THE PERSISTENCE OF PROFITS: AN ORDERED PROBIT APPROACH§

BY

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Abstract: The aim of our paper is to highlight the main results of the literature on profit persistence and to provide new empirical findings which can deal with the drawbacks of previous empirical studies. Using a panel of more than 5,000 Italian manufacturing firms for the period 1989-1997, we set up an empirical investigation which enables us to specify an ordered probit model, which defines three different firm profitability levels (high, mean and low) as a function of firm and sectoral characteristics. We use a panel order probit technique to estimate the impact of such variables on profit status, and then test for persistency. Firm size and market concentration have a negligible impact on the probability of being a highly profitable firm, while a firm's propensity to innovate strongly affects such a probability. Sectoral fixed effects are also taken into account, and they highlight the fact that operating in one of most of the traditional industries (food, beverages and tobacco, wearing, leather) and large-scale assembly industries (e.g., the machinery and equipment industry), negatively contributes to the probability of being a successful firm, i.e. a highly profitable firm. The opposite result is found for those sectors (chemicals, electrical machines, professional, scientific and optical goods) in which technological opportunities are higher as measured by standard indicators (R&D and patent activity). Persistence is tested for by looking at possible state dependence, i.e. the effect of a lagged profit status variable. Our estimates suggest that state dependence is highly significant, in that a firm's profit condition at time t is crucially affected by its profit condition at time t-1. Our results emphasise how the probability of being a highly profitable firm depends more on the firm's ability to innovate than on market structure or firm size, thus indicating possible policy issues.

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1. Introduction

The explanation of profitability differentials between firms and industries has been studied widely. In particular, since the beginning of the '70s new research studies have tried to explain such differentials by using different perspectives from the traditional paradigm, which had been dominant until then. The structure-conduct-performance paradigm (Bain 1956) predicted that, without barriers to entry, competitive market forces would determine the profit level of firms. This implies that in the long-run, any discrepancy between actual profit level and equilibrium level would disappear. However, this hypothesis has been challenged by new studies which have emphasised intra-industry or inter-industry variations in profitability (McGahan and Porter (1999), Hawawini, Subramania and Verdin (2003), Schumacher and Boland (2005)) . One crucial issue which has been highlighted is whether profits tend to show a persistent pattern through time, i.e., there are firms or industries which systematically earn profits above the equilibrium level. Persistence typically depends upon entry conditions, as shown in the study by Mueller (1990). His model, which is an extension of Mueller (1986) and a refinement of a model by Cubbin and Geroski (1987), shows a pure autoregressive structure, in that profits at time t are determined by entry conditions, which in turn define profits at time t-1. The results of the empirical estimates show that a firm's profit rate tends to converge to its long-run equilibrium, but this equilibrium level does significantly differ across firms and sectors.

Profit persistence has also been janalysed with different analytical tools. Cefis (2003a, 2003b) and Cefis and Orsenigo (2001) use a transition probability matrix approach, similar to that used by Quah (1993, 1997) for analysing the distribution of world per capita income, to study innovation and profit persistence in manufacturing industries. In particular, Cefis (2003a) underlines how profit persistence is closely related to innovation persistence, though this result is confined to a small number of sectors and firms, and thus these findings cannot be generalised to cover the whole manufacturing sector.

In our study we summarise the results of our previous study (Bartoloni and Baussola 2004) and then present econometric results based on an ordered probit approach, allowing us to specify an empirical model in which the dependent variable is qualitative (i.e., profit status: high, mean, low), and firm and industry characteristics are used as explanatory variables.

In sections two, three and four we briefly summarise the methodology and results of previous studies which are based on a Markov Chain approach. In section five, we present and discuss the econometric results, and section six concludes the paper.

2. The Transition Probability approach to profit persistence

The use of TPM to analyse persistence behaviour has recently been extended to a wider range of applications, particularly within empirical growth and industrial organisation studies. The empirical literature, which has increased since the early '90s, has focused on the definition of short-run and long-run transitions, and the identification of a steady-state (or ergodic) distribution which can describe the equilibrium of the dynamic process underlying the Markov process under observation.

Quah (1993, 1997) studies cross-country patterns of economic growth by analysing the transition of countries' economic development from one state to another according to the change in their per-capita income level. The stylised empirical finding of these studies is a twin peak phenomenon in the cross-sectional distribution of income, thus suggesting that persistence characterises the growth patterns of world economies, and convergence may eventually occur within "clubs" of countries.

Within industrial organisation literature, studies by Cefis (2003a, 2003b) and Orsenigo and Cefis (2001) use TPM to describe persistence with respect to profitability and innovation activities. These studies do find some evidence that both innovation activity and profitability are characterised by some (not negligible) degree of persistence, by using both sectoral- and country-specific micro-data. However, bimodality or, in the terminology of growth theory literature, the twin peaks phenomenon, appears to be relevant. This means that the distribution of firms towards the polar states is relatively high. In the following section we describe our methodological approach, and provide findings which throw light on the persistence of profits within different manufacturing sectors.

