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Start-up size and industrial dynamics: some evidence from Italian manufacturing

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Abstract

The aim of this paper is to shed some light on industry dynamics in Italy. For this purpose we use a large and comprehensive longitudinal data base, identifying the start-up of new manufacturing firms and their subsequent post-entry performance. This enables us to link the survival and growth of firms in each manufacturing industry specifically to their start-up size. While in a tobit regression (at the two-digit level) we find no evidence to link start-up size with survival, the growth rates are negatively and significantly correlated with initial size. As in previous studies dealing with other countries, this evidence suggests that Gibrat's Law fails to hold, at least for small, new-born manufacturing firms.

Keywords: Entry; Growth; Survival; Industry evolution

JEL classification: L11; L60

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1. Introduction

The last two decades have witnessed an explosion in studies on the economic role of entry and the determinants of new firm formation.[2] Entry was viewed as important to economics, because a level of profitability in excess of equilibrium would induce entry into an industry. The new entrants performed an equilibrating function in the market, in that the levels of profitability and price should be restored to their long-run competitive levels. Under this view, outputs and inputs in an industry were assumed to be homogeneous. That is, the entry of new firms were about business as usual: only that with the new entrant there was more of it. For example, in the country studies on the dynamics of company profits conducted by Dennis Mueller (1990), entry was viewed as the mechanism by which profits in excess of the long-run equilibrium were eroded.

However, entry and new firm formation are not always synonymous, since in most cases the rates of new firm formation[3] are far higher than those of market penetration,[4] and, as a consequence, new firms give rise to a higher degree of market turbulence rather than to an expansion of the market. This implies that a significant increase in the business birthrate does not necessarily result in an equally significant increase in either the stock of businesses or in the market share accounted for by new firms in a given industry. In this respect, after reviewing a series of studies conducted in various countries and which applied a standardised methodology in analysis of the determinants of entry (Geroski and Schwalbach, 1991), Geroski (1991b, p. 282) concluded that ‘‘Scholars have had some trouble in reconciling the stories told about entry in standard textbooks with the substance of what they found in their data’’. Most studies consistently found that new firms account for a substantial share of the total number of enterprises, employment and sales in an industry. However, just as identifying a consistent set of industry-specific structural characteristics imposing a strong deterrent upon entry has proven to be surprisingly elusive, so only ‘‘modest effects of entry on market performance’’ have been found (Geroski, 1991b, p. 294–95).

The impact of new firm formation on an industry is apparently not so obvious as the numbers and share of economic activity accounted for by new businesses would suggest. A solution to the paradox was suggested by Audretsch (1995) and Geroski (1995): entry may be less interesting in the sense of profitability and price in the market, but more interesting and important because of its disequilibrating influence. That is, rather than representing *business as usual*, a new entrant may represent an *agent of change*. As Geroski (1991a, p. 7) concludes, ‘‘Entry is, then, one of several methods by which markets restructure themselves [...] The market dynamics associated with entry are not, it appears, so much those associated with

[2] For a survey of the relevant literature and empirical analyses of the Italian case, cf. Audretsch and Vivarelli, 1995, 1996; Santarelli and Sterlacchini, 1994; Santarelli and Piergiovanni, 1995.

[3] Number of new firms divided by the average number of firms operating in the relevant period.

[4] Gross sales by entrants divided by total industry sales.

changes in the size of the population of firms or products in a market as they are those associated with changes in the population of firms or products''. In response to these insights, a new literature focusing on the *post-entry performance of firms* has emerged in the last few years. In particular, these studies focus on what happens to new firms subsequent to their entry, both in terms of their likelihood of survival and their growth patterns.

While a number of important studies have been undertaken on industry dynamics in the United States (Dunne et al., 1988, 1989; Audretsch, 1991, 1995; Audretsch and Mahmood, 1995), United Kingdom (Dunne and Hughes, 1994), Portugal (Mata and Portugal, 1994; Mata et al., 1995), Germany (Wagner, 1992, 1994; Boeri and Cramer, 1992), and Canada (Baldwin, 1995), very little is known about the post-entry performance of new firms in Italy (with the main exceptions – to our knowledge – of Brusco et al., 1979; Giunta and Scalera, 1997; Solinas, 1995; Santarelli, 1997, 1998), or about the process by which new firms either survive and grow, or else exit from the industry.

After reviewing, in Section 2, the recent literature on post-entry performance of new firms, the purpose of this paper is therefore to shed some light on industry dynamics in Italy. It does so by using a large and comprehensive longitudinal data base, identifying the start-up of new manufacturing firms and their subsequent post-entry performance. This enables us to link the survival and growth of firms in each manufacturing industry specifically to start-up size. While we find no evidence to suggest that the likelihood of survival is influenced by start-up size (Section 3), it turns out that the post-entry performance of new firms is similar to that found in other countries, in that Gibrat's Law fails to hold (Section 4).

