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IN AND OUT OF THE CAPITALIA SAMPLE: EVALUATING ATTRITION BIAS

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1. Introduction

The Capitalia[1] sample survey of manufacturing firms in Italy represents a potentially important source of panel data on Italian firms. To date 8 waves have been released the most recent of which takes the survey upto the year 2000. In each wave, data is collected for a three year period and resampling of the same firms allows the construction of a firm panel over a much longer period. The composition of such a panel for the 5th, 6th 7th and 8th waves covering the period 1989-2000 inclusive was undertaken as part of the PRIN 2003 research project "Metodi e applicazioni per la valutazione delle politiche del lavoro e di aiuto alle imprese".

In this paper, the characteristics of the sample are considered. In particular, sample entry and exit behaviour are studied in order to gain some understanding of the potential for using the database constructed at the University of Salerno for undertaking panel studies of firms over 2 or more waves of the survey. Such panels would be useful in many contexts, for example, in gaining a better understanding of the impact of industrial policies on indicators of firm success than has thusfar been possible with the analysis of single waves of the sample. Given the unique richness of the database in terms of the range of qualitative as well as quantitative information on Italian firms which it contains, the potential uses and usefulness of a panel dataset constricted from the Capitalia sample are extensive.

Panel attrition, however, represents a significant potential obstacle to such a use of the sample. Firms exit the sample and are replaced (more or less). The nature of the exit (and to some extent replacement) process will influence the extent to which a panel of firms constructed over more than one wave of the survey may be relied upon to produce unbiased estimates of the parameters of interest in a model of, for example, the impact of subsidies on firm performance. In this paper an attempt is made to throw light on this issue by analysing these processes.

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[1] Originally, the survey was undertaken under the aegis of Mediocredito centrale.

In the following section we take a first look at the data, providing some descriptive statistics on the 5th to 8th waves of the Capitalia sample and comparing it to information drawn from the Censi of Industrial production of 1991 and 2001. In section 3, the problem of panel attrition is considered in general as well as in the context of the Capitalia data. In section 4 a test for attrition bias suggested by Verbeek & Nijman (1992) is implemented. Finally, section 5 reports our conclusions.

2. The nature of the Capitalia sample survey. A comparison with the data from the Censi of Industrial production.

This paper considers the 5th, 6th, 7th and 8th waves of the Capitalia survey undertaken in 1991, 1994, 1997 and 2000 respectively. The survey covers a sample of firms with between 11 and 500 employees and a census of firms with a workforce of over 500. Information is collected in two parts, a qualitative questionnaire administered to firms and quantitative balance-sheet data collected from firms covering a three year period. Although small changes have been introduced in each wave of the survey, the same basic structure has been adopted since the 5th wave in 1989 allowing, in principle, the construction of time series information on numerous variables. In each wave around 4500 fims are included (usually a slightly smaller number for the balance-sheet data) which represents (usually) a little under 5% of the total number of manufacturing firms[2]. The sample is stratified such that larger firms are much more likely to be sampled; indeed, for firms of over 500 workers a census is actually taken. Table 2.1 reports the size distribution of firms in the samples and, for comparison purposes the size distribution of firms drawn from the Censi of

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[2] Although if one considers the size of the sample in relation to either employment or output, the figure is closer to 10% of the manufacturing total as is pointed out in the report on the 8th wave (Capitalia, 2002).

1991 and 2001 the first of which was used to construct the Capitalia samples[3].

TABLE 2.1				
	% of firms			
No. of employees	1991 (5th wave)	1994 (6th wave)	1997 (7th wave)	2000 (8th wave)
Capitalia Sample				
11-19	0.5	14.2	21.6	33.3
20-49	19.2	20.5	41.0	42.5
50-249	41.8	33.6	26.5	17.2
250+	38.6	31.8	10.9	6.9
Total number of firms	4156	5415	4497	4680
Censi		**1991**		**2001**
11-19		59.0		58.5
20-49		28.5		28.5
50-249		10.8		11.4
250+		1.7		1.6
Total number of firms (with at least 10 employees)		97,165		95,017
	Capitalia sample as % of 1991 Census firms by firm size			
	1991	1994	1997	2000 (% of 2001 Census)
11-19	0.03	1.34	1.69	2.81
20-49	2.87	4.00	6.66	7.35
50-249	16.52	17.32	11.33	7.41
250+	98.71	105.85	30.23	21.36
Total number of firms	4.28	5.57	4.63	4.93

Clearly small firms are relatively underrepresented in the sample. It may be observed however, that over time, their relative representation has increased substantially. In the fifth wave, firms

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[3] In practice, the first Capitalia sample considered here - the fifth wave undertaken in 1991 – was based on the Chambers of Commerce database of small and medium sized enterprises (CERVED).

with fewer than 20 employees were virtually absent. This is perhaps due to the fact that the sample was drawn from the CERVED database in which possibly very small firms of under 20 workers are severely underrepresented given the necessary registration process. At the other end of the scale, the 5th and 6th waves included a practical census of firms with at least 250 workers[4]. Subsequently, the percentage of large firms has fallen off fairly dramatically as the census was restricted to firms with over 500 workers.

3. Panel Attrition in the Capitalia sample

Missing data represents an important issue in econometrics. In particular, in panel surveys, observation units not only may decide not to answer specific questions, but they are also likely to drop out of the panel between two consecutive waves. This problem is known as "attrition".

