Innovation, profitability and growth of the new-established Italian firms operating in the Knowledge Based Industry

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Abstract

This paper examines the relationship between entry, innovation and economic performance of a sample of Italian firms. It focuses on a set of industries that experienced a high rate of innovation, called (in this paper) "Knowledge Based Industries" (KBI).

An enormous literature has examined the relationship between innovation and entry and has identified great differences across entrants in innovativeness.

In this paper, we want to analyze these issues for entrants in Italian knowledge base industries. We first examine the relationship between innovation, profitability and growth in a sample of Italian firms active in knowledge based industries and then, against this background, we try to answer the following three questions.

Is entry in Italian knowledge base industries associated with innovation?

Do innovative entrants have higher profitability than non-innovative ones?

Do innovative entrants have higher growth rates than non-innovative ones?

1. Introduction

This study aims to analyze the underlying relationships between innovation and economic performance (in terms of both profitability and growth) in the so-called knowledge based industry. In the last two decades this relationship has been widely investigated at the firm level due to the growing availability of longitudinal micro data-sets collecting not only financial and economic informations, but also indicators of innovative activities carried out by the firms. Thus, a large new body of literature has grown mainly suggesting that innovative firms perform better than non innovative ones in terms of a profits, growth, productivity, export, survival, and so on. However, as Brusoni et al. (2006) point out, the beneficial effects of innovation on firms performance still have some unanswered questions: are they transitory or permanent? Are they sector-, technology-, and firm-specific? Why certain performance variables seem to be affected by innovation but others do not? How does innovation impact on performance?

There are two main points of view concerning how innovative activities may affect the profitability of the firms. In the traditional view, innovations have only a transitory effect on the firm profitability by increasing its competitiveness in the short-run. The introduction of an innovation gives to the firm a temporary monopoly power and allows to exploit higher profits by increasing the firm's market share until other firms can imitate the innovation (Aghion and Howitt, 1992; Klepper, 1996).

A second approach stresses the assumption that innovations intrinsically "characterize" a firm by creating a structural difference between innovating and non-innovating firms. According to this point of view, each firm owns specific and cumulative technological competencies developped from the various learning processes the firm has experienced. These firm's specific competencies enable it, together with specific behavioral patterns, to better face changes in the market in order to survive or even to obtain satisfactory profits over time (see Malerba and Orsenigo (1995), Cohen and Levin (1989), Dosi et al. (1995).

Previous empirical studies (Geroski, Machin and Van Reenen (1993); Geroski, Van Reenen and Walters (1997), Cefis and Ciccarelli (2005)) have found positive, although not well-determined, direct effects of innovations on profitability in the short run, and large indirect effects due to the relative insensitiveness of innovating firms to adverse macroeconomic shocks.

Concerning the impact of innovation firm's growth there is a less clear picture arising from the empirical evidence. These studies mainly rely on the literature assesseing the so-called Gibrat's law, which basically assumes that firm's size follows a random walk and hence that firm s growth is driven by small idiosyncratic shocks. Hence, if we believe that innovation is a driving force for growth, this theory would imply to consider it as a process that occurs randomly among firms, which sounds to be misleading in some sense.

In this work we assume, instead, that innovation can be view as a crucial activity (particularly in the knowledge based industries) which enables new entrants to survive and grow faster than competitors. Moreover firms can recognize the key role played by innovation and pursue it in a strategic way that may sacrifices short term profits for growth to ensure them a larger market share.

The outline of this paper is the following:

- section 2 describes the building steps of the dataset involved in thee analysis and explains the definition adopted in this work for innovation and knowledge based industry;

- section 3 introduces the types of economic performance indicators adopted and report some statistically significant patterns in our sample;
- section 4 describes the methodology adopted for estimating the firm's return to innovation and draws some conclusions on the main findings.

2. Data description

2.1 Panel Construction

Our analysis is based on a comprehensive dataset which involves different data sources[1]. It has been built with data coming from the third Italian Innovation Survey (1998-2000), the equivalent for Italy of the third Community Innovation Survey (CIS3), which has been matched with other data sources coming from the Italian Statistical Archive of Operating Firms (ASIA – Archivio Statistico delle Imprese Attive) and the financial accounting budgets register of the observed firms for the years 1998-2003.
The original CIS3 dataset encompasses various informations of representative sample of 15512 Italian firms who responded to the Third Community Innovation Survey carried for Italy by the Italian National Institute of Statistics (ISTAT) on behalf of the Statistical Office of the European Communities (EUROSTAT) during 2002.

The target population of the survey is determined by all the enterprises (about 160.000 according to the Council Regulation (EEC) N° 696/93 definition) with at least 10 employees operating in manufacturing and service sectors during 2000. The final sample (about 30.000) of surveyed firms included all the enterprises with more than 250 employees and a random sample for the enterprises with less than 250 employees stratified according to their industrial sector (2 digits level NACE classification), their size class according to their number of employees (10-19, 20-49, 50-249) and their regional allocation (Nuts classification)[2].

The matching between the CIS3 dataset and the financial accounting budgets registers database has been performed by linking the firm's fiscal code (Codice Fiscale) which uniquely identifies every firm operating in Italy. If a firm in the innovation survey never matched any of the financial accounts datasets during years 1998-2003 it has been dropped from the sample, with a total of 3949 dropouts.
Table 2.1 summarizes the size distribution between matched and unmatched firms according on informations available on the CIS3 survey for year 2000.

Table 2.1

SIZE DISTRIBUTION (year 2000) between matched and unmatched	N. of obs.	Mean	Std. Dev.	Min.	Max.
Turnover matched	11563	35479	326980.4	3	24500000
Turnover unmatched	3949	32909	249671.0	10	7362804
N. of employees matched	11563	154	1783.4	7	172224
N. of employees unmatched	3949	88	599.0	10	17072

[1] The authors are grateful to Giulio Perani and Claudio Cozza for their very valuable effort in setting-up the dataset.
[2] See ISTAT (2004) for more details on survey's methodology.

We can see that, in term of number of employees, larger sized firms have a greater probability to be matched, in particular for firms with more than 17072 employees there was at least one year of financial accounting data available. A similar evidence holds also, to a lesser extent, for size differences in term of total turnover.

Since sales is a key variable in our analysis (we adopt %change in sales as a measure of firm performance), we further deleted potential outliers by dropping those firms with a sales amount greater than 2 billions of euros and we control for potential dramatic changes in sales due to reorganization activities such as splits or mergers by dropping also those firms who experienced both an increase in sales greater than 200% and a decrease greater than 66% in a year.

We then end-up with an unbalanced panel of 10616 firms distributed across the years 1998-2003 (**See Table 2.2**).

Table 2.2

PANEL CLEANING	**Sample Size**	**Dropouts**
INITIAL SAMPLE (CIS3 Survey)	15512	
No match with any financial data (98-03)	11563	3949
sales<0 or sales>2blns	11364	199
% sales increase>200 (mergers?)	10939	425
% sales decrease>66 (splits?)	10616	323

Due to entry (e.g. establishment occurred in the period 1998-2000) and exit (e.g. failure occurred in the period 1998-2003) of the firms during their life-cycle, our dataset is affected by attrition. **Figure 2.1** shows the distribution of matched firms along the years considered, if we compare it with **Figure 2.2** we can see that (as expected) attrition becomes more severe the wider the time-span window considered. Unfortunately we have no precise information on the nature of the exit of a firm from the sample, whereas we are aware that it doesn't happen purely at random but as a consequence of different events such as change in fiscal domicile or juridical form, fusion, total merge or acquisition by other firms, inheritance and succession, bankruptcy and failure[3].