2. The post-entry performance of new firms

A body of literature has emerged recently which deals with the post-entry performance of new firms, thereby refocusing attention on the traditional division between a ''Deterministic'' (or ''Empiricist'') and a ''Stochastic'' approach in the theory of the size distribution of firms (cf. Marris, 1979). The ''Deterministic'' school tended to explain the growth of a firm and the process of concentration by firm behaviour and observable industry characteristics, along with ''particular historical chains of cause and effect'' (Marris and Mueller, 1980, p. 47). The ''Stochastic'' school contended that, in a world in which there are no initial interfirm differences in profitability, size, and market share, ''if the magnitude of the successes actually realized on different investment bundles is distributed randomly, we infer that future values of measures of different firms profit rates, size, market share, and past growth will differ solely because of chance'' (Mancke, 1974, p. 182). In particular, what Mancke (1974) asserts is that received empirical tests do not take the possibility that firm size differences are due to chance, so they cannot be seen as rejecting it.

As regards recent developments in the ‘‘Stochastic’’ approach, the theoretical model of *noisy selection* introduced by Jovanovic (1982) suggests that the likelihood of survival should be random across all firms. Jovanovic presents a model in which the new entrants, which he terms *entrepreneurs*, face costs that are not only random but also differ across firms. A central feature of his model is that a new firm does not know what its cost function is – that is, its relative efficiency – but rather discovers it through the process of learning from its actual post-entry performance.[5] In particular, Jovanovic (1982) assumes that entrepreneurs are unsure about their ability to manage a new-firm start-up and are therefore uncertain about their prospects of success (Jovanovic, 1994). Although entrepreneurs may launch a new firm based on a vague sense of expected post-entry performance, they only discover their true ability – in terms of managerial competence and of having based their firm on an idea viable in the market – once their business is established. Those entrepreneurs who discover that their firm is, in fact, efficient will survive and grow. Those who discover that their firm is inefficient will tend to exit from the industry. The firm will typically have a small start-up size, since actual experience in the industry is necessary for the entrepreneur to discover whether the new firm is able to gain a significant share in the market or not. But the salient feature of Jovanovic’s theory is that, *a priori*, a new firm has no expectation about its post-entry performance, which suggests that the likelihood of survival is simply stochastically distributed across firms. Similarly, according to Jovanovic’s model, the post-entry growth rates of new firms should be stochastically distributed across firms, and independent of both (observable) firm and industry specific characteristics.

A different set of recent theories – belonging in a broad sense to the ‘‘Deterministic’’ tradition – suggest that the post-entry performance is not random across firms, but rather shaped by characteristics specific to the firm. Dixit (1989) and Hopenhayn (1992) both argue that the post-entry performance of firms will be influenced by the amount of sunk costs in the industry. A greater degree of sunk costs should reduce the likelihood of exit and lead to lower observed growth rates of surviving firms. Empirical evidence linking the extent of sunk costs to a lower likelihood of exit and lower observed growth rates of surviving firms has been provided by Audretsch (1991 and 1995).

Following a similar approach, other theories suggest that the post-entry performance of firms will be influenced by the degree of scale economies in an industry (Audretsch, 1995). In industries where the minimum efficient scale (MES) is high, it follows from the observed general small size of new-firm start-ups that the post-entry growth rates of the surviving firms will presumably also be high. However, those new firms not able to grow and to approach the MES level of output will presumably be forced to exit from the industry, resulting in a relatively low likelihood of survival. In industries characterised by a low MES,

[5] See also Hopenhayn (1992).

neither the need for growth, nor the consequences of its absence are as severe, so that relatively lower growth rates but higher survival rates would be expected. Empirical evidence for the United States (Audretsch, 1991; Audretsch and Mahmood, 1995), United Kingdom (Dunne and Hughes, 1994), Portugal (Mata and Portugal, 1994), and Germany (Wagner, 1994) supports the theory that the likelihood of survival tends to be lower in industries characterised by a greater degree of scale economies.

The innovative environment of the industry has also been hypothesised to influence the post-entry performance of firms. The underlying argument is that, on average, less risk-averse entrepreneurs would be attracted to enter high-innovation opportunity industries. In such industries, one would expect the growth of successful enterprises to be greater, but the likelihood of survival would be correspondingly lower. Empirical evidence for the United States (Audretsch, 1991 and Audretsch, 1995; Amirkhalkhaly and Mukhopadhyay, 1993) suggests that the likelihood of survival tends to decrease as the degree of innovative activity in an industry increases. But the growth rates of those firms that do survive tend to be positively related to the degree of innovative activity in the industry.