There is huge literature focusing on the consequences of panel attrition (e.g. Hausman & Wise, 1979; Little & Rubin, 1987; Fitzgerald et al., 1998; Rendtel et al., 2004; Dennis-Rick Li, 2003; Liao, 2006; Flossmann, 2006) for the validity of estimates based on such surveys; the focus point is the mechanism causing attrition.

In particular, if the mechanism causing non response is random, so that the lost observation units and the remaining ones exhibit similar patterns, panel attrition affects only the representativeness of the original sample, but it does not cause biased estimates. However, if panel attrition is not random, but, in particular, the factors which determine non response are correlated with the issue being analysed by the researcher, attrition may cause non response bias.

This section investigates the presence and the likely consequences of attrition in the Capitalia sample reporting how the

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[4] Possibly the figure of over 100% for the 6th wave is due to the growth of firms between the date of the census (1991) and the date of the survey (1994). Another possibility is that in this wave, firms are included in both questionaire and balance sheet datasets but are not identified as the same firm in each case.

sampled firms retained in the panel differ from the respondents lost. In particular, the following section compares the size distribution of firms in two-wave panels with firms in the cross-section; section 3.2 displays summary statistics, section 3.3 contains probit regressions of the probability that firms drop out or enter the panel in each of the following waves: wave 5 (years 1989-1991), 6 (years 1992-1994), 7 (years 1995-1997) and 8 (years 1998-2000).

3.1 The Capitalia Panel

In practice there are several sources of data loss which occur in constructing a panel from the sample survey waves. First, before one actually comes to constructing the panel itself, not all firms can be included because, although included in the sample with information from the questionnaire or from balance-sheets, for some firms information is only provided for one but not both of these. In the seventh and eighth waves the firms for which balance sheet data were collected are a subsample of firms who completed the questionaire, in the fifth and sixth, the methodology is a little different with overlapping samples being collected. That is, in these waves some firms are included with only information on balance sheet data, others with only questionaire data and third group comprise firms for which information was collected from both sources. Figure 1 illustrates this.

Figre 1
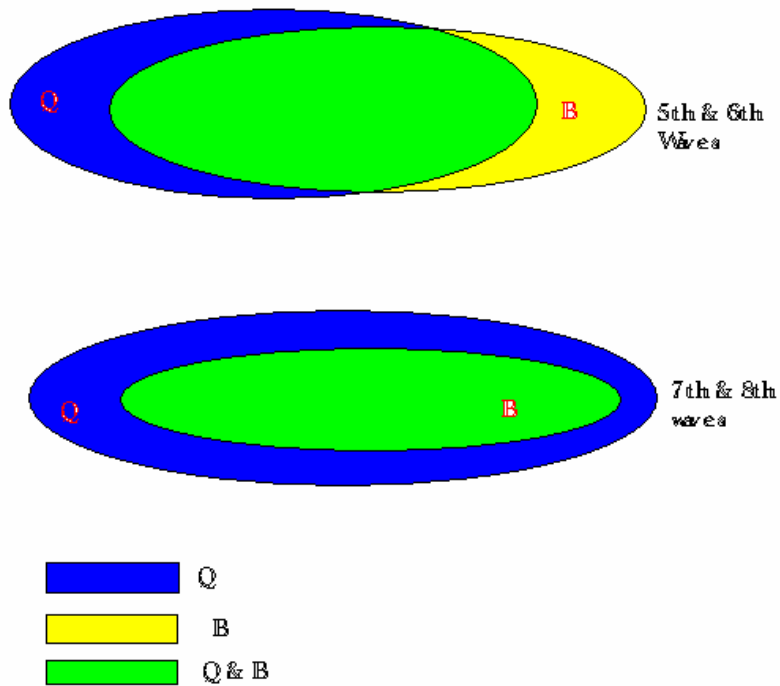
Thus, a first source of data loss arises from the exclusion of firms for which information is incomplete in the sense that either the questionaire data or the balance sheet data is entirely absent from the sample. This issue is analysed in more detail below; however, in order to get an idea of the impact on the samples, table 3.1.1 compares the size distribution of firms in the complete sample with those for whom information is available from both (questionaire and balance sheet) sources. For the most part there is not a huge difference between the distributions apart from the case of the 6th wave where the number of large firms is almost halved in the reduced sample, providing further support for the idea that

8

some firms at least were double counted in the the full sample. More generally the number of very small firms drops further in all waves.

TABLE 3.1.1								
	% of firms							
No. of employees	1991 (5th wave)		1994 (6th wave)		1997 (7th wave)		2000 (8th wave)	
Capitalia Sample	Full sample	Q & B	Full sample	Q & B	Full sample	Q & B	Full sample	Q & B
11-19	0.5	0.1	14.2	9.7	21.6	18.0	33.3	31.0
20-49	19.2	20.6	20.5	24.1	41.0	40.2	42.5	44.4
50-249	41.8	42.6	33.6	47.3	26.5	29.8	17.2	18.1
250+	38.6	36.8	31.8	18.9	10.9	12.0	6.9	6.4
Total number of firms	4156	3823	5415	3522	4497	3688	4680	4004

What then is the cause of incomplete information? Either data was not sought: solicited (in the case of the questionnaire) or collected (in the case of balance sheets); or was not provided - firms declined to respond to the questionnaire or information was not available on balance sheets. Without further information from Capitalia (or Mediocredito) it is not possible to know which of these is responsible.