We use Transition Probability Matrices to identify a firm movement from one state to another, i.e., from state i to state j. In our case the set of states is simple, as it only includes state H (high profit level), state M (mean profit level) and state L (low profit level). In order to identify each state we first calculate the average profit rate over the period 1989-97 for manufacturing on the whole and the corresponding standard deviation. Thus, a firm belongs to the high profit state (H) if its profit rate is higher than the average rate defined above plus one standard deviation. By contrast, a firm belongs the low profit state (L) if its profit rate is less than such an average rate minus one standard deviation. Those firms whose profit rate falls within the range of the average rate plus/minus one standard deviation determine the mean profit state (M).

We compute the total number of transitions from each state towards the other by adding up each yearly flow, and then averaging the total amount thus calculated over the entire time period (1989-97). Thus, we can compute the average annual transition probability from one state to another by dividing the average annual flow by the average annual initial stock. The result is a TPM which reflects a first order discrete Markov process with transition probabilities given by:

$$p_{ij} = P\left[X_t \in i \middle| X_{t-1} \in j\right] = \begin{bmatrix} p_{hh} & p_{hm} & p_{hl} \\ p_{mh} & p_{mm} & p_{ml} \\ p_{lh} & p_{lm} & p_{ll} \end{bmatrix} := \begin{bmatrix} hh & hm & hl \\ mh & mm & ml \\ lh & lm & ll \end{bmatrix} \qquad 1)$$

where X represents the variable under investigation, i.e., the profit rate of a firm, and i and j represent the possible states of the process, which in our case are H (high profits), M (mean profits) and L (low profits) respectively, and t = 1989, 1990…..1997.

Each element on the main diagonal of the TPM describes the persistence in each state; thus *hh* reflects the average annual probability of remaining a high profit firm during the period 1989-97, while *ll* reflects the corresponding probability of being a low profit firm and *mm* the probability of being an averagely profitable firm. On the one hand, *hl* and hm represent the probability of leaving the high profit state for the low and mean profit states respectively. On the other hand, *lh* and *lm* show the corresponding probability of leaving the low profit state for the high and average profit states respectively, while *mh* and *ml* show the corresponding probability of leaving the mean profit state.

3. Data description

We have applied the methodology described in the previous section to our data set, which includes 5445 firms drawn from the Micro1 data set selected by ISTAT (Italian National Institute of Statistics)[1] to analyse the dynamics of industrial sectors in the Italian economy during the '90s.

This data set includes data from different statistical sources and surveys set up by ISTAT, including the Firms' Account System Survey (SCI) and the Community Innovation Survey (CIS1), which investigates the innovative activity performed by industrial firms during the period 1990-1992. The link between these two data sets generates a closed panel of firms covering the period 1989-97 which, however, does not account for mergers, as the panel is by definition closed.[2]

Table 2 describes the characteristics of the data set by showing the distribution of firms by sector and firm size. We observe that during the eight years between 1989 to 1997 the distribution of firms is substantially steady with respect to big firms (> 500 employees) and small-medium sized firms (50-99 employees). The two central classes (100-199) and (200-499) show a mild increase, while, conversely, the bottom class (20-49) shows a corresponding decrease. This pattern partially corresponds to that which has characterised the Italian manufacturing industries during the same period. Indeed, we have to remember that our data set excludes firms with less than 20 employees, which however is the majority of manufacturing firms. Small firms, that is firms with less than 20 employees, do increase their weight within Italian manufacturing firms in the same period. Medium sized firms also increase their weight,

[1] We gratefully acknowledge Roberto Monducci's help in providing assistance in the selection of the data set.

[2] In the case of a merger, the "new" firm is identified by a new code. In this case it is excluded from the panel which is, by definition, closed and thus does not allow for the inclusion of a new firm.

but to a lesser extent, while large firms (>500 employees), in contrast, have experienced a reduction of their whole employment weight.

We also present the breakdown of innovative and non-innovative firms by size, according to the information derived from the CIS1 (Community Innovation Survey) and included in the MICRO1 data set. Innovative firms are those firms which have introduced either a process and/or a product innovation between 1990 and 1992.

We have used this data base to set up the transition of firms according to their profit rate, and thus it has been necessary to exclude those sectors which did not have a sufficient number of firms, in order to get significant transition probabilities. We have thus excluded sector 23 (Petroleum refineries) and 30 (Office and computing machinery). We have also excluded sector 20 (Wood products), as firms do not always satisfy the three state representations of the Markov process we have described in the previous section.

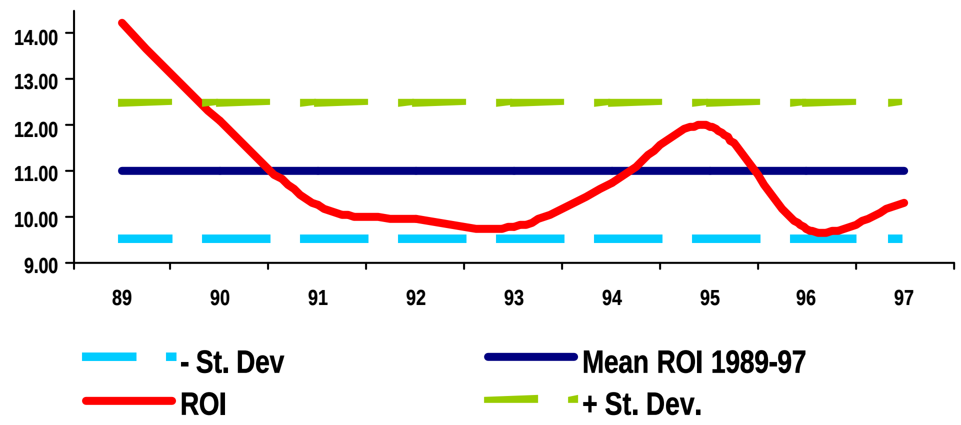
The profitability variable that we have used is the return on investment (ROI), and is defined as the ratio of gross operating profits to total tangible and intangible assets. Figure 1 shows the long-term average of ROI within the whole manufacturing industries together with the standard deviation intervals. We have used these measures to classify the three states of the transition probability matrix we have adopted.