Several theories in the ''Deterministic'' tradition have also argued that characteristics specific to the firm influence their post-entry performance (Audretsch, 1995). For example, a greater start-up size of the firm increases the likelihood of survival, since the cost disadvantage confronting a firm operating at a sub-optimal scale level of output will be reduced. At the same time, the greater the size of the firm, the less it will need to grow in order to exhaust potential scale economies and ultimately survive. That is, if the start-up size of the firm is large enough relative to the MES of the industry, the firm need not grow at all and will still be viable in the long run. Both a positive relationship between firm size and the likelihood of survival and a negative relationship between firm size and post-entry growth rates have been found in the United States (Hall, 1987; Dunne et al., 1988, 1989; Audretsch, 1991, 1995; Audretsch and Mahmood, 1995), United Kingdom (Dunne and Hughes, 1994), Portugal (Mata and Portugal, 1994; Mata et al., 1995), Germany (Wagner, 1994), and Canada (Baldwin, 1995). In addition, other studies (Doms et al., 1995) show that firm-specific factors such as capital intensity and the use of specific advanced manufacturing technologies influence the post-entry performance of new firms. Taken together, the wave of recent empirical studies therefore provides systematic evidence that post-entry performance is not stochastic across firms and industries, but is in most cases specific to factors particular to the firm and industry.

Indeed, the supporters of the ''Stochastic'' interpretation by no means imply that the growth of a firm is a totally chance phenomenon. In their turn, advocates of the ''Deterministic'' view do not exclude that in some cases the growth of a firm may not be episodic in character. In this respect, Sutton (1995) has attempted to build a bridge between such apparently contrasting approaches. He stressed that each industry contains several clusters of products or firms that compete closely, thereby exhibiting both some *strategic interdependence* and some degree of *independence* across submarkets. Combining these two features is, in Sutton's view, a task to be addressed by those who intend to develop a theory leading to testable predictions as regards the impact of 'strategic factors', while simultaneously taking into account a 'null hypothesis' based on the descriptions of what happens in the industry when such strategic factors are absent and the only sources of skewness are represented by statistical 'independence effects' and cost differences between firms. From a purely theoretical viewpoint, Sutton (1995) develops a model of the size distribution of businesses related to a single market in which all active firms produce similar substitute goods. In his model, a bound is placed on the degree of skewness that might be generated by ''independence effects'', and testable predictions are thus obtained for certain industries in which the ''least skew distribution'' defined by the model is rarely violated.

3. The survival of new firms in Italian manufacturing

The greatest obstacle to the direct measurement and analysis of the post-entry performance of firms has been the lack of panel data sets tracking the evolution of firms subsequent to their birth. In this paper we use for Italy a data set from the National Institute for Social Security[6] (INPS) which identifies new manufacturing firms (with at least one paid employee[7]) born in January 1987 and tracks their post-entry performance at monthly intervals until the beginning of January 1993. The original INPS file has been subject to a cleaning procedure aimed at a correct identification of entry and failure times and at detecting inconsistencies in individual tracks due to administrative reasons, problems related to file truncation in January 1993, cancellations due to firm transfers and take-overs. This cleaning procedure has led to the reduction of the total number of firms included in the database from 1889 to 1570. Table 1 shows the new-firm survival and hazard rates for 1570 new manufacturing firms identified in the INPS data base in January

[6] All private Italian firms are compelled to transfer to INPS national security payments for their employees; when a new firm is registered as ''active'' in INPS files an entry can be identified, while a firm cancellation denotes a failure (this happens when a firm ultimately stops paying national security fees). Sometimes – for administrative reasons – cancellation is preceded by a period during which the firm results as ''suspended''. In the present paper, suspended firms of this kind have been considered as exited from the market at the moment (month) of their transition from the status of ''active'' to that of ''suspended'' firm. Of course, firms which suspended operations only temporarily (for one or a few months) during the follow-up period and were ''active'' in January 1993 have been considered as survived.

[7] No information on firms that have zero paid employees is forthcoming from the INPS file. However, these firms usually identify self-employment and only occasionally become true entrants with positive post-entry growth rates.

Table 1
Survival and hazard rates of new firms in Italian manufacturing: 1987–93

Month	Survival		Hazard	
	Surviving firms	Survival rate[a]	Exiting firms	Hazard rate[b]
1/87	1570			
1/88	1435	91.1%	141	9.4%
1/89	1286	81.6%	149	11.0%
1/90	1183	75.1%	103	8.3%
1/91	1077	68.3%	106	9.4%
1/92	988	62.7%	89	8.6%
1/93	932	59.1%	56	5.8%

[a] share of new firms started up in January 1987 still in existence as of January of each subsequent year.
[b] ratio of firms escaping from operation in each year following start-up to the average number of firms surviving during that year (mean of the absolute values at the beginning and the end of the relevant year).