On the basis of the sample for which full information was available, a panel was constructed. At each wave a large proportion (roughly betwen 2/3 and 3/4) of firms dropped out Table 3.1.2 again reports the size distribution of firms in panels constructed from 2 successive waves[5] compared in this case to the full information samples from each successive wave. Two principal

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[5] Given the very high rate of panel attrition, it did not appear useful to constuct panels with more than two waves. The appendix includes full descriptive statistics, however, it may be noted here that only for only 132 firms is full information available on all four waves.

points are worth observing. Survival in the panel does not seem to be closely related to firm size, however, it is very clear that there is a substantial degree of variation in firm size for survivors on the panel particularly for the 5th-6th wave. For the 5th and 6th waves, the size distribution of the panel (5th-6th and 6th-7th respectively) is reasonably close to the original size distribution. This is not true of the 7th wave (vis-a-vis the 6th-7th panel) and the 8th wave (vis-a-vis the 7th-8th) panel. That is, the size distribution for the later panels reflects the size distribution of the earlier rather than later cross-section of firms.

TABLE 3.1.2									
	% of firms								
No. of employees	Size in 5th wave		Size in 6th wave			Size in 7th wave			Size in 8th wave
	5th wave	5th & 6th wave	6th wave	6th & 7th waves		7th wave	7th & 8th waves		8th wave
11-19	0.1	0.1	8.4	9.7	4.5	4.8	18.0	19.8	15.8	31.0
20-49	20.6	15.2	21.0	24.1	20.2	19.8	40.2	42.0	43.4	44.4
50-249	42.6	41.0	46.7	47.3	46.2	45.0	29.8	27.2	29.8	18.1
250+	36.8	43.7	23.9	18.9	29.1	30.4	12.0	11.1	11.1	6.4
Total number of firms	3823	1765	3522	749		3688	1031		4004

The question arises why did firms drop out of the panel? Several alternatives are possible. First, it is possible that information was not solicited on the part of Capitalia/Mediocredito at the successive round. Given the extremely high rate of attrition, it seems likely that this is at least partially responsible for panel attitrition – after all, it was never the stated intention of Mediocredito or Capitalia to create a complete panel dataset on firms. Second firms may not have been willing or able to provide responses which in turn may depend on several different factors:

- The firm made a decsion not to respond a second time for whatever reason;
- The firm no longer exists because it has gone bankrupt;

- The firm no longer (effectively) exists because it has been taken over or merged with another.

Once again, without further information from Capitalia itself it is not possible to know the relative importance of each of these possibilities

Finally, as we will see in more detail below, a third source of data loss is due to incomplete responses to either the questionaire or balance sheet data files.

3.2 Summary statistics

Full descriptive statistics on firms in each wave and in the Capitalia panel are reported in the Appendix, in this section, we limit ourselves to a comparison of the characteristics of firms retained in two consecutive waves of the panel with the characteristics of the firms lost. In particular, in the first column of table 3.2.1 statistics are displayed concerning the respondents to selected variables, both in the questionnaire and in the balance sheet, in the fifth wave, column 2 regards the sixth wave, and so on.

Table 3.2.2, in column 1, reports summary statistics about respondents in the fifth wave that were interviewed again in the sixth wave and answered to all the specific questions; column 2 concerns firms "included" and "respondent" in the sixth and in the seventh waves; in column 3 are reported data for firms "included" and "respondent" in the seventh and in the eighth wave.

TABLE 3.2.1- Summary statistics about Respondents to selected variables				
	5° WAVE* 1989-1991	6° WAVE* 1992-1994	7° WAVE* 1995-1997	8° WAVE* 1998-2000
Variables	%	%	%	%
Number of observations	3520	3254	3530	3903
FORM OF OWNERSHIP Individual firm Partnership Business Corporation	0.25 9.37 90.2	0.03 2.00 97.5	- 0.59 97.19	0.02 0.82 96.05

Cooperatives	0.11	0.37	2.15	3.02
Others	0.05	0.06	0.06	0.08
SECTORS ECON.ACTIVITY				
Traditional sectors	43.03	43.02	41.98	52.96
Scale	34.97	34.70	27.17	18.29
Specialised	19.34	17.85	25.58	23.93
High tech	2.64	4.42	5.27	4.82
MEMBER OF A GROUP**				
No	70.14			
Yes		33.37	27.39	19.57
0.1-10%	0.45			
10 - 20%	0.36			
30 - 50%	2.18			
> 50%	26.84			
CONSORTIUM	17.04	10.26	10.23	10.09
RECEIVED STATE FINANCIAL INCENTIVES	53.35	44.62	42.80	40.92
YEAR FIRM FOUNDED***	967 (29.54)	1969 (19.86)	1972.87 (18.68)	1975 (18.40)
NUM. OF EMPLOYEES (third year)	364.08 (691.04)	186.13 (558.69)	135.73 (404.01)	75.85 (263.44)
ROI****(third year)	0.09 (0.08)	0.07 (0.1)	0.07 (0.09)	0.06 (0.07)

Notes:
* In the fifth wave missing data are labelled with "0", in the seventh wave missing data are labelled with "9", in the other two waves mainly with "-1". ** In the fifth wave there is no distinction between firms not answering and firms not belonging to a group.***The sample does not include observations reporting errors on the year of foundation (9 variables have been excluded in wave 5, 4 variables in wave 8); values "0" have been considered as missings;.*** *Roi= Ro/Total assets. In the fifth wave, "Ro" was not available so that it has been obtained as difference between added value and labour cost; the values 0 of the relevant variables have been considered as missings.