[3] This sample selection problem has to be taken into account when interpreting the results of our analysis focussing on the balanced subset of firms. However, although the firms subject to attrition (i.e. exited in t+1 period considered) are (on average) smaller, less profitable and with lower growth rates than non exiting ones, the probability of introducing new product (InnPd) and its intensity (TurnMar), which are our key independent variables (cfr. the next section), seem to be unaffected by attrition, as verifyied by paremetric test on the mean and nonparametric test on the distribution between exited and not-exited firms. These findings should attenuate the concern about the presence of attrintion bias when discussing the results in section 4.3.

Figure 2.1

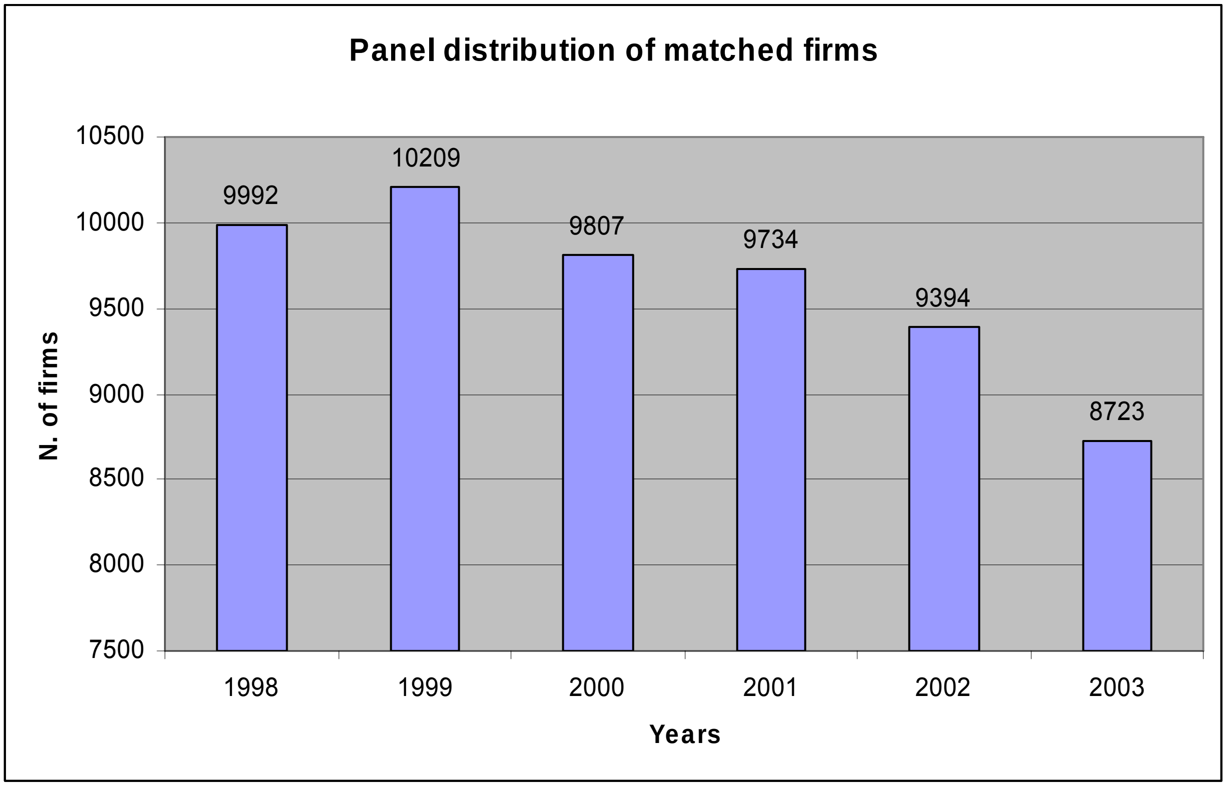
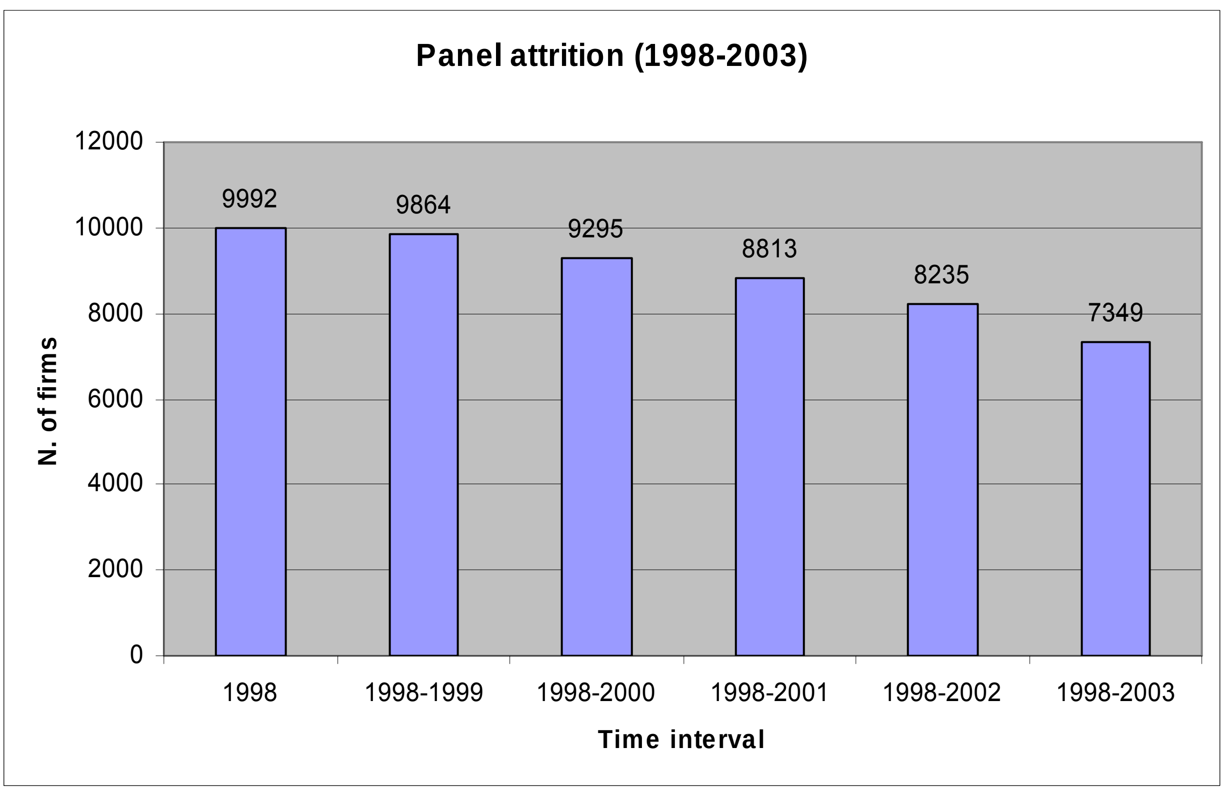


Figure 2.2



2.2 The 1998-2003 Panel dataset (CIS3 1998_2003)

The first step of our analysis is descriptive comparison of the economic performance between innovators and non-innovators during the years immediately after the CIS3 reference period. Our analysis involves the 1998-2003 dataset which is a balanced panel of 7349 firms for which we have data on innovation activity during the period 1998-2000 coming from the CIS3 survey and accounting balance sheet data for the years 1998-2004 (henceforth **CIS3 1998_2003** dataset).
As already mentioned above, Figure 2.2 shows in detail the sample size decay as long as we consider a wider time-span balanced panel data starting from 1998 to 2003.
Since our interest lay mainly on Knowledge Based Industry (KBI), we focus our attention only on the following sectors which are traditionally known to be the most intensive in innovation activities:

24 - Manufacture of chemicals and chemical products;
25 - Manufacture of rubber and plastic products;
29 - Manufacture of machinery and equipment n.e.c;
30_72 - Manufacture of office machinery and computers; computer and related activities
31- Manufacture of electrical machinery and apparatus n.e.c;
32_64.2 - Manufacture of radio, television and communication equipment and apparatus; Telecommunications
33 - Manufacture of medical, precision and optical instruments, watches and clocks;
34 - Manufacture of motor vehicles, trailers and semi-trailers.