In addition we have considered firm and sectoral characteristic to specify an empirical model in order to econometrically measure the evidence suggested by the TPM approach. In particular we consider the following variables:

Table 1 - Breakdown of firms by relevant characteristics - *selected years*

	1989	1992	1997	1989	1992	1997
by size		*number*			*column percentage*	
20-49 employees	2,547	2,507	2,365	46.8	46.0	43.4
50 - 99 employees	1,490	1,475	1,490	27.4	27.1	27.4
100 - 199 employees	710	750	846	13.0	13.8	15.5
200 - 499 employees	422	441	478	7.8	8.1	8.8
500 employees and more	276	272	266	5.1	5.0	4.9
Total	**5,445**	**5,445**	**5,445**	**100.0**	**100.0**	**100.0**
by sectors:ISIC CODE						
15+16 Foods, beverages	394	396	396	7.2	7.3	7.3
17 Textile	537	522	526	9.9	9.6	9.7
18 Wearing	221	228	226	4.1	4.2	4.2
19 Leather	168	178	172	3.1	3.3	3.2
20 Wood products	141	152	149	2.6	2.8	2.7
21 Paper products	173	169	168	3.2	3.1	3.1
22 Printing and publishing	175	170	169	3.2	3.1	3.1
23 Petroleum refineries	18	21	22	0.3	0.4	0.4
24 Chemicals	275	259	263	5.1	4.8	4.8
25 Rubber and plastic	337	317	317	6.2	5.8	5.8
26 Non metallic products	429	429	429	7.9	7.9	7.9
27 Basic metal industries	224	215	215	4.1	3.9	3.9
28 Metal products	632	615	601	11.6	11.3	11.0
29 Machinery and equipment	727	742	752	13.4	13.6	13.8
30 Office and computing machinery	8	8	8	0.1	0.1	0.1
31 Electrical machinery	218	214	213	4.0	3.9	3.9
32 Radio, TV and Telecom.	78	73	70	1.4	1.3	1.3
33 Professional, scientific etc.	87	101	104	1.6	1.9	1.9
34+35 Transp. Equipment	190	215	219	3.5	3.9	4.0
36+37Other manufact.industries	413	421	426	7.6	7.7	7.8
Total	**5,445**	**5,445**	**5,445**	**100.0**	**100.0**	**100.0**
innovative						
20-49 employees		773			35.3	
50 - 99 employees		601			27.5	
100 - 199 employees		379			17.3	
200 - 499 employees		248			11.3	
500 employees and more		187			8.5	
Total		**2,188**			**100.0**	
non innovative						
20-49 employees		1,734			53.2	
50 - 99 employees		874			26.8	
100 - 199 employees		371			11.4	
200 - 499 employees		193			5.9	
500 employees and more		85			2.6	
Total		**3,257**			**100.0**	

Figure 1- Return on Investment (ROI)in the Italian Manufacturing Industries



4. Short-run and long-run transition

We firstly analyse the simple TPM of each sector (Table 2) according to the definition given in the previous section, and then discuss the econometric estimates derived from an order probit specification, which enable us to discuss which factors affect, and thus determine- a firm's profit status and eventually its persistence pattern. We consider both short- and long-run transitions, namely an average one-year transition probability and an eight-year transition probability between 1989 to 1997.

4.1 Short-run transition

If we look at the one-year transition probability, persistence is on the whole high, ranging between 0.8095 in the rubber and plastic sectors, and 0.6736 in the leather industries. Persistence is also high within low profit firms, as the persistence rate varies between 0.7871 in the food and beverages industries and 0.6374 in the rubber and plastic sectors. On average in the manufacturing sector persistence is higher within the high profit rate firms (0.7440), as compared with the low profit rate firms (0.7067). This is confirmed by the ergodic distribution, which implies that in manufacturing more than 44% of firms fall within the high profit state, while about 40% fall within the low profit state and more than 15% fall within the mean profit state respectively.