The data in table 3.2.1 show that sampled firms, respondent in each wave, are mainly "business corporations", working in traditional sectors. The percentage of firms belonging to a group decreases in the eight wave, while the share of firms in a consortium is higher in the fifth wave. The "ROI" value does not greatly vary among the four waves, while the decrease of the mean number of employees is very impressive. Finally, it is interesting to note that the percentage of firms that received financial state incentives is more than the fifty percent only in the fifth wave.

Let us compare the data reported in table 3.2.2 with those in table 3.2.1. What surprisingly emerges is that the share of firms that had received financial support from the government, included and respondent in the 6th-7th wave panel, is now higher than fifty percent; the other interesting features observed for the 6th-7th wave panel, are the increase in firms belonging to a group, firms in the scale sector and above-all the mean number of employees per firm.

TABLE 3.2.2- Summary statistics about respondents to selected variables in two consecutive waves			
	5° -6° WAVE* 1989-1994	6°-7° WAVE* 1992-1997	7°-8° WAVE* 1995-2000
Variables	%	%	%
Number of observations	1526	665	945
FORM OF OWNERSHIP			
Individual firm	0.32	-	-
Partnership	2.88	0.90	0.53
Business Corporation	96.59	98.95	96.19
Cooperatives	0.13	0.15	3.17
Others	0.06	-	0.10
SECTORS ECON.ACTIVITY			
Traditional sectors	41.74	38.65	44.23
Scale	35.45	38.34	24.55
Specialised	20.12	19.40	26.45
High tech	2.69	3.61	4.76
MEMBER OF A GROUP**			
No	69.53		
Yes		41.20	21.90

0.1-10%	0.59		
10 - 20%	0.39		
30 - 50%	2.42		
> 50%	27.06		
MEMBER OF A CONSORTIUM	18.61	10.68	11.42
RECEIVED STATE FINANCIAL INCENTIVES	57.86	51.58	42.01
YEAR FIRM FOUNDED***	967.79 (25.74)	1966.77 (20.32)	1972.57 (17.68)
NUM. OF EMPLOYEES (third year)	366.65 (589.50)	228.70 (441.30)	106.46 (248.50)
ROI**** (third year)	0.09 (0.07)	0.07 (0.08)	0.07 (0.07)
Notes: see notes to table 3.1.1			

The most important pattern exhibited by the 5th-6th wave panel when compared to wave 5 respondents is an increase in the share of "business corporations" and in the probability of having received state financial incentives.

Finally, when we consider the 7th-8th wave panel, the consequences of attrition on the sample composition seems to be less significant: what one can observe is a lower percentage of firms belonging to a group and the reduction of firm size.

3.3 The Process of Attrition: Probit analysis

Separate regressions were conducted to predict whether sampled firms in one wave were observed in the following wave, reporting complete data on selected variables. Two problems are not considered at this stage in the research: firstly, we do not investigate the likely correlation between non response in two consecutive waves; secondly, we do not distinguish between different sources of data loss.

The results of the probit regressions are reported in table 3.3.1. In particular, the results in the first column have been obtained comparing wave 5 respondents "included" at wave 6, and wave 5 respondents "lost" at wave 6.

The impact both of the number of employees and of state financial incentives in predicting the probability of remaining in the sample is very interesting (see columns 1, 2 and 3 in table 3.3.1). More specifically, the coefficients on these variables are almost always significant and exhibit the same sign (with the exception of the 7th-8th wave). These results are confirmed considering the estimates of the probability of entering the sample reported in the column 4, 5, 6^6.

The other results may be summarised as follows. The members of a consortium or of a group report higher probabilities both of entering and of remaining in the 5th-6th wave panel, the Pavitt sector also significantly affects the composition of the 6th-7th wave panel, while the variable "SOLV^7" significantly influences the probability both of leaving and of entering waves 7 and 8.

As a consequence, one can summarize the evidence reported in this section by underlining that significant differences have been found for respondents lost and respondents "included" across different variables usually used in literature to characterize firm profiles. The most important feature, however, is that the firms retained in two consecutive waves in the panel are more likely to have received financial support from the government.

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[6] In the fourth column, the results concern the probability that respondents "found" at the sixth wave were already in the panel in the fifth wave; in the column 5, the results concern the probability that respondents "found" at the wave 7 were already in the panel in the wave 6; column 6 concerns the waves 7 and 8.

[7] It must be noted that a significant number of firms (almost 400) in the fifth and in the eight wave exhibit "unusual values" for CASH and for SOLV, in particular, very high values for CASH and negative values for SOLV (CASH, SOLV and other variables are defined in the tables). However, in this first step of the research, we retained these observations in the sample since their exclusion does not affect our main results.

