investments

In the innovation challenge, technological investments are crucial. Indeed, the adoption a new technology, new to the firm but not necessarily new to the sector, is innovation in itself and represents the first step towards further changes, as regards both the production and the management aspect.



Table 5: Internal and external innovative activities of all surveyed firms.

	Never	Sometimes	Often	Always
<b>R&amp;D within the firm</b>	27.17%	20.81%	24.66%	27.36%
<b>Technological licences purchase</b>	33.46%	29.18%	25.49%	11.87%
<b>Marketing of innovative products</b>	48.52%	26.23%	15.98%	9.27%
<b>Analysis of products of competitive firms</b>	34.64%	29.94%	19.57%	15.85%
<b>Research activity by private corporations</b>	66.67%	23.98%	6.24%	3.12%
<b>Research activity by public corporations</b>	79.34%	15.98%	3.51%	1.17%
<b>Research project with other firms</b>	32.43%	41.36%	21.17%	5.05%
<b>Research project with Universities</b>	70.76%	22.61%	4.87%	1.75%

Source: Osservatorio Fi.La.S [24].

Table 6: Technological investments by sector and firm size.

Sector/Size	Technological Investments
<b>Advertising</b>	73.91%
<b>Audiovisual</b>	61.50%
<b>Biomedical</b>	95.00%
<b>Information &amp; Technology</b>	83.97%
<b>High Tech Manufacturing</b>	69.44%
<b>Publishing</b>	64.15%
<b>Business Services</b>	79.52%
<b>Telecommunications</b>	76.67%
<b>All firms</b>	<b>74.90%</b>
<b>Micro firms</b>	70.78%
<b>Small firms</b>	78.20%
<b>Medium firms</b>	79.63%
<b>Large firms</b>	83.33%

Source: Osservatorio Fi.La.S [24].

The general attitude of the surveyed firms is encouraging (Table 6): three-fourth of them will invest in technology at least 5% of their turnover. In particular, biomedical and I&T enterprises present the highest percentage values; on the contrary, technological investments are less contemplated than the average for firms belonging to audiovisual and publishing fields. Because of the larger availability of resources, small, medium and in particular large firms will invest a greater share of their turnover with respect to micro ones.

### 3.4.1 Reasons of technological investment

Among surveyed firms which are willing to invest, reasons of such important decision have been analysed (Table 7). It is clear that the aim of technological investments is, for almost half of the sample, the growth of the turnover, especially for firms of advertising, biomedical and telecommunications sectors.

Competition (18.2%), gain of market share (16.1%) and expansion of the size is at the basis of investment decision for fewer and larger firms. Other reasons, for example the expansion of the productive capacity or the reduction of personnel costs, turned out to be not really relevant in the sample.

### 3.4.2 Obstacles to innovation

Among the main obstacles to technological investments (Table 8), the role of the bureaucratic-financial obstacle is predominant: almost 60% of the surveyed firms



singled out the lack of own funds as the main barrier to innovation, in particular the high tech manufacturing and information & technology sectors and micro firms. On the contrary, advertising and biomedical are the less hit sectors. At the same time, half of the sampled enterprises suggested the difficulty in accessing to public funds, especially as regards telecommunications and advertising ones, while for business services ones this kind of problem is less evident.

Table 7: Reason of technological investments (% values).

<b>Reason \ Sectors</b>	<b>ADV</b>	<b>AUD</b>	<b>BIO</b>	<b>IT</b>	<b>MAN</b>	<b>PUB</b>	<b>SER</b>	<b>TEL</b>	<b>All firms</b>
Growth of turnover	65.0	49.2	61.1	46.2	42.9	46.9	44.1	68.4	<b>49.1</b>
To meet the competition	15.0	27.7	27.8	14.4	17.9	15.6	18.6	10.5	<b>18.2</b>
Gain of market share	10.0	7.7	11.1	18.2	21.4	21.9	16.9	21.1	<b>16.1</b>
Expansion of the size	10.0	15.4	0.0	15.2	10.7	12.5	13.6	0.0	<b>12.6</b>
Other	0.0	0.0	0.0	6.1	7.1	3.1	6.8	0.0	<b>3.8</b>
<b>Reason \ Firm size</b>	<b>Micro</b>		<b>Small</b>		<b>Medium</b>		<b>Large</b>		<b>All firms</b>
Growth of turnover	52.6		44.2		50.0		20.0		<b>49.1</b>
To meet the competition	19.1		19.9		9.5		40.0		<b>18.2</b>
Gain of market share	12.7		18.6		21.4		20.0		<b>16.1</b>
Expansion of the size	13.3		10.3		19.0		20.0		<b>12.6</b>
Other	2.3		7.1		0.0		0.0		<b>3.8</b>

Source: Osservatorio Fi.La.S [24].

Table 8: Obstacles to technological investments (% values).