Table 3 - Average annual transition probabilities (1989-1997)

Food and beverages

	High	Medium	Low
High	0.7255	0.1361	0.1384
Medium	0.3561	0.2919	0.3520
Low	0.0962	0.1167	0.7871
Ergodic Distribution	0.3647	0.1501	0.4852

Textile

	High	Medium	Low
High	0.7467	0.1264	0.1269
Medium	0.3610	0.2627	0.3763
Low	0.1677	0.1685	0.6638
Ergodic Distribution	0.4736	0.1641	0.362

Wearing

	High	Medium	Low
High	0.6844	0.1265	0.1891
Medium	0.3140	0.2674	0.4186
Low	0.1389	0.1058	0.7553
Ergodic Distribution	0.3576	0.1351	0.5073

Leather and footwear

	High	Medium	Low
High	0.6736	0.1545	0.1719
Medium	0.2965	0.2389	0.4646
Low	0.1606	0.1498	0.6895
Ergodic Distribution	0.3762	0.1664	0.4574

Paper products

	High	Medium	Low
High	0.7524	0.1369	0.1107
Medium	0.4254	0.2588	0.3158
Low	0.1783	0.1654	0.6563
Ergodic Distribution	0.5151	0.1662	0.319

Printing and publishing

	High	Medium	Low
High	0.7295	0.1304	0.1401
Medium	0.3098	0.2337	0.4565
Low	0.1097	0.1227	0.7677
Ergodic Distribution	0.3628	0.1412	0.496

Chemical

	High	Medium	Low
High	0.7918	0.1041	0.1041
Medium	0.3666	0.2926	0.3408
Low	0.1682	0.1481	0.6836
Ergodic Distribution	0.5239	0.1462	0.3299

Rubber

	High	Medium	Low
High	0.8095	0.0989	0.0916
Medium	0.4048	0.2884	0.3069
Low	0.1774	0.1852	0.6374
Ergodic Distribution	0.5756	0.1511	0.273

Non metallic products

	High	Medium	Low
High	0.7560	0.1223	0.1218
Medium	0.3511	0.2447	0.4043
Low	0.1454	0.1286	0.7260
Ergodic Distribution	0.4485	0.1423	0.4092

Basic metal industries

	High	Medium	Low
High	0.7185	0.1347	0.1468
Medium	0.4104	0.2032	0.3865
Low	0.1832	0.1575	0.6593
Ergodic Distribution	0.4694	0.1538	0.3768

Metal products

	High	Medium	Low
High	0.7676	0.1126	0.1197
Medium	0.3975	0.2542	0.3483
Low	0.1659	0.1710	0.6630
Ergodic Distribution	0.5063	0.1543	0.339

Machinery and equipments

	High	Medium	Low
High	0.7074	0.1352	0.1575
Medium	0.3292	0.2539	0.4169
Low	0.1348	0.1311	0.7341
Ergodic Distribution	0.3841	1512	0.4647

Electrical machinery

	High	Medium	Low
High	0.7860	0.0892	0.1249
Medium	0.3587	0.1839	0.4574
Low	0.1670	0.1800	0.6531
Ergodic Distribution	0.5959	0.1346	0.3595

Professional, scientific, photogr. and opt.goods

	High	Medium	Low
High	0.7513	0.1269	0.1218
Medium	0.4174	0.2435	0.3391
Low	0.1548	0.1349	0.7103
Ergodic Distribution	0.4793	0.1471	0.374

Transp. Equipment

	High	Medium	Low
High	0.7447	0.1186	0.1366
Medium	0.3733	0.2304	0.3963
Low	0.1481	0.1003	0.7516
Ergodic Distribution	0.4367	0.1245	0.4388

Other manufact.industries

	High	Medium	Low
High	0.6911	0.1530	0.1559
Medium	0.3013	0.2864	0.4123
Low	0.1146	0.1872	0.6981
Ergodic Distribution	0.3562	0.1943	0.4495

Manufacturing

	High	Medium	Low
High	0.7440	0.1239	0.1321
Medium	0.3546	0.2627	0.3827
Low	0.1451	0.1482	0.7067
Ergodic Distribution	0.4428	0.1552	0.42

Innovating firms

	High	Medium	Low
High	0.7633	0.1194	0.1173
Medium	0.3645	0.2662	0.3693
Low	0.1542	0.1579	0.6879
Ergodic Distribution	0.4786	0.1564	0.365

Non innovating firms

	High	Medium	Low
High	0.7298	0.1272	0.1430
Medium	0.3480	0.2603	0.3917
Low	0.1397	0.1425	0.7178
Ergodic Distribution	0.4192	0.1543	0.4265

4.2 Long-run transition

Persistence declines sharply if we look at the long-run transition between 1989 and 1997. In this case transition probabilities are derived as in (1) with t= 1989, 1997. The range of the persistence index in the high profit state (H) varies between 0.6742, in the rubber and plastic industries, to 0.2714 in leather and footwear. On the whole, this index declines to 0.5123 in manufacturing as compared with the value of 0.7440 in the short-run transition.

Persistence also declines within the other two states, i.e., mean (M) and low (L) profit states. In the former state persistence varies from 0.4167 in the professional, scientific, photographic goods industries to 0.0909 in the wearing sector, while in manufacturing on the whole it declines to 0.1829.[3]

In the latter, namely the low profit state, persistence declines although it remains high. In manufacturing on the whole this index is about 0.64 and it varies from 0.7831, in food, beverages and tobacco industries, to 0.4462 in rubber and plastic.