TABLE 3.3.1	5th- 6th wave	6th - 7th wave	7th- 8th wave	6th -5th- wave	7th -6th wave	8th -7th wave
Form of Ownership						
- Partnership	-1.14*** (0.34)	0.55 (0.55)	-0.49** (0.34)	0.16 (0.36)	1.81*** (0.47)	-0.25 (0.28)
- Business Corporation	-0.11 (0.33)	0.85* (0.50)	-0.37*** (0.15)	-0.06 (0.33)	1.33*** (0.34)	-0.17 (0.13)
"Pavitt" Sectors						
- Scale	0.12 (0.05)	0.12** (0.05)	-0.07 (0.06)	-0.03 (0.05)	0.10 (0.07)	0.03 (0.06)
- Specialised	0.04 (0.06)	0.10 (0.07)	-0.02 (0.06)	-0.03 (0.06)	0.25*** (0.07)	0.09 (0.06)
- Hi-Tech	-0.01 (0.14)	-0.16 (0.13)	-0.06 (0.11)	-0.08 (0.11)	-0.09 (0.13)	-0.34*** (0.12)
Member of a group	-0.09* (0.05)	0.08 (0.06)	-0.19*** (0.06)	0.18*** (0.05)	-0.01 (0.07)	-0.03 (0.06)
Member of a consortium	0.11* (0.06)	0.02 (0.08)	0.10 (0.08)	0.13* (0.07)	0.52*** (0.08)	-0.03 (0.08)
Year firm founded (nat. log)	0.17 (0.55)	-2.47 (2.55)	-0.88 (2.56)	-2.87 (2.28)	-11.77*** (2.68)	-12.48*** (2.39)
No. of employees (nat. log)	0.01 (0.02)	0.14*** (0.03)	-0.04 (0.03)	0.05** (0.02)	0.38*** (0.03)	0.30*** (0.03)
Received State financial incentives	0.15*** (0.04)	0.13*** (0.05)	-0.001 (0.047)	0.16*** (0.04)	0.11** (0.05)	0.11** (0.05)
CASH	0.32 (0.49)	-0.05 (0.04)	-0.04 (0.04)	0.009 (0.03)	-0.0001 (0.01)	-0.96** (0.33)
SOLV	-0.07 (0.06)	0.14 (0.17)	0.51** (0.19)	-0.009 (0.132)	0.25 (0.17)	0.67*** (0.12)
Log lik.	-2317.693	-1574.396	-2018.543	-2209.89	-1433.119	-1991.305
Restr. Log lik.	-2408.674	-1647.802	-2050.800	-2249.227	-1708.072	-2160.361
Chi squared	181.963	146.812	64.514	78.673	549.906	338.113
N	3520	3254	3530	3254	3530	3903
Actual Y=1	1526	665	945	1526	665	945

Notes: standard errors are in brackets. Statistical significance of coefficients is indicated by * (p< 10%), ** (p < 5%) or *** (p < 1%). Regional dummies are included (North-East, North-Ovest, Center, South). ROI=RO/total assets, CASH=net working capital/total current liabilities, SOLV=equity plus reserves/total assets[8].

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[8] These indices are also used by Bagella et al. (2004) in the work carried out using the Capitalia sample.

4. Panel Attrition in the Capitalia sample. A simple test.

Why is panel attrition important? Essentially, the non-random selection of the sample which panel attrition is likely to involve may lead to biased estimates of parameters in the estimation of econometric models based on the panel. The problem is one of incidental truncation and in the context of industrial policy examined below may be thought of as analogous to the sample selection problem in the evaluation of treatment effects. Stated simply, if the attrition of firms is related to (observed or unobserved) characteristics of firms which in turn influence the outcome indicator of interest, the impact of these characteristics on the survival (in the sample) of the firm may be 'interpreted' by the econometric model as the effects of observed characteristics on the outcome variable of interest. The issue is complicated further by the fact that survival of the firm on the market and therefore (at least potentially) in the sample may itself be a variable of interest. Here the reason for non-response becomes important. If it is simply a case of firms not being included in the sample on a random basis by Capitalia/Mediocredito, then the problem should not arise. However, if non-response is due in part to firm failure and to firm merger, the combination of these effects may confound estimates of the effect of say industrial policy. On the one hand, if it were simply the case that firms which drop out from the sample have either failed or simple not been re-selected (on a random basis) by the institution undertaking the survey, then attrition may be used as an instrument for firm failure and consequently the problem at least partially resolved. In the present case however, as well as not being (in all probability) randomly selected for follow up by the surveying institution, it is also the case that firm disappearance from the market can not be attributed to firm failure alone but may depend on mergers between firms which will invalidate the instrumental variable approach suggested above.

In what follows, we leave aside (for the present) the details of the nature of the attrition and concentrate on the implementation of a simple test for selection bias arising from non-random panel

attrition in the context of a simple model for evaluating industrial policy.

4.1 A simple test of sample selection bias

As noted above, panel attrition has received considerable attention in the econometrics literature over the years[9]. In this section, a simple test for attrition bias suggested by Verbeek & Nijman (1992) is implemented. Essentially, this involves estimating models based on cross section data, introducing a dummy variable to represent the presence of the firm in the full panel. Table 4.1.1 reports the results of this process in the estimation of simple models of the impact of firm subsidies on different indicators of importance for the 6th, 7th and 8th waves. The first coloumn for each wave reports the results of a probit estimation of the determinants of receiving a subsidy, whilst the remaining three waves estimate the deteminants of three measures of firm performance using OLS.

The key result to which we would wish to draw attention concerns the coefficients on the 'panel dummy' variable which is included to identify the existence of attrition bias in the parameter estimates[10]. It will be observed that these parameters are sometimes, albeit not invariably, statistically significant. This suggests that the presence of panel attrition bias cannot be ignored in the Capitalia sample. Further work will look at how to resolve this problem.

