technical efficient is found in half of the industries. These factors may explain, at least to some extent, productivity differentials between small and large plants. However, the efficiency "disadvantage" of small plants should be interpreted cautiously because the dynamics of industrial evolution may also lead to "temporary" productivity and efficiency differentials.

This study reveals the importance of inter-sectoral differences in the factors influencing technical efficiency at the plant level. Therefore, inter-sectoral differences should be taken into consideration in the development and design of effective policies to support SMEs.

Table 5.1 Technical change, returns to scale, average efficiency and average plant size in Turkish manufacturing industries, 1987-92

Sector	Number of indust.[b]	Tech. change	Returns to scale	Average efficiency	APS[a] 1985
31 Food and tobacco	15	0.026	0.984	75.0	116
32 Textile	9	0.013	1.016	80.4	58
33 Wood products	3	0.043	0.983	74.8	35
34 Paper and printing	4	–0.005	1.101	80.5	87
35 Chemicals	13	0.036	0.985	74.8	140
36 Glass and cement	5	0.014	1.085	76.9	131
37 Basic metal	2	0.037	1.022	80.7	155
38 Engineering	20	0.048	1.037	77.0	70

a Geometric average of 4-digit industries

b "Number of industries" refers to the number of 4-digit industries within the 2-digit sector whose stochastic production frontiers are estimated.

Table 5.2 Correlations between average plant size, technical change, returns to scale and average efficiency

	APS	Tech change	Returns to scale	Efficiency
APS	1			
Tech change	.268**	1		
Returns to scale	–.161*	–.120	1	
Efficiency	–.084	.013	.381**	1

Notes: Three outlier industries (ISIC 3825, 3832, and 3854) are excluded (n=70).
Average plant size (APS) variable is in log form.
** (*) means statistically significant at the 5% (10%) level, one-tail test.

Table 5.3 Technical change in Turkish manufacturing industries, 1987-92

Industry	Rate	A/D	Bias
3111 Meat	0.026 *		L-using, I-saving
3112 Dairy products	0.028 *		I-saving E-using
3113 Fruits and vegetables	0.007		
3115 Oils and fats	0.005		L-using
3116 Grain mill products	0.020 *	A	L-using, I-saving
3117 Bakery products	–0.006		
3118 Sugar	0.084 *	A	I-using, E-saving, K-using
3119 Confectionery	0.042 *	A	
3121 Other food products	–0.004	D	
3122 Animal feeds	0.005	D	I-using
3131 Spirits	0.066 *		
3132 Wine	–0.029		
3133 Malt liquors and malt	0.083 *		
3134 Non–alcoholic beverages	0.015		
3140 Tobacco	0.051 *		I-using, K-saving
3211 Spinning and weaving	0.014 *	A	L-using, I-saving
3212 Textile exc. wearing apparel	0.044 *		I-saving
3213 Knitting	–0.066 *	D	L-using, I-saving, K-saving
3214 Carpets and rugs	–0.002		L-using
3221 Fur and leather products	0.037 *	A	K-saving
3222 Wearing apparel	–0.041 *	A	I-saving
3231 Leather finishing	0.039 *	D	
3233 Other leather	0.028		
3240 Footwear	0.068 *		I-saving, E-using
3311 Sawmills and planing	0.041 *		L-saving
3319 Other wood products	0.074 *		
3320 Furniture	0.012		
3411 Pulp and paper	0.057 *		K-using
3412 Containers and boxes of paper	–0.044 *	D	L-using, I-saving, K-saving
3419 Other paper and pulp	0.074 *		

Table 5.3 Continued

Industry	Rate	A/D	Bias
3421 Printing and publishing	–0.108 *	D	L-using, I-saving
3511 Basic chemicals	0.080 *		I-saving, E-using, K-saving
3512 Fertilizers and pesticides	–0.014	D	I-saving, E-using
3513 Synthetic resins, plastics	0.151 *		L-using, E-saving
3521 Paints, varnishes and lacquers	0.074 *	A	
3522 Drugs and medicines	0.055 *		I-saving
3523 Soap and cleaning prep.	–0.064 *		I-saving, E-using
3529 Other chemical products	0.094 *		L-using
3530 Petroleum refineries	0.067 *		
3543 Lubricating oils and greases	–0.067		
3544 LPG tubing	–0.021		
3551 Tyre and tube	0.007		
3559 Other rubber products	0.033 *		
3560 Other plastic products	0.078 *		L-using
3610 Pottery, china and earthenware	0.063 *		
3620 Glass and glass products	0.056 *		E-saving, K-using
3691 Structural clay products	–0.005	A	I-using, E-using
3692 Cement, lime and plaster	–0.006		
3699 Other non–metallic min. prod.	–0.038 *		I-using, E-saving
3710 Iron and steel	0.046 *	A	
3720 Non–ferrous metal	0.027 *	D	
3811 Cutlery and hand tools	0.108 *	A	L-using, I-saving
3812 Metal furniture	–0.019	A	K-using
3813 Structural metal products	–0.010	A	
3819 Other fabricated metal prod.	0.017 *		L-using
3821 Engines and turbines	0.015		
3822 Agricultural machinery	0.008		
3823 Metal and wood working m/c	0.036 *	A	
3824 Special industrial m/c	0.055 *	A	L-using, I-saving, E-using
3825 Office, comp. and acc. m/c	0.351 *		

Table 5.3 Continued

Industry	Rate	A/D	Bias
3829 Other machinery	0.030 *		
3831 Electrical industrial m/c	0.055 *	D	I-saving
3832 Radio, TV and comm. eqmnt	0.036 *		
3833 Electrical appliances	0.049 *		L-saving
3839 Other electrical machinery	0.032 *		L-using, K-saving
3841 Ship building	0.061 *	A	L-using, I-saving, E-using, K-saving
3843 Motor vehicles	0.040 *		E-using
3844 Motorcycles and bicycles	0.099 *		
3851 Professional and scien. eqmnt	0.077 *	D	L-using, K-saving
3852 Photographic and opt. goods	0.013		
3854 Other professional eqmnt	–0.094 *		
3901 Jewellery	–0.079 *		
3909 Other manufacturing	–0.068 *		L-using, E-using

* means statistically significantly different from zero at the 5% level.
A (D) means the rate of technical change accelerates (decelerates).

Table 5.4 Returns to scale, average efficiency and average plant size in Turkish manufacturing industries, 1987-92

Industry	Returns to scale	Average efficiency	APS 1985
3111 Meat	0.972	78.2	118
3112 Dairy products	0.966	75.3	48
3113 Fruits and vegetables	1.003	77.9	123
3115 Oils and fats	0.965	83.8	102
3116 Grain mill products	1.039 +	88.9	31
3117 Bakery products	0.996	86.6	24
3118 Sugar	0.881 +	71.1	1166
3119 Confectionery	0.964	74.5	44
3121 Other food products	1.035 +	77.1	177
3122 Animal feeds	0.962 +	87.6	51
3131 Spirits	0.960	49.2	297
3132 Wine	0.912	66.9	45
3133 Malt liquors and malt	1.025	67.9	428
3134 Non–alcoholic beverages	0.968	64.2	84
3140 Tobacco	1.111 +	76.4	818
3211 Spinning and weaving	1.000	78.8	180
3212 Textile exc. wearing apparel	1.020	80.1	65
3213 Knitting	1.026	80.7	45
3214 Carpets and rugs	0.898 +	74.3	121
3221 Fur and leather products	1.029	82.1	50
3222 Wearing apparel	1.022 +	77.8	44
3231 Leather finishing	1.108 +	84.5	32
3233 Other leather	0.952	86.0	31
3240 Footwear	1.086 +	79.3	50
3311 Sawmills and planing	1.029	79.3	58
3319 Other wood products	0.873	70.1	24
3320 Furniture	1.046	75.1	30
3411 Pulp and paper	1.058 +	93.6	480

Table 5.4 Continued

Industry	Returns to scale	Average efficiency	APS 1985
3412 Containers and boxes of paper	1.024	84.3	64
3419 Other paper and pulp	1.354 +	70.2	36
3421 Printing and publishing	0.967	74.0	51
3511 Basic chemicals	0.819 +	67.3	120
3512 Fertilizers and pesticides	0.938	67.8	542
3513 Synthetic resins and plastic materi	1.094 +	93.2	488
3521 Paints, varnishes and lacquers	1.076 +	80.6	54
3522 Drugs and medicines	1.028	74.3	145
3523 Soap and cleaning preparations	1.143 +	75.7	52
3529 Other chemical products	1.045	75.9	75
3530 Petroleum refineries	1.017	99.9	981
3543 Lubricating oils and greases	0.706	45.0	118
3544 LPG tubing	0.967	80.9	153
3551 Tyre and tube	0.956	77.9	273
3559 Other rubber products	0.991	78.6	45
3560 Other plastic products	1.019	80.5	36
3610 Pottery, china and earthenware	0.908	61.7	192
3620 Glass and glass products	1.034	75.6	243
3691 Structural clay products	0.977	82.2	58
3692 Cement, lime and plaster	1.408 +	89.1	230
3699 Other non–metallic mineral products	1.095 +	76.1	63
3710 Iron and steel	0.990	76.9	184
3720 Non–ferrous metal	1.054 +	84.4	130
3811 Cutlery and hand tools	0.971	75.8	51
3812 Metal furniture	1.147 +	78.4	32
3813 Structural metal products	1.026	76.0	52
3819 Other fabricated metal products	1.060 +	92.4	55
3821 Engines and turbines	0.999	99.9	209
3822 Agricultural machinery	1.030	78.4	83

Table 5.4 Continued

Industry	Returns to scale	Average efficiency	APS 1985
3823 Metal and wood working machinery	1.093 +	81.4	58
3824 Special industrial machinery	1.067 +	77.3	71
3825 Office, comp. and acc. machinery	0.980	70.5	54
3829 Other machinery	1.019	88.8	76
3831 Electrical industrial machinery	1.097 +	79.8	102
3832 Radio, TV and comm. eqmnt	1.059 +	74.3	174
3833 Electrical appliances	1.079 +	83.0	37
3839 Other electrical machinery	0.996	76.0	78
3841 Ship building	0.814 +	63.1	201
3843 Motor vehicles	1.055 +	79.2	105
3844 Motorcycles and bicycles	0.696	56.0	97
3851 Professional and scientific eqmnt	1.047	70.7	45
3852 Photographic and optical goods	1.064	71.4	28
3854 Other professional eqmnt	1.435 +	66.8	43
3901 Jewellery	1.285 +	55.8	36
3909 Other manufacturing	1.173 +	75.8	50

+ means statistically significantly different from unity.

Table 5.5 Estimated values of the coefficient of the Lsize variable in the efficiency effects model

Industry	Coefficient	t–statistic
3111 Meat	–2.334	–19.721
3112 Dairy products	–0.645	–4.799
3113 Fruits and vegetables	0.258	2.550
3115 Oils and fats	–0.601	–3.944
3116 Grain mill products	–0.347	–5.948
3117 Bakery products	–0.594	–2.853
3118 Sugar	–3.559	–11.704
3119 Confectionery	–1.124	–9.637
3121 Other food products	0.233	1.666
3122 Animal feeds	–0.033	–0.370
3132 Wine	–0.445	–0.996
3133 Malt liquors and malt	–0.627	–2.065
3134 Non–alcoholic beverages	–0.937	–5.235
3140 Tobacco	0.276	2.421
3211 Spinning and weaving	–1.005	–33.552
3212 Textile exc. wearing apparel	–0.154	–1.535
3213 Knitting	–0.409	–3.915
3214 Carpets and rugs	–0.446	–3.697
3221 Fur and leather products	–0.645	–4.044
3222 Wearing apparel	–1.325	–31.297
3231 Leather finishing	0.102	0.846
3240 Footwear	–0.190	–1.924
3311 Sawmills and planing	0.140	1.570
3319 Other wood products	–0.432	–1.086
3320 Furniture	–0.209	–1.271
3411 Pulp and paper	–0.015	–0.550
3412 Containers and boxes of paper	–0.893	–3.300
3419 Other paper and pulp	0.425	1.927
3421 Printing and publishing	–0.528	–3.571
3511 Basic chemicals	–0.378	–3.392

Table 5.5 Continued

Industry	Coefficient	t–statistic
3512 Fertilizers and pesticides	–0.215	–0.814
3513 Synthetic resins and plastics	0.035	0.568
3521 Paints, varnishes and lacquers	0.011	0.231
3522 Drugs and medicines	–1.393	–5.545
3523 Soap and cleaning preparations	0.052	0.398
3529 Other chemical products	–0.089	–0.693
3544 LPG tubing	–0.080	–4.892
3559 Other rubber products	–0.267	–2.258
3560 Other plastic products	–0.206	–2.486
3610 Pottery, china and earthenware	–0.342	–4.316
3620 Glass and glass products	–0.391	–2.561
3691 Structural clay products	–0.043	–0.518
3699 Other non–metallic min. products	–0.128	–1.018
3710 Iron and steel	–1.363	–17.087
3720 Non–ferrous metal	–0.414	–2.977
3811 Cutlery and hand tools	–0.578	–4.175
3812 Metal furniture	0.145	0.646
3813 Structural metal products	–0.028	–0.204
3819 Other fabricated metal products	–0.198	–2.554
3822 Agricultural machinery	0.226	1.265
3823 Metal and wood working m/c	–0.074	–0.672
3824 Special industrial machinery	0.249	1.714
3825 Office, comp. and acc. m/c	–0.279	–1.300
3829 Other machinery	–0.456	–4.126
3831 Electrical industrial machinery	–0.294	–0.975
3832 Radio, TV and communication	–1.649	–6.103
3833 Electrical appliances	0.051	0.426
3839 Other electrical machinery	–0.743	–4.050
3841 Ship building	–0.795	–3.102
3843 Motor vehicles	–0.725	–11.949

Table 5.5 Continued

Industry	Coefficient	t-statistic
3844 Motorcycles and bicycles	–1.230	–9.108
3851 Professional and scientific eqmnt	–0.108	–0.467
3852 Photographic and optical goods	1.448	2.188
3854 Other professional eqmnt	0.333	1.652
3901 Jewellery	0.735	3.014
3909 Other manufacturing	0.660	3.368

Note: Negative coefficient of the SIZE variable shows a negative relationship between plant size and technical *in*efficiency.

Table 5.6 The effects of plant size on technical efficiency, summary statistics

Sector	Number of industries	Number of industries that have positive effect	no effect	negative effect
31 Food and tobacco	14	9	3	2
32 Textile	8	5	3	0
33 Wood products	3	0	3	0
34 Paper and printing	4	2	2	0
35 Chemicals	10	5	5	0
36 Glass and cement	4	2	2	0
37 Basic metal	2	2	0	0
38 Engineering	19	8	10	1
39 Other manufacturing	2	0	0	2
3 All industries	*66*	*33*	*28*	*5*

Table 5.7 Correlations between the coefficient of the Lsize variable and a selected set of variables

	All industries (n=66)	Excluding outliers[a] (n=63)
Entry/selection rate[b]	.269**	.268**
APS, 1985	–.373**	–.352**
Rate of technical change	–.151	–.178*
Returns to scale	.489**	.518**
Average efficiency	.099	.103

a For outlier industries, see Table 5.2

b Entry/selection rate is defined by (the number of workers in 1985 employed in plants closed in the 1985-92 period *plus* the number of workers in 1992 employed in plants opened in the 1985-92 period)/(total number of workers employed in 1985 and 1992).

** (*) means statistically significant at the 5% (10%) level.

Figure 5.1 Technical efficiency vs average plant size, wearing apparel industry

Figure 5.2 Technical efficiency vs average plant size, iron and steel industry

Figure 5.3 Technical efficiency vs average plant size, motor vehicles industry

Figure 5.4 Technical efficiency vs average plant size, jewellery industry

Chapter 6
The dynamics of new firms: Entry, survival, and growth

6.1 Survival and growth patterns of new firms

Any study on SMEs would be incomplete without an analysis of the dynamics of new firms. As explained in the second chapter, the new small business economics emphasizes the role of the SME sector as the source for entrepreneurship and continual innovation. New products and processes are claimed to be introduced by new, small firms. New firms are typically small and rapidly grow if they prove to be successful. Moreover, since the employment generation effect of new firms is thought to be significant, support for new business is an essential component of employment promotion policies. For these reasons, this chapter is devoted to the analysis of the dynamics of new firms to shed light on SME births and deaths, failures and successes. After an analysis of the employment generation potential and growth patterns of new firms (Section 6.1), the determinants of entry at the industry level are analyzed in Section 6.2. The determinants of survival (Section 6.3) and growth (Section 6.4) at the plant level are then investigated by estimating hazard functions and growth equations.

New firms play an important role in generating employment opportunities in many countries. The effect on employment by new firms depends on two factors: survival and growth. If the survival rate is low, then creation of new establishments will merely increase the rate of labour turnover without making any lasting contribution to employment. Moreover, new firms are usually small

when they start because of market imperfections. The successful ones grow rapidly and generate further employment opportunities. Any public policy towards SME should be based on a through analysis of the factors that impede or foster SME births and successes.

The "survival rate" is the ratio of the number of surviving new plants at a certain point in time to the initial number of new plants. It shows the percentage of plants survived through time. Table 6.1 presents the data on the one-year, three-year and five-year survival rates in a selected group of countries. As shown in the table, the five-year survival rate in Turkish manufacturing industries is 52%, i.e., almost half of establishments founded in 1986 and 1987 were closed down within the first five years of their existence. The survival rate is quite high in Austria, Sweden and Holland where the entry rate is known to be low.

Table 6.2 shows the survival pattern for four groups of establishments: the first group is those that were operational in 1985. The next three groups are those that were established in 1986, 1987 and 1988, respectively. Table 6.2 presents the data on the number of establishments in each group in the period 1986-1992, the number of exits (plant closures) and the survival rates. The survival rate is considerably higher for the first group. For example, the four-year survival rate for the first group was 71%, whereas it was 50%, 61% and 60% for the next three groups, respectively. Note that the first group includes new as well as old plants in 1985. A part of establishments in the first group were founded before 1985, proved to be successful by surviving until 1985. We can conclude that the survival rate is lower among new plants than old ones.

The entry and survival rates by plant size and sector are shown in Table 6.3. 524 plants founded in 1986 employed 10-24 people at the time of entry (see the figure at the top of the third column in Table 6.3). There was only 8 plants established in 1986 that employed more than 500 people. The entry rates show that new firms begin at a small size. In 1986, 11% of establishments employing 10-24 people were opened in the same year, i.e., the entry rate was 11% for the "10-24 employees group" in 1986. The entry rate was only 2% for the largest group (those employing more than 500 people). The entry rate is consistently low in the glass and cement industry (ISIC 36) and high in the textile (ISIC 32) and basic metal (ISIC 37) industries in the mid-1980s.

The exit rate is also correlated to the initial plant size. 64% of establishments employing 10-24 people when they were opened in 1986 were

closed down by 1992. The exit rate for the comparable largest group was only 38%. Therefore the data show that most of the new firms start small, but the risk of closure is also much higher for those that start small.

Table 6.4 summarizes the growth patterns of plants existing in 1985 and opened in 1986-1988. The growth matrix shows the transition probabilities among size groups until 1992. For example, there were 2207 plants in the smallest size category ("10-24") in 1986 that survived until 1992;13.2% of those establishments were in the "1-9" group in 1992, 60.1% maintained their initial category ("10-24"), 19.5% moved up to the "25-49" group, etc. The growth matrices show the "regression-towards-the mean" phenomenon: small plants tend to grow, and large plants tend to contract. The growth matrices for all four groups look strikingly similar: there seems to be no change in the growth patterns for different cohorts of plants.

The contribution of new plants to manufacturing employment is shown in Table 6.5. There were 952 thousand people employed in the manufacturing industry in 1986. (The data does not include micro establishments.) 4.25% of those workers employed by the establishments opened in the same year. The employment share of these establishments (1986 entrants) declines steadily: the share of 1986 entrants in total employment in 1992 was 2.63%. The decline in the share of 1986 entrants shows that the employment loss in plant closures dominates the employment generated by growing plants. A similar pattern is observed for those establishments opened in 1987 and 1988.

The net contribution of establishments opened in 1986-1988 to employment in 1992 is quite substantial: 8.14% of all workers in 1992 were working in establishments founded in 1986-1988. If the employment pattern of establishments opened in the period 1989-1992 is assumed to be the same as that of those opened in 1988, the net contribution of new establishments opened after 1985 rises to 22%. In other words, one fifth of all employees in 1992 worked in establishments opened in the last seven years.

Table 6.6 disaggregates the employment generation by plant size. The data show that small plants, if they survive, grow faster than large plants. For example, the average annual employment growth in SMEs opened in 1986 was around 5-5.5% in the 1986-92 period. On the other hand, employment in LSEs shrank by 1.5% in the same period.

To summarize, new plants enter usually into the SME sector. The likelihood

of survival is low for small plants, but those who survive grow faster than others. In the following sections, the factors that determine entry, survival, and growth processes will be analyzed by using some statistical techniques.

6.2 Determinants of entry at the industry level

In this section, the industry-specific conditions that are conducive to the formation of new firms are analyzed by using regression analysis. The variable that is explained is the entry rate: the proportion of new plants to total number of plants in 1986, 1987, and 1988. The following variables are used as explanatory variables:

***Profit margin* is the average sectoral profit margin at time of entry. It is expected that the profitability of a sector determines its attractiveness for new firms. Although there is a strong theoretical argument explaining the positive impact of the profit margin on the entry rate, empirical studies usually fail to find any support for the hypothesis (see also Barber, Metcalfe and Porteous, 1989b).**

***Growth* is the growth rate of sectoral output in the period 1985 to 1992. We expect that new firms will prefer to enter into rapidly growing industries. Thus, the expected sign of the coefficient of the Growth variable is positive. A *growth rate fluctuations* variable (the standard deviation of annual growth rates from 1985 to 1992) is included into the model to test the effects of uncertainty on entry.**

Technologically dynamic industries are more attractive than others because of their growth potentials. We use the *R&D intensity* of an industry[*] as a proxy for its technological dynamism. A positive relationship between R&D intensity and the entry rate is expected.

The growth rate of an industry and its profitability reveal its attractiveness for potential firms. But entry is not a cost-free process: there are sunk costs and risks involved. Entry barriers should be taken into consideration in the model of the entry process. *Capital intensity* is closely related to entry costs, because if the industry uses capital intensive technology, the cost of the initial investment could be substantial. If the investment is indivisible and if capital markets are not

[*] **Since the SIS started to collect R&D data since 1992, the R&D intensity variable is calculated for 1992. Unless otherwise stated, all variables are calculated for the entry year.**

perfect, the entry rate will be lower.

The level of *labour productivity* is relatively high in continuous process industries in which indivisible and massive investment requirements discourage potential firms from entering. Moreover, the level of productivity may reflect the performance of existing firms. Potential firms avoid entering into those sectors in which existing firms are very productive because of the risks of severe post-entry competition.

The level of concentration is also important. It is easier to enter perfectly competitive industries in which many small firms produce standard products. The *Herfindahl index* is used to measure the level of concentration. The Herfindahl index is equal to one for a monopolised market.

The *advertisement intensity* is another source of entry barriers, because new firms need to match the advertisement level of the incumbent firms to be known and tested by consumers. Therefore the cost of entry is increased by the advertisement intensity of existing firms.

The *average wage rate* in an industry is expected to be negatively correlated to the entry rate. The average wage rate reflects the demand for industry-specific skills. In high wage industries, new firms will face problems in hiring the workers they need.

Finally, we use the *wage rate differential* and *productivity differential* variables to test for the possibilities of creating niche markets. The wage rate differential is defined as the coefficient of variation of the wage rate in the industry. It measures the intra-industry wage disparity. The productivity differential is defined in a similar way. High values of wage rate and productivity differential indicate the existence of a diverse set of establishments in an industry in which new plants can establish a niche for their products.

In our regression model, the entry data for three years (1986-88) were pooled together. The model is estimated for the pooled data. Therefore, two time dummies, *Dummy 1987* and *Dummy 1988* are added to the entry model to incorporate intertemporal changes in the entry rate.

The regression results based on pooled cross-section estimation are reported in Table 6.7. The dependent variable is the proportion of the number of new establishments to the number of existing plants for a given year over the period 1986-1988. All coefficients that are statistically significant have the expected signs. The entry rate is positively correlated to the growth rate of the

industry, R&D intensity and the intra-industry wage and productivity differentials. The advertisement intensity of the incumbent establishments, fluctuations in the growth rate, high productivity and high wages have a negative impact on the entry rate. The estimation results suggest that entry barriers in the Turkish manufacturing industries are high enough to inhibit entry. The detrimental effect of fluctuations in growth rate highlights the importance of macroeconomic stability for the formation of new businesses.

The coefficient of the profit margin variable is not statistically significant at the 10% level. Geroski (1995: 427) summarized, as a stylized fact on entry, that "Entry seems to be slow to react to high profits". The Herfindahl index does not have a significant impact on the entry rate. The concentration level itself seems to have no effect on entry, but the entry barrier variables that are correlated with the Herfindahl index affect the entry rate negatively.

6.3 Determinants of survival and growth at the plant level

The economic impact of new firms is observed only if significant number of new firms survive after entry. We know that most new firms are small, and most new firms are not likely to compete with the incumbent firms. In this section, we analyze the factors that determine the probability of survival of new plants.

Our econometric analysis of survival is based on the estimation of the hazard function that defines the probability of exit in a certain time period as a function of a set of time-varying covariates:

$$h(t; X_t) = \lim_{dt \to o} \frac{p(t \le T < t + dt \mid T \ge t, X_{t+dt})}{dt} \qquad \textbf{[6.1]}$$

where *h(.)* is the hazard function, *P(.)* the probability function, and X_t is the covariate path of *x* up to t. A functional form has to be assumed for the hazard function, h(t), in the empirical implementation of the model. The Cox proportional hazards model is used frequently in empirical studies (for a recent study, see Mata, Portugal and Guimarres, 1995). The Cox model assumes a proportional hazard function which is defined by

$$h(t) = h_0(t)e^{(x_t Я)} \qquad \textbf{[6.2]}$$

where $h_0(t)$ is the baseline hazard function, x is a vector of explanatory variables, and β is a vector corresponding of regression coefficients. The β parameters are estimated by the maximization of the partial likelihood function that does not require the specification of $h_0(t)$.

The dependent variable is the time of death (exit). The exit time of those plants that survived until the end of 1992 is not observed (the longitudinal data for the period 1986 to 1992 were used in the analysis). Thus the distribution of the dependent variable is censored.

In the estimation of Model 6.2, we use two sets of explanatory variables. The first set includes plant-specific variables. The second set includes data about the characteristics of the industry defined at the 4-digit ISIC level in which the plant operates. This specification allows us to infer the plant- and sector-specific characteristics that determine the new plant survival process.

Plant-specific factors that may determine the survival probability are as follows: *Establishment size* at the time of entry is one of the most important variables found in empirical studies. Large firms are more likely to survive. Establishment size is measured by the (log) number of employees. The composition of labour force could also play a significant role in the survival of a plant. The *share of technical personnel* and the *share of administrative personnel* are included into the model to test if skill-intensive plants are more likely to survive.

New plants tend to pay lower wages than the incumbents. The ratio between the wage rate in the new plant and the average rate of the industry, the *relative wage rate*, is used to check if paying low wage increases the survival probability. The level of labour productivity in new plants is usually lower than that of the average incumbent plant. However, new plants have a diverse range of characteristics: most of them are less productive than incumbents, but some new plants are quite productive from the very beginning. The *relative productivity*, the ratio between plant's productivity at the time of establishment and the average productivity of the industry, is used to test the effect of productivity differential on survival. Similarly, the *profit margin* of the plant is included into the model to check the relationship between profitability and survival.

Two additional plant-specific variables, *communication intensity* (the proportion of communication expenditure to sales revenue) and *advertisement*

intensity (the proportion of advertisement expenditure to sales revenue) are added to the list of explanatory variables. These variables reflect the strategic choices made by the plant. Both of these variables are related to the degree of product differentiation and enthusiasm in marketing.

Finally, there are two dummy variables: the *corporation dummy* variable takes the value one if the firm is a limited liability and joint stock company, zero otherwise. If the limited liability and joint stock companies have favourable access to external resources, they will have a higher survival probability. The *public dummy* variable takes the value one if the firm is a public firm, zero otherwise. It is claimed that public enterprises are not easily closed down by governments because of political objectives. If this is the case, the public dummy variable should have a significant positive impact on the survival probability.

Entry rate is the first industry-specific variable. It is found in many empirical studies that the survival probability is lower in those industries that attract many new plants. It seems that new plants are usually over-optimistic, and if many plants jump into an industry most of them will soon go bankrupt. The survival probability is likely to be high in rapidly growing industries that are conducive to the development of new plants. Fluctuations in the growth rate will increase uncertainty and hence decrease the survival probability. *Sectoral growth rate* and *growth rate fluctuations* variables are used to test these relationships.

Competition will be tough in oligopolistic industries. Thus, new plants entering into concentrated industries will be faced with difficulties in surviving. We use the *Herfindahl index* to measure the level of concentration. The *sectoral advertisement intensity* will have a similar effect.

Finally, two additional variables, sectoral *R&D intensity* and the *R&D share of SMEs* are added into the model. The R&D intensity variable measures technological opportunity in and dynamism of an industry. Audretsch (1995: 96) argues that "this measure of the technological opportunity class, although reflecting the overall importance of innovative activity in the industry, does not distinguish between two technological regimes - the routinized technological regime and the entrepreneurial technological regime." When the small firm innovation rate is large relative to the total innovation rate, the industry is better characterized by the entrepreneurial regime. He uses the share of SMEs in total innovations as a proxy for the relative innovation of small firms and finds support for the hypothesis that under the entrepreneurial regime the hazard rate confronting new establishments tends to be higher than that under a routinized regime. Since there is no reliable innovation data, we use the R&D share of SMEs to capture the effects of entrepreneurial and routinized regimes.

The regression model is estimated for the pooled data of establishments founded in the period 1986-88. These plants are tracked throughout the period 1986-92 using the longitudinal database. Two dummy variables, *Dummy 1987* and *Dummy 1988* are included in the model because the hazard rate could be different for different cohorts of firms.

The estimated coefficients and their significance levels calculated from the Wald test are reported in Table 6.8. The most important variable that determines the survival probability is the initial size of the establishment.* As expected, large plants are less likely to be closed. The entry rate variable has a positive and significant coefficient: the hazard probability is higher for those establishments that enter into attractive industries *en masse.*

An oligopolistic market structure is not conducive for survival: the hazard probability is higher if the plant is opened in an oligopolistic industry as shown in the positive coefficient of the Herfindahl index.

The variable that measures the degree of fluctuations in the sectoral growth rates has an unexpected negative sign. It seems that plants tend to survive longer if the sectoral growth rate is not stable.

Public ownership, the establishment's advertisement intensity and relative productivity also enhance the prospects for survival, although the coefficients of these variables are statistically significant only at the 20-25% level.

The determinants of growth are analyzed by a regression model in which the annualized growth rate of employment in the period 1986/87/88-92 is the dependent variable. The growth model is estimated for all establishments that were opened in 1986-88 and survived until 1992. The same set of variables that

* Model 6.2 defines the hazard (death) function that is estimated by the Cox regression method. A negative coefficient of an explanatory variable in the model shows that there is a negative relationship between the variable and the hazard rate, i.e., a positive correlation with the survival rate.

are used in the hazard function are added into the growth model. Since this model is estimated for surviving establishments, the regression results are conditional.

The results of the growth model are shown in Table 6.9. There are only four factors that have a significant impact on the growth rate of establishments: the status of the firm, its relative productivity at the time of entry, the type of ownership and the technological dynamism of the industry.

Limited liability and joint stock companies tend to grow faster than other firms. This is a striking result because the status variable is found to be significant even after controlling for all other plant characteristics, such as the plant size, the share of technical personnel, etc. Limited liability and joint stock companies evidently are in a more favourable position in financing their growth.

Relative productivity is also important for growth. Those plants that are more productive then their competitors grow faster.

The type of ownership has a significant impact: Public plants grew on average faster than private plants in the late 1980s and early 1990s.

Finally, the technological dynamics of an industry, as proxied by its R&D intensity, is important. The growth rate of employment in new plants, if they survive, is higher in technologically dynamic industries.

Table 6.1 Survival rates of new establishments, selected countries (%)

Year	Country	One year after entry	Three years after entry	Five years after entry
1985	Denmark	..	..	48
1985	Holland	84	68	65
1986	Austria	96	91	87
1986	United Kingdom	87	61	47
1987	France	87	67	52
1987	Finland	80	71	53
1988	Sweden	..	66	61
1986-87	Turkey	85	66	52

Note: The data for Turkey cover only manufacturing establishments.

Table 6.2 Survival rates in Turkish manufacturing industries, 1986-92

	Number of est.	Number exits	Survival rate (%)	Number of est.	Number of exits	Survival rate (%)
	Establishments existing in 1985			*Establishments opened in 1986*		
1986	10,474	1,296	87.6			
1987	9,178	635	81.6	799	130	83.7
1988	8,543	641	75.4	669	101	71.1
1989	7,902	501	70.7	568	61	63.5
1990	7,401	626	64.7	507	69	54.8
1991	6,775	632	58.7	438	42	49.6
1992	6,143	536	53.5	396	49	43.4
	Establishments opened in 1987			*Establishments opened in 1988*		
1988	544	79	85.5			
1989	465	52	75.9	634	89	86.0
1990	413	41	68.4	545	63	76.0
1991	372	42	60.7	482	51	68.0
1992	330	44	52.6	431	54	59.5

Table 6.3 Share of new establishments by size and sector, 1986-88

	# estab.	# new estab.			Entry rate[a] (%)			Exit rate[b] (%)		
	1985	1986	1987	1988	1986	1987	1988	1986	1987	1988
Plant size										
10-24	5,629	524	268	282	11	6	7	64	56	55
25-49	2,239	135	135	180	6	6	8	49	41	30
50-99	1,124	70	71	92	6	6	7	31	32	34
100-249	747	48	48	50	6	5	5	38	42	24
250-499	392	14	12	24	4	3	5	50	50	21
500+	342	8	10	6	2	3	2	38	40	16
Sector										
31	2,239	199	98	73	9	5	4	51	48	44
32	2,508	163	218	292	8	10	13	58	45	41
33	481	42	15	18	10	4	5	55	40	44
34	445	26	22	22	6	5	6	45	41	47
35	1,008	99	45	43	10	5	5	62	49	44
36	671	31	22	26	5	3	4	45	45	42
37	481	42	21	48	9	5	10	69	71	38
38	2,520	185	100	106	8	4	5	58	50	35
39	121	12	3	6	10	3	6	67	33	33
Total	*10,474*	*799*	*544*	*634*	*8*	*6*	*7*	*57*	*47*	*41*

a Entry rate is the proportion of the number of new establishments to total number of establishments.

b Exit rate is the ratio between the number of establishments closed in 1992 and the number of new establishments.

Table 6.4 Growth matrix by plant size (in percentage), 1985-1992

Initial plant size	Initial # of plants	Plant size in 1992: 1-9	10-24	25-49	50-99	100-249	250-499	500+	Other[a]
				Plants existing in 1985					
10-24	2207	13.2	60.1	19.5	4.5	1.3	0.2	0.1	1.2
25-49	1412	1.2	25.8	48.7	18.1	5.3	0.2		0.7
50-99	806	0.1	9.3	26.3	37.2	21.5	4.7	0.4	0.5
100-249	551	0.2	3.1	5.3	22.0	52.6	14.9	1.6	0.4
250-499	321		0.3	0.9	2.8	27.1	52.7	15.9	0.3
500+	309				0.3	4.2	19.1	76.4	
				Plants opened in 1986					
10-24	188	16.0	58.	15.4	5.3	2.1			3.2
25-49	69	2.9	20.3	47.8	18.8	8.7			1.5
50-99	48		10.4	27.1	33.3	27.1	2.1		
100-249	30			16.7	10.0	53.3	13.3	6.7	
250-499	7				28.6	42.9	28.6		
500+	5							100.0	
				Plants opened in 1987					
10-24	119	4.2	52.1	27.7	13.5	1.7			0.8
25-49	79		21.5	32.9	19.0	22.8	2.5		1.3
50-99	48		6.3	25.0	41.7	22.9	2.1		2.1
100-249	28		3.6	7.1	25.0	42.9	17.9	3.6	
250-499	6				16.7	16.7	50.0	16.7	
500+	6				16.7	16.7	16.7	50.0	
				Plants opened in 1988					
10-24	128	3.1	60.2	26.6	7.8	1.6			0.8
25-49	126	0.8	23.8	44.4	16.7	11.9	0.8		1.6
50-99	61		6.6	19.7	50.8	19.7	3.3		
100-249	38			7.9	21.1	44.7	23.7	2.6	
250-499	19				5.3	31.6	52.6	10.5	
500+	5						40.0	60.0	

a Unidentified plants

Table 6.5 Employment generation by new establishments in Turkish manufacturing industries, 1986-92

	Total number of employees	Employment share[a] of new plants opened in 1986	1987	1988
1986	951,512	4.25		
1987	979,805	3.89	3.33	
1988	1,015,432	3.53	3.27	3.69
1989	1,027,353	3.15	3.02	3.72
1990	1,028,196	2.93	2.90	3.44
1991	946,838	3.00	2.77	3.48
1992	985,091	2.63	2.40	3.11

a In percentage

Table 6.6 Employment generation in new plants by plant size, 1986-92

Initial plant size	Entrants in 1986: 1986 emp	net change growth rate[a]	Entrants in 1987: 1987 emp	net change growth rate[a]	Entrants in 1988: 1988 emp	net change growth rate[a]
10-24	2832	9915.13	1955	159912.70	2086	119812.01
25-49	2294	8895.61	2756	270014.64	4318	203110.12
50-99	3250	6373.03	3227	7184.10	4129	1061 5.88
100-249	4644	5031.73	4224	8483.73	6030	1137 4.41
250-499	2297	–782–6.70	2378	–148–1.28	6506	–598–2.38
500+	8847	–509–0.98	4308	–909–4.63	3395	–626–4.97
Total	*24164*	*17291.16*	*18848*	*48084.65*	*26464*	*4203 3.75*

a "Growth rate" is the annualized growth rate employment (in percentage).

Table 6.7 Determinants of entry, 1986-88
The dependent variable: The share of new plants in total

Variable	Coefficient	t-statistic
Growth	.06	4.94
Wage rate differential	.03	2.37
Advertisement intensity	–.45	–2.15
Labour productivity	–8.80	–1.93
Growth rate fluctuations	–.03	–1.84
Productivity differential	.01	1.84
R&D intensity	2.17	1.81
Average wage rate	–5.30	–1.77
Capital intensity	1.70	1.16
Profit margin	–.02	1.04
Herfindahl index	.0001	.96
Dummy 1987	–.03	–4.26
Dummy 1988	–.02	–2.55
Constant	.03	1.91
R^2	30.5	
Adjusted R^2	26.5	
F-statistic	7.8	
n	240	

Table 6.8 Determinants of survival, 1986-92
Dependent variable: Time of exit (plant closure)

Variable	Coefficient	Significance level
Establishment size	–.35	.000[a]
Entry rate	1.45	.01
Herfindahl index	1.59	.01
Growth rate fluctuations	–.60	.07
Public dummy	–.39	.21
Plant's advertisement intensity	–5.29	.23
Relative productivity	–.0001	.24
Share of technical personnel	.26	.28
Share of administrative personnel	–.13	.32
Relative wage rate	.001	.36
Sectoral growth rate	–.01	.38
R&D intensity	–4.88	.76
Communication intensity	.45	.77
Sectoral advertisement intensity	–.84	.82
Profit margin	.004	.84
Corporation dummy	.01	.91
Share of R&D by SMEs	–.13	.32
Dummy 1987	–.27	.001
Dummy 1988	–.51	.000[a]
Total number of establishments	1991	
Number of establishments survived	1024	
Number of establishments closed	967	
χ^2	159.2	

a Less than .001

Table 6.9 Determinants of growth, 1986-92
Dependent variable: Average annual growth rate in terms of employment

Variable	Coefficient	t-statistic
Corporation dummy	.12	5.25
Relative productivity	.0001	3.79
Public dummy	.11	2.09
R&D intensity	9.16	1.97
Communication intensity	.85	.93
Entry rate	.16	.86
Herfindahl index	.12	.80
R&D share of SMEs	.02	.71
Profit margin	.004	.46
Sectoral growth rate	.0003	.39
Establishment's advertisement intensity	.05	.34
Share of technical personnel	.01	.17
Establishment size	–.006	–.63
Relative wage rate	–.00003	–.81
Advertisement intensity	–.93	–.90
Dummy 1987	.09	4.12
Dummy 1988	.08	3.90
Constant	–.20	–4.65
R^2	9.6	
Adjusted R^2	8.0	
F-statistic	6.16	
n	1010	

Chapter 7
Conclusions

Recent literature on small businesses emphasizes the technological dynamism, entrepreneurial spirit and employment generation effects of SMEs. This study describes the characteristics of small and medium-sized manufacturing establishments in Turkey. However, beyond the mere description, the unique longitudinal establishments data collected by the State Institute of Statistics were also analyzed through statistical techniques i) to shed light on the determinants of average plant size, ii) to test differences between SMEs and LSEs, iii) to measure the rate of technical change, the degree of returns to scale, and the extent of technical inefficiency, iv) to test the effects of plant size on technical efficiency, and v) to understand the factors behind the entry, survival, and growth processes. We can summarize the basic findings as follows:

- **The SMI sector is a major source of employment in Turkey. SMEs (those establishments employing less than 100 people) employed more than 50% of all employees in 1992.**
- **The data show that manufacturing employment is concentrating in SMI since the early 1970s. The shift in the size distribution towards SMI has been accompanied by the dissolution of traditional manufacturing activities. The share of non-wage labour (owners and unpaid family members) dropped from 33.0% in**

1963 to 16.6% in 1992.

- **A typical new establishment is smaller than the incumbent in all manufacturing sectors, i.e., new establishments start small.**
- **LSEs pay much higher wages to employees than SMEs. The wage disparity seems to be larger in Turkey than in developed countries. The share of the base wage in total payments to employees declines by establishment size.**
- **The proportion of administrative employees is higher in LSEs than in SMEs. However, there is not a significant difference between SMEs and LSEs in terms of the proportion of technical personnel (engineers and technicians).**
- **The average duration of employment tends to increase by establishment size, especially in the engineering industries.**
- **The value added/output ratio is higher in LSEs that are more likely to employ vertically integrated production processes.**
- **SMEs tend to work only one shift per day.**
- **Subcontracting relations are more common among SMEs than LSEs.**
- **LSEs spend more on advertisement than SMEs.**
- **SMEs have a younger machine stock than micro establishments and LSEs in the textile and engineering industries. They are more likely to invest in the best practice technology. On the other hand, SMEs prefer to buy second-hand and domestic machinery.**
- **SMEs seem to be less productive and profitable than their large counterparts. In 1992, establishments employing more than 500 persons were 200% more productive than small establishments. The profit margin is consistently higher in LSEs than in SMEs.**
- **The stochastic production frontier approach is used to determine plant-specific factors that influence technical efficiency. Our findings show that in half of the industries, large plants are more efficient than small plants. Small plants are more efficient in only five industries.**
- **Increasing returns to scale are found in 25 industries whereas there are decreasing returns in only five industries. These two factors (technical efficiency and increasing returns to scale) can explain why LSEs are more productive than SMEs.**

- **The net contribution of new firms to employment generation is quite substantial. For example, about 8% of all workers in 1992 were employed by establishments founded in 1986-88. Under the assumption of no change in the entry and exit rates in the late 1980s, we estimate that one fifth of all employees in 1992 worked in establishments opened in the last seven years.**
- **The survival rate is considerably lower for SMEs. 5-year survival rate for establishments employing 10-24 people is about 35%, whereas it is more than 60% for the largest size category (+500).**
- **Empirical analyses show that the survival probability of a plant depends on its initial size, the level of concentration in the market, entry rate, and the degree of market fluctuations. The growth rate of a plant depends on its legal status, type of ownership, relative productivity and sectoral R&D intensity.**

Since this is the first study that uses the SIS data at the plant level, it covers all manufacturing sectors, and, therefore, does *not* analyze each sector in detail. It is far from fully exploiting the wealth of data collected by the Institute. Our findings show that there are profound inter-sectoral differences. Thus, more work at the plant level is necessary to understand characteristics, advantages and disadvantages of small firms in Turkish manufacturing industries.

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