Table 2.3 summarizes the distribution across industry sectors of the total number of firms in the CIS3 1998_2003 dataset and the percentage (calculated within each sector) of the firms with any ongoing or completed innovation activity during the period 1998-2000 (**Any Innovators**), with any new or significantly improved products (for the enterprise) introduced onto the markets (**Product Innovators**) and with any new or significantly improved production processes (including methods of supplying services and ways of delivering products)[4] introduced (**Process Innovators**). The last column summarizes an estimate (for each sector) of the percentage of the firms' turnover in year 2000 due to new or significantly improved products introduced during the period 1998-2000 (**TurnIn**).
The KBI industry encompasses 1988 firms (about 27% of the CIS3 1998_2003 sample size), 1230 of those are (Any) Innovators (40.3% of the total number of Innovators), 813 are Product Innovators (37.2% of the total number of product innovators) and 1060 are Product Innovators (40.3% of the total number of Product Innovators), reflecting an higher intensity of innovation activities with respect to the other sectors. This higher innovative intensity is also reflected by **Turnin** which has an average value of 21.3% for firms in KBI sectors and 8% for firms in non-KBI sectors.

[4] See for details the Harmonized Questionnaire of the Third Community Innovation Survey – Eurostat.

Table 2.3 - Distribution of Innovators across sectors Panel 1998-2003

ATECO 2digits	N. of firms	% of Innovators within sectors			TurnIn = % of turnover in 2000 from new or improved products
		Any Innovators	Product Innovators	Process Innovators	
10	1	100.00	0.00	100.00	0.00
11	1	0.00	0.00	0.00	0.00
13	1	0.00	0.00	0.00	0.00
14	123	21.95	11.38	18.70	3.28
15	297	43.43	30.64	33.33	8.89
17	266	45.11	30.08	33.46	11.36
18	190	24.21	12.63	17.89	4.22
19	138	29.71	16.67	22.46	9.06
20	168	38.10	28.57	32.14	11.65
21	197	37.06	21.83	30.46	7.21
22	210	49.52	27.62	42.86	13.00
23	58	37.93	18.97	31.03	2.88
24	322	63.66	52.17	42.55	14.79
25	299	50.17	37.79	37.79	12.02
26	307	48.53	33.88	39.41	13.67
27	204	50.49	27.45	37.75	8.40
28	333	47.75	33.93	33.03	10.86
29	401	69.83	61.85	41.65	25.68
30	39	64.10	58.97	20.51	31.67
31	240	58.75	54.17	40.83	20.51
32	116	66.38	57.76	47.41	23.80
33	172	71.51	65.70	45.35	31.24
34	159	59.12	52.20	41.51	21.81
35	92	40.22	32.61	27.17	14.00
36	254	42.52	30.71	29.92	11.50
37	44	31.82	13.64	20.45	4.77
40	37	24.32	8.11	21.62	2.11
41	26	34.62	15.38	34.62	8.81
50	236	23.31	14.83	17.80	8.11
51	373	35.12	19.57	24.66	7.73
52	280	18.93	9.29	14.29	3.68
55	225	24.00	15.11	17.33	4.73
60	254	19.69	9.06	14.57	3.94
61	33	15.15	9.09	3.03	3.21
62	12	16.67	16.67	8.33	8.33
63	327	20.80	11.01	15.29	4.70
64	21	14.29	14.29	14.29	9.05
65	13	23.08	15.38	23.08	5.77
67	42	21.43	4.76	16.67	3.12
70	35	8.57	8.57	2.86	1.11
71	41	24.39	21.95	14.63	14.95
72	233	56.65	48.07	37.77	24.66
73	30	66.67	40.00	46.67	21.83
74	499	29.06	19.64	21.64	6.91
Total	7349	41.54	29.99	29.77	11.65

3. Differences in Profitability and Growth Rates between Innovators and Non-Innovators in KBI sectors.

The aim of this section is to compare the economic performance of KBI firms in our panel between innovators and non-innovators both in term of profitability and growth.
Two different index of profitability are computed:

1) **OPR** (Operating Profit Ratios) which is the ratio between operating profits (excluding any financial revenues) and sales;
2) **ROTA** (Return on Total Assets) which is the ratio between overall profits[5] (including financial revenues) and total assets.

Economic growth is measured by calculating total sales growth rates: **GRTurn** = $\log(SALES_t) - \log(SALES_{t-1})$.
Our comparison in the next subsections will be also disentangled among small, medium and large firms (according to the number of employees in year 2000) and between newly established and incumbent firms.

3.1 Product Innovation and Profitability in the KBI.

In this sub-section we analyze the differences in term of profitability (measured by both OPR and ROTA) between "Innovators" and "Non-Innovators" across the years 2000-2003, i.e. during the years immediately following the CIS3 Survey reference period (1998-2000). We refer the term "Innovators" only to "Product Innovators" i.e. those firms (operating in KBI sectors) who introduced any new or significantly improved products (for the enterprise) onto the markets during the 1998-2000. Unfortunately we have no informations available on the innovative activity of firms during the next period 2001-2003[6].
The advantage of using this indicator of "innovativeness" coming from the CIS3 Survey, compared to other indicators such as patents and R&D expenses, relies in its availability even for small enterprises which often do not have enough resources to apply for a patent or to face the risk of engaging important R&D projects.
Table 3.1 reports the percentage of Product innovators according to firm's size measured by the number of employees registered in 2000. As we can see, about 53% of the firms in our panel introduced at least one new or significantly improved product, but the percentage of product innovators increases significantly with the size of the firms. Of course there could be several factors for explaining this phenomenon (high costs and high risks for developing new product, liquidity constraints more binding for small firms, and so on), the analysis of the determinants of product innovations will be the focus of the second part of this work.

[5] Calculated bifore taxes.
[6] A further integration of the dataset with CIS4 Survey data is scheduled as a future development of this work.

Tab. 3.1 - Distribution of Product Innovators according to size (n. of employees)

Size	No InnPd	InnPd	Total
10-20	333	210	543
	61.33%	38.67%	100%
21-50	286	268	554
	51.62%	48.38%	100%
>50	309	582	891
	34.68%	65.32%	100%
Total	928	1,060	1,988
	46.68%	53.32%	100%

Pearson chi2(2) = 103.7862 Pr = 0.000
Lik-ratio chi2(2) = 104.9261 Pr = 0.000

Tables 3.2 and 3.3 show the distribution of average OPR and ROTA indexes calculated across different size classes (in columns): small (10 to 20 employees[7]), medium (21 to 50 employees) and large (more than 50 employees) and for different years (in rows). The last two rows of the tables we report the average profitability index during the 4 years period and the number of firms in each group.

Considering all firms, regardless to the their size, the last two columns of Tables 3.1 and 3.2 show that, on average, firms who successfully developed new products experienced a greater profitability in the following four years than non-innovators. The statistical significance of this difference is greater when considering OPR than ROTA and tends to decay with time.

Focusing on size, we can see that the higher profitability of Innovators with respect to Non-Innovators holds in particular for medium-sized firms, whereas for small-sized firms this difference is weaker and for large sized-firms is also negative in some years, suggesting that (for larger firms) profitability may be driven by other forces than product innovation, such as process innovation or other non innovation-related revenues such as the ones related to their market dominant position.