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[9] In addition to the references given above, one might also see Hal (1987) and Dionne et al (1998).

[10] Note however that this *does not control* for attrition bias. In order to do so several approaches have been suggested (e.g. Kyriazidou, 1997; Dionne et al. 1998; and, Vella & Verbeek, 1999).

	6th wave				7th wave				8th wave			
TABLE 4.1.1												
	Financial Incentives	ROI	CASH	SOLV	Financial Incentives	ROI	CASH	SOLV	Financial Incentives	ROI	CASH	SOLV
Form of Ownership												
- Partnership	58 (.38)	1.35 (.92)	.06 (.13)	-.15 (.26)	-.16 (.41)	.36 (.68)	-.31 (.29)	-.51 (.60)	.40 (.38)	.02 (.26)	-.07 (.11)	-.22 (.26)
-Business Corporation	.79** (.37)	1.25 (.91)	-.01 (.12)	-.16 (.24)	.01 (.40)	.19 (.65)	-.47* (.28)	-.51 (.57)	.70** (.31)	.01 (.20)	-.04 (.09)	-.20 (.20)
- Cooperative	.52 (.49)	.26 (.95)	-.07 (.16)	-.25 (.31)	.36 (.42)	-.69 (.66)	-.41 (.28)	-.57 (.58)	.85*** (.33)	-1.08*** (.22)	-.11 (.09)	-.30 (.22)
"Pavitt" Sectors												
- Scale	.10** (.05)	.01 (.04)	-.03* (.02)	.03 (.03)	.09* (.05)	.06 (.04)	.04** (.02)	.04 (.06)	.10* (.05)	-.01 (.04)	-.03* (.02)	-.04 (.04)
- Specialised	.15** (.06)	-.10** (.05)	.07*** (.02)	-.02 (.04)	.10** (.06)	.14*** (.04)	.03* (.02)	.00 (.03)	.17*** (.05)	.13*** (.04)	.07*** (.02)	.06 (.04)
- Hi-Tech	-.05 (.10)	.01 (.08)	.06* (.04)	-.03 (.06)	.05 (.09)	.32*** (.08)	.10*** (.03)	.05 (.06)	-.20 (.09)	.55*** (.07)	.27*** (.03)	.40*** (.07)
Member of a group	-.13** (.05)	-.10** (.04)	-.04** (.02)	.06* (.03)	-.09* (.06)	.02 (.04)	-.00 (.02)	.13*** (.03)	-.22*** (.05)	-.13*** (.04)	-.01 (.02)	.11*** (.04)
Member of a consortium	.42*** (.07)	-.01 (.06)	-.01 (.02)	-.09** (.05)	.31*** (.06)	-.05 (.05)	-.00 (.02)	-.06 (.04)	.44*** (.06)	-.19*** (.05)	-.01 (.02)	-.04 (.04)
Age of firm (nat. log)	-.05* (.03)	-.01 (.02)	.08*** (.01)	.14*** (.02)	.08*** (.03)	-.03 (.02)	.10*** (.01)	.23*** (.02)	-.04 (.03)	-.07*** (.02)	.09*** (.01)	.26*** (.02)
No. of employees (nat. log)	.14*** (.02)	-.14*** (.02)	-.00 (.01)	-.01 (.01)	.18*** (.02)	-.08*** (.02)	.02*** (.01)	.03* (.02)	.35*** (.02)	-.03 (.02)	.01 (.01)	.05** (.02)
Received State financial incentives	-	-.00 (.03)	-.03* (.01)	.05* (.03)	-	.03 (.03)	-.01 (.01)	.07** (.03)	-	-.03 (.03)	-.01 (.01)	.19*** (.03)
Panel attrition bias	**.21*** (.04)**	**.01 (.03)**	**.02* (.01)**	**.07** (.03)**	**.06 (.06)**	**.01 (.05)**	**.02 (.02)**	**-.03 (.04)**	**.09** (.05)**	**-.03 (.03)**	**.02 (.01)**	**.08** (.03)**
(Pseudo-) R2	.04	.07	.03	.03	.05	.05	.05	.07	.07	.11	.06	.08
N	4287	3039	3441	3391	4479	3301	3681	3642	4650	3626	3996	3944

Note: standard errors are in brackets. Statistical significance of coefficients is indicated by * (p< 10%), ** (p < 5%) or *** (p < 1%). In addition to the coefficients reported here, estimates include regional dummies. The dependent variables in th OLS regressions were expressed in natural logarithms. The estimates are based on the full cross-section in each case for which observations were available.

5. Conclusions

In this paper we have looked at issues concerning the use of panel data derived from the Capitalia sample survey of Italian Manufacturing firms. The key result emerging is that it is unwise to implement panel data estimates on the basis of this sample without taking into consideration selection bias due to panel attrition.

More specifically, three sources of data loss occurred in constructing the Capitalia panel.

Firstly, the Capitalia panel was derived from the single waves excluding the firms for which both the questionnaire data and the balance sheet data were completely absent; on this point, it must be noted that the cause of incomplete information is unknown: either data was not required by Capitalia or was not provided by the firms.

Secondly, at each wave a large portion of firms dropped out of the panel, and we don't know the cause of data loss: either firms were not re-interviewed by Capitalia at each stage or firms were unable (or unwilling) to answer.

Finally, some firms are excluded from the final sample by researchers because of missing data on specific variables.

