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The Survival of Manufacturing SMEs in Iran during the Second Development Plan

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Abstract

This paper has examined the survival of Small and Medium-sized Enterprises (SMEs) in manufacturing industries in Iran during the years Second Development Plan. For the fist time it uses a large dataset to examine this issue in the context of a developing country. The paper discusses some methodological problems involved and derives estimating model for survival.

The results of the paper tend to be consistent with the theories of firm survival, and other empirical work carried out in both developed and developing countries. In the case of the initial plant size, the results show that plant survival is not associated with size. We found that plants with private ownership are more likely to close compared with plants with public ownership. The plants with greater price-cost margin had lower failure rates. Furthermore, plants with a higher proportion of younger workers are less likely to survive, as are those plants with a higher share of female employees. Finally, the concentration ratio has a negative effect but the entry rate has a positive effect.

Keywords: Logit Models, Plant Survival, Manufacturing Plants, Iran, Second Development Plan, SMEs

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1- Introduction

Research from different countries shows that small and medium-sized enterprises (SMEs) have an increasingly important role in the development of economies. Studies find that SMEs employ more than 50 percent of the working population of many countries around the world. However, it is widely known that many SMEs fail within a few years of their start-up, so that only a few are able to survive and grow. For example, according to Agarwal and Audretsch (2001), smaller firms generally have much higher failure rates in comparison with their larger counterparts. However, according to Yonggui *et al.* (2001), survival is not a random event, so that in order to understand this phenomenon, a systematic empirical investigation is required using data for many different countries. This is especially important in Iran as SMEs are a potential source of job creation.

Although a large number of small and medium-sized enterprises do not survive and only some of the survivors grow, SMEs can contribute to economic growth in many different ways. For example, in the case of developing countries, SMEs provide employment for large numbers of unskilled workers and women, which is desirable for the alleviation of poverty. Hobohm (2001), for instance, argues the SMEs are more labour intensive and also that they tend to lead to a more equitable distribution of income than their larger counterparts. SMEs also tend to be more widely spread geographically than larger enterprises; consequently they can reduce economic inequalities between rural and urban areas, especially in less-developed countries.

In Iran, small and medium-sized enterprises are at the forefront of the economic policy debate in recent years, and Iranian policymakers consider SMEs as one of the most important engines for growth and employment creation to solve the unemployment crisis. Reflecting this, Iranian Ministry of Industry and Mines has created a division for SMEs. However, while it is expected that SMEs will play a significant role in job creation in Iran, relatively little is known about this sector and its performance. According to our knowledge, there is no empirical work on the factors influencing the survival of SMEs in Iran, partly due to lack of data availability.

The purpose of this paper is to examine those factors that contribute to the survival of manufacturing SMEs in Iran, as a potential remedy for unemployment. This study is conducted over the period 1994/95 to 1998/99. As a definition of an SME we take all those plants with strictly less than 100 employees at 1994/95. These are manufacturing plants, on which we belive we observe plants in the size range 10-99 employees, but for which we have only a sample of plants with less than 10 employees.

This paper is organized as follows. The role of SMEs in Iranian manufacturing industry is discussed in section 2. Section 3 explains some methodological issues on the measurement of survival. The models and explanatory variable are presented in section 4. Section 5 gives the results for the survival of SMEs, and finally section 6 concludes.

2- SMEs in Manufacturing Industry in Iran

Employment in Iran has experienced slow growth relative to population growth for a long time. Several explanations have been suggested for this, such as inflexibility in the labor market and economic instability. Another explanation is related to the small and medium-sized enterprise. It is argued that a lack of attention to SMEs prior to the 1979 Revolution is an important explanation for the slow growth of employment. In the mid-1960s, for example, 97 percent of manufacturing plants in urban areas were micro scale (i.e. establishments with less than 10 workers). Furthermore, more than 65 percent of manufacturing employment in urban areas was in micro plants. In 1972, about 90 percent of manufacturing plants were still micro-scale and nearly 95 percent were SMEs (i.e. less than 100 employees). However, such was the neglect of SMEs that they received only about 5 percent of the value of all IMDBI loans over the period of 1960-77.[1]

It is argues that small-scale industries were also neglected after the Revolution, when they continued to make up more than 90 percent of all plants and accounted for more than 50 percent of the labor force. Parvin (1997), for

1- The IMDBI (Industrial and Mining Development Bank of Iran), loan constituted more than 70 percent of total long term industrial credits granted to the private sector over the 1963-77 periods.

example, believes that public policy not only did not encourage the SME sector, but that government policies created stumbling blocks for them. The labour laws, is one of the major problem for SMEs. Moreover, within the manufacturing sector, it is also often argued that large-scale producers are singled out for special subsidies, and in Iran, like in most developing countries, when policies do not explicitly favour large firms then they are able to lobby the government much more effectively. As a result, manufacturing industry in Iran has an employment structure like a “snap-glass”, or U shaped, i.e. a large share of employment in both micro and large-sized firms, but relatively little employment in SME firms. This can be observed from.

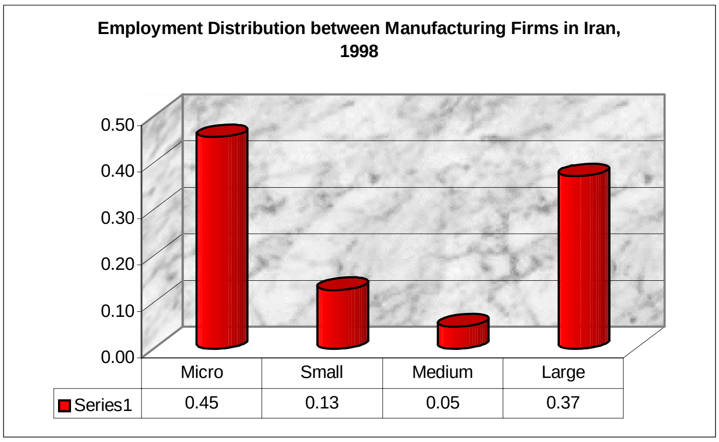

Figure 1: Employment Distribution between Manufacturing Firms, 1998 (%)

Source: SCI, 2000, Tehran

In Table 1 we again show the percentage of employment in micro, small, medium and large firms in Iran, and compare this with the situation elsewhere for some developed countries. As the table shows, the employment share of micro plants is substantially higher in Iran than in developed countries. On the other hand, large-scale manufacturing plants have a relatively smaller share of employment. In addition, whereas at least 30 percent of employment in manufacturing industry in developed countries is within small and medium-sized manufacturing plants, in Iran these account only for 18 percent of total manufacturing employment. The relatively small share of small and medium-sized plants could be explained by survival phenomenon. For example, it could be that only a very small percentage of small and medium-sized firms survive. This issue is now explored in the next section.

Table 1: Distribution of Manufacturing Employment by Plant Size, Developed Countries, 1990s

Country	Year	Employment. (000's)	Distribution by size categories (%)			
			0-9	10-49	50-99	100+
Australia	1990	580	11	22	12	55
Austria	1992	580	2	16	14	68
Canada	1992	1,540	4	19	13	64
Germany	1993	6,929	13	23	9	55
Holland	1992	949	11	20	11	58
Japan	1992	11,156	12	29	13	46
Portugal	1992	989	15	26	14	45
Sweden	1989	749	1	16	12	71
Switzerland	1991	868	12	22	28	38
Iran	1998	1,618	45	13	5	37

Source: Palas, 1996

3- Methodological Issues: The Measurement of Survival

Survival analysis is much used in medical science, and there are a lot of such studies in medicine and biology (Klein and Moeschberger, 1997). However, in the field of labour and industrial economics, survival analysis has really only been used by economists over the last two decades, following the availability of longitudinal data (Caves, 1998). The main idea of survival analysis is to study the time duration to an event, which could be the loss of a job, for example, or in our case the closure of a firm. Survival analysis examines the survival time duration of plants (firms or establishments) that enter an industry, and which are then followed over time from the date of birth (entry) until death (closure or exit).

Generally, there are three methods for the study of survival analysis. These are: parametric methods (for example, assuming a log-normal distribution of survival durations), non-parametric (for example, using a Kaplan-Meier estimator that assumes no underlying distribution) and semi-parametric methods (for example, the Cox proportional hazards model). In survival analysis four concepts are important, these are: the survival function, the hazard rate, the observed duration and the censoring of observations. The survival function describes the time duration to the event. In our case, it is the probability that a firm survives until time *x*. The survival function is defined as:

$S(x) = \Pr(X > x) = \int_{x}^{\infty} f(t)dt$, where X is a continuous random variable.

It is clear that the survival function is non-increasing with a value of 1 at the origin and zero at infinity. The hazard rate is the instantaneous failure rate at time *t* and it is defined as:

$$h(x) = \lim_{\Delta x \to 0} \frac{p[x \le X < x + \Delta x \mid X \ge x]}{\Delta x}$$

This can be interpreted as the approximate probability that a plant of age *x* experiences the closure in the next instant ($x + \Delta x$). The observed duration is the period over which a firm is observed, and censoring is when the firm’s lifetime extends beyond the observed duration. In the case of survivors these are right-censored observations, as their lifetimes are not observed.

In practice, there are many different survival distributions, and hence hazard rates, that can be used in empirical work. The parametric method assumes a specified distribution such as normal, log-normal, log-logistic or Weibull distribution, which are the most common survival functions used in practice (for example, Holmes et al. 2001). However, many studies prefer non-parametric or semi-parametric models for their analysis (see, for example, Harris and Hassaszadeh, 2001 and 2002). These models are more flexible as the distribution is estimated from data directly, rather than being imposed.

Access to longitudinal micro data is necessary for plant survival analysis, otherwise it is impossible to identify the actual start-up and closure dates of individual plants, and trace their life cycle. In our case we use data for SMEs for the years 1994/95 to 1998/99, and due to a lack of longitudinal data we are not going to estimate the life duration of firms. Instead, we undertake a probit analysis, so that the dependent variable is a binary variable that indicates whether a plant has exited or is still operating at 1998/99 - it takes a value of 1 if the plant is in operation at 1998/99 and 0 if it exited. It should be noted that this analysis is potentially problematic, since it takes no account of the differences in the time period over which a plant is at risk of exit. However, we include a variable which proxies the age of a plant.

The exit of a plant can occur for many reasons, and it could be a signal of success as well as of failure.1 Since the definition of an exit can affect the results, from a methodological point of view it is very important to make clear this definition. In the literature on industrial organisation, generally, the definition of exit is usually based on the firm’s reported employment figures. Hence, exit occurs “when employment falls to zero and does not become positive again during the observation period” (Gucht et al., 2000). According to Audretsch, et al. (1997), exit is defined as those firms which are reported in database in year t-1 but not in year t. Like Audretsch, et al. (1997), here we define exit as those plants that are reported in 1994/95 but are missing from the database in 1998/99. In this study, in effect, an exit occurs when a plant ceases to trade.

1- For example, a successful plant may exit because it has been acquired.

4- The Data

The Statistical Centre of Iran resumed the annual implementation of the Survey of Manufacturing Establishments. This covered all manufacturing plants with at least 10 employees. However, to provide much more detail on the nature of plants, the General Census of Manufacturing and Mines (GCMM) was implemented in 1995. This covers all manufacturing and mining plants with at least 10 employees, but a sample of establishments with less than 10 employees were surveyed for the years 1995 through to 1998. In total, the GCMM surveys about 13,000 to 14,000 plants annually. This includes 11,500 plants that have 10 or more employees, and a sample of around 2,000 smaller plants. There are a lack studies using disaggregated data in Iran, because such data has been kept confidential by law.

These data include information on the vast majority of firms in the manufacturing sector at a very disaggregated level. The GCMM data include information on ownership, employment, inputs, investment, output and expenditure at the plant level. Ownership is categorized according to private, co-operative and public statutes, and employment data include two categories of worker: administrative and operatives, with the operatives further classified by the level of skill. In addition, total employment is separated by gender, level of education and years of service. It is possible to distinguish between employees with and without wages and salaries. Total inputs include material costs, energy costs and wages and salaries, while investment is split into three main types: plant and machinery, building and land, and vehicles. Finally, there are a range of other plant-level expenditure terms, including transportation, communications, training, R&D and advertising. The published data are disaggregated at the 2, 3 and 4-digit industry levels.

Although the General Census of Manufacturing and Mining database (GCMM) is the most disaggregated and most comprehensive data on manufacturing industries in Iran, there are some problems. Unfortunately, the database covers only those firms with at least 10 employees, whereas around 45 percent of manufacturing employees in Iran are in plants with less than 10 employees. However, the data cover a sample of these smaller firms, but for a few years, which are available for the years 1994/95 to 1997/98 only. In addition, it seems that these smaller plants (i.e. with less than 10 employees) were not randomly sampled in the dataset, as they were included only if their production corresponded to that of firms with 10-19 employees, but no further details are available. Given this, the sample of smaller plants may not be fully representative of the population of Iranian plants with less than 10 employees.

In addition, although the GCMM database includes all manufacturing industries with at least 10 employees, the data for any individual establishment with more than 500 employees are confidential. For this reason, there is no way of knowing from the available data whether the larger establishments that disappeared from the data really closed or if they survived but grew to have more than 500 employees, and so are not separately reported. Since the data were collected only for firms with at least 10 employees after 1997/98, there is a same problem when the size of firm has decreased to less than 10 employees, i.e. it is not clear whether the firm closed or shrunk in size. Nevertheless, the data represent an extremely valuable source with which to investigate the survival of manufacturing plants in Iran. The number of observations on the SME plants from the GCMM data is shown in Table 2, disaggregated by years and by the three sizes of plants. It shows that there are 11,768 SME plants in 1994/95 and that 9,298 of them survived until 1997/98. Since in the year 1998/99 none of the smaller plants (less than 10 employees) was surveyed, it excluded from the analysis.

Table 2: SME Plants during 1994/95-97/98

Size Classes	1994/95	1995/96	1996/97	1997/98
$emp < 10$	1.962	1.857	1.891	1.932
($emp < 10$ (1995 sampled))	(1.962)	(1.838)	(1.582)	(1.571)
($emp < 10$ (decliners))	(0)	(19)	(309)	(361)
$10 \leq emp < 49$	8.788	8.351	6.781	6.511
$50 \leq emp < 99$	1.018	1.054	929	855
Total Plants	11.768	11.262	9.601	9.298

5- The Models and Explanatory Variables

5.1-.The Models

We seek to estimate the following general equation of firm growth:

$$S_{it} = \gamma_0 + \gamma_1 \ln EMP_{it'} + \gamma_2 (\ln EMP_{it'})^2 + \gamma_3 (\ln EMP_{it'})^3 + \sum_{i=1}^{n} \theta_i X_{it'} + \mu_{it} \qquad (1)$$

where S_{it} = 1 if the plant survives until the end of period (t = 1998/99), Sit= 0 otherwise, and $\mu_{it} \approx N(0, \sigma_i)$. The model is estimated using the probit method.

Generally, it is assumed that the survival of a firm is not a function of its size in a linear way, so $\ln EMP_{it'}$, $(\ln EMP_{it'})^2$ and $(\ln EMP_{it'})^3$ stand for the log of employment to the first, second and third powers respectively[1]. The $X_{it'}$ is a vector of other explanatory variables explained below and μ_{it} is a normally-distributed error term.

5.2- Explanatory Variables

In this section we discuss the variables in $X_{it'}$ that can explain firm survival. Usually, the literature on firm survival considers five types of variable to explain the survival of a firm. These include:

- Personal Characteristics and Human Capital (such as the age of the management team or entrepreneur, and their education, gender, skill and years of experience)
- Organizational Strategy (using bank finance to start up, a business focus on a specific type of customer or market and product differentiation, for example)
- External Environment (availability of external finance, access to foreign markets and local services and support for SMEs)
- Firm Characteristics (size, age and ownership, for example)
- Industry Characteristics (minimum efficient scale, entry rate and concentration ratio)

1- For further discussion, see Disney, R., J. Haskel, et al. (1999).

Despite this, economists usually just focus on two types of variable in their analyses, i.e. plant-related and industry-related variables (Audretsch et al., 1997), and this is what we do here. In the case of the plant-related variables, we use most of those variables that were considered in literature, such as employment and expenditure. We also add some more plant-related variables, including the price-cost margin and labour productivity. In the case of industry-related variables, they include such things as the minimum efficient scale and industrial concentration. These are measured for individual plants, but vary according to the industry in which the plant is located.

We now consider each of the plant and industry-related variables in turn. Part of the purpose of this is to indicate the expected effect of the variables on survival. A full list of the variables, with some simple descriptive statistics, is given in Table 3. This gives all of the variables, but of course in the regression some of these are omitted to avoid dummy-variable type traps. Possible correlation between the variables is considered below. We discuss the base-case plant below.

5.2.1- Plant-related Variables

The plant-related variables are sub-divided into three groups: plant-specific, employment-specific and expenditure-specific variables. We now briefly describe the variables.

The size and age of a plant are perhaps the most widely used variables when studying the performance of plants. For example, as Mata et al. (1995), Disney et al. (1999) and Honjo (2000) argue that the likelihood of survival increases with the current plant size. Furthermore, it is expected that the current age of a plant has a positive effect on survival (see Evans, 1987a and 1987b; Wren and Storey, 2002). The size of plant is measured by number of employees and it is logarithmised to adjust for skewness (lnEMP95). In addition, it is argued that the survival of a plant is a function of its size in non-linear way, so that $(\ln EMP_{it'})^2$ and $(\ln EMP_{it'})^3$ are also included.

As regards the plant age, the plants are divided in four age groups according to the years of services of their employees.1 These are: infants (less than 5 years old), young (5 to 9 years old), mature (10 to 19 years old) and old plants (more than 20 years old), which are described by AGE1D to AGE4D respectively. Table 3 shows that in comparison with infant and young plants, the mature plants have the largest share of plants. Furthermore, old plants have the lowest share of SMEs.

Only a relatively few studies have taken the effect of ownership on survival into account (for example, Harhoff et al. 1998; and Harris and Hassaszadeh, 2002). The OWN1D to OWN4D in Table 3 tell us about the ownership structure, whether it is a sole proprietor (OWN1D), a partnership (OWN2D), a co-operative (OWN3D) or a plant operating in the public sector (OWN4D).2 As Table shows, most SMEs (nearly 95 percent) are concentrated in two of the ownership categories, i.e. sole proprietors and partnerships. The share in co-operatives and the public sector is therefore very small. In addition to these, the plant price-cost margin (PCM) and labour productivity (LP) are also included as explanatory variables. The price-cost margin is a proxy for profitability of a plant, and the effect of this on growth and survival is expected to be positive. Quite simply, more profitable plants are expected to be more successful. A conventional proxy for the calculation of the price-cost margin is:

$$PCM = \frac{OUTPUT - (WAGE + MATERIAL\ \ COSTS)}{OUTPUT} \qquad (2)$$

According to Audretsch et al. (2002) this is definition adopted by Cowling and Waterson (1976). It is used by Nurmi (2002a) in a study of the Finnish

1- Although the General Census of Manufacturing and Mining database (GCMM) is the most disaggregated and most comprehensive data on manufacturing industries in Iran, there are some problems. For example, most of studies of firm performance have used the age of the firms as a key variable, but the age of a firm is not known from the GCMM data. Without knowing the age of the plants, it is not possible to follow through time a cohort of firms that have started operation in the same year.

2- Changes in ownership structure can play a significant role in plant survival (Harris and Hassaszadeh, 2002 and Wei *et al*., 2002). However, these kinds of data were not available.

manufacturing plants. Some other studies use a slight variant, so that Audretsch et al. (2002) used total revenue instead of value added in their analysis.

Labour productivity (LP) is defined as the ratio of total plant value added (or output) to the total number of plant employees. The effect of labor productivity on firm survival is expected to be positive, because of a ‘cleaning effect’, i.e. “the least productive plants exit first” (Harris and Hassaszadeh, 2001, p. 1). This is also predicted by learning theory. Yang and Temple (2002) show that labour productivity has a positive effect on a firm’s survival. A difficulty in estimating this effect is that there is usually a positive relationship between labor productivity and firm size, indicating that larger firms are more efficient than their smaller counterparts. This predicts a higher survival rate for larger firms based on their productivity.

As regards the employment-specific variables, the role of human capital is explained by the skill of the employee. This variable also reflects the level of the employee’s education. It is expected that SMEs with higher percentage of high-skilled employees, especially SKILL1 and SKILL2, will survive more than their larger counterparts. The role of gender (MALE) on plant survival cannot be signed, although Mead and Liedholm (1998) show that in African countries female-owned micro and small-sized plants have higher closure rates than those owned by males. Employees are also divided into those with and without wages and salaries (WAGE). An SME with a high percentage of unpaid jobs can be interpreted as a family-owned business, and it might be expected that these survive more than plants with low percentage of unpaid jobs.

Finally, the years of service (SERV1 to SERV4) represent the age structure of a firm’s employees, and we believe this to be performing a different task to the AGED variables discussed above.1 Plants with a higher percentage of younger and more dynamic employees may be show higher failure rates.

1- Although the age of plants is also categorized by the employee’s years of service, it is different from the percentage of employees with different years of service. For example, if a plant has 1 employee with 10 to 19 years of services, it is classified as a mature plant. However, the highest percentage of employees in this plant may have less than 5 years of services. Nevertheless, this may still cause the multicollinearity, which is checked in the estimation.

A description of these employment-specific variables is given in Table 3. It shows that on average 6 percent of the labour force are technologists or technicians. Women have only a very small direct role in manufacturing industry, so that only 7 percent of SMEs employees are female. The share of non-wage labour (owners and unpaid family members) is around 8 percent. Finally, most employees have less than 5 years of services.

The expenditure-specific variables are also included in plant related variables. Transportation (TRANS), communication (COMM) and advertisement (ADVERT) expenditure, for example, reflect the strategic choices made by a plant. These expenditure variables reflect the degree of product differentiation and enthusiasm in marketing, and are expected to promote an SME's survival. They show that SMEs pay more on average on transportation and advertising in comparison with other expenditures, such as training and research and development (Table 3). Finally, SMEs that invest more are expected to survive more.

5-2-2- Industry-related Variables

In addition to the plant-related variables, recent empirical work by Audretsch (1995) Audretsch and Mahmood (1995), Baldwin and Rafiquzzaman (1995), Nurmi (2002a) and Koning (2002) show that the industry characteristics can affect the survival of plants in an industry. For example, many empirical studies find that the survival probability is lower in those industries that attract many new plants. The industry-related variables included in this study, are as follows:

Industrial Concentration: Industry concentration is included to represent the competitive environment that a plant faces. It is expected that there is a negative relationship between industry concentration and firm survival. This is because firms that do not grow rapidly fail. Audretsch and Mahmood (1995) show that the probability of survival decreases with market concentration. However, Mata and Portugal (1994) find that the effect of concentration on firm survival is insignificant. We calculate industry concentration using a concentration ratio, which is the percentage of industry employment shared by the largest k firms in the industry. Usually the four largest plants are considered in the calculation of the concentration ratio, and this is what we do here.1 The concentration ratio is calculated at the level of a 4-digit industry using employment as follows:

$$CR4 = \frac{\sum_{i=1}^{4} EMP_{95}^{i}}{\sum_{i=1}^{n} EMP_{95}^{i}} \qquad (3)$$

where the numerator is for the four largest plants. If the CR4 were close to zero, this would indicate an extremely competitive industry, since the four largest firms do not have any substantial market share. Conversely, if the CR4 is close to 100 the industry is controlled by just four firms or fewer (this is the case for the Tobacco industry in Iran, for example). As Table 3 shows, manufacturing industries in Iran are not highly concentrated, since the concentration ratio on average is around 0.24.

Industry (Net) Entry Rate: It is argued that the likelihood of a firm surviving is lower where there are a greater number of competing new entrants (Hannan and Freeman, 1989). If only a few firms enter an industry, then existing SMEs should have a greater chance of survival than if they must compete with a high number of new entrants. We expect the industry entry rate to have a negative impact on the likelihood of incumbent plants survival. This is measured as the ratio of total number of net new entrants over a period divided by the total number of firms in the industry at the beginning of the period. According to Geroski (1995), we can define the entry rate as total number of firms at the end of period of study divided by the total number of firms in the first year as well. However, in this study we use net entry rate as follows:

$$NER_{t't} = \frac{ENTRY_{t't} - EXIT_{t't}}{TOTAL_{t'}} \qquad (4)$$

1- The share of 8 or 10 largest plants in industry are used in some studies. For example, Segarra and Callejon (2000) have used the market share of 10 larger firms in the analysis of firm survival in Spain.

where $ENTRY_{t't}$ is the total number of new entrants during 1994/95-98/99, $EXIT_{t't}$ is the number of plants that ceases to trade over 1994/95-98/99, $TOTAL_{t'}$ represent the total number of plants in 1994/95, t' is beginning (1994/95) and t is the end of study (1998/99). By this definition, the average entry rate is around 10 percent across 4-digit manufacturing industries in Iran over 1994/95-98/99.

Annual Industry Growth Rate: Industry growth is expected to increase the survival of plants in an industry. For example, Mata and Portugal (1994) find a positive correlation between firm survival in Portugal. The growth rate of an industry can be measured using employment, value added or output.1 In this paper, we use output as an indicator of industry growth. This is calculated at the 4-digit industry level. As Table 3 shows, industry growth (GROW) varies substantially across industries (compare the minimum and maximum figures in this table).

Minimum Efficient Scale: Minimum efficient scale is the lowest point on a firm's long-run average cost curve. If the long-run average cost curve has the typical U shape, then this the minimum point identifies the maximum efficient plant scale (see Carbal, 2000; and Waldman and Jensen, 1998). According to Audretsch (1991), it is expected that the minimum efficient scale has a a negative effect on survival. A high minimum efficient scale may make it harder for firms to survive, since these firms need more capital investment, which in the case of SMEs comes mainly through loans (Al Mahrouq, 2003). However, the empirical evidence of Mata and Portugal (1994) shows minimum efficient scale has an insignificant effect on firm survival. Following Mahmood (2000) we use the Comanor-Wilson (1967) proxy for measuring minimum efficient scale (MES). According to Comanor and Wilson (1967), MES is the mean size of the largest plants in each industry accounting for one-half of the industry value of

1- In practice such variables are highly correlated, since they are measuring very similar activity. As a result they are not included jointly in the analysis.

gross real output. Nurmi (2002b) uses the same definition in his study of firm survival in Finland.

Barriers to Entry: The evidence suggests that barriers to entry tend to lead to lower survival rates. As Caves (1998) argues, these effects are consistent with the hypothesis that firms may purposely startout small in industries with high barriers, examine their returns, and then either exit with a small loss or grow rapidly to reach minimum efficient scale. We measure barriers to entry (BARR) by the share of research and development and advertisement expenditures in total inputs, as follows (see Table 3), where INPUT (not shown in the table) measures the total value of inputs to the plant1:

$$BARR = \frac{RANDD_{t'} + ADVERT_{t'}}{INPUT_{t'}} \qquad (5$$

Table 3: Explanatory Variables Using in the Survival Analyses

Variable	Description	Min.	Max.	Mean	CV
Plant-Related Variables:					
a) plant specific					
$lnEMP_{95}$	Logarithm of employment, 1994/95	0.00	4.60	2.85	0.24
$(lnEMP_{95})^2$	Squared term of the logarithm of employment, 1994/95	0.00	21.10	8.58	0.48
$(lnEMP_{95})^3$	Cubic term of the logarithm of employment, 1994/95	0.00	97.03	27.23	0.72
AGE1D	Less than 5 years old	0.00	1.00	0.23	--
AGE2D	5-10 years old	0.00	1.00	0.25	--
AGE3D	10-20 years old	0.00	1.00	0.33	--
AGE4D	More than 20 years old	0.00	1.00	0.19	--
OWN1D	Sole proprietors	0.00	1.00	0.47	--
OWN2D	Partnership	0.00	1.00	0.48	--
OWN3D	Co-operative	0.00	1.00	0.02	--
OWN4D	Public Sector	0.00	1.00	0.03	--

1- There are of course other entry barriers, such as level of technology and location (see . Lees, J., R. Kemp, J. Maas, et al., 2003, for more details), However, R&D and advertising intensity are used elsewhere. See for example, Nurmi, S. (2002).

Variable	Description	Min.	Max.	Mean	CV
PCM	Price cost margin	-4.75	0.99	0.38	0.61
LP	Labour productivity	0.00	696.22	15.46	1.50
b) employment specific					
SKILL1	Technologists	0.00	1.00	0.03	2.36
SKILL2	Technical employees	0.00	1.00	0.03	2.49
SKILL3	Skilled workers	0.00	1.00	0.38	0.76
SKILL4	Unskilled workers	0.00	1.00	0.56	0.55
MALE	Male	0.00	1.00	0.93	0.18
WAGE	Employees with wages and salaries	0.00	1.00	0.92	0.12
SERV1	Employees with less than 5 years of service	0.00	1.00	0.68	0.80
SERV2	Employees with 5 to 10 years of service	0.00	1.00	0.20	1.18
SERV3	Employees with 10-19 years of service	0.00	1.00	0.12	1.64
SERV4	Employees with more than 20 years of service	0.00	1.00	0.03	3.01
c) expenditure specific *					
COMM	Communication expenditure	0.00	156.00	1.54	2.14
TRANS	Transportation expenditure	0.00	988.00	3.68	6.32
TRAIN	Training and education expenditure	0.00	150.00	0.13	14.85
RANDD	R&D expenditure	0.00	340.00	0.72	8.74
ADVERT	Advertisement expenditure	0.00	611.00	2.32	5.47
INV	Total investment	0.00	11495.00	53.22	5.63
Industry-Related Variables					
CR4	Concentration ratio (4 largest plants, %)	3.20	100.00	24.04	0.79
NER	Net entry rate (%)	-100.00	150.00	9.58	1.48
GROW	Industry growth (at 4-digit level)	-100.00	1285.82	0.20	370.73
MES	Minimum efficient scale	119.50	91969.32	10150.64	1.28
BARR	Barrier to entry	0.00	4086.59	926.94	0.94

Note: Both plant and industry-related variables are measured at the plant level. A D after the variables indicates that it is a dummy variable. *All variables in 1995 in million Rials and in real terms at 1995 prices.

6- Estimation and Results

We estimate the survival equations in (1) using data for manufacturing plants in Iran. Our explanatory variables are those discussed in the previous section, and shown in Table 3. The survival equation is based on11,768 observations over 1994/95-97/98, of which 2,389 plants (20.3 percent) closed. The baseline case in this analysis is a plant with the following characteristics: a plant of 20 or more years old (AGE4D); a plant in the public sector (OWN4D); a share of employees who are unskilled (SKILL4); and a share of employees with more than 20 years of service (SERV4). The regressions also include fixed effect for the twenty-two 2-digit industries, for which the base case is the food products and beverages industry.

The probability of plant survival in the case of SMEs is examined by estimating equation (1) using the probit method. This estimation is undertaken for manufacturing plants with less than 100 employees at 1994/95, and their survival is examined at the year 1997/98. The results of this estimation are shown in Table 4, which also gives the parsimonious version of the model. It may be expected that the probability of plant survival in small and medium-sized enterprises increases with the size of plant, but the table shows that plant survival is not associated with the size of a plant either in a linear or non-linear fashion. The coefficient estimates for lnEMP95, (lnEMP95)2 and (lnEMP95)3 are statistically insignificant. However, when lnEMP95 is included on its own (i.e the squared and cubed size terms dropped), it is positive and significant, but only at about the 10 percent level. The poor performance of these size terms might be because there is relatively little variation in the plant size according to our definition of an SME (i.e. plants with less than 100 employees), and in fact most of plants have less than 50 employees (around 90 percent). It seems that the effect of size on plant survival is picked up by other variables. For example, when OWN2D is excluded size shows no effect on plant survival. Overall, it seems that the effect of plant size on SME firm survival is negative for manufacturing plants in Iran. Likewise, for the UK manufacturing plants, Holmes et al. (2001) show that for micro-enterprises the impact of plant size on firm survival is negative. They argue that the size- survival relationship may differ substantially between subgroups of firms. Thus, we are led to conclude that size probably has a negative effect in determining plant survival.

Table 4: Probit Estimation of Plant Survival, 1994/95-97/98

SURVIVAL	Coef.	z	Coef.	z
CONSTANT	-0.028	(0.07)	0.578	(7.55)
$lnEMP_{95}$	0.747	(1.52)	---	---
$(lnEMP_{95})^2$	-0.243	(1.18)	---	---
$(lnEMP_{95})^3$	0.029	(0.87)	---	---
OWN1D	-0.030	(0.35)	---	---
OWN2D	-0.177	(2.14)	-0.171	(6.15)
OWN3D	-0.153	(1.30)	-0.136	(1.55)
AGE1D	-0.092	(1.87)	-0.060	(1.65)
AGE2D	-0.043	(0.97)		
AGE3D	-0.056	(1.43)		
PCM1	0.171	(2.90)	0.173	(3.05)
LP	0.0001	(0.09)	---	---
SKILL1	-0.388	(1.61)	---	---
SKILL2	0.163	(0.75)	---	---
SKILL3	0.041	(0.87)	---	---
MALE	0.359	(4.62)	0.393	(5.19)
WAGE	-0.006	(0.67)	---	---
SERV1	-0.023	(0.87)	---	---
SERV2	-0.196	(2.86)	-0.187	(2.96)
SERV3	-0.006	(0.06)	---	---
COMM	0.005	(1.20)	---	---
TRANS	-0.0004	(0.73)	---	---
TRAIN	0.003	(0.36)	---	---
RANDD	0.002	(0.60)	---	---

ADVERT	0.003	(1.75)	0.002	(1.59)
INV	-0.00002	(0.41)	---	---
CR4	-0.072	(4.29)	-0.068	(4.73)
NER	0.009	(7.78)	0.009	(8.24)
GROW	0.0001	(0.68)	---	---
MES95	0.0000002	(0.18)	---	---
BARR	-0.000004	(0.20)	---	---
No. of Observations	**11,768**		**11,768**	
Log likelihood	**5843.09**		**5852.96**	
Wald Test	χ^2 (30) = 186.81		χ^2 (9) = 166.80	

Note: The table shows the full and parsimonious results from estimating equation (1) using the probit method. The STATA package is used for estimation.

Many of the plant-related variables in Table 4 show a significant effect on plant survival. The partnership structure (OWN2D) decreases the probability of SME survival, as does co-operative ownership (OWN3D). Both are these ownership types are in the private sector, suggesting that they are more likely to close compared with firms in the public sector. However, what is interesting is that the results show that sole proprietors (OWN1D), which are also in the private sector, are no more likely to close than public-sector firms. Thus, closure is an issue for SME plants in the private sector, but only for those plants that are not sole proprietors, which tend to be larger. As predicted by theory and most of the empirical literature, the results suggest that young firms (AGE1D) have a higher rate of failure, which is significant at about the 10 percent level. However, firms with higher price-cost margins (PCM), which implies greater profitability, have lower failure rates.

As regards the employment-related variables, two of these are significant. These are the share of males in total employment (MALE) and the percentage of the labour force with 5-10 years of service (SERV2). Interestingly, the survival probability of a plant increases with the share of employees that are male. This is similar to the results found for some other developing countries (Mead and Liedholm, 1998). As regards the other variable, SERV2, this seems to be picking-up an age effect, similar to the AGE1D variable discussed above. Indeed, when the AGED variables are dropped, then both SERV1 and SERV2 are significant and negative. Conversely, when the SERV variables are dropped instead then none of the AGED terms is significant, suggesting that the SERV variables may be better able to pick-up these age effects. However, overall, they suggest that plant age has a negative effect on survival, even for SMEs. This has also been found elsewhere (eg. Evans, 1987a and1987b).

Of the expenditure-related variables, only advertising expenditure (ADVERT) is significant, with a positive effect on survival. The only other variable that approaches anything like significance is communications expenditure (COMM). The effect of the other expenditure-related variables, such as training (TRAIN) and research and development (RANDD) are positive, but none of these is statistically significant. However, when all the expenditure-related variables are added together and included as a single variable then this term is significant and positive. Overall, it suggests that the greater the level of expenditure by the plant the greater is its probability of survival, but that certain categories of expenditure have a greater effect.

Two of the five industry-related variables are statistically significant. These are the concentration ratio (CR4) and the net-entry rate (NER). The concentration ratio has a negative effect, which suggests that plants are more likely to fail in heavily-concentrated industries. This accords well with results found elsewhere (eg. Holmes, et al. 2001 and Caves, 1997).

The net-entry rate affects survival, as clearly industries with higher survival rates are likely to be associated with higher plant survival rates, leading to higher net-entry rates as well. We dropped this term (NER) from the regression, but the other estimates were little changed. The other variables - the growth of an industry (GROW), the minimum efficient scale (MES) and the barriers to entry (BARR) - do not appear to influence the probability of SME plant survival.

We also included dummy variables to capture fixed effects at the two-digit industry level. The results for survival equation with these variables are reported in Table 5. It shows that many of the fixed effects are statistically significant, implying that SME survival differs across activities. However, as the Table shows, the other estimates are largely unaffected by the inclusion of these sectoral fixed effects.

Finally, it should be noted that in the estimation of the survival equations, some of the explanatory variables may be correlated with each other. If this is the case, then they should not all be included in the regression equation, as it results in multicollinearity, and indeed we have already found this possibility with the AGED and SERV variables in the survival equation. Table 6 displays the pairwise correlations between the explanatory variables in the parsimonious version of the survival equation, but including all of the AGED and SERV terms. As the tables show, in general, the correlations between the explanatory variables are very low, so that correlation is not problematic for our analyses. The only real exception is for the AGED and SERV terms in some cases, but again there is not strong correlation.

Table 5: Probit Estimation of Survival, 1994/95-97/98 (Fixed effect included)

SURVIVAL	Coe.	Z	Coe.	Z
CONSTANT	-0.030	(0.07)	0.605	(7.56)
lnEMP95	0.709	(1.45)	--	--
$(lnEMP_{95})^2$	-0.229	(1.12)	--	--
$(lnEMP_{95})^3$	0.026	(0.78)	--	--
OWN1D	0.009	(0.1)	--	--
OWN2D	-0.144	(1.71)	-0.155	(5.49)
OWN3D	-0.135	(1.14)	--	--
AGE1D	-0.085	(1.73)	-0.061	(1.67)
AGE2D	-0.037	(0.82)	--	--
AGE3D	-0.049	(1.22)	--	--
PCM1	0.133	(2.18)	0.145	(2.49)
LP	0.000	(0.34)	--	--
SKILL1	-0.408	(1.61)	-0.356	(1.50)
SKILL2	0.260	(1.17)	--	--
SKILL3	0.093	(1.87)	--	--
MALE	0.352	(4.25)	0.406	(5.21)
WAGE	-0.005	(0.52)	--	--
SERV1	-0.028	(1.08)	--	--
SERV2	-0.205	(2.96)	-0.186	(2.93)
SERV3	-0.019	(0.21)	--	--
COMM	0.007	(1.44)	--	--
TRANS	-0.0005	(0.88)	--	--
TRAIN	0.002	(0.23)	--	--
RANDD	0.002	(0.59)	--	--
ADVERT	0.002	(1.69)	0.002	(1.69)
INV	-0.00002	(0.41)	--	--

SURVIVAL	Coe.	Z	Coe.	Z
CR4	-0.056	(2.69)	-0.076	(5.09)
NER	0.010	(7.19)	0.011	(8.71)
GROW	0.0002	(1.02)	--	--
MES95	-0.000001	(0.53)	--	--
BARR	0.00002	(0.99)	--	--
D17*	-0.100	(1.85)	-0.077	(1.83)
D18	-0.121	(1.42)	--	--
D19	-0.161	(1.83)	-0.126	(1.60)
D20	-0.075	(0.68)	--	--
D21	-0.163	(1.31)	--	--
D22	0.251	(2.16)	0.300	(2.74)
D23	-0.532	(2.08)	-0.454	(1.84)
D24	0.006	(0.08)	--	--
D25	-0.229	(2.90)	-0.204	(2.87)
D26	0.041	(0.87)	--	--
D27	-0.044	(0.42)	--	--
D28	-0.125	(2.01)	-0.080	(1.62)
D29	-0.109	(1.61)	--	--
D30	-0.306	(0.58)	--	--
D31	0.006	(0.06)	--	--
D32	-0.156	(0.82)	--	--
D33	-0.146	(0.91)	--	--
D34	-0.348	(3.07)	-0.310	(2.89)
D35	-0.178	(1.08)	--	--
D36	-0.009	(0.10)	--	--
D37	-1.350	(2.71)	-1.288	(2.55)
No. of Observations	**11,768**		**11,76**	
Log Likelihood	**-5817.32**		-5834.55	
Wald Test	χ^2 **(51) = 244.00**		χ^2 **(17) = 204.42**	

Note: The table shows the full and parsimonious results from estimating equation (1) using the probit method. The STATA package is used for estimation

Table 6: Correlation Matrix between the Explanatory Variables in Survival Equation

	OWN2D	OWN3D	AGE1D	AGE2D	AGE3D	PCM	MALE	SERV1	SERV2	SERV3	ADVE	CR4	NER
OWN2D	1.00												
OWN3D	-0.15	1.00											
AGE1D	0.04	0.03	1.00										
AGE2D	0.01	0.00	-0.31	1.00									
AGE3D	0.00	0.02	-0.38	-0.41	1.00								
PCM	-0.06	0.01	-0.05	0.02	0.01	1.00							
MALE	0.02	-0.02	-0.05	-0.03	0.05	0.11	1.00						
SERV1	-0.08	-0.01	0.37	0.04	-0.20	-0.03	-0.15	1.00					
SERV2	0.09	-0.01	-0.45	0.34	0.09	0.00	0.06	-0.34	1.00				
SERV3	0.05	0.05	-0.33	-0.35	0.48	0.02	0.11	-0.38	0.00	1.00			
ADVERT	0.13	-0.02	-0.01	0.00	0.01	-0.03	-0.03	-0.02	0.03	0.00	1.00		
CR4	0.16	-0.01	-0.02	0.03	-0.02	-0.12	0.06	-0.03	0.09	0.03	0.08	1.00	
NER	0.20	0.01	0.08	-0.02	-0.02	-0.10	0.05	-0.03	0.03	0.00	0.09	0.21	1.00

7- Conclusions

This paper has examined the survival of small and medium-sized enterprises (SMEs) in manufacturing industries in Iran over the period 1994/95-98/99. For the fist time it uses a large dataset to examine this issue in the context of a developing country. The paper discusses some methodological problems involved with survival. It outlines the nature of the explanatory variables, and it derives estimating model for survival. The results of the paper tend to be consistent with the theories of firm survival, and other empirical work carried out in both developed and developing countries. The main findings of the paper can be summarized as follows.

First, in the case of the initial plant size, the results show that plant survival is not associated with size. In the case of ownership, we found that plants with private ownership are more likely to close compared with plants with public ownership.

The plants with greater price-cost margin had lower failure rates. Second, in the case of the employment-related variables, the results show that plants with a higher proportion of younger workers are less likely to survive, as are those plants with a higher share of female employees. Third, in the case of expenditure-relayed variables, the Advertising expenditure increases the probability of SME survival. Fourth, in the case of industry-related variables, the concentration ratio has a negative effect but the entry rate has a positive effect on SME plants survival. The first of these suggests that plants are more likely to fail in concentrated industries. Overall, the results of the paper are broadly consistent with other empirical work, mostly carried out in developed countries. The only real exception is the lack of an effect of plant size on survival, which possibly reflects factors that are peculiar to the Iranian economy.

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