1987. The survival rate is defined as the share of new firms started up in January 1987 still in existence as of January of each subsequent year. Thus, 1 year subsequent to start-up, 91% of the new firms still existed, whereas this value decreases to 59% at the end of the 6th year.

The hazard rate is defined as the risk of failure at each point in time, on the condition that the firm had survived up to the previous time period. The 1 year hazard rate is 9.4%, and then rises to 11% for the 2 year hazard rate, before falling to 5.8% for the 6 year hazard rate. As in previous studies dealing with other industrialised countries (Audretsch and Mahmood, 1995; Audretsch, 1995; Mata et al., 1995; Wagner, 1994), also in the case of Italian manufacturing hazard rates increase markedly during the first 2 years and tend to decrease non-monotonically (with a slight increase in the 4 year hazard rate) afterwards.

Table 2 shows the number of new entrants, the average start-up size (employment) and the survival rates for each disaggregated manufacturing industry. As Audretsch (1991, 1995) has found for the United States, Mata and Portugal (1994) for Portugal, and Wagner (1994) for Germany, the survival rates for Italy vary considerably across industries, ranging from 37.5% for the 6 year survival rate in office machinery and computers to 81.3% in mining and transformation of metals.

However, there is no clear evidence that the probability of survival tends to be higher in those sectors in which the start-up size is larger, and there are some sectors (like mining and transformation of metals and rubber and plastics) where a very small start-up size is associated with high survival rates. The substantial variations in survival rates across manufacturing industries are instead consistent with the findings of previous studies that characteristics specific to each industry shape the post-entry performance of firms in that industry. For instance, if one looks at the traditional consumer good industries one notes that these are

Table 2
New firm entry (absolute value), average start-up size (employment), and survival rates compared across manufacturing industries: 1987–93

Industry	New firm entry, January 1987	Average start-up size[a]	Survival rate, January 1993
Mining and transf. of metals	16	7.9 (13.08)	81.3%
Metal working	29	28.4 (74.86)	65.5%
Mining and transf. of other minerals	20	6.3 (7.05)	60.0%
Stone, clay, glass	73	13.73 (22.41)	57.5
Chemicals	49	65.88 (196.20)	55.1%
Fabricated metal products	118	9.11 (13.43)	55.9%
Mechanical engineering	101	20.24 (48.46)	70.3%
Office machinery and computers	7	7.43 (14.05)	37.5%
Electrical and electronic engineering	129	12.43 (38.92)	64.3%
Other means of transportation	20	19.5 (38.86)	55.0%
Instruments	214	12.17 (30.18)	61.2%
Food	82	11.07 (25.16)	47.6%
Sugar, beverages and tobacco	27	14.6 (31.23)	66.7%
Textiles	102	15.6 (29.55)	52.9%
Leather products	54	9.74 (15.48)	61.1%
Footwear and clothing	231	14.61 (34.62)	48.5%
Wood and furniture	115	11.51 (24.58)	60.9%
Paper and printing	109	10.23 (24.57)	55.0%
Rubber and plastics	85	7.23 (9.60)	77.6%

[a] Standard deviation in brackets.

characterised by survival rates which are around or below the manufacturing average (59.1%). In particular, this is true of the footwear and clothing industry, where 48.5% of the new firms started up in January 1987 had not exited the market by January 1993, and the food industry (47.6%). These are respectively industries of traditional and recent specialisation of Italian manufacturing, which are also characterised by low barriers to entry, low market concentration and a negligible level of sunk costs. The rate of entry is therefore remarkably high in such industries, but most firms exit the market before reaching the MES level of output, as a result of a "try and see" entry process. The case of mechanical engineering and electrical and electronic engineering is different. These too are industries in which Italy holds a competitive advantage, and which are characterised by higher barriers to entry and sunk costs, although market concentration is still low. Survival rates equal respectively to 70.3% and 64.3% confirm that in these industries market selection is stronger and more effective at the pre-entry stage, whereas the entry process involves only those firms with a relatively higher probability of survival, namely those approaching the MES level of output.

Thus, in order to test the hypothesis that the likelihood of survival is shaped by what the literature has identified as the most important observable characteristic specific to the firm – its size – we must control for industry-specific factors. While Audretsch (1991 and 1995), Audretsch and Mahmood (1995); Wagner (1994); Mata et al. (1995) all control for industry specific characteristics by directly including measures reflecting various factors specific to the industry, here we follow the example of Dunne et al. (1988), (1989); Doms et al. (1995); Hall (1987), by estimating a model for new-firm survival for each manufacturing industry separately.

