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# The duration of new firms in banking: an application of Cox regression analysis*

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**Abstract.** This paper studies the duration of two cohorts of entrants in the Italian financial intermediation industry. Using the Cox (1972) Proportional Hazards Model, it analyses the link between duration of each newborn firm and its start-up size, as well as a series of industry-specific characteristics. It emerges that not only did regulatory reform in 1990 result in a process of branch proliferation and industry concentration, but it also set in motion a pre-entry selection mechanism. Conversely, before completion of the regulatory reform, in 1989, entry was possible even for very small firms, and larger new entrants survived longer than their smaller counterparts, and this independently of the features of spatial and structural competition.

**Key words:** Proportional Hazards Model; Entry; Survival; Banking

**JEL classification:** L11; G21

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## 1. Introduction

The empirical literature on the longevity of entrants has mostly focused on manufacturing, showing that the duration of new firms varies systematically across industries (Geroski, 1991, 1995; Audretsch, 1995). However, following the reforms recently made to the regulatory systems of most countries[1], it is of particular interest to apply duration analysis to the case of financial intermediation services as well. In Italy, the regulatory reform of 1990 (De Cecco, 1993) has engendered a branching and restructuring process which was initially punctuated by the entry of non-banking intermediaries competing with banks in rapidly growing market niches (Barros, 1995; Santarelli, 1995). In this regard, the purpose of this paper is to analyze the likelihood of survival of banking and, mostly, non-banking financial intermediaries in Italy *vis-à-vis* the regulatory reforms of 1990. By using a comprehensive longitudinal database tracking their variations in employment at monthly intervals, the paper applies the Cox Proportional Hazards Model estimation method to analysis of the duration of two cohorts of entrants: the first preceding (1989) and the second following (1990) removal of constraints on branching and entry. Section II summarizes the raw data on the two cohorts of entrants, while section III presents an econometric analysis of new-firm duration. In section IV some concluding remarks are made.

## 2. Entry and survival: a descriptive analysis

The longitudinal database used here has been taken from the National Institute for Social Security (INPS). It contains all new firms in the industry[2], with at least one paid employee, born during each month in 1989 and 1990, and tracks their post-entry performance (employment[3]) at monthly intervals until December 1994 and December 1995 respectively. The database comprises 110 (18 banks) firms for the first period and 72 (18 banks) for the second, with information on the average number of workers employed in each month, and the sub-sector of activity. Among entrants of the banking type, 1 in the first cohort and 6 (5 of which survived to the end of the period) in the second one

[1] Cf., for example, the studies by Spiller and Favaro (1984), Amel and Liang (1990), Barros (1995), and Tschoegl (1996) on Uruguayan, US, Portuguese, and Japanese banking respectively; and the study by Lunde *et al.* (1999) on mutual funds in the UK.

[2] The original file also included 14 purported insurance firms (9 in the 1989 cohort, 5 in the 1990 one). However, these proved to be local agencies (units) of incumbent companies rather than independent firms. For this reason, and because in Italy insurance companies are mostly engaged in activities (e.g. third party insurance) not directly related to financial intermediation, I decided to exclude them from the analysis.

[3] The use of number of employees, like any other measure of firm size (assets, sales, market value, value added, etc.), has several shortcomings. For example, since fractions of employees are usually not recorded in firm level data, it creates problems when measuring the size of firms in the smallest size classes. Besides, although the size distributions of business firms have in most industries similar shapes irrespective of the measure used, the different measures are not equally interchangeable (Smith, Boyes and Peseau, 1975). In the case of the financial services in Italy, in which employment is likely to shrink substantially over the next few years, the number of employees is a measure of firm size that proves even more inadequate than it is for other industries. These problems notwithstanding, I tend to agree with Hart and Oulton (1996), who recognize that the choice of measure is ultimately governed by the data available.

were foreign[4]. The other 92 entrants in 1989 were rather heterogeneous: 5 specialized in leasing, 2 in factoring, 7 were foreign exchange agents, and 3 were stockbrokers, whereas the remaining 73 were financial intermediaries in the broad sense (not otherwise specified in the INPS file). As regards the 54 non-banking intermediaries in the 1990 cohort, it was possible to identify 2 leasing firms, 1 firm specializing in factoring, 9 foreign exchange agents, 6 stockbrokers, and 36 financial intermediaries not otherwise specified.