Tab. 3.1 - Average OPR (meanX100) according to size and innovation activity (all firms)

OPR all									
	Size						All		
Year	**10-20**		**21-50**		**>50**				
	InnPd	**No InnPd**	**InnPd**	**No InnPd**	**InnPd**	**No InnPd**	**InnPd**	**No InnPd**	
2000	5.35	5.36	7.00	5.50	6.68	5.64	6.50	5.50	**
2001	6.67	5.57	6.62	5.28	5.61	5.78	6.08	5.55	**
2002	6.42	3.96	6.65	3.96	4.48	5.12	5.41	4.35	**
2003	4.38	2.79	4.56	2.91	3.54	3.94	3.96	3.21	
avg 00_03	5.70	4.42	6.21	4.41	5.08	5.12	5.49	4.65	**
N	**210**	**333**	**268**	**286**	**585**	**309**	**1063**	**928**	

Difference in mean statistically significant. Significance level one tail t-test *=1%, **=5%, ***=10%

[7] In year 2000.

Tab. 3.2 - Average ROTA (meanX100) according to size and innovation activity (all firms)

ROTA all									
	Size						All		
Year	10-20		21-50		>50				
	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	
2000	6.34	6.29	7.36	6.98	6.85	5.94	6.88	6.38	*
2001	7.51	5.53	7.52	6.07	5.56	6.09	6.44	5.88	*
2002	6.08	5.03	6.90	4.65	4.88	5.27	5.63	4.99	*
2003	3.92	4.23	4.60	3.21	3.95	3.64	4.11	3.72	
avg 00_03	5.96	5.27	6.60	5.23	5.31	5.23	5.76	5.24	*
N	210	333	268	286	585	309	1063	928	

Difference in mean statistically significant. Significance level one tail t-test *=1%, **=5%, ***=10%

In Tables 3.3 and 3.4 we restrict our analysis only on new firms which were established during years 1993-1998. For this subsample of newly established firms there are no overall significant differences in profitability between Innovators and Non-Innovators (last two columns), although small innovative firms tend to show an higher profitability (both in term of OPR and ROTA) than non-innovative ones in the closest years immediately after the CIS3 Survey reference period (2000-2003) and medium sized innovative firms tend to show the same superior profitability with some years of delay (2002-2003).

Tab. 3.3 - Average OPR (meanX100) according to size and innovation activity (newly established firms)

OPR new								
	Size						All	
Year	10-20		21-50		>50			
	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd
2000	5.29	4.81	4.95	5.80	4.37	6.57	4.79	5.39
2001	6.37	5.68	4.89	5.86	4.21	6.09	4.97	5.80
2002	6.09	2.12	6.49	3.73	2.12	6.78	4.54	3.35
2003	2.34	4.37	4.15	3.89	1.95	3.05	2.77	4.01
avg 00_03	5.02	4.25	5.12	4.82	3.16	5.62	4.27	4.64
N	29	77	38	43	49	23	116	143

Tab. 3.4 - Average ROTA (meanX100) according to size and innovation activity (newly established firms)

ROTA new								
	Size						All	
Year	10-20		21-50		>50			
	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd
2000	8.34	5.90	5.24	7.36	6.00	5.79	6.34	6.32
2001	7.17	5.76	6.98	4.99	5.39	7.21	6.35	5.76
2002	6.73	4.25	3.23	-1.46	2.92	7.53	3.97	3.06
2003	2.98	5.01	4.34	1.80	3.02	2.35	3.44	3.61
avg 00_03	6.30	5.23	4.95	3.17	4.33	5.72	5.03	4.69
N	29	77	38	43	49	23	116	143

3.2 Product Innovation and Growth in the KBI.

In the previous sub-section we considered two well known indexes of profitability as indicators of the firm's economic performance. Although profits can be considered as the final goal, there could also be alternative objectives that the firm (especially if new and small) may want to pursue in the mid term such as increasing market shares or expanding the market.
If this is true, only looking at firm's profitability may be a misleading indicator of firm's economic performance. For small or newly founded firms, in particular, we may see a trade off between profits and market shares if, for example, they lowered prices in order to achieve the minimum market size needed to reach the minimum efficient operating scale.
Since we do not know the true market share for each firm, we considered the size of total sales (turnover) as a proxy and the firm's growth rate in turnover (GRTurn) as an indicator of firm's market share expansion.
Tables 3.5 and 3.6 summarize the differences in yearly total turnover growth rates between innovating and non-innovating firms. During the period 2000-2003 innovating firms experienced an average growth rate almost doubling than non innovating firms. This difference becomes more severe the smaller the firm's size considered and the closest the year considered with respect to the CIS3 Survey reference period.

Tab. 3.5 - Average Growth Rate in Turnover (mean) according to size and innovation activity (all firms)

GRTunr									
	Size						All		
Year	10-20		21-50		>50				
	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	
2000	9.10	5.22	12.20	9.94	12.93	8.92	11.99	7.91	***
2001	7.78	3.09	3.59	2.40	2.68	2.80	3.92	2.78	*
2002	-1.22	-1.45	2.81	0.00	1.46	0.02	1.27	-0.51	**
2003	-2.67	-2.37	-3.52	-1.12	-1.25	-0.85	-2.11	-1.48	
avg 00_03	3.25	1.12	3.77	2.80	3.97	2.72	3.78	2.17	***
N	210	333	268	286	585	309	1063	928	

Difference in mean statistically significant. Significance level one tail t-test *=1%, **=5%, ***=10%

Moreover these differences are more striking when considering newly established firms (see Tab. 3.6): small innovating firms experienced an average growth rate more than tripling than non innovating ones (especially in year 2000).
These results seem to suggest that, in term of the ability to growth, developing new products is a crucial activity for small firms, in particular for small newly founded firms, since it enable them to expand their market shares more rapidly than their non innovative competitors. On the other side the same evidence can be hardly found for medium and small sized firms.

Tab. 3.6 - Average Growth Rate in Turnover (mean) according to size and innovation activity (newly established firms)

GRTunr new									
	Size						All		
Year	10-20		21-50		>50				
	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	InnPd	No InnPd	
2000	21.52	7.06	12.89	18.24	15.86	22.05	16.30	12.83	*
2001	7.29	7.18	7.75	6.56	5.70	4.16	6.77	6.51	
2002	7.11	0.08	7.72	-5.63	0.61	5.28	4.56	-0.80	**
2003	-4.66	-5.34	-2.91	0.32	-2.62	-0.84	-3.22	-2.92	
avg 00_03	7.81	2.04	6.36	4.87	4.89	7.66	6.10	3.91	**
N	29	77	38	43	49	23	116	143	

Difference in mean statistically significant. Significance level one tail t-test *=1%, **=5%, ***=10%

3.3 Intensity of Innovation and Profitability in the KBI.

Up to this point we have looked for differences in economic performance between product innovators and non product innovators. In this sub-sections we will try to deepen our analysis by further categorize innovating firms according to their intensity of innovation. We measured the intensity of innovation using an indicator (named henceforth **TurnMar**) coming from the CIS3 Survey which asked firms to quantify the share of their total sales in 2000 coming from newly technological products (with respect to their market of reference) launched during the period 1998-2000.

Amongst all the firms who responded to this question this share of total sales has a very low mean (about 6.5%) and a very skewed distribution (the 75% percentile is still 0), the same values we find if we consider firms in the 1998-2003 panel. Of course, if we further restrict our analysis on firms working in KBI sectors the mean of this indicator increases to 12.19% with a less skewed distribution.