Table 3 - Long-run persistence rate

		High profit state	Mean profit state	Low profit state
15+16	**Food and beverages**	0.5030	0.2258	0.7831
17	**Textiles**	0.4845	0.1714	0.6475
18	**Wearing**	0.4286	0.0909	0.7826
19	**Leather**	0.2714	0.1923	0.6129
21	**Paper products**	0.6322	0.2581	0.5000
22	**Printing and publishing**	0.4301	0.1429	0.6744
24	**Chemical**	0.4845	0.1714	0.6475
25	**Rubber**	0.6742	0.2000	0.4462
26	**Non metallic products**	0.3926	0.1837	0.7397
27	**Basic metal industries**	0.4964	0.2857	0.6286
28	**Metal products**	0.6118	0.2090	0.6383
29	**Machinery and equipment**	0.4958	9.0000	0.6502
31	**Electrical machinery**	0.5929	0.2105	0.5128
33	**Professional, scientific, photogr. and opt.goods**	0.5116	0.4167	0.5294
34+35	**Transp. Equipment**	0.5567	0.1935	0.6522
36+37	**Other manufact.industries**	0.4339	0.1860	0.7128

[3] We do not show the ergodic distribution as we are evaluating 8-year transition probabilities, and this implies that such probabilities may change as do the results for different factors which may depend on firm attitude and/or exogenous shocks such as technological shocks.

Table (6) shows concentration indexes, the average firm size by sector, and sectoral innovation propensities, to verify whether there is a relationship with the sectoral pattern of profit persistence. Simple correlation indexes show that persistence is positively affected by innovation, as sectors with a higher proportion of innovating firms do show higher persistence indexes.

Table 4 - Sectoral characteristics and persistence rate

		Persistence rate	CR4*	Herfindal*	Size*	Innovation
15+16	**Food and beverages**	0.7255	38.4819	7.7287	52	0.3350
17	**Textiles**	0.7467	19.0043	1.6106	56	0.3259
18	**Wearing**	0.6844	28.6638	3.5704	48	0.2127
19	**Leather**	0.6736	15.3473	1.6133	43	0.2440
21	**Paper products**	0.7524	41.5328	6.4436	53	0.4335
22	**Printing and publishing**	0.7295	41.4656	6.3077	54	0.4686
24	**Chemical**	0.7918	19.4763	2.0176	70	0.4982
25	**Rubber**	0.8095	38.0127	5.9877	53	0.4481
26	**Non metallic products**	0.756	21.8946	1.8883	47	0.3566
27	**Basic metal industries**	0.7185	26.8875	2.9780	64	0.3304
28	**Metal products**	0.7676	6.8870	0.4726	44	0.3797
29	**Machinery and equipment**	0.7074	19.1226	1.5150	60	0.5365
31	**Electrical machinery**	0.786	26.2309	3.0663	65	0.4954
33	**Professional, scientific etc.**	0.7513	24.9823	2.8948	49	0.5632
34+35	**Transp. Equipment**	0.7447	79.4778	35.0543	76	0.4579
36+37	**Other manufact.industries**	0.6911	15.0830	1.0841	45	0.3245
	Correlation		0.1286	0.0756	0.3555	0.5907

CR4= Four largest firms market share; Herfindal = Herfindal Index; Size = Median firm size; Innovation = Ratio of innovative firms to the total number of firms.

* Calculated at initial sample period.

5. An ordered probit approach

In the previous section we have summarised the result of the analysis of profit persistence by using a TPM approach. In this section we integrate such an approach with a parametric technique, which enables us to assess more precisely the relevance of firm or industry effects as possible determinants of profit persistence.

We model a firm's performance by using an ordered probit approach, which enables us to specify a three-state condition, i.e., high profit state, mean profit state and low profit state, in accordance with the classification given in section 2.

We consider the profit level of each firm as a latent variable y* and, as usual for this class of models, we hypothesise that:

$$y^* = \quad + \qquad\qquad (2)$$

where **x** is the matrix of explanatory variables (i.e., firm and industry characteristics), b is a vector of fixed coefficient and ε is the stochastic component assumed to be normally distributed with zero mean and unit variance. We then allow for a complete censoring of *y**, by defining an observable variable y which takes the following values:

$$\begin{aligned} y &= 0 \quad if\ y^* \leq l_0 \\ y &= 1 \quad if\ l_0 \leq y^* \leq l_1 \qquad\qquad (3) \\ y &= 2 \quad if\ y^* > l_1 \end{aligned}$$

where λ is a threshold parameter. In addition, we use the classification of section 2 to identify the profit thresholds; thus the model is now one in which the thresholds are known and, therefore, it must be estimated by using the approach suggested by Greene (1997, 2002), which implies a censored regression similar to the Tobit estimation procedure.

The profit state of each firm depends on variables which reflect either a firm's characteristics or industry characteristics. In such a regression (censored) the values of *y* are ranked in an ascending order, i.e., from the lowest profit level (score value 1) to the highest profit level (score value 3). According to the empirical literature, we can discriminate between variables which reflect:

a) firms' characteristics

  - innovative activity (INNOV)
  - size (SIZE)
  - location (dummy variables; NEAST, NWEST, CENTRE)

b) industry characteristics

  - concentration index (CR5)
  - sectoral dummies

Thus, we are interested in testing the relative effect of firm- and industry-specific variables on the probability of being a highly profitable firm. We therefore use a censored panel estimation to test industry and firm effects. These effects are taken into account mainly by introducing firm and industry dummies. In addition, we introduce a dummy variable which reflects innovation (INNOV) at the beginning of the sample period (1990-92). Thus, this panel estimates we report are derived from a random effect model, as the fixed effect model cannot be implemented given the specification we have adopted.