Since firms are identified according to their VAT registration number, the database forestalls problems arising from the distinction between "true" entrants and movers from other industries (e.g. producer services, insurance, etc.) and/or geographical areas in the country[5]. As regards exits, which can be consequent upon either failure or take-over, the database displays different patterns of behavior for banking and non-banking intermediaries. Among banks, in two out of three cases of exit identified in the file (all in the 1990 cohort), cancellation from the INPS archives indicates that the firm (in both cases a rural bank) has been taken over[6]. Conversely, in the case of non-banking intermediaries none of the firms that exited before the end of the period had been involved in take-overs or mergers.

I applied a cleaning procedure to the original INPS file, in order to identify entry and failure times correctly and to detect inconsistencies in individual tracks due to administrative procedures, and cancellations due to firm transfers. This cleaning procedure reduced the total number of firms in the database from 229 to 182[7].

Information on entry and survival, as well as the hazard rates computed for the two cohorts of single firms, are summarized in Table 1 and in Figures 1–4, which report the slopes of the *empirical* survival and hazard functions computed by the Kaplan and Meier (1958) product limit estimator. In general, entrants face a high risk of failure, since for both cohorts less than half of new firms survived until the end of the *follow-up* period[8]. The hazard rate, defined as the risk of failure in each year subsequent to start-up, on the con-

[4] Representative offices of foreign banks (1 in 1989 and 5 in 1990) have been excluded from the analysis, since by definition they are not involved in financial intermediation activities of any kind.

[5] In this connection, foreign-owned banks establishing subsidiaries in the Italian market are taken to be "true" entrants, although irrespective of their start-up size they are not small in the same sense as totally new firms.

[6] The third case of exit is that of a foreign bank which remains in the market for less than three years with 2 paid employees.

[7] This 20.52% reduction in the total number of firms included in the database is consistent with the 16.89% reduction resulting from application of the same cleaning procedure to the INPS file on Italian manufacturing used by Audretsch *et al.* (1999). The structure of the INPS file facilitates the cleaning procedure. In effect, when a new firm is registered as "active" in the file an entry can be identified, while cancellation of a firm denotes that it has stopped paying national security contributions. Sometimes – for administrative reasons – cancellation is preceded by a period during which the firm is logged as "suspended". The paper considers suspended firms of this kind to have exited from the market at the moment (month) of their transition from the status of "active" to that of "suspended". Of course, firms which have suspended operations only temporarily (for one or a few months) after start-up and are "active" at the end of the relevant period, are considered to have survived (the same procedure is followed in Santarelli, 1998).

[8] The follow-up period is the given interval between $t = 1$ and $t = T$ during which N firms are observed. If a firm exits the market at any given time between $1 \leq t \leq T$ its death (*failure time*) is correctly reported; otherwise the only possible finding is that its duration exceeds a given threshold corresponding to $T$.