A specification for the start-up size/survival relationship is to measure the dependent variable in terms of months survived and to put forward a tobit estimation. In effect, the INPS data base tracks the post-entry performance of firms started in January 1987 only until January 1993. As a consequence, when testing the likelihood of survival of new manufacturing firms one may only consider the interval, named *follow-up time*, comprised between $t = 1$ (where 1 corresponds to January 1987) and $t = T$ (with T corresponding with January 1993), during which N survived firms for each industry are observed. If a firm exited the market at any time comprised by t and T its *failure time* is correctly reported, otherwise one may only stress that its duration exceeds the threshold T. To analyse this truncated distribution, we follow Greene (1993, pp. 691–697) in defining a new random variable, y, transformed from the original one, y^*, by

$$y = T \quad \text{if } y^* \geqslant T$$

and

$$y = y^* \quad \text{if } 0 < y^* < T$$

The regression model based on the above discussion is a common censored regression model, or tobit model, the general formulation of which is represented by the index function

$$y_i = B'x_i + \varepsilon_i \tag{1}$$

with

$$y_i = T \quad \text{if } y_i^* \geqslant T$$

and

$$y_i = y_i^* \quad \text{if } 0 < y_i^* < T$$

The results from the tobit regression (at the two-digit level), in which the dependent variable is the number of months that each new-born firm survived during the relevant period, are presented in Table 3. In effect, there is virtually no evidence to link firm size with survival, although 9 sectors out of 13 show the expected sign, and in three of these – mechanical engineering, textiles, and leather products – the positive relationships prove to have some degree of significance (90%). Thus, irrespective of the high variability of start-up size identified for most

Table 3
Tobit model estimates: Duration (in months) on start-up size for new firms in selected manufacturing industries (with at least 30 entrants in January 1987): 1987–93

Industry	Constant	Start-up size	*N*
Stone, clay, glass	81.28	−0.155	73
	(9.97)	(−0.63)	
Chemicals	78.00	−0.03	49
	(91.3)	(−0.90)	
Fabricated metal products	73.70	0.210	118
	(10.67)	(0.57)	
Mechanical engineering	59.00	0.064	101
	(26.46)	(1.50)	
Electrical and electronic engineering	89.48	0.043	129
	(11.41)	(0.26)	
Instruments	56.63	0.655	214
	(34.50)	(1.09)	
Food	66.07	−0.134	82
	(9.60)	(−0.60)	
Textiles	67.27	0.330	102
	(11.29)	(1.56)	
Leather products	66.88	1.580	54
	(5.41)	(1.38)	
Footwear and clothing	25.73	0.127	231
	(5.31)	(0.62)	
Wood and furniture	82.46	6.071	115
	(10.73)	(0.32)	
Paper and printing	72.91	0.11	109
	(11.85)	(0.50)	
Rubber and plastics	12.71	−0.890	85
	(6.80)	(−0.96)	

Note: *t* statistics in brackets

sectors (cf. standard deviations reported in Table 2), the hypothesis that firm size is conducive to new firm survival is not supported by the data. This stands in contrast not only to the results found for other countries, such as Germany, Portugal, the United Kingdom and the United States, but also to the findings of Santarelli (1997 and 1998) with respect to tourism services and the financial intermediation industry in Italy.

At least three explanations of this somewhat controversial result can be provided. Firstly, it is likely that the underdeveloped and highly imperfect Italian capital market entails that *barriers to entry* in manufacturing industries characterised by high capital raising requirements (such as chemicals, electric and electronic engineering, instruments, paper and printing, and rubber and plastics) are comparatively higher than in other countries and in Italian tourism services and banking. Accordingly, new firms in such industries are subject to a pre-entry selection process which selects only those characterised by the choice of more capital intensive production techniques, larger availability of internal finance, and easier access to outside financing. Secondly, *barriers to survival* are instead lower within industrial districts, which are typical of the North-eastern and Central Italian regions, and in those industries (fabricated metal products, food, footwear and clothing, wood and furniture) which are characterised by low concentration, low capital and financial requirements, and the presence of market niches in which competition from incumbents is less strong. Thirdly, it might be the case that some firms registered their position for the first time in the INPS files in January 1997, after having been active for years in the informal sector of the economy.[8] In this case, the ‘‘new firm’’ identified in the INPS file is in fact an established, although small and often marginal firm with a likelihood of survival comparatively higher than that of new firms in the strict sense.