As a consequence of the very high rate of non-random panel attrition, construction of panels of more than two waves is unwise.

In the paper we reported significant differences between the characteristics of the firms "included" in two consecutive waves of the panel and the characteristics of the firms "lost"; in particular, firms retained in the panel are more likely to have received financial aids by the government.

Finally, a test for attrition bias has suggested that the presence of panel attrition bias cannot be ignored in the Capitalia sample.

The procedure to adopt in order to resolve panel attrition bias will be the subject of further work.

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Appendix

	5th WAVE 1989-1991	6th WAVE 1992-1994	7th WAVE 1995-1997	8thWAVE 1998-2000
Variables	%			
Number of observations	4156	5415	4497	4680
FORM OF OWNERSHIP				
Individual firm	0.23	0.09	0.15	0.02
Partnership	9.44	14.43	3.53	0.09
Business corporation	90.13	85.00	94.11	96.03
Cooperatives	0.10	0.38	2.11	2.96
Others	0.08	0.09	0.07	0.06
Number of observations	3823	4420	4496	4661
SECTORS ECON. ACTIVITY	41.9	45.65	41.78	52.22
Traditional sectors	36.09	33.41	27.62	18.14
Scale	18.9	16.80	25.68	24.34
Specialised	3.08	4.14	4.91	5.29
High Tech	4156	5415	4497	4680
Number of observations				
REGION				
Piemonte	11.84	11.16	9.96	9.29
Valle d'Aosta	0.20	0.17	0.09	0.13
Liguria	2.40	1.38	1.11	0.99
Lombardia	30.86	29.09	29.29	27.28
Trentino	1.05	1.23	0.91	0
Veneto	16.13	14.06	14.21	11.92
Friuli Venezia Giulia	3.53	3.30	3.27	2.76
Emilia Romagna	12.13	13.13	11.16	12.22
Marche	3.60	4.45	4.00	4.69
Toscana	6.27	8.85	10.38	12.03
Umbria	1.20	1.50	0.87	1.58
Lazio	3.43	3.18	2.02	2.55
Campania	2.60	3.13	2.82	4.56
Abruzzo	2.11	2.10	2.13	2.40
Molise	0.20	0.28	0.33	0.26
Puglia	0	0	2.85	3.50
Basilicata	0.20	0.47	0.42	0.28
Calabria	0.27	0.3	0.27	0.41
Sicilia	1.15	1.23	2.58	2.27

Sardegna	0.83	0.95	1.31	0.88
Number of observations	4080	5276	4497	
MEMBER OF A GROUP				
No	^	68.26	75.1	79.62
Yes		31.74	24.89	20.38
0.1- 10%	1.45		*	
10 2-0%	1.53		*	
30 - 50%	7.08		*	
> 50%	89.93		*	
Number of observations	1172	4420	4495	4671
MEMBER OF A CONSORTIUM	16.87	9.70	10.02	10.11
Yes	83.10	90.3	89.98	89.89
No	3823	4214	4493	4660
Number of observations				
STATE FINANCIAL INCENTIVES	53.75	40.61	41.49	40.55
Yes	46.25	59.39	58.51	59.45
No	3823	4211	4488	4619
Number of observations				
	Mean (dev. Std.)			
YEAR OF FOUNDATION	1967 (135.97)	1967 (23.18)	1973 (18.39)	1979 (264.33)
Number of observations	3675	4404	4492	4630
NUMBER OF EMPLOYES	598.15 (2984.61)	231.28 (1330.30)	120.66 (373.58)	87.76 (364.23)
Number of observations	4156	4409	4483	4680

	5th WAVE 1989-1991	5th-6th WAVE 1989-1994	5th-6th-7th wave 1989-1997	5th-6th-7th-8th wave 1989-2000
Variables	%			
Number of firms	4156	2571	544	164
FORM OF OWNERSHIP				
Individual firm	0.23	0.21	0.39	0.63
Partnership	9.44	7.69	5.24	1.90
Business corporation	90.13	91.88	94.17	97.47
Cooperatives	0.10	0.13	0.19	-
Others	0.08	0.08	-	-
Number of observations	3823	2378	515	158
SECTORS ECON. ACTIVITY				
Traditional sectors	41.9	42.63	37.68	39.63
Scale	36.09	34.42	38.05	34.15
Specialised	18.9	19.29	20.77	24.39
High Tech	3.07	3.66	3.49	1.83
Number of observations	4156	2571	544	164
REGION				
Piemonte	11.84	10.87	13.97	12.96
Valle d'Aosta	0.20	0.20	0	0
Liguria	2.40	1.85	2.05	0.62
Lombardia	30.86	31.63	39.11	41.97
Trentino	1.05	1.10	0.56	1.23
Veneto	16.13	14.85	14.90	14.20
Friuli Venezia Giulia	3.53	4.06	3.17	2.47
Emilia Romagna	12.13	12.92	10.43	10.49
Marche	3.60	3.78	2.98	4.94
Toscana	6.27	6.66	6.70	8.02
Umbria	1.20	1.26	0	0
Lazio	3.43	3.62	2.42	1.85
Campania	2.60	2.52	0.37	0
Abruzzo	2.08	2.28	1.49	1.23
Molise	0.20	0.16	0.19	
Puglia	0	0	0	
Basilicata	0.20	0.20	0.19	
Calabria	0.27	0.27	0.19	
Sicilia	1.15	1.06	0.74	
Sardegna	0.83	0.71	0.56	