**Table 1.** Survival of new firms in the Italian financial intermediation industry (cohorts 1989, 1990)

| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|
| [1]N. of survivors: | | | | | | | |
| Cohort 1989 | 110 | 87 | 73 | 63 | 52 | 50 | |
| Cohort 1990 | | 72 | 57 | 44 | 35 | 32 | 32 |
| [2]Survival rate*: | | | | | | | |
| Cohort 1989 | 95.45% | 79.09% | 66.36% | 57.27% | 47.27% | 45.45% | |
| Cohort 1990 | | 88.89% | 79.17% | 61.11% | 48.61% | 44.44% | 44.44% |
| [3]N. of employees: | | | | | | | |
| Cohort 1989 | 396 | 456 | 488 | 477 | 462 | 476 | |
| Cohort 1990 | | 518 | 571 | 519 | 561 | 569 | 644 |
| [4]N. of employees per firm**: | | | | | | | |
| Cohort 1989 | 3.50 | 4.75 | 6.18 | 7.01 | 8.25 | 8.81 | |
| | (7.77) | (7.27) | (10.33) | (12.15) | (14.41) | (15.91) | |
| Cohort 1990 | | 7.19 | 8.78 | 10.59 | 14.02 | 15.38 | 17.41 |
| | | (13.11) | (14.79) | (17.87) | (22.21) | (24.74) | (30.80) |
| [5]Hazard rate***: | | | | | | | |
| Cohort 1989 | 4.55% | 17.14% | 16.09% | 13.70% | 17.46% | 3.85% | |
| Cohort 1990 | | 11.11% | 9.38% | 22.81% | 20.45% | 8.57% | 0% |

* Number of firms surviving in each year in the follow-up period, as a percentage of the total number of new firms established in the initial year; ** Standard deviation in brackets; *** Ratio between firms exiting from the industry in each year following start-up and the average number of firms surviving during that year (mean of the absolute values at the beginning and the end of the relevant period).

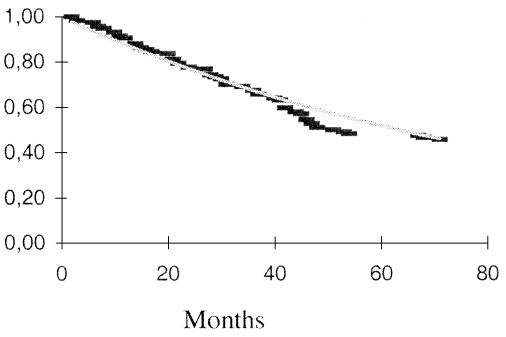


**Fig. 1.** Empirical survival rates: cohort 1989

dition that the firm had survived until the previous year, increases markedly during the first three years for both cohorts and tends to decrease non-monotonically afterwards for the 1990 cohort, whereas there is a significant increase in the five year hazard rate for the 1989 cohort. Application of a *t*-test for paired samples shows that means of the annual hazard rates for the two cohorts are statistically different at the 95% significance level.

The six-year hazard rate is 3.85 percent for the first cohort and 0 percent for the second. For both cohorts, therefore, Figures 3 and 4 show – consistently with the results of previous studies carried out for different industries/