Thus – due the peculiarities of some industries in Italian manufacturing and some general features of the Italian economy – firm size may prove not to affect significantly the likelihood of survival within any given industry.[9]

4. An empirical test of Gibrat’s law

While there are various interpretations of Gibrat’s Law of Proportionate Effect (Gibrat, 1931), the most common view is that firm growth is independent of firm size, or that the ‘‘probability of a given proportionate change in size during a specified period is the same for all firms in a given industry – regardless of their

[8] As known, this is largely developed in some Italian industries (in particular consumer goods industries) and regions (mostly in the South).

[9] In order to keep an acceptably high number of observations across sectors, this paper is organised at the two-digit disaggregation level. Analysis carried out for three-digit manufacturing industries would have allowed a more clear-cut identification of idiosyncratic industry characteristics, possibly affecting the degree of significance of the positive relationship between initial size and likelihood of survival.

size at the beginning of the period'' (Mansfield, 1962, pp. 1030–1031[10]). Closer inspection, however, reveals at least three versions of Gibrat's Law (for a recent survey, cf. You, 1995). The first version postulates that the law holds for firms that have exited out of the industry as well as for those still in existence. The second interpretation is that the law holds only for firms that have survived over the entire time period (Hart and Prais, 1956). According to this interpretation, firms that have exited from the industry should not be included in a sample used to test Gibrat's Law statistically. The third version is that the law applies only to firms large enough to exceed the MES level of output (Simon and Bonini, 1958).[11]

As regards criticisms of Gibrat's Law, (Lucas, 1978, p. 514; cf. also Lucas, 1967) puts forward theories which are not in contrast with the Law of Proportionate Effect.[12] Thus, although he rejects the theory on which Gibrat's Law is based because it is not implied by the ''Stochastic'' model, Lucas notes that in any case ''there are empirical reasons for giving special attention to the special case which satisfies the law''. Nor is empirical estimation of Gibrat's Law immune to criticism. For instance, business turnover has been shown to be highly influential on the estimated growth of firms in any given industry (Mandelbrot, 1963), whereas Audretsch and Mahmood (1995, p. 26) state that ''although the skewed size distribution of firms persists with remarkable stability over time, it does not appear to be a constant set of small and sub-optimal scale firms responsible for this skewness''. In fact, if we take into account the processes of entry and exit, the log-normal distribution does not necessarily refer to the same firms over time, but to a constantly renewed population of firms.

The above problems notwithstanding, the Law of Proportionate Effect has been widely studied over the last 40 years. Empirical studies have yielded varying results, depending upon the time period, size measure, and interpretation used (Hymer and Pashigian, 1962; Singh and Wittington, 1975; Mansfield, 1962; Kumar, 1984). For example, Hart and Prais (1956) found that firm growth is roughly independent of the size of the firm, therefore providing empirical evidence consistent with Gibrat's Law. In her turn, Hall (1987) assembled a large panel of U.S. COMPUSTAT files and identified a 4% difference in the annual growth rates between firms in the 25th and 75th percentiles. The smaller firms were found to grow faster than their larger counterparts. In addition, Hall found that the variance of growth rates is greater for small than for large firms. A series of studies (Dunne et al., 1988, 1989; Audretsch, 1995; Wagner, 1992; Cabral, 1995; Mata et al.,

[10] In his study Mansfield analysed four 10-year periods in the steel and petroleum industries, and two shorter intervals in the tire industry. He found that Gibrat's Law failed to hold in more than one-half of cases, regardless of the version tested.

[11] It should be noted, however, that Simon and Bonini (1958) obtain results confirming this interpretation for a sample composed by the *largest* firms in United Kingdom and the United States, which by definition belong to the same size class.

[12] For a discussion of the theoretical implications of different versions of Gibrat's law on concentration and industrial organisation, see McCloughan (1995).

1995) have instead found, across a broad spectrum of analyses, that observed growth rates of new and small firms tend to be negatively related to their start-up size. On the basis of such results, Geroski (1995) thus concludes that Gibrat's Law tends to hold for large firms that have attained the MES level of output,[13] but not for firms operating at a level of output that is below MES. However, this conclusion is partly in contrast with the result recently obtained for a large sample of UK firms by (Hart and Oulton, 1996a,b) who show (a) that growth is negatively related to initial size, but also (b) that no significant relationship between growth and size emerges for larger firms.

Gibrat's Law is formally expressed as:

$$S_{it} = \varepsilon_{t_*} S_{it-1} \quad (2)$$

where S_{it} is the size of the ith firm at time t, S_{it-1} is the size of the ith firm at the previous time and ε is a random variable distributed independently of S_{it-1}.