Figure 3.1 shows the quantile distribution of TurnMar in the latter subsample of KBI firms. Given the high skewed distribution we decided to categorize this variable in three different levels:

- firms with no newly technological products (TurnMar=0);
- firms with a share total sales in 2000 coming from newly technological products higher than 0 and lower than 0.33 (TurnMar<0.33);
- firms with a share total sales in 2000 coming from newly technological products equal or greater than 0.33 (TurnMar>0.33);

Figure 3.1

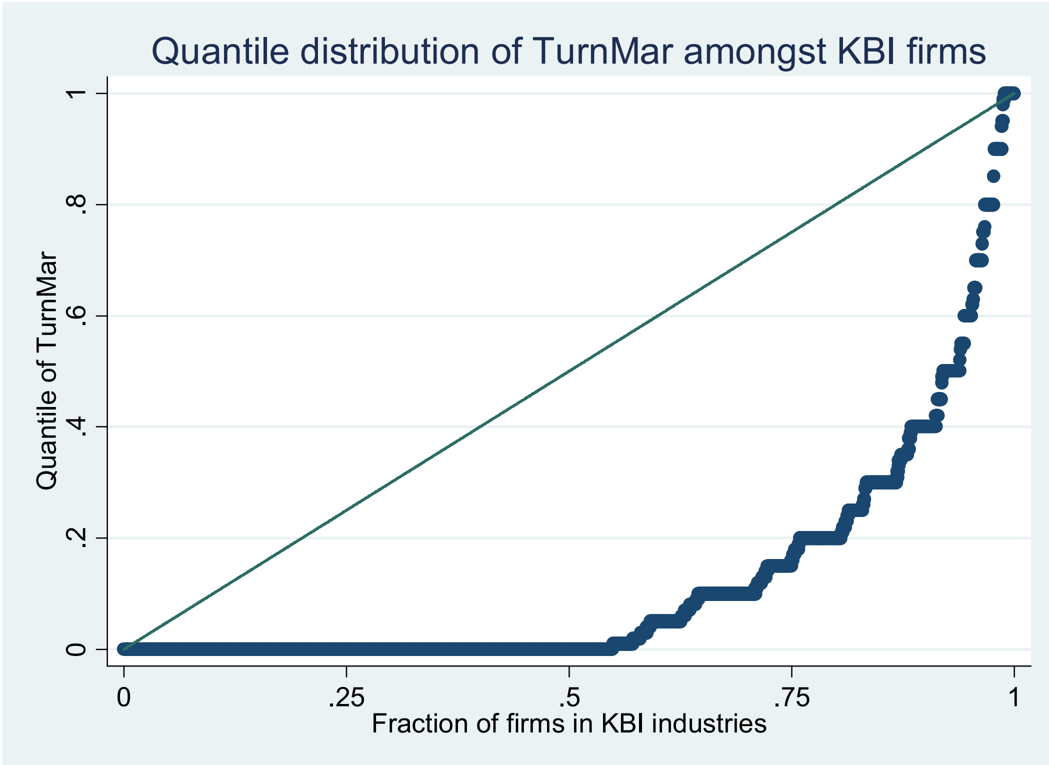


Table 3.7 reports the distribution of KBI firms according to their size (measured by the number of employees registered in 2000) and degree of intensity of innovation (TurnMar).

Tab. 3.7 - Distribution of TurnMar according to firm's size (n. of employees)

Size	TurnMar			Total
	0	0-0.33	0.33-1	
10-20	375	105	63	543
	69.06%	19.34%	11.60%	100%
21-50	323	162	69	554
	58.30%	29.24%	12.45%	100%
>50	394	370	127	891
	44.22%	41.53%	14.25%	100%
Total	1,092	637	259	1,988
	54.93%	32.04%	13.03%	100%

Pearson chi2(4) = 95.2302 Pr = 0.000
Likelihood-ratio chi2(4) = 97.5013 Pr = 0.000

As we can see, about 55% of the firms in our panel did not introduce any newly technological products for the market during the period 1998-2000, 32% of firms did it with low-medium degree of innovativeness (share less than 30% on 2000 turnover) and the remaining 13% with a medium-high degree of innovativeness (over 30% of the share of 2000 turnover).
This distribution changes significantly across groups of different sized firms, in particular the percentage of no innovators significantly decreases the larger the size of the firms considered whereas the percentage of firms with medium and high intensity of return on innovation significantly increases.
Tables 3.8 and 3.9 show the distribution of average OPR and ROTA indexes calculated across different size classes, different levels of TurnMar (in columns) and for different years (in rows).
Innovating firms show, on average, a higher profitability than non-innovating ones. Regardless to firm's size the entity of this performance seems to be quite similar with respect to TurnMar levels (i.e. the "degree" of innovativeness introduced), although for small firms an highest level of TurnMar seems to praise more with an highest short-term profitability. This evidence seems to be reversed when considering medium-sized firms, whereas, for large sized-firms, innovators show a higher (average) profitability, with respect to non-innovating firms, with an equal magnitude across to the "degree" of innovativeness introduced.

Tab. 3.8 - Average OPR (meanX100) according to size and intensity of innovation activity (all firms)

OPR all						
Year	**Size: 10-20**			**Size: 21-50**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	6.04	5.09	5.32	4.81	7.51*	5.89
2001	7.02*	5.92	5.84	5.47	6.83	5.58
2002	6.86**	5.76*	4.35	5.82	7.29**	4.13
2003	3.47	4.41	3.11	2.13	5.49*	3.15
avg 00_03	5.85*	5.29	4.65	4.56	6.78**	4.69
N	**63**	**105**	**375**	**69**	**162**	**323**
Year	**Size: >50**			**All**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	7.78***	6.87***	5.33	6.57**	6.74**	5.49
2001	6.53**	5.78	5.30	6.37*	6.07	5.57
2002	3.55	5.32*	4.49	4.95	5.89***	4.34
2003	3.07	4.25*	3.35	2.92	4.59**	3.21
avg 00_03	5.23	5.55**	4.62	5.20	5.82***	4.65
N	**129**	**371**	**394**	**261**	**638**	**1092**

Difference in mean statistically significant with respect to TurnMar=0 in each size group.
Significance level one tail t-test *=1%, **=5%, ***=10%

Tab. 3.9 - Average ROTA (meanX100) according to size and intensity of innovation activity (all firms)

ROTA all						
Year	**Size: 10-20**			**Size: 21-50**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	7.55	5.94	6.21	6.20	7.45	7.22
2001	8.25**	6.63	5.87	5.62	7.85*	6.47
2002	7.68**	5.63	5.00	5.54	7.84***	4.74
2003	2.04	4.27	4.41	2.70	5.33*	3.41
avg 00_03	6.38	5.62	5.37	5.01	7.12**	5.46
N	**63**	**105**	**375**	**69**	**162**	**323**
Year	**Size: >50**			**All**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	8.07***	6.75*	5.83	7.45**	6.80	6.37
2001	6.79	5.44	5.68	6.83*	6.25	5.98
2002	4.80	5.56*	4.57	5.69	6.15***	4.77
2003	4.39*	4.20	3.33	3.38	4.50*	3.72
avg 00_03	6.01*	5.49	4.85	5.84	5.92**	5.21
N	**129**	**371**	**394**	**261**	**638**	**1092**

Difference in mean statistically significant with respect to TurnMar=0 in each size group.
Significance level one tail t-test *=1%, **=5%, ***=10%

When considering only newly established firms, however, the highest level of TurnMar is always associated with a higher degree of profitability (especially in the short-term) with respect to innovating firms with a lower level of TurnMar, regardless to their size (see Tab. 3.10 - 3.11). Unfortunately, statistical test for the significance of these differences are poorly reliable in this case because of the small sample size of the groups.