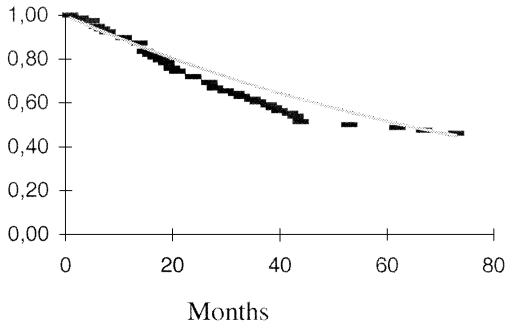


**Fig. 2.** Empirical survival rates: cohort 1990

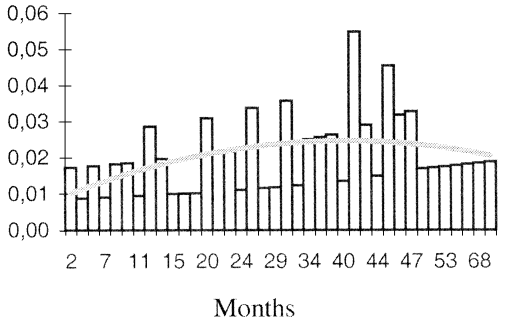


**Fig. 3.** Empirical hazard rates: cohort 1989

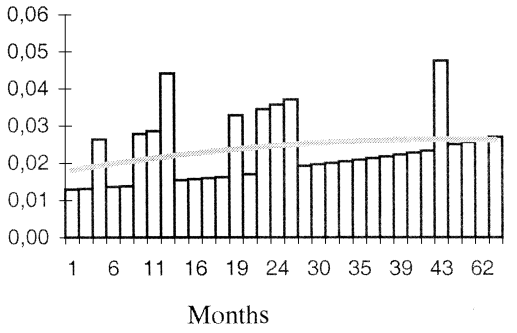


**Fig. 4.** Empirical hazard rates: cohort 1990

countries – a distribution for which the likelihood of failure at time $t$, conditional upon duration up to time $t$, is initially increasing (positive duration dependence) and then decreasing (negative duration dependence) in $t$. In the present case, the (very low or 0) value of the six-year hazard rate suggests that, by the end of the follow-up period, surviving firms in both cohorts had become part of the relatively stable share of firms with a low likelihood of "unexpected" exit.

As regards the evolution of the total number of employees in the new firms, Table 1 shows that the decline of employment in each cohort due to exiting firms is largely offset by the growth of survivors in the same cohort: the total number of employees grew by 20.20 percent for the 1989 cohort, and 24.32 percent for the 1990 one.

Significantly, (Table 1) the total number of entrants diminishes by nearly 35 percent between 1989 and 1990, whereas the average start-up size of new firms in 1989 is less than half that in 1990[9]. The six-year survival rates are instead higher (45.44%) in the first cohort than in the second one (44.44%), suggesting that in 1990 the process of market selection was stronger and more effective at the pre-entry stage. This implies that in 1990 only those intermediaries with a relatively higher likelihood of survival actually entered the industry. Such startups were relatively large in size. In 1989, before the regulatory reform, the industry was therefore still experiencing a process of entry of the "try and see" type – one in which sunk costs were presumably low – whereas in 1990, after the introduction of significant regulatory changes, it was characterized by a pre-entry selection process which selected only firms with a more developed organizational structure and a larger start-up size[10].

According to this preliminary analysis of post-entry performance, regulatory reform in 1990 is likely to have affected the nature of entrants in the industry. However, even if larger scale entry induced by regulatory reform renders the nature of 1990 entrants different from that of 1989 ones, it cannot be excluded *a priori* that the likelihood of survival depends on start-up size for both cohorts. This would entail that the likelihood of survival is positively affected by start-up size, (Audretsch *et al.*, 1999), with smaller new firms being less likely to survive. At this point, further investigation of the start-up size/industry structure/survival relationship, as conducted in section III will shed clearer light on these matters.

## 3. Firm size, spatial competition, industry concentration, and the longevity of entrants

Since the INPS database tracks post-entry performance of new firms only to the end of their sixth year of life, when not all of them have failed, the data employed for the present analysis are characterized by (right) censoring. Accordingly, the variable of interest is the length of time that elapses from start-up until the measurement is made. This implies that, since duration is measured in terms of total months survived until the end of the period for which data were forthcoming, firms which entered the market at the end of the initial year and survived until the end of the follow-up period remained in the market for a shorter time than did firms which started at the very beginning of the initial year and exited a few months before the end of the follow-up period. In the presence of this censored distribution, conventional econometric OLS procedures are ill suited to duration analysis, because they would produce biased and inconsistent estimates (cf. Cox and Oakes, 1984). With regard to the

[9] Although higher values of the standard deviation signal a more skewed distribution in 1990.