Table 5

Ordered probability model with fixed threshold parameters
Censored regression – Panel data estimates*

	COEFF.	S.E.	p-value
Constant	7.51157036	0.27872667	0.0000
CR5	-.196378D-04	0.00401313	0.0000
SIZE	-0.00019342	.413943D-04	0.0000
INNOV	0.86415164	0.084261	0.0000
MARKET	0.21588201	0.11387664	0.0000
NWEST	3.32672364	0.18917848	0.0000
NEAST	3.6000452	0.19258031	0.0000
CENTRE	2.77100841	0.20945146	0.0000
D15	-0.45320851	0.1904802	0.0173
D17	1.82458371	0.19487017	0.0000
D18	-0.15979192	0.23062939	0.4884
D19	-0.01993496	0.2625937	0.9395
D20	1.75626213	0.27547651	0.0000
D21	2.16589094	0.25910385	0.0000
D22	0.22558344	0.25637985	0.3789
D23	4.82306266	0.732722	0.0000
D24	2.00519421	0.22438961	0.0000
D25	3.10584713	0.20714887	0.0000
D26	2.13902208	0.19828086	0.0000
D27	1.73835482	0.23787876	0.0000
D28	2.22560964	0.20672787	0.0000
D29	-0.40171591	0.17254283	0.0199
D30	-0.17212861	1.0940986	0.8750
D31	1.756658	0.23659192	0.0000
D32	1.28714813	0.38720643	0.0009
D33	1.21089934	0.32153428	0.0002

McFadden R2=0.015
N=48996
Log likelihood = -48515.0(
Log likelihood (0)= -
49251.86
T= 9

*Random effect model. The dependent variable y takes the following values: 1, low profit state; 2, mean profit state; 3, high profit state.
D15-D33= industry dummies, see Appendix 1 for sectoral classification.

The results show that innovation at the beginning of the sample period does affect the probability of being a highly profitable firm during the whole time span of our data set. The dummy reflecting the ability of a firm to capture market evolution (MARKET) is significant too, while firm size is significant but with a very small coefficient, implying that the probability of being a highly profitable firm is not crucially affected by its size[4].

Geographical location is, instead, an important factor affecting such a probability. Firms in the north east of Italy do show a high probability of being in a high profit state as compared with firms located in the south, which is the reference area. Geographical location in the north west and central Italy positively affects such a probability however, with a smaller and decreasing impact as compared to the north east. This result is coherent with the evolution of the Italian manufacturing sector in the '90s, characterised by the dynamics of small and medium sized enterprises localised in the industrial districts of the north east. These firms were able to gain from the last devaluation of the mid '90s, and thus to increase their profit margins. However this situation lasted, only until the end of the decade when the introduction of the euro placed Italian manufacturing firms in a new competitive scenario. Against this background, even the industrial sector of the north east had to face new threats, which weakened its overall competitiveness.

We also consider sectoral characteristics as possible determinants of a firm's profit status and thus of the persistence pattern. We use the CR5 index (i.e., the ratio of the largest five firms' output to the corresponding sectoral output). The effect of this variable is not significant, while sectoral dummies confirm the results of the descriptive analysis, in that sectors with low technological opportunities (food, beverages and tobacco, clothing and leather) and large-scale assembly industries (machinery and equipment) negatively contribute to the probability of being in a high profit status. On the other hand, sectors in which technological opportunities are higher (e.g. chemicals, electrical machines, professional, scientific and optical goods) positively contribute to such a probability.

We have modified the empirical specification summarised in Table 5 to take the possible state dependence effect into account. We have introduced a lagged dependent variable, i.e. the profit state condition at time (t-1), to test this hypothesis. The results do confirm that there is positive state

[4] MARKET= A dummy variable taking the value of one for positive advertising and marketing expenditure, and zero otherwise.

dependence, and thus they also confirm the persistence hypothesis. In addition, this specification confirms the role of innovation as a crucial variable for determining a firm's profit status. The effect of firm size is again negligible, and geographical dummies continue to have a significant effect.

Table 6
Ordered probability model with fixed threshold parameters (Censored regression). Panel data estimates State dependence effect.

	COEFF.	S.E.	p-value
Constant	-0.39703623	0.27329803	0.1463
LAGPROF	4.78117501	0.06088362	0.0000
CR5	.973427D-04	0.00348605	0.9777
SIZE	-.883419D-04	.350848D-04	0.0118
INNOV	0.46223481	0.07265287	0.0000
MARKET	-0.04612265	0.09852341	0.6397
DNWEST	1.46894577	0.16304082	0.0000
DNEAST	1.60470947	0.16566914	0.0000
DCENTRE	1.24340553	0.18127989	0.0000
D15	0.0049431	0.16563989	0.9762
D17	0.74953915	0.16780561	0.0000
D18	-0.18976941	0.19959248	0.3417
D19	0.10878955	0.22544675	0.6294
D20	0.76471385	0.2355717	0.0012
D21	1.07600265	0.22324939	0.0000
D22	0.04970815	0.22402038	0.8244
D23	2.53915828	0.64898465	0.0001
D24	1.11397163	0.19399919	0.0000
D25	1.5823226	0.17815176	0.0000
D26	0.60954306	0.17067681	0.0004
D27	0.5958034	0.20420215	0.0035
D28	0.96808505	0.17750226	0.0000
D29	-0.1283155	0.14878368	0.3885
D30	0.36345964	0.95756508	0.7043
D31	0.94203339	0.20457479	0.0000
D32	0.3469259	0.33728172	0.3037
D33	0.52534851	0.27657614	0.0575

Mc.Fadden R2=0.1893
N=43552
Log likelihood = -35627.31
Log likelihood (0) = -43947.97

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*Random effect model. The dependent variable y takes the following values: 1, low profit state; 2, mean profit state; 3, high profit state.
LAGPROF= Profit condition at time t-1.
D15-D33= industry dummies, see Appendix 1 for sectoral classification.