Tab. 3.10 - Average OPR (meanX100) according to size and intensity of innovation activity (new firms)

OPR new						
Year	**Size: 10-20**			**Size: 21-50**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	6.27	3.09	5.01	6.09	4.24	5.76
2001	7.04	3.05	6.09	7.38	3.39	5.81
2002	5.14	4.56	2.78	8.49	6.43	3.38
2003	-1.39	2.92	4.61	7.76	2.01	3.91
avg 00_03	4.27	3.41	4.62	7.43	4.02	4.71
N	**11**	**11**	**84**	**13**	**22**	**46**
Year	**Size: >50**			**All**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	8.16	1.16	6.03	7.02	2.78	5.42
2001	7.77	1.72	5.26	7.46	2.66	5.85
2002	4.25	1.39	4.78	5.79	4.04	3.34
2003	3.27	0.35	3.10	3.44	1.53	4.11
avg 00_03	5.86	1.15	4.79	5.93	2.75	4.68
N	**18**	**22**	**32**	**42**	**55**	**162**

Tab. 3.11 - Average ROTA (meanX100) according to size and intensity of innovation activity (new firms)

ROTA new						
Year	**Size: 10-20**			**Size: 21-50**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	10.64	5.55	6.17	5.99	4.52	7.35
2001	8.24	2.27	6.38	7.69	6.34	5.23
2002	6.21	4.86	4.77	-1.94	6.44	-1.23
2003	1.81	2.79	5.02	9.71	1.36	1.87
avg 00_03	6.72	3.87	5.58	5.36	4.66	3.30
N	**11**	**11**	**84**	**13**	**22**	**46**
Year	**Size: >50**			**All**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	9.69	2.28	6.34	8.79	3.83	6.54
2001	7.76	3.28	6.82	7.86	4.30	6.14
2002	5.12	2.91	5.00	3.22	4.71	3.11
2003	4.13	2.19	2.47	5.25	1.98	3.62
avg 00_03	6.67	2.66	5.16	6.28	3.70	4.85
N	**18**	**22**	**32**	**42**	**55**	**162**

3.4 Intensity of Innovation and Growth in the KBI.

As we did previously in section 3.2 we focus on firm's growth rates as an alternative measure of economic performance. Also in this case, when considering all the KBI firms, the intensity of innovating activity (as measured by TurnMar) seems not to be crucial in determining significant differences in growth rates among innovators (see. Tab. 3.12), but the difference between innovators and non-innovators remains significant especially in the short term (during years immediately following the CIS3 Survey reference period).
Nevertheless important differences in growth rates appear when considering newly established firms (Tab. 3.13). These results shed more light on what we found in section 3.2. In fact, the advantage in growth rates for newly established innovators seems to hold only for high intensity innovators (TurnMar>0.33) with an average growth rate (during the period 2000-2003) doubling the one of non-innovators when ignoring differences in size, and more than tripling when considering very small sized firms (again, these results hold especially in the short term).
On the other side, innovators with low TurnMar experienced an average growth rate very close to the one of non-innovators.
Despite the small number of firms considered, these results seem to emphasize our previous findings: developing highly innovative new products is a crucial activity particularly for small newly founded firms for expanding their market shares more rapidly.

Tab. 3.12 - Average GRTurn (meanX100) according to size and intensity of innovation activity (all firms)

GRTurn all						
Year	**Size: 10-20**			**Size: 21-50**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	12.24**	9.80**	4.93	13.18	12.07	10.06
2001	7.22	6.72*	4.01	2.89	4.03	2.46
2002	-0.04	-2.25	-1.33	3.11	3.19**	0.07
2003	-7.61	0.04	-2.33	-1.27	-3.20	-2.04
avg 00_03	2.95	3.57*	1.32	4.48*	4.02*	2.64
N	**63**	**105**	**375**	**69**	**162**	**323**
Year	**Size: >50**			**All**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	17.55*	12.43*	8.74	15.11***	11.90***	7.82
2001	1.64	3.52	2.32	3.32	4.18*	2.94
2002	-0.71	2.96**	-0.36	0.46	2.16***	-0.57
2003	-1.55	-1.01	-1.07	-2.94	-1.39	-1.79
avg 00_03	4.29**	4.48*	2.41	4.01***	4.22***	2.10
N	**129**	**371**	**394**	**261**	**638**	**1092**

Difference in mean statistically significant with respect to TurnMar=0 in each size group.
Significance level one tail t-test *=1%, **=5%, ***=10%

Tab. 3.13 - Average GRTurn (meanX100) according to size and intensity of innovation activity (new firms)

GRTurn new						
Year	**Size: 10-20**			**Size: 21-50**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	31.60	9.39	8.53	10.42	14.28	17.93
2001	5.38	1.50	8.20	7.00	9.81	5.86
2002	7.89	2.63	1.15	7.37	9.04	-5.28
2003	-10.06	-1.13	-5.04	11.17	-11.12	0.06
avg 00_03	8.70	3.10	3.21	8.99	5.50	4.64
N	**11**	**11**	**84**	**13**	**22**	**46**
Year	**Size: >50**			**All**		
	TurnMar>0.33	**TurnMar<0.33**	**TurnMar=0**	**TurnMar>0.33**	**TurnMar<0.33**	**TurnMar=0**
2000	22.90	12.28	18.82	21.31	12.50	13.23
2001	7.62	4.20	4.55	6.84	5.90	6.81
2002	4.68	3.03	0.01	6.35	5.35	-0.90
2003	-2.60	-5.00	0.29	-0.29	-6.67	-2.54
avg 00_03	8.15	3.62	5.92	8.55	4.27	4.15
N	**18**	**22**	**32**	**42**	**55**	**162**

4. Estimating the economic return to innovation.

So far our analysis has been focused on differences in profitability and growth rates between innovators and non-innovators. Since our ultimate goal is not only to test the statistical significance of such differences but also to estimate the "true" marginal effect of innovation on profitability and growth we first need to analyze the reverse causality question: which are the main determinants of innovation activities? In particular we will try to analyze which firm's and industry's characteristics affect the probability to develop new or significantly improved products for the enterprise (**InnPd**) and (following a more strict definition of innovation) new or significantly improved products for the market (**InnMar**). The resulting predicted probabilities can be interpreted as propensity scores, i.e. the conditional probabilities of receiving a treatment (i.e. to introduce product innovations) given pre-treatment characteristics (Rosembaum and Rubin, 1983; Imbens, 2000).

4.1 Method

Propensity score matching methods are widely known in evaluation problem literature to reduce the bias in the estimation of treatment effects with observational studies when traditional regression methods often are unreliable because of the non-random assignments of subjects to the treatment and control group which leads the estimation of the treatment effect to be biased for the existence of confounding factors. In our particular case these confounding factors can be viewed as unobserved (to the researcher) factors which may affect both the firm's economic performance and the firm's propensity to innovate (e.g. intrinsic managerial abilities, unobservable changes in the firm's operating environment or in the business cycle and so on). Propensity score matching is a way to "correct" the estimation of the treatment effects (TE) controlling for the existence of these confounding factors based on the idea that bias is reduced when the comparison of outcomes is performed using treated and control subjects (e.g. innovators and non-innovators) who are as similar as possible, by "summarizing" pre-treatment characteristics of each subject into the propensity score which makes the matching feasible when the n-dimensional vector of characteristics is large (Rosembaum and Rubin, 1983; Imbens, 2000; Becker and Ichino, 2002; Dehejia and Wahba, 2002).
This method, however, is not immune from drawbacks. The main criticisms arisen in the literature focus on the reliability on which propensity scores are estimated. Smith an Todd (2005) have shown that TE estimation based on propensity score matching are highly sensitive to its specification (based on both the set of variables included in the scores and the particular analysis sample used in the estimation). This potential limitation has recently driven the attention of many researchers to semi or non-parametric matching methods for TE estimation (Iacus and Porro, 2007).
In our case what we would like to estimate is the average effect of the treatment on the treated (ATT) which is defined as:

$$\tau \equiv E\{\Delta_i\} \equiv E\{Y_{1i} - Y_{0i} \mid D_i = 1\} \equiv E\{Y_{1i} \mid D_i = 1\} - E\{Y_{0i} \mid D_i = 1\} \qquad (4.1)$$

where Y_{1i} is the economic performance of firm *i* in case of innovation performed and Y_{0i} is the economic performance of the same firm in case of non-innovation performed. $D=\{1,0\}$ is an indicator of exposure to the treatment (1 = innovate, 0 = did not innovate).
Unfortunately only $E\{Y_{1i} \mid D_i = 1\}$ and $E\{Y_{0i} \mid D_i = 0\}$ are observed, whereas $E\{Y_{0i} \mid D_i = 1\}$ and $E\{Y_{1i} \mid D_i = 0\}$ are unobserved counterfactuals.
Note that in a randomized experimental setting this problem does not hold since $E\{Y_{1i}, Y_{0i}\} \perp D_i$.
The rational behind matching estimator is to assume that such independence holds for within cells defined by a set of observed characteristics X:

$$E\{Y_{1i}, Y_{0i}\} \perp D_i \mid X \tag{4.2}$$

which is known in the literature as the conditional independence assumption (C.I.A.).
Rosembaum and Rubin (1983) show that if C.I.A. holds, it also holds within cells defined by the values of the mono-dimensional variable *p(X)*, which is called propensity score, i.e. the conditional probability of receiving a treatment given pre-treatment characteristics:

$$p(X) \equiv \Pr\{D = 1 \mid X\} = E\{D \mid X\} \tag{4.3}$$

Given this result the ATT can be estimated as follows:

$$\hat{\tau} \equiv E\{E[Y_{1i} \mid D_i = 1, p(X_i)] - E[Y_{0i} \mid D_i = 0, p(X_i)] \mid D_i = 1\} \tag{4.4}$$

Equation 4.4 implies two different conditions which must be satisfied in order to let $\hat{\tau}$ an unbiased estimator of $\hat{\tau}$:

1) Balancing of pre-treatment variables given the propensity score:

$$D \perp X \mid p(X) \tag{4.5}$$

2) Unconfoundedness given the propensity score:

$$Y_1 Y_0 \perp D \mid p(X) \tag{4.6}$$

4.2 Propensity score estimation.

In order to estimate *p(X)* we studied the role played by several firm's and industry's characteristics on the probability of introducing new products by running separated logit regressions for **InnPd** and **InnMar**.
Tables 4.1 summarizes a description and table 4.1 summarizes the main descriptive statistics of the variables involved in the analysis
Our regressors include firm's characteristics as:

- if firm has been established during 1993-1998 (**dumnew**). This indicator for newly established firm will be interacted with most of our regressors in order to detect potential differences between old firms (incumbents) and new firms (recent entrants) with respect to factors affecting the propensity to innovate;
- the firm's relative size (measured by its total turnover in 1998) with respect to the average size of firms in the same industry (**dimrel**). This indicator has been computed on a relative scale for taking into account industry-level heterogeneity in firm's size.
- the firm's share of turnover in 1998 from export (**tunr_exp98**). This indicator should capture the degree of internationalization of the firm.
- the firm's total debt over its total turnover in 1998 (**debt_turn98**). This indicator should capture the financial leverage-exposure of the firm.
- the firm's total liquidity available over its total turnover in 1998 (**cf_turn98**). This indicator should capture the ability of the firm to generate cash flow for self financing (R&D) investments.

Table 4.1: Variable description.

Variable	**Description**	**Definition**
DEPENDENT VARIABLES		
InnPd	The firm introduced new products (for the firm) during the period 1998-2000.	dummy: 0=no; 1=yes
InnMar	The firm introduced new products (for the market) during the period 1998-2000.	dummy: 0=no; 1=yes
TurnIn	Share of 2000 tunrover from InnPd	continuous [0-1]
TurnMar	Share of 2000 tunrover from InnMar	continuous [0-1]
FIRM LEVEL REGRESSORS		
dumnew	Firm established during 1993-1998	dummy: 0=no; 1=yes
dimrel	Firm's relative size=Firm's turnover in 1998/(estimated average industry turnover in 1998)	continuous[0, +∞]
turn_exp98	Firm's share of turnover 1998 from export	continuous [0-1]
debt_turn98	Firm's total debts in 1998 / Turnover in 1998	continuous [0-1]
cf_turn98	Firm's available liquidity in 1998 / Turnover 1998	continuous [0-1]

In addition to firm's characteristics we also included in each model industry (defined according to ATECO 2 digits level) dummies as proxies for sector-specific characteristics (such as incoming spillovers, appropriability conditions, degree of concentration and so on).

Table 4.2: Descriptive statistics

Variables	Mean	Std. Dev.	Min	Max
DEPENDENT VARIABLES				
InnPd	0.5332	0.4990	0	1
InnMar	0.4507	0.4977	0	1
TurnIn	0.2130	0.2849	0	1
TurnMar	0.1219	0.2133	0	1
FIRM LEVEL REGRESSORS				
dumnew	0.1303	0.3367	0	1
dimrel	0.9517	3.2723	0.0001	96.3520
turn_exp98	0.2234	0.2823	0	1
debt_turn98	0.6372	0.1910	0.0642	0.9988
cf_turn98	0.0669	0.0902	0	0.4936

Propensity scores estimates are reported in Table 4.3. Each regressor has been included both in levels an multiplied with the **dumnew** dummy variable to check for possible different influences of each factor on propensity to innovate for new established firms[8] with respect to incumbents. We do not care (at the moment) for potential multicollinearity[9] problems arising from the high level of correlation amongst the regressors included. In fact this problem should be a matter of concern if we wanted to perform inference on the statistical significance of each single regressor, whereas our goal in estimating the logit model reported in table 4.3 was to obtain proper propensity score estimates, i.e. to get accurate predictions of the firm's conditional probability of innovating.

Thus, before running ATT estimation based on propensity score matching, we checked if the overall model is statistically significant, if the balancing property condition is satisfied, if the estimated *p(X)* spread on a reasonable wide common support and finally if the sign of each regressor is coherent in an economic sense. In particular, looking at table 4.3 we can see that the firm size has a positive influence on the probability of introducing new innovative products, which is consistent with the findings of the previous sections. Also the firm's export intensity positively affects the propensity to innovate consistently with the previous empirical findings of the literature focusing on the innovation-export complementarity relationship[10].

[8] We will also estimate separate ATT for these firms.

[9] We only checked for no perfect multicollinearity of our regressors.

[10] See for instance Bernard and Jensen (1999), Hitt et al. (1997), Alvarez and Robertson (2004).

Table 4.3: LOGIT estimates of propensity scores

	LOGIT	
	InnPd	**InnMar**
dumnew	-1.046 (-1.15)	-3.745 (-1.32)
dimrel	0.366 (6.24)***	0.311 (6.36)***
dimrel^2	-0.009 (-4.07)***	-0.009 (-5.00)***
turnexp_98	1.213 (5.78)***	0.835 (4.83)***
turnexp_98*dumnew	0.711 (1.15)	0.838 (1.43)
debt_turn98	0.337 (1.20)	0.362 (1.28)
debt_turn98*dumnew	-0.627 (-0.72)	-0.334 (-0.38)
cf_turn98	-0.668 (-1.14)	-0.321 (-0.55)
cf_turn98*dumnew	0.261 (0.16)	0.024 (0.01)
Constant	-0.461 (-1.74)*	-0.764 (-2.89)***
Observations	1988	1988
(Pseudo) R-squared	0.082	0.065
LR chi2(23) (P>chi2)	229.51 (0.00)	178.3 (0.00)
Log-likelihood	-1258.84	-1279.149

ATECO 2-digit level Industry dummy variables included
Robust z statistics in parentheses
*** significant at 1%; ** significant at 5%; * significant at 10% level;

4.3 ATT estimation.

Given the PS calculated as predictions of the logit models estimated in the previous section, we calculated the average treatment effects on the treated (ATT) for all the three performance indicators by using different matching methods: radious, kernel and stratification.