[10] However, this did not render them immune to instantaneous probability of exit, as confirmed by the fact that the percentage of entrants surviving for more than 2 years is lower in the 1990 cohort than in the 1989 one.

slope of the hazard functions reported in figures 3 and 4 above, estimation of a Cox Proportional Hazards Model (PHM) seems therefore to be the most appropriate procedure (Cox, 1972). Here the hazard function $h(t)$, depicting instantaneous escape from operations, is

$$h(t) = \lim_{\Delta t \to 0^+} \frac{P(t \leq T \leq t + \Delta t \mid T \geq t)}{\Delta t} = \frac{f(t)}{S(t)} \tag{1}$$

where $T$ denotes the firm's life duration, and $f(t)$ and $S(t)$ represent the probability density function and the survival function respectively. When the purpose is to investigate the influence of a series of covariates on the probability of survival, the PHM is the most commonly used specification of a multivariate model of the life duration of firms, representable as

$$h(t) = e^{-\beta' \mathbf{x}t} h_0(t) \tag{2}$$

where $h(t)$ denotes the hazard rate for each newborn firm, $h_0(t)$ is the baseline hazard function, $\mathbf{X}$ represents a vector of covariates, and $\beta$ is a vector of parameters. The main advantage of Cox's partial likelihood estimator is that it enables estimation of $\beta$ without requiring estimation of $h_0(t)$. In this model, since the baseline hazard function equals the hazard function for $\mathbf{X} = 0$, the effect of a unit change in a covariate is a constant proportional change in the hazard rate. In the presence of censoring, as is the case with the data used in the present paper, let us suppose that there are $d$ observed failures from a sample of size $n$, with the ordered observed failure times being $t_1 < t_2 < \cdots < t_d$. Using $\Phi_j$ to denote the firm which exits the market at $t_j$, let $\Phi_j = i$ if firm $i$ fails at time $t_j$, with $\Re(t_j) = \{i : t_i \geq t_j\}$ representing the corresponding risk set of size $r_j$. Let then $\Psi_j$ be the conditional probability that $\Phi_j = i$; $\Psi_j$ may be assumed to include the censoring in $(0, t_j)$, as well as the failures. At this point, the fact that no censoring can occur in $(t_{j-1}, t_j)$ ensures that the risk set $\Re(t_j)$ does not depend on $t_j$ (Cox and Oakes, 1984, p. 93).

The PHM estimation method has been employed to control for firm-specific and industry-specific characteristics likely to affect the duration of new firms in each cohort. As regards the most important observable characteristic specific to the firm, its START-UP SIZE, the total number of paid employees measures firm size in the first month of activity. This variable is taken to be a major factor in a higher likelihood of survival, on the assumption that those entrepreneurs who have easier access to better information and are less finance-constrained are more likely to choose a larger initial size. Thus, a continuous variable for start-up size that correlates positively with survival is consistent with a Gibrat (1931) process whereby, for any given mean and variance of growth rates, the expected first passage time to failure correlates negatively with the distance of the starting point from zero.

A second firm-specific characteristic is denoted by a dummy variable (CRED) which captures the nature of the intermediaries comprised in the database: it is equal to 1 for banking firms in the strict sense, and equal to 0 for non-banking firms specialized in consumer credit, leasing, factoring, the management of investment funds, etc. This variable allows account to be taken of the behavior of banking firms, which not only display a higher likelihood of survival than their non-banking counterparts, but also (as already

explained in section II above) when they exit the market, in two cases out of three do so because they have been taken over by incumbents[11].

The two industry-specific characteristics identify local-market/industry features: the ratio of resident population to the total number of branches within each local (municipal level) market in June 1994 (BRANCHPOP) is an index of spatial competition commonly employed in analysis of the financial intermediation industry; the value of the Herfindahl index (HERFINDAHL) measured in terms of number of branches is instead taken as a proxy for structural competition (concentration) in the industry (municipal level) in June 1994[12]. BRANCHPOP is an inverse measure of density of branches in the market, and it is expected to influence the hazard rate negatively (i. e. the likelihood of duration positively), since a high value of this variable denotes low spatial competition and the inadequacy of the total services supplied by banks with respect to the potential requirements of the resident population in each municipal market. HERFINDAHL is computed with the usual formula