The estimates we have discussed so far, though highlighting the different effects of firm or industry variables, do not allow for a precise measurement of the impact of each of them, as we cannot compute the marginal effects because the conditional mean cannot be derived from the censored regression. Thus we decided to apply a standard ordered probit estimation without imposing any constraint on the threshold values (Table 7). In this case we present marginal values which allow us to describe more precisely the impact of each variable on the profitability status.

Marginal effects reflect the change in the probability of the event brought about by a marginal change in the regressors. For dummy variables, marginal effects are the simple difference of the two probabilities with and without the variable (at sample means). The marginal effect of the innovation dummy shows a positive effect on the probability of being a highly profitable firm (y=2), with a difference in probability between non-innovating firms of about ½ a percentage point. The reverse effect is observed for the probability of being in a low profit state (y=0), while the effect on the probability of being in a mean state is negligible (Table 8).

Geographical dummies do have a strong impact on the probability of being in a high profit state, and conversely of being a low-profit firm. The north east dummy variable brings about a high profit probability which is about 1.9 percentage points higher than that of the firms located in the south (the reference area). The corresponding differences for the north west and central Italy are 1.7 and 1.4 respectively. These differences do hold with the opposite sign for the probability of being a low-profit firm, while for the mean profit state the impact is very mild and negative.

Marginal effects for sectoral dummies confirm the previous discussion, and thus the differentiated effect of each industry on a firm's profitability status. When we check for state dependence (Tables 9 and 10), the impact of all other explanatory variables declines as compared with the estimation without a lagged dependent variable. The marginal effect of this variable is strong, as it implies that the probability of being in a high profit state is more than 3 percentage points higher as compared with the corresponding probability of the other firms.

Table 7
Ordered probit regression – Panel data estimates

	COEFF.	S.E.	p-value
Constant	-0.26555705	0.03698977	0.0000
CR5	-. 262265D-05	0.00053596	0.9961
SIZE	-.258320D-04	.552292D-05	0.0000
INNOV	0.11540844	0.01119924	0.0000
MARKET	0.02883129	0.01520597	0.0580
DNWEST	0.44428774	0.0249065	0.0000
DNEAST	0.48079015	0.02530664	0.0000
DCENTRE	0.37007134	0.02774834	0.0000
D15	-0.06052651	0.02543236	0.0173
D17	0.24367524	0.02592122	0.0000
D18	-0.02134039	0.03080013	0.4884
D19	-0.00266234	0.03506968	0.9395
D20	0.23455081	0.03672315	0.0000
D21	0.28925721	0.03449391	0.0000
D22	0.03012693	0.0342386	0.3789
D23	0.64412553	0.09765907	0.0000
D24	0.26779598	0.0298582	0.0000
D25	0.41478944	0.02737981	0.0000
D26	0.28566884	0.02633946	0.0000
D27	0.23215927	0.03169145	0.0000
D28	0.29723271	0.0274624	0.0000
D29	-0.05364962	0.02303766	0.0199
D30	-0.02298797	0.14611795	0.8750
D31	0.23460368	0.03151727	0.0000
D32	0.1719001	0.05168583	0.0009
D33	0.16171699	0.04291346	0.0002

McFadden R2=0.015
Coun R2=0.5084
N=48996
Log likelihood=-48515.06
Log likelihood (0)=-49251.86

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*Random effect model. The dependent variable y takes the following values: 0, low profit state; 1, mean profit state; 2, high profit state. .
D15-D33= industry dummies, see Appendix 1 for sectoral classification

Table 8 Summary of Marginal Effect of Ordered Probability Model

	Y=0	Y=1	Y=2
*INNOV	-0.0427	-0.0031	0.0457
*MARKET	-0.0108	-0.0007	0.0115
*DNWEST	-0.1636	-0.0113	0.1749
*DNEAST	-0.1715	-0.0159	0.1874
*DCENTRE	-0.129	-0.0143	0.1434
*D15	0.0227	0.0014	-0.0241
*D17	-0.0868	-0.0086	0.0954
*D18	0.008	0.0005	-0.0085
*D19	0.001	0.0001	-0.0011
*D20	-0.083	-0.0086	0.0916
*D21	-0.1011	-0.0113	0.1123
*D22	-0.0111	-0.0008	0.0119
*D23	-0.2004	-0.0338	0.2342
*D24	-0.0943	-0.0101	0.1043
*D25	-0.1411	-0.0178	0.1588
*D26	-0.1006	-0.0107	0.1113
*D27	-0.0823	-0.0084	0.0908
*D28	-0.1049	-0.011	0.1159
*D29	0.0201	0.0012	-0.0213
*D30	0.0086	0.0006	-0.0091
*D31	-0.0832	-0.0085	0.0917
*D32	-0.0617	-0.0058	0.0675
*D33	-0.0582	-0.0054	0.0636