Following the terminology of Becker and Ichino (2002) let T and C be the sets of treated and control units, Y_i^T and Y_i^C be the respective observed outcomes and $C(i)$ the set of control units matched to the treated unit i with an estimated value of the propensity score p_i.

With **radius matching** all the control units with estimated propensity scores falling within a radious r from p_i are matched to the treated unit:

$$C(i) = \{p_j \mid \|p_i - p_j\| < r\}$$

Denoting by N_i^C then number of controls matched with observation $i \in T$ and defining the weights $w_{ij} = 1/N_i^C$ if $j \in C(i)$ and $w_{ij} = 0$ otherwise, the formula for the radious matching estimator of the ATT defined by (4.1) is the following:

$$\tau^R = \frac{1}{N^T} \sum_{i \in T} \left[Y_i^T - \sum_{j \in C(i)} w_{ij} Y_j^C \right] = \frac{1}{N^T} \sum_{i \in T} Y_i^T - \frac{1}{N^T} \sum_{j \in C(i)} w_j Y_j^C$$

where $w_j = \sum_{i \in T} w_{ij}$.

With **kernel matching** all the treated units are matched with a weighted average of all controls with weights that are inversely proportional to the distance between the propensity scores of treated and control. The formula for the kernel matching estimators is given by:

$$\tau^R = \frac{1}{N^T} \sum_{i \in T} \left[Y_i^T - \frac{\sum_{j \in C} Y_j^C G\left(\frac{p_j - p_i}{h_n} \right)}{\sum_{k \in C} G\left(\frac{p_j - p_i}{h_n} \right)} \right]$$

where *G()* is a kernel function and a h_n is a bandwidth parameter which have to satisfy some standard conditions in order to consistently estimate the counterfactual outcome Y_{0i}.

With the **stratification matching** the whole sample is stratifyied in Q blocks defined over intervals of the propensity scores. Then within each block treated and control units have on average the same propensity score i.e. the covariates are balanced and the assignment to treatment can be considered random. The formula for the stratification matching estimator of the ATT is the following:

$$\tau^S = \sum_{q=1}^{Q} \tau_q^S w_q$$

where the weights w_q for each block is given by the corresponding fraction of treated units,

$$\tau_q^S = \frac{\sum_{i \in I(q)} Y_i^T}{N_q^T} - \frac{\sum_{j \in I(q)} Y_j^C}{N_q^C}$$

I(q) is the set of units in block *q*, N_q^T and N_q^C are the numbers of treated and control units in block *q*.

Standard errors for τ^S and τ^R are computed analytically[11] and for τ^K with bootstrap methods.

[11] See Becker and Ichino (2002) for the analytical formulas.

Tables 4.4 and 4.5 focus on the whole firm in our sample and report the ATT estimated for each of the matching methods described above. In particular table 4.4 consider as "treated" the firms which introduced any new or significantly improved products for the enterprise (**InnPd**) whereas table 4.5consider as "treated" the firms which introduced any new or significantly improved products with respect to the market (**InnMar**).

Table 4.4 - ATT estimation (D_i=InnPd) all firms (mean 2000-2003).

	Treated	**Control**	ATT (Y_i=OPR)	ATT (Y_i=ROTA)	ATT (Y_i=GRTurn)
Matching method:					
kernel	1060	917	0.009*	0.007*	0.021***
radious	1060	917	0.009*	0.003	0.015***
stratification	1060	917	0.009*	0.007*	0.022***

Statistically significant at 1%***, 5%**, 10%* level

Table 4.5 - ATT estimation (D_i=InnMar) all firms (mean 2000-2003).

	Treated	**Control**	ATT (Y_i=OPR)	ATT (Y_i=ROTA)	ATT (Y_i=GRTurn)
Matching method:					
kernel	896	1089	0.011***	0.009**	0.026***
radious	896	1089	0.010**	0.005*	0.020***
stratification	896	1089	0.011***	0.010**	0.027***

Statistically significant at 1%***, 5%**, 10%* level

Tables 4.6 and 4.7 report the same ATT estimates of tables 4.4 and 4.5 focusing only on new established firms.

Table 4.6 - ATT estimation (D_i=InnPd) new established firms (mean 2000-2003).

	Treated	**Control**	ATT (Y_i=OPR)	ATT (Y_i=ROTA)	ATT (Y_i=GRTurn)
Matching method:					
kernel	116	133	-0.015	-0.013	0.057**
radious	116	133	-0.009	-0.005	0.023*
stratification	116	133	-0.011*	-0.008	0.046*

Statistically significant at 1%***, 5%**, 10%* level

Table 4.7 - ATT estimation (D_i=InnMar) new established firms (mean 2000-2003).

	Treated	**Control**	ATT (Y_i=OPR)	ATT (Y_i=ROTA)	ATT (Y_i=GRTurn)
Matching method:					
kernel	97	160	-0.013*	-0.014	0.030*
radious	97	160	-0.0079	-0.005	0.017
stratification	97	160	-0.008	-0.009	0.017*

Statistically significant at 1%***, 5%**, 10%* level

4.4 Comments and conclusions.

The results reported in Tables 4.4 and 4.5 basically confirm the findings of section 3, with innovative firms showing an average profitability during the years 2000-2003 greater than non innovating firms of about +0.9% when considering OPR and about +0.5% when considering ROTA. Furthermore the ATT estimated with respect to GRTurn shows a difference in growth rates of about +2% with respect to non-innovating firms which is slightly greater than the difference in mean of 1.6% detected in section 3. These findings are also confirmed when considering a more strict definition of innovation activity (InnMar) and clearly tell us that innovation leads to an average greater profitability and greater growth rates for firms in operating in KBI.

Things change more considerably when looking at Tables 4.6 and 4.7 that focus on new established firms. In fact, for this sub-sample of new entrants, ATT analysis estimates an average profitability of innovating firms which is considerably lower than non innovating ones (about -1.2% for OPR and -0.7% for ROTA) with respect to the previous differences estimated in section 3. On the other side, differences in growth rates estimated by the ATT analysis (more than +3% for InnPd and about +2.5% for InnMar) are greater than the mere differences in mean estimated in section 3 (+2.19%). These findings suggest a strategic different behavior of new entrants firms in the KBI with respect to incumbents. In particular, for the former ones innovation seems to be a more crucial activity for pursuing economic growth than for the latter ones and this goal is pursued even at cost of a less degree of profitability in the short run.

One of the limitations of this paper is the scarcity of informations concerning firm's survival: given that the presence of different survival paths of firms may arise sample selectivity issues, it represents itself an (unobserved) indicator of economic performance.

Indeed the literature on entry in advanced countries has exstensively examined the survival and post-entry performance of entrants and has come to the conclusion that most of the entrants are not quite capable firms and exit quite soon from the industry (the so "called garbage in - garage out process") as outlined by the works of Geroski (1994), Audretsch (1995), Baldwin (1995), Klepper (2002).

Unfortunately our time-span horizon of the informations available for our sample is too short for performing a survival analysis and forced us to focus on short-term profitability and growth returns.

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