$$H_j = \sum_{i=1}^{m} (S_{ij})^2 \tag{3}$$

in which $j = 1, 2, \ldots, n$ denotes the $n$ local (municipal level) markets, $i = 1, 2, \ldots, m$ stands for the $m$ banks in each local market, and $S$ represents the share of total branches by each bank. Accordingly, a high value of the HERFINDAHL concentration index may positively influence the hazard rate (i.e. negatively influences the likelihood of survival), because it denotes the presence of a few large-scale banks in $j$, and these are likely to impose barriers to entry and survival for newborn firms in the local (municipal level) market.

Although both sets of estimates get very high values of the likelihood ratio index, the results obtained from estimating the PHM, which are presented in Table 2, suggest that the two cohorts of entrants behave differently. The model is estimated with account taken of the direct effect of firms' start-up size on survival as regards the 1989 cohort in the first column of Table 2. The negative and significant coefficient of START-UP SIZE confirms that larger firms have lower risks of early exit. Estimation of the complete model in column II not only confirms the influence of START-UP SIZE, but also shows that, as already known from preliminary inspection of data (cf. section II above), banking firms in a strict sense display a much higher likelihood of survival. Conversely, there is no evidence that the (low) number of resident population per branch and the level of industry concentration significantly affect the hazard rate. The same conclusion is suggested by column III, in which the direct effect of firms' initial size is ignored.

As regards the 1990 cohort, the impact of initial size on the instantaneous failure rate proves to be less marked than in the case of the 1989 cohort: the estimated coefficient of the START-UP SIZE variable in column IV is much

[11] In this case, a possible alternative is estimation for each year of two separate hazard equations for the two types of firms (banks and non-banking intermediaries). In order to obtain an acceptable sample size (only 18 entrants in each cohort are of the banking type), I included a dummy variable to account for differences.

[12] The original data are taken from Corbellini (1995), and relate to individual local (municipal level) markets. They refer only to 1994 because it was not possible to obtain the municipal level data needed to construct the same variables in relation to the other years during which each cohort of new entrants was observed.

**Table 2.** The determinants of new-firm survival in the Italian financial intermediation industry: regression results from the Proportional Hazards Model

| Variables | Cohort 1989 | | | Cohort 1990 | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Start-up size | −0.817*** | −0.725*** | | −0.419** | −0.391** | |
| | (0.286) | (0.280) | | (0.176) | (0.176) | |
| Branchpop | | −0.363 | 0.127 | | −0.570* | −0.600* |
| | | (0.536) | (0.528) | | (0.347) | (0.337) |
| Herfindahl | | −0.118 | −0.074 | | 0.208 | 0.373* |
| | | (0.278) | (0.268) | | (0.230) | (0.217) |
| Cred | | −2.407*** | −2.547** | | −2.750*** | −2.875*** |
| | | (1.080) | (1.060) | | (1.063) | (1.052) |
| $-2\log L$ | 485.760 | 469.446 | 480.180 | 291.324 | 274.100 | 280.69 |
| *Chi squared* | 8.479*** | 19.375*** | 11.878*** | 6.245** | 19.369*** | 13.548*** |
| LRI | 0.984 | 0.921 | 0.932 | 0.981 | 0.953 | 0.965 |
| N | 110 | 110 | 110 | 72 | 72 | 72 |

Standard errors in brackets. * = significant at the 90% level of confidence; ** = significant at the 95% level of confidence; *** = significant at the 99% level of confidence

lower than that obtained in the previous case (column I) and significant only at the 95 per cent level of confidence. Estimation of the complete model in column V shows that also a low value of BRANCHPOP, besides CRED, affects the hazard rate, whereupon the effect of firms' start-up size becomes even less marked. Finally, when START-UP SIZE is excluded from the estimated model (column VI), BRANCHPOP exhibits a negative coefficient, but HERFINDAHL a positive one. Thus, in local markets in which the level of branch density is higher and large-scale banks have a larger market share the likelihood of survival for new entrants tends to be lower[13].