Table 9
Ordered probit regression
Panel data estimates

	COEFF.	S.E.	p-value
Constant	-0.89722879	0.04237699	0.000
LAGPROF	0.83853091	0.0069897	0.000
CR5	.170724D-04	0.00061139	0.978
SIZE	-.154936D-04	.615141D-05	0.012
INNOV	0.08106757	0.01271728	0.000
MARKET	-0.00808905	0.01727907	0.640
DNWEST	0.2576263	0.02848284	0.000
DNAEST	0.28143677	0.02892461	0.000
DCENTRE	0.21807064	0.03172156	0.000
D15	0.00086692	0.02905022	0.976
D17	0.13145552	0.02940292	0.000
D18	-0.03328209	0.03500318	0.342
D19	0.01907971	0.03953891	0.629
D20	0.13411686	0.04129537	0.001
D21	0.18871125	0.03911181	0.000
D22	0.0087179	0.03928899	0.824
D23	0.44532202	0.1137327	0.000

D24	0.19537032	0.03397109	0.000
D25	0.27751052	0.03112627	0.000
D26	0.10690274	0.02991641	0.000
D27	0.10449306	0.03579938	0.004
D28	0.16978449	0.0310875	0.000
D29	-0.02250418	0.02609279	0.388
D30	0.06374374	0.1679377	0.704
D31	0.16521546	0.03584067	0.000
D32	0.06084448	0.05914969	0.304
D33	0.09213654	0.04849882	0.058

McFadden R2=0.1893
Count R2 = 0.6760
N=43552
Log likelihood = -35627.31
Log likelihood (0) = -43947.97

*Random effect model. The dependent variable y takes the following values: 0, low profit state; 1, mean profit state; 2, high profit state.
LAGPROF= Profit condition at time t-1
D15-D33= industry dummies, see Appendix 1 for sectoral classification

Table 10 - Summary of Marginal Effects for Ordered Probability Model

	Y=0	**Y=1**	**Y=2**
LAGPROF	-0.305	-0.0261	0.3311
***INNOV**	-0.0294	-0.0026	0.032
***MARKET**	0.0029	0.0003	-0.0032
***DNWEST**	-0.0933	-0.0081	0.1014
***DNAEST**	-0.0999	-0.01	0.11
***DCENTRE**	-0.0763	-0.0085	0.0848
***D15**	-0.0003	0	0.0003
***D17**	-0.0467	-0.0048	0.0515
***D18**	0.0122	0.001	-0.0132
***D19**	-0.0069	-0.0006	0.0075
***D20**	-0.0474	-0.005	0.0524
***D21**	-0.0658	-0.0075	0.0733
***D22**	-0.0032	-0.0003	0.0034
***D23**	-0.1433	-0.0225	0.1658
***D24**	-0.0681	-0.0078	0.0759
***D25**	-0.0949	-0.0119	0.1068
***D26**	-0.0381	-0.0038	0.0419
***D27**	-0.0372	-0.0038	0.0409
***D28**	-0.0599	-0.0064	0.0663
***D29**	0.0082	0.0007	-0.0089
***D30**	-0.0229	-0.0022	0.0251
***D31**	-0.058	-0.0064	0.0644
***D32**	-0.0218	-0.0021	0.0239
***D33**	-0.0328	-0.0033	0.0361

6. Conclusions

We have analysed profit persistence in Italian manufacturing industries by using econometric estimation techniques, allowing us to test the impact of firm and industry characteristics on the probability of being in a high, mean or low profit state. Our findings suggest that location and innovation are the two major factors of firms' characteristics affecting the probability of being a highly profitable firm. Firm size, instead, has a negligible impact on such a probability. Sectoral characteristics are taken into account by using industry dummies, emphasising that operating in traditional industries (e.g. food, beverages and tobacco, clothing, leather) and large scale assembly industries negatively affects the high profit status probability. On the other hand, those sectors where innovation activity is high (e.g. chemical, electrical machines, professional, scientific and optical goods) positively affect the probability of being a successful (i.e. profitable) firm.

Persistence is tested for by including the lagged profit state condition, which significantly enters the estimated equations. Thus, the econometric results we have discussed reinforce our nonparametric evidence based on a Transition Probability approach, and they underline how the ability to innovate and geographical location are more relevant factors than firm size or industry concentration in determining a firm's likely profitability.

Appendix 1 : Industry Classification

Industry description	ISIC (2 digit)
1. Foods, Beverages and Tobacco	15+16
2. Textiles	17
3. Wearing	18
4. Leather and Footwear	19
5. Wood Products except Furniture	20
6. Paper Products	21
7. Printing and Publishing	22
8. Petroleum Refineries	23
9. Chemicals	24
10. Rubber and Plastic	25
11. Non Metallic Products	26
12. Basic Metal Industries	27
13. Metal Products	28
14. Machinery and Equipment	29
15. Office and Computing Machinery	30
16. Electrical Machines	31
17. Radio, TV and Communication Equipment	32
18. Professional, Scientific, Photographic and Optical Goods	33
19.Transport Equipment	34
20. Other Transport Equipment	35
21. Other Manufacturing Industries	36+37

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