<b>Obstacle \ Sector</b>	<b>ADV</b>	<b>AUD</b>	<b>BIO</b>	<b>IT</b>	<b>MA</b>				<b>All Firms</b>
					<b>N</b>	<b>PUB</b>	<b>SER</b>	<b>TEL</b>	
Lack of own funds	39.1	50.5	43.8	72.4	69.4	58.5	46.4	50.0	<b>58.0</b>
Difficulty in accessing to public funds	65.2	44.0	44.4	57.7	58.3	52.8	33.3	66.7	<b>50.7</b>
Organizational problems	30.4	20.2	20.0	31.4	16.7	26.4	28.6	17.9	<b>25.8</b>
Lack of information	30.4	14.7	29.4	33.3	22.2	32.1	16.7	7.1	<b>23.9</b>
Lack of scientific-technological structures	26.1	23.9	20.0	27.6	25.0	18.9	17.9	17.9	<b>23.2</b>
Lack of partner firms	21.7	22.0	6.7	26.9	16.7	11.3	15.5	3.6	<b>19.4</b>
Lack of professional formation	34.8	18.3	6.7	19.2	27.8	18.9	17.9	10.3	<b>19.2</b>
Lack of visibility	17.4	15.6	20.0	21.2	8.3	17.0	17.9	3.6	<b>16.9</b>
<b>Obstacle \ Firm size</b>	<b>Micro</b>		<b>Small</b>		<b>Medium</b>		<b>Large</b>		<b>All Firms</b>
Lack of own funds	60.2		57.2		50.9		16.7		<b>58.0</b>
Difficulty in accessing to public funds	49.8		54.5		41.5		16.7		<b>50.7</b>
Organizational problems	22.2		31.9		17.3		0.0		<b>25.8</b>
Lack of information	22.6		26.9		17.0		0.0		<b>23.9</b>
Lack of scientific-technological structures	24.0		24.2		17.0		0.0		<b>23.2</b>
Lack of partner firms	21.9		18.4		13.2		0.0		<b>19.4</b>
Lack of professional formation	16.5		22.7		17.0		0.0		<b>19.2</b>
Lack of visibility	18.6		17.4		7.5		0.0		<b>16.9</b>

Source: Osservatorio Fi.La.S [24].



One-fourth of the firms highlighted the negative role played by organizational problems, lack of information and scientific-technological structures on the path to innovation, even if biomedical, business services and above all telecommunications sectors are less involved.

Finally, the lack of partners, professional formation and visibility in scientific-technological structures are less determinant: only 15–20% of surveyed firms considered these reasons as a real obstacle.

As expected, large firms call for a distinct stance: no significant obstacles to investment have been observed given their relative financial and organizational advantage with respect to SMEs.

### 3.5 Expected turnover growth

Regardless the innovation level of the surveyed firms, the expected average turnover growth for period 2004–2005 reveals their health and optimism over the future and the economy as a whole (Table 9).

Table 9: Expected turnover growth by sector and size (2004–2005).

Sector/Size	Expected turnover growth
Advertising	23.7%
Audiovisual	11.5%
Biomedical	17.8%
Information & Technology	25.0%
High Tech Manufacturing	22.7%
Publishing	20.1%
Business Services	16.7%
Telecommunications	20.8%
<b>All firms</b>	<b>19.5%</b>
Micro firms	19.0%
Small firms	19.8%
Medium firms	20.2%
Large firms	11.7%

Source: Osservatorio Fi.La.S [24].

The situation for high tech sectors of Latium is reassuring: the average expected turnover growth is around 20%, ranging from 11.5% of audiovisual field to 25% of I&T one. Besides, there are not significant differences in the values of micro, small and medium enterprises, while as expected large firms brought in lower estimations, given the extremely larger initial levels of their turnover.

## 4 Conclusions

For the development of the economy as a whole, innovation is a key element that firms can't waive to consider. Globalisation has widened market competition and innovation is crucial in the challenge launched by emerging countries.

Innovation has been deeply analysed within a sample of 518 high tech enterprises. Not only process and product innovation has been considered, but also organizational change, other internal and external activities as well as the technological investments and the obstacles faced by firms to implement them.



Results for high tech firms of Latium are encouraging: first of all, the sampled enterprises realize the primary role of innovation to gain competitiveness on the markets, as shown by the satisfactory level of propensity to technological investments.

Best practices of innovation are, in general, in advertising, biomedical and I&T sectors; from the point of view of firm size, core of innovation is of course in large firms, even if adopting a wide concept of innovation, differently from a lot of other surveys, no correlation with size has been traced among micro, small and medium sampled firms.

In this regard, as pointed out by European Commission [2], business of micro, small and medium enterprises has to be fostered and safeguarded. Policy debate has to take into account their wealth and potential: thanks to a clear and detailed picture of the situation over firms of different sectors, policy tools and reforms may be specifically addressed, playing an effective and successful role in the spread of innovation, the sharing of best practices and the support to less developed and troubled enterprises.

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