Comparison of the results obtained for the two cohorts with those of the descriptive analysis in section II suggests that, the overlap in the periods under consideration notwithstanding, there is a significant difference between the firms founded in anticipation of deregulation and those founded after deregulation had started and its first impact had been felt[14]. In particular, it turns out *a)* that the likelihood of survival is shaped by firm-specific characteristics; and *b)* that after 1990 branch density and industry concentration acted as entry deterring features.

Thus, although newborn firms of the non-banking type offered consumer credit, leasing, and factoring services in 1989 as well as in 1990, they were likely to do so in different portions of the market: whereas those in 1989 served mostly the marginal fringe of the market, those in 1990 entered its more dynamic portion, in which they faced competition from banking groups undertaking diversification strategies. Even though no information is forthcoming from the database concerning the customers of each newborn firm, it is reasonable to conclude that in 1990 non-banking intermediaries with an

[13] When foreign banks are omitted from the regressions, the results do not change significantly.

[14] Although it remains true that differences in estimation results between 1989 and 1990 may be due to differences in the percentage of entrants that are banks and in the type of non-bank entrants rather than to regulatory changes.

average start-up size of more than seven paid employees (plus family workers) *did* possess the organizational structure required to do business in the more developed portion of the market. In the competitive environment created in that year by branching and the liberalization of new bank formation, incumbents protected existing rents by increasing efficiency and introducing organizational innovations. Accordingly, larger scale entry, which signals greater *a priori* expectations of success[15], does not always and necessarily render new firms immune to instantaneous probability of exit, because incumbents have more room to react, which makes life harder for new entrants[16].

## 4. Conclusions

This paper has applied a Cox Proportional Hazards Model to the analysis of duration of two cohorts of entrants in the Italian financial intermediation industry, the first preceding (1989) and the second following (1990) the lifting of constraints on branching and new bank formation. As regards the 1989 cohort, start-up size is identified as the main factor conducive to new-firm survival, whereas for the 1990 cohort the likelihood of survival is also sensitive to industry-specific characteristics (low branch density and low industry concentration). This suggests that the regulatory reforms introduced in the Italian banking sector at the beginning of 1990 fostered a pre-entry selection process whereby potential entrants are larger in size than in the previous year. Thus, whereas in 1989 the industry was still characterized by a process of entry of the "try and see" type, which took place in its marginal fringe, in 1990 entry involved firms better equipped to offer their services in the more dynamic portion of the market.

## Appendix

**Table A1.** Descriptive statistics for the independent variables (cohort identification year in brackets)

| Variable name | Description | Mean | SD | N |
|---|---|---|---|---|
| Branchpop (1989) | Logarithm of the average number of resident population per branch | 7,82 | 0.37 | 110 |
| Herfindahl (1989) | Logarithm of the Herfindhal index (municipal level) | −2.06 | 0.84 | 110 |
| Start-up size (1989) | Logarithm of employment in the firm (1989) | 0.42 | 0.73 | 110 |
| Branchpop (1990) | Logarithm of the average number of resident population per branch | 7.80 | 0.42 | 72 |
| Herfindhal (1990) | Logarithm of the Herfindhal index (municipal level) | −2.05 | 0.95 | 72 |
| Start-up size (1990) | Logarithm of employment in the firm (1990) | 0.69 | 1.16 | 72 |

[15] In which case several periods of bad performance will be needed for *ex ante* positive profit expectations to disappear and force newborn firms to exit the market (Frank, 1988; Mata *et al.*, 1995)

[16] An alternative explanation for the differences across the two cohorts arises from differences in the line of business of non-banking entrants in 1989 and those in 1990. However, due to a lack of information (cf. Section II above), this point cannot be considered in the present paper.

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