Number of observations	4080	2539	537	162
MEMBER OF A GROUP				
No				
Yes	1.45	1.47	2.82	3.85
0.1- 10%	1.53	1.61	2.26	3.85
10 2-0%	7.08	7.5	7.91	7.69
30 - 50%	89.93	89.41	87.00	84.61
> 50%	1172	746	177	52
Number of observations				
MEMBER OF A CONSORTIUM	16.87	17.62	17.28	21.52
Yes	83.10	82.38	82.72	78.48
No	3823	2378	515	158
Number of observations				
STATE FINANCIAL INCENTIVES	53.75	57.23	62.13	71.52
Yes	46.25	42.77	37.87	28.48
No	3823	2378	515	164
Number of observations				
	Mean (Std. dev)	Mean (Std. dev.)	Mean (Std. dev)	Media (Std. dev)
YEAR OF FOUNDATION	1967 (135.97)	1967 (35.05)	1965 (41.20)	1967 (21.99)
Number of observations	3675	2288	498	154
NUMBER OF EMPLOYES	598.15 (2984.61)	696.82 (3622.54)	770.07 (1634.26)	718.78 (1422.60)
Number of observations	4046	2571	544	164

28

Variables	6thWAVE 1992-1994	6th-7th WAVE 1992-1997	6th-7th-8th WAVE 1992-2000
Number of firms	5415	927	258
FORM OF OWNERSHIP			
Individual firm	0.09	-	-
Partnership	14.43	6.99	1.20
Business corporation	85.00	92.78	98.80
Cooperatives	0.38	0.22	-
Others	0.09	-	-
Number of observations	4420	887	251
SECTORS ECON. ACTIVITY			
Traditional sectors	45.65	37.97	36.04
Scale	33.41	38.73	39.15
Specialised	16.80	18.98	22.09
High Tech	4.14	4.31	2.71
Number of observations	5415	927	258
REGION			
Piemonte	11.16	15.70	16.53
Valle d'Aosta	0.17	0.11	0
Liguria	1.38	1.32	0.39
Lombardia	29.09	37.43	37.40
Trentino	1.23	0.44	0.79
Veneto	14.06	13.83	14.17
Friuli Venezia Giulia	3.30	3.73	3.15
Emilia Romagna	13.13	8.89	9.45
Marche	4.45	3.62	5.51
Toscana	8.85	8.45	9.06
Umbria	1.50	0.11	0
Lazio	3.18	1.98	1.18
Campania	3.13	0.55	0.39
Abruzzo	2.10	1.54	1.57
Molise	0.28	0.33	0.39
Puglia	0	0	
Basilicata	0.47	0.33	
Calabria	0.3	0.11	
Sicilia	1.23	0.77	
Sardegna	0.95	0.77	
Number of observations	5276	911	254
MEMBER OF A GROUP			
No	68.26	59.41	59.60

Number of observations	4420	887	250
MEMBER OF A CONSORTIUM			
No	90.3	89.14	13.69
Number of observations	4214	838	241
STATE FINANCIAL INCENTIVES			
Yes	40.61	49.82	43.57
No	59.39	50.18	56.43
Number of observations	4211	837	241
YEAR OF FOUNDATION	1967	1964.22	1964.36
	(23.18)	(24.41)	(22.68)
Number of observations	4404	886	251
NUMBER OF EMPLOYES			
	231.28	263.96	258.12
	(1330.30)	(536.11)	(514.94)
Number of observations	4409	889	251

	7th WAVE 1995-1997	7-8th WAVE 1995-2000
Variables		
Number of firms	4497	1313
FORM OF OWNERSHIP		
Individual firm	0.15	-
Partnership	3.53	0.53
Business corporation	94.11	96.42
Cooperatives	2.11	2.97
Others	0.07	0.08
Number of observations	4497	1313
SECTORS ECON. ACTIVITY		
Traditional sectors	41.78	43.94
Scale	27.62	25.06
Specialised	25.68	26.58
High Tech	4.91	4.42
Number of observations	4497	1313
REGION		
Piemonte	9.96	10.05
Valle d'Aosta	0.09	0
Liguria	1.11	0.46
Lombardia	29.29	31.38
Trentino	0.91	1.14
Veneto	14.21	15.38
Friuli Venezia Giulia	3.27	2.82
Emilia Romagna	11.16	10.81
Marche	4.00	3.50
Toscana	10.38	11.20
Umbria	0.87	0.91
Lazio	2.02	1.52
Campania	2.82	2.51
Abruzzo	2.13	1.98
Molise	0.33	0.38
Puglia	2.85	2.89
Basilicata	0.42	0.15
Calabria	0.27	0.23
Sicilia	2.58	1.67
Sardegna	1.31	0.99
Number of observations	4497	1313
MEMBER OF A GROUP		
No	75.11	78.45

Number of observations	4495	1313
MEMBER OF A CONSORTIUM No Number of observations	89.98 4493	89.03 1312
STATE FINANCIAL INCENTIVES Yes No Number of observations	41.49 58.51 4488	41.30 58.70 1310
	Mean (dev std.)	
YEAR OF FOUNDATION Number of observations	1973 (18.39) 4492	1973,45 (17.43) 1312
NUMBER OF EMPLOYEES Number of observations	120.66 (373.58) 4483	106.36 (287.76) 1311

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