By following Chesher (1979), Gibrat's Law can be empirically tested using the following specification:

$$\log S_{it} = \alpha + \beta \log S_{it-1} + \varepsilon_t \quad (3)$$

Gibrat's Law will be confirmed if and only if $\beta = 1$. In the context of a regression model this implies that the estimated coefficient of β is not statistically different from one. By contrast, if $\beta < 1$ or $\beta > 1$ Gibrat's Law is not accepted, since in the first case smaller firms would grow at a systematically higher rate than do their larger counterparts, whereas the opposite will be true in the second case.

Using the data base described in the previous section, we tested the first and the second interpretation of Gibrat's Law introduced above. It was not possible to test the third interpretation, due – on the one hand – to the impossibility of identifying correctly the MES level of output for each of the relevant industries in Italian manufacturing, and – on the other hand – to the availability of data regarding only the growth rates of (small) new-born firms and not also those of (large) incumbent enterprises. Thus, we estimate Eq. (3), where the start-up size in the initial period (January 1987) is taken to be S_{it-1}, for all firms (i.e. those that exited from the industry and those still in existence) and for those surviving at least until January 1993 respectively. Our regression analysis consists of a series of within-industry cross-sections in which the relevant observations are represented by the number of firms in each two-digit manufacturing industry. The regression results from estimating Eq. (3) in relation to the first interpretation are shown in Table 4.[14]

[13] Cf. also Geroski and Machin (1993); Geroski et al. (1997) who, for a sample of large, quoted UK firms, identify a positive, robust correlation between growth rates and profitability.

[14] Having taken into account firms that exited from the industry raises the problem of the logarithmic transformation of a final size which is equal to 0. To overcome this problem, and to allow the size of firms with one employee to decrease, the original series have been augmented by 0.1.

Table 4
The relationship between final and initial firm size in selected manufacturing industries (with at least 30 entrants in January 1987): 1987–93 (all firms)

Industry	α	β	R^2	F	White[a]	Wald[b]	N
Stone, clay, glass	−0.11	0.33*	0.03	2.30	16.62***	7.29***	73
	(−0.23)	(1.32)					
Chemicals	−0.07	0.18	0.02	0.86	25.16***	9.78***	49
	(−0.14)	(0.68)					
Fabricated metal products	−0.42	0.47**	0.05	6.14***	7.22**	6.57**	118
	(−1.15)	(2.31)					
Mechanical engineering	−0.58*	0.94***	0.25	33.01***	0.30	0.13	101
	(−4.48)	(5.75)					
Electrical and electronic engineering	−0.06	0.50***	0.07	9.36***	25.91***	5.78**	129
	(−0.18)	(2.42)					
Instruments	−0.39**	0.57***	0.10	22.63***	28.52***	12.90***	214
	(−1.70)	(4.76)					
Food	−0.65**	0.34*	0.04	2.94*	22.40***	6.42**	82
	(−1.87)	(1.33)					
Textiles	−1.06***	0.77***	0.15	18.15***	8.97**	1.34	102
	(−2.76)	(3.85)					
Leather products	−0.62	0.80***	0.11	6.71*	0.13	0.40	54
	(−1.01)	(2.59)					
Footwear and clothing	−0.73	0.12***	0.04	10.76***	76.03***	21.06***	231
	(−2.60)	(3.28)					
Wood and furniture	−0.44	0.65***	0.11	13.98***	22.40***	2.66	115
	(−1.21)	(3.01)					
Paper and printing	−0.65***	0.62***	0.13	15.74***	23.31***	3.93**	109
	(−2.43)	(3.26)					
Rubber and plastics	0.79**	0.26	0.02	1.32	9.10**	8.49***	85
	(2.09)	(1.00)					

Note: t statistics in brackets.
[a], Null hypothesis: homoskedasticity; in the case of heteroskedasticity (at least 90% significance level) a consistent covariance matrix has been used (White's correction).
[b], Null hypothesis: β (start-up size coefficient) = 1.
*, Significant at the 90% level of confidence; **, significant at the 95% level of confidence; ***, significant at the 99% level of confidence

Based on the Wald Test for the hypothesis that $\beta = 1$, the empirical evidence is not consistent with Gibrat's Law in 9 out of 13 industries with at least 40 new-born firms, whereas it is not rejected for mechanical engineering, textiles, leather, and wood and furniture. Among the nine industries for which Gibrat's Law does not hold, in four cases (fabricated metal products, electrical and electronic engineering, food, and paper and printing) the null hypothesis of $\beta = 1$ is rejected with a 95% level of confidence, and in the remaining five cases with a 99% level of confidence.

As regards the second interpretation of Gibrat's Law (Table 5), this is rejected by the regression analysis in all but one of the twelve industries with at least 30

Table 5
The relationship between final and initial firm size in selected manufacturing industries (with at least 30 entrants in January 1987): 1987–93 (only firms still in existence at the end of the relevant period)

Industry	α	β	R^2	F	White[a]	Wald[b]	N
Stone, clay, glass	1.47***	0.52***	0.29	16.17***	7.81**	11.08***	42
	(3.94)	(3.67)					
Fabricated metal products	1.61***	0.45***	0.26	22.86***	11.63***	25.91***	66
	(6.01)	(4.24)					
Mechanical engineering	1.15***	0.74***	0.61	107.21***	1.00	13.37***	71
	(6.29)	(10.35)					
Electrical and electronic engineering	1.36***	0.61***	0.42	58.80***	5.19*	16.84***	83
	(7.64)	(6.44)					
Instruments	1.18***	0.62***	0.46	108.20***	2.35	41.08***	131
	(9.76)	(10.40)					
Food	0.98***	0.79***	0.39	23.80***	1.80	1.64	39
	(3.33)	(4.88)					
Textiles	1.41***	0.57***	0.39	33.09***	6.91**	15.81***	54
	(4.45)	(5.36)					
Leather products	2.12***	0.28**	0.12	4.43**	3.08	30.08***	33
	(7.44)	(2.10)					
Footwear and clothing	1.27***	0.64***	0.47	96.10***	1.05	29.74***	112
	(8.51)	(9.80)					
Wood and furniture	1.42***	0.56***	0.48	63.01***	11.05***	32.17***	70
	(7.45)	(7.09)					
Paper and printing	1.25***	0.55***	0.53	65.04***	0.11	43.19***	60
	(9.33)	(8.06)					
Rubber and plastics	1.36***	0.56***	0.24	19.70***	0.48	12.02***	65
	(6.34)	(4.44)					

Note: *t* statistics in brackets.
[a], Null hypothesis: homoskedasticity; in the case of heteroskedasticity (at least 90% significance level) a consistent covariance matrix has been used (White's correction).
[b], Null hypothesis: β (start-up size coefficient) = 1.
*, Significant at the 90% level of confidence; **, significant at the 95% level of confidence; ***, significant at the 99% level of confidence.

survived firms,[15] the only exception being represented by the food industry. The empirical evidence clearly suggests that, on the condition of firm survival, smaller new firms tend to grow faster than larger ones in all the remaining industries. All the estimated coefficients are significant and positive, but are less than one, while the null hypothesis of $\beta = 1$ is rejected in 11 cases out of 12 with a 99% level of confidence.

These results testing Gibrat's Law for new-firm start-ups in Italy – in particular those obtained in relation to firms which survived until the end of the relevant

[15] Chemicals were in this case excluded from analysis since only 27 firms in this industry survived until the end of the relevant period.

period – are generally consistent with those found for the United States (Audretsch, 1995), United Kingdom (Dunne and Hughes, 1994), Portugal (Mata and Portugal, 1994), Germany (Wagner, 1992), and Canada (Baldwin, 1995 and Baldwin and Rafiquzzaman, 1995). As Jovanovic (1982) has argued and Audretsch (1995) Geroski (1995) Baldwin and Rafiquzzaman (1995) have shown, the process of entry involves learning. Those entrepreneurs who start a new business and learn that it is viable will tend to grow. If the firm is to survive, smaller firms must grow at a higher rate than their larger counterparts. Thus, post-entry growth rates of surviving firms are observed to be negatively related to firm size. This tendency is possibly reinforced in Italian manufacturing, where in most industries new firms operate at a level of output that is below MES and entry by (very) small firms is common, in particular within industries in which the most common organisational structure is of the ‘‘industrial district’’ type (cf. Brusco et al., 1979; Solinas, 1995).

5. Concluding remarks

In this paper we have analysed industry dynamics in Italian manufacturing. The four main findings of the paper are: (1) survival patterns differ significantly across specific industries; (2) the hazard function has a bell shape with a peak at the second year of activity; (3) within each industry, start-up size is not statistically related to the likelihood of new-firm duration; and (4) Gibrat’s Law does not apply to new-firm start-ups in most industries.

In view of recent theories about the links between firm size and observed growth rates of surviving firms, the issue may not be why Gibrat’s Law fails to hold among new and small enterprises, but rather why the likelihood of survival does not appear to be significantly related to firm size for new Italian manufacturing firms, as has been found to be the case in other countries and when analysing Italian tourism services and banking. The most plausible explanation is that, if Jovanovic’s model of *noisy selection* is correct, the inherent potential of each new-firm start-up is independent of its initial size. This independence is probably related to some peculiarities of the Italian economy, and to the inner features of most industries in Italian manufacturing.

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