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THE ROLE OF SMALL FIRMS AS JOB PROVIDERS IN THE INFORMATION TECHNOLOGY SECTOR: A PRELIMINARY ANALYSIS*

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ABSTRACT: This paper analyses the role of small firms in the evolution of the information technology sector in Finland. This sector consists of relevant manufacturing and telecommunications industries as well as relevant wholesale and service industries. The investigation period extends from 1993 to 1997. We find that, as a whole, large firms create more jobs than do smaller firms. In contrast, our regression analysis suggests that, after controlling for observed and unobserved covariates, the growth rate of employment for individual small firms is higher than that for large ones. We thus conclude that while large firms create more jobs on aggregate, the associate effect of size on the growth rate of individual firms is negative, providing that other growth factors are controlled for.

Keywords: Information technology, The growth of firms, small firms

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TIIVISTELMÄ: Tässä työssä tarkastellaan yrityksen koon vaikutusta kykyyn tarjota uusia työpaikkoja informaatioteknologian toimialalla vuosina 1993-1997. Toimiala koostuu tietotyötä tekevistä teollisuus-, telekommunikaatio-, kaupanalan ja palveluyrityksistä. Tulosten mukaan suuret yritykset kokonaisuudessaan luovat enemmän työpaikkoja kuin pienet. Sen sijaan regressiotulokset osoittavat, että suuremman yrityskoon vaikutus yrityksen henkilökunnan määrän kasvuasteeseen on negatiivinen. Tämä tarkoittaa, että kun muut kasvuun vaikuttavat tekijät on kontrolloitu, pienemmät yritykset kasvavat nopeammin kuin suuremmat.

Avainsanat: informaatioteknologia, yritysten kasvu, pienyritykset

CONTENTS

1. INTRODUCTION

The information technology sector is currently enjoying its heyday. Electronics manufacturing, together with the sale of these products and the provision of related services and transportation of telecommunications, is the fastest growing sector in Finland and many other countries. For instance, the manufacturing core of the sector, the electronics industry, has rapidly transformed from a small industry into one whose export share and the value added are larger than those of the traditional paper industry. The electronics industry produced about 5% of the total manufacturing value added in the early 1980s, but the proportion grew to 22% by 1998. In the 1990s, the average growth rate of the production volume in the industry was more than 20%. The leading corporation, Nokia, has become the largest firm in Europe in terms of market value, and the value of its brand name is the fifth highest in the world.[1] Moreover, Nokia's contribution to the growth of Finnish GDP was one percentage point in 1999, while the total GDP growth was 4.2%, and the company produced 4% of the total GDP in Finland.

This paper asks what types of firm provide most of the new jobs in this growing sector. Empirical evidence suggests that the entry of firms is more likely to occur into smaller than larger size classes; and the rates of mortality are higher for entrants than incumbents, but surviving entrants have higher rates of growth in employment (Caves, 1998; and Sutton, 1997).[2] The result is partly explained by the fact that in different age cohorts, the mean growth rate of surviving firms declines with size and the variance of proportional growth rate of firms diminishes with their size.[3] In other words, both mortality and growth rate decrease with increasing age and size of firms.

The first objective of the present paper is to analyze which is dominant in the IT sector of Finland: growth or mortality. If growth is dominant over mortality, then SMEs should create more jobs than larger firms, since the number of jobs created in SMEs is higher than that in larger firms even after higher mortality if accounted for. This hypothesis rests on the fact that the market of the information technology sector is expanding, which improves the probability that entering firms will stay in business (hence decreasing mortality). If, on the other hand, a higher mortality rate dominates, then SMEs should create fewer jobs than larger ones, as the higher mortality rate out-weights the higher growth rate resulting in a low net increase in jobs. This scenario implies that al-

[1] The situation in the fall of 2000.
[2] For example, Dunne et al. (1988) found for the USA that in the average industry an entrant cohort accounts for 39% of the firms and 16% of the market share after a five-year period. Results concerning the effects of entries and exits on market shares and concentration show, for example, that the entrant cohort's combined (survivors and failures) market share is found to first rise and then fall.
[3] The likelihood of failure declines with increasing initial size, whereas those smaller entrants that happen to survive show higher growth than initially larger ones.

though the market is expanding, competition is nevertheless fierce, and there are several potentially profitable, but still unsuccessful, innovations that are introduced to the markets by new firms.

The literature suggests that mortality dominates growth. The average establishment size and change in employment (mobility) is found to be positively correlated, indicating that the number of hired or fired employees relative to the stock is higher in larger than smaller firms (Sutton 1998). There is also evidence that growing incumbent firms account for the majority of the mobility in plants and firms, implying that the role of entries and exits is smaller (Caves, 1999). This means that employment growth in continuing firms is higher than the number of employees hired by entrants, and the firing of employees in declining firms is larger than the number of people that lose their job as a result firm closure.

To preview the results of the present study, we find that the same also applies in the IT sector in Finland: on aggregate, large firms create more jobs relative to their employment stock than do smaller firms. An interesting feature of the results is that medium-sized firms have an inferior employment record to that of small and large firms.

These results raise the question of whether the widely obtained association between the size and growth rate of surviving firms also holds for the IT sector. Evidence suggests that within different age categories of firms, smaller firms grow faster than larger ones (Evans, 1987; Dunne et al., 1994). Thus, the second objective of the study is to take a micro perspective and to analyze the average employment growth of firms over time. The aim is to determine the effect of size on the growth rate once other growth factors are controlled for. Our regression analysis suggests the same: after controlling for covariates, the growth rate of the smallest firms is higher than that of the largest ones. This result applies to both continuing firms and to all firms (including surviving and exiting firms). We thus conclude that while large firms create more jobs on aggregate, the effect of size on the growth of individual firms is negative, providing that other growth factors are controlled for.

The remainder of this article is organized as follows. In section 2 we take a look at the insights provided by theoretical models into the evolution of firms and the role of small firms. In section 3 we firstly describe the data used, and secondly the evolution of firms and their size as well as their market share. Section 4 analyses job creation in the sector between 1993 and 1997. In section 5 we provide regression results. Finally, section 6 concludes the article.

2. THEORETICAL BACKGROUND

This section provides a review of theoretical models of the evolution of firms and industries. Due to the enormous size of the literature, the review cannot be exhaustive. However, we summarize features of the literature most relevant to the present study. Literature surveys are also provided, inter alia, by Bartelsman and Doms (2000), Caves (1999), Sutton (1997, 1998) and You (1995).

Entry and exit

One of the most frequently cited models of the entry of firms is that by Jovanovic (1982). In a one-product model, production costs are random and differ between firms. The distribution of true costs among potential entrants is known, but no firm knows its true cost prior to entry. All firms have the same beliefs, and each firm considers itself as a random draw from the population distribution of true costs. After entry and the payment of the non-recoverable entry fee, firms start to receive noisy information on their true cost level (for example, suitability of location). Gradually advancing knowledge, or passive learning, about true costs causes a firm to grow or contract over time, or to exit. In complementary models, Hopenhayn (1992) and Lucas (1978) see the entry of firms as a reaction to exit. In this model, firms face individual productivity shocks on the basis of which they decide when it is optimal to exit. As firms exit the industry, new ones come in.[4]

Evolution of firms and exit

In the model by Jovanovic (1982), all firms are of the same size in period one. The output sequence of the firms tends to diverge over time due to differences in their efficiency. In other words, the size of firms is determined by their long-term efficiency. More efficient firms grow, whereas less efficient firms decline or exit. In any period, therefore, the firms that survive to the next period are larger than those that do not. The model also has the feature that the growth rate of younger (and smaller) firms varies more than that of older (and larger) firms. Since the potential entrants do not know their true efficiency, the growth rate of entrants may vary from the highest possible to failure. In contrast, the growth rate of the older cohorts of firms cannot vary as much as in the entering cohort, since the least efficient firms have already exited the market. However, the model predicts higher growth rates for those young firms that survive than for the older ones.

[4] Cabral (1993) develops a model where firms are not atomistic competitors benefiting from the length of time they stay active in the market.

So-called 'active learning models' differ from the model by Jovanovic in one particular respect (Olley and Pakes, 1996; Ericson and Pakes, 1995). In passive learning models, firms gradually learn their efficiency relative to others, whereas in active learning models firms invest in uncertain but expectedly profitable innovations or cost reductions. The future of a firm depends on the success of its own innovations, that of direct competitors, the efficiency of entrants, and advances in alternatives to the industry's products. If the evolution is unfavorable a firm may decide to exit from the market.

Effects of turnover on job allocation

Both active and passive learning models imply the occurrence of a continuous job reallocation process in the market. Even at equilibrium, the growth and contraction of continuing firms and entry and exit take place. Some of the entrants turn out to be efficient enough to stay in the market, which together with the simultaneous occurrence of exiting firms results in job reallocation regardless of whether the market is expanding or contracting. The active learning model implies an even higher job reallocation than the passive one, since investments (in new technology or cost reductions for instance) of continuing firms affect their efficiency relative to others, thus causing additional job reallocation. In the passive learning model the incumbents have learned their efficiency relative to other incumbents. The entrants and exiting firms are therefore the only source of job reallocation in this model.[5]

Implications of turnover on the size distribution and market structure

This subsection discusses the implications of entry, exit and growth processes for the size distribution of firms and market concentration.

In the traditional and dominant analyses of firm size, firms operate in a competitive market (Viner, 1932; Baumol et al. 1982; Panzar 1989). When the market approaches equilibrium, firms reach an efficient size in the sense that their long-term average costs are minimized. The long-term minimum is determined by the interplay between economies of scale and diseconomies that stem from decreasing returns to organization technology. In other words, there is a limit to expansion. There will be firms of several sizes in the market due to three factors. First, if constant returns prevail after the minimum efficient scale is reached, then the efficient size is indeterminate and there is room for several sizes of firm. Second, variability in the size of firms in the market may emerge

[5] There are also other reasons for job reallocation. First, reallocation has been found to evolve across the business cycle. Reallocation tends to be higher during contractions than expansions since the opportunity costs are lower. In addition, exogenous shocks increase job reallocation. For example, the oil shock of the 1970s increased the demand for small energy saving cars, decreasing demand for larger cars (Davis and Haltiwanger, 1992). This had an adverse effect on the American car industry that was poorly prepared to respond a rise the crude oil price.

due to heterogeneous technologies for which the efficient scales of operation are different. Finally, since entrepreneurial and managerial talent varies across firms, firms of different sizes may be equally efficient at the margin.

The model by Jovanovic (1982) is one example of those that utilize the notion of efficiency as a determinant of market structure. In this model, all firms are of the same size in period one. The model assumes that all firms are of measure zero, so the concentration ratio is zero. Since the output sequence of firms tends to diverge over time due to differences in their efficiency, the concentration ratio increases over time. The model has a unique equilibrium where price is constant over time and entry and exit occur in every period. In other words, there is an upper limit for market concentration. Furthermore, due to continuous entries as well as the existence of declining firms there are always small firms in the market.

In the competitive market approach, firm size is determined by efficiency. Imperfect competition may, however, make the efficient firm size non-unique. According to these models, there are small firms in the market due to heterogeneous costs and tastes. Without this assumption the market would be served by a monopoly, an oligopoly or by monopolistic firms. With heterogeneous tastes, product differentiation takes place. The size of firms that serve different market segments is determined by the different technologies in these segments or the magnitude of demand (You, 1995). Product differentiation may lead to brand-name competition. If there are economies of scale in advertising, brand-name competition may be fatal for small firms. With heterogeneous costs, small firms have two possible advantages. First, responsiveness to changing circumstances in general and that to changes in customer requirements or technological environments is crucial for the success of firms (Carlsson, 1989). If small firms are more flexible in this sense then they have a market advantage over larger firms. Second, small and large firms may face different factor prices (Wilkinson, 1981; Lucas, 1978). For example, it is often alleged that smaller firms pay lower wages than larger firms. This cost advantage can be hazardous, however, since lower wages do not attract the best possible workers to the firm. On the other hand, small firm owners may accept lower returns on investments than owners of larger firms, as small firm owners may prefer independence or they may have been ‘forced’ to set up a business due, for instance, to the threat of unemployment.

The models reviewed so far imply that although larger firms generally grow faster than smaller ones, there are still various possibilities for small firms to survive and be successful. Another line of argument is that firm growth is independent of its current size and past growth history, but firms have the same growth rate subject to random disturbance (Gibrat, 1931; Simon and Bonini, 1958; Ijiri and Simon, 1977). This means that larger firms would have no growth advantage over smaller firms. This process leads to a

skewed firm size distribution that approximates a log normal distribution. This implies that the size of any particular firm is a product of its age in the market and chance. Recently, empirical studies have strongly suggested that this empirical regularity, called Gibrat's Law, does not hold, but within each age category the smaller firms grow faster than the larger ones (Evans, 1987; Dunne et al., 1994).

To summarize, apart from unexpected disturbance, we may argue that the distribution of firm size and market structure is determined by factors such as the toughness of price competition, scale economies, advertising and R&D intensity. The effect of R&D is particularly important in the case of the rapidly changing information technology sector. In this sector, and also elsewhere, firms have to continuously change and innovate in order to preserve their market share and stay in the market. A faster evolution of industry favors the upper end of the firm size distribution (larger firms), if there are scale economies in R&D and innovation. On the other hand, rapid changes in technology may provide market niches that small firms can exploit.

3. THE DATA AND A DESCRIPTION OF THE IT SECTOR

3.1 Data

Firms in the information technology sector operate in one of four sub-markets. First, they may manufacture IT machinery, such as cell-phones, computers, or components of this machinery, such as semi-conductors and cables. Second, these firms may sell IT machinery or components. Third, firms may operate in the transportation of telecommunications. Finally, they may provide related services, such as information processing services (see Appendix, Table A1). In other words, we consider the development of firms that produce goods and services in the information technology sector, excluding firms and individuals that use these products and services. For instance, we exclude broadcasting companies or individuals that use cell-phones. Our data are register-based and include all private firms that operated in the information technology sector, i.e. they were either subject to value-added tax or were employers, between 1993 and 1997. The data was compiled by the Business Register of Statistics Finland.

3.2 Age structure of firms

In 1993 there were 4699 firms in the IT sector (Table 1). From this pool of firms, 910 (19.4%) ceased operating actively in 1994, meaning that these firms either genuinely exited from the market, were acquired by another firm or had a major change in organizational form. On the other hand, 3789 firms continued to operate and 1092 new firms (23.2%) started operating in the sector, altogether yielding 4881 active firms in 1994. In these data, business start-up means that a firm is genuinely established or started operating after a major change in organizational form. The number of firms in the sector increased over time, as the number of entering firms continuously exceeded that of exiting firms. In 1994, the net change in the number of firms was 3.9%. Apart from 1994, the net entry rate was quite stable: the stock of firms grew 7-9% annually. In 1997 there were 6185 firms in the IT sector. In contrast to the number of active firms in the sector, the number of entering and exiting firms decreased over time, resulting in growth in the average age of firms.

Table 1. Number of active firms and stream of new, continuing and exiting firms

Year	Number of firms: New	Continuing	All	Exiting	Net entry	Rates: Entry (%)	Exit (%)	Change (%)
1993			4699	910			19.4	
1994	1092	3789	4881	707	182	23.2	14.5	3.9
1995	1105	4174	5279	617	398	22.6	11.7	8.2
1996	1098	4662	5760	662	481	20.8	11.5	9.1
1997	1087	5098	6185		425	18.9		7.4

Firms in the IT sector are indeed rapidly aging (Table 2). In each year, the proportion of firms that were more than 5 years old increased at the expense of the youngest firms. For example, in 1994, firms less than one year old formed the second largest group of firms (22.4%), whereas by 1997 the number of both 6-10-year-old firms and firms more than 10 years old had overtaken the youngest group of firms. The life of IT firms is highly turbulent, as 2-5-year-olds are the largest age group. This implies a high number of exits, acquisitions and mergers during the first 5 years of a firm's life cycle.

Table 2. Age structure of firms

Year	Less than 1 year (%)	1 year (%)	2-5 years (%)	6-10 years (%)	Over 10 years (%)
1994	22.4	6.0	34.9	18.0	17.4
1995	20.9	7.4	32.3	21.7	17.6
1996	16.2	6.1	34.8	24.5	18.3
1997	14.7	5.3	34.6	26.1	19.3
All years	18.3	6.2	34.3	22.9	18.3

The first years are indeed the most critical for the survival of a firm (Table 3). Each year more than 70% of firms exit the market before their 6th birthday and one-third of the firms that exit in any one year entered the market during the previous year. The first years are tough for young firms, particularly in the IT sector. According to the Business Register, about half of all firms in Finland exit the market before their 6th birthday (not shown in the table). Examination of the IT entrants in 1994 reveals that 19% of them exited the market during the following year (1995), and about 64% survived at least until 1997 (not shown in the table). In other words, the risk of exit is the largest in the first year of existence, after which it declines to about 10% per year.

Table 3. Age structure of exiting firms

Exit Year	Age in year t-1				
	Entrant (%)	1 year	2-5 years (%)	6-10 years (%)	Over 10 years (%)
1995	34.5	7.7	36.6	12.9	8.4
1996	37.3	5.5	31.8	15.9	9.6
1997	27.0	8.6	33.4	20.4	10.6
All years	32.8	7.3	33.9	16.5	9.5

3.3 Size structure of firms

On the other hand, those firms that survive do grow fast in terms of employment, since the relative proportion of the smallest firms decreases with increasing firm age (Table 4). Among the entrants, the proportion of the smallest firms is 91%, whereas among the 10-year-olds and older the proportion is only 59%. Nevertheless, 59% of firms remain very small, indicating that not all firms want to or can grow big, even in a growing industry such as information technology. Note that the proportion of entrants is very low in the larger size classes, which suggests that entry is strongly focused on the smallest size classes.

Table 4. Age structure of firms by size class

Size	Age (years)				
	Entrants (%)	1 (%)	2-5 (%)	6-10 (%)	More than 10 (%)
Less than 5	91.3	85.8	81.1	72.4	58.8
5-9	3.8	7.1	9.4	13.2	13.7
10-49	3.2	4.6	6.9	11.3	17.6
50-249	1.1	1.6	1.9	2.0	7.4
Over 250	0.6	1.0	0.7	1.0	2.4
All size classes	100	100	100	100	100

As the mean age of firms is very low and most of the entering firms are small, the size distribution of all firms is skewed towards the small end of the distribution (Table 5). The size structure of firms has remained very stable over the years. For example, the proportion of firms employing less than 5 persons has remained around 77%, whereas that of firms employing more than 250 persons has been around 1%. While the total number of firms in the market rose during the period, the number of the smallest firms grew from 3500 in 1993 to 4700 in 1997, and that of the largest firms increased from 52 to 65. The smallest firms account for the largest part of the rise in the number of firms.

The number of small firms grew by one-third between 1993 and 1997, whereas that of the largest firms grew only by a quarter (not shown in the table).

Table 5. Size structure of firms

Year	Size (number of employees)					
	<5	5-9	10-49	Small Firms	50-249	250+
1993 (%)	76.5	10.7	8.9	96.1	2.8	1.1
1994 (%)	77.8	9.4	8.7	95.9	3.0	1.1
1995 (%)	77.4	9.5	9.0	95.9	3.0	1.1
1996 (%)	76.8	10.3	9.1	96.2	2.7	1.0
1997 (%)	77.1	10.2	9.2	96.5	2.4	1.1
All years (%)	77.1	10.0	9.0	96.1	2.8	1.1

Since most firms die young and small, the mean size of exiting firms is only a little larger than that of entering firms (Table 6). As found above, some 89% of the entering firms are small-sized, and some 88% of exiting firms were small-sized in the year preceding their exit year.

Table 6. Size distribution in year t-1 for firms that exit in year t

Exit year	Size in year t-1 (number of employees)					
	Less than 5	5-9	10-49	Small firms	50-249	250+
1994 (%)	87.9	5.6	4.9	98.4	1.3	0.3
1995 (%)	91.0	4.1	3.3	98.4	1.2	0.4
1996 (%)	90.6	2.4	4.3	97.4	1.7	0.9
1997 (%)	87.7	4.0	4.3	95.9	3.2	0.9
All firms (%)	89.3	4.2	4.2	97.7	1.8	0.6

The risk of exit dropped by a half between 1994 and 1997 (Table 7). In 1994, one-fifth of firms exited the market, whereas in 1997 only one-tenth of firms did so. The risk of exit decreased during the period in each size class excluding the two largest (not shown in the table). This result may be accounted for by the fact that the number of mergers, takeovers and acquisitions increased during this period. Since the number of firms is clearly lowest in the largest size class, only a few mergers or firm acquisitions result in a high relative figure. Nevertheless, the probability of exit in the largest firm size category is only half of that in the smallest category (Table 7).

Table 7. The risk of exit by size class and years

	All years	1994	1995	1996	1997
All firms	19.6%	20.2%	16.8%	13.2%	11.4%
	All firms	Size (<10)	(10-49)	(50-249)	(250+)
All years	19.6%	16.3%	7.2%	9.3%	8.1%

The higher exit probability in the smaller size class of firms is also explained by the fact that the mean age of firms is clearly lower among smaller than larger firms. Therefore, a proper analysis of the effect of size on firm exit should take into account the effect of age on growth.

Although only about 1% of firms are large, they account for more than 60% of the sales in the market (Table 8). On the other hand, 96% of the firms are small-sized, but their market share is only some 20%. Large firms dominate the market.

Table 8. Market share of firms by size class

		Size class					
		Size (<5)	(5-9)	(10-49)	Small	(50-249)	(250+)
1993 (%)	100	4.4	4.7	11.5	20.6	18.9	60.5
1994 (%)	100	4.3	3.7	11.3	19.4	18.5	62.2
1995 (%)	100	4.3	3.5	10.7	18.4	18.5	63.0
1996 (%)	100	3.3	5.8	12.3	21.4	16.4	62.2
1997 (%)	100	3.0	2.8	14.8	20.6	14.8	64.6
Mean (%)	100	3.9	4.1	12.1	20.1	17.4	62.5

4. JOB CREATION AND DESTRUCTION IN RELATION TO FIRM SIZE

Employment growth has been remarkable in the information technology sector. While employment grew by 9% in all Finnish firms between 1993 and 1997, the growth was as high as 52% in the IT sector (Figure 1). Even the second best job provider, business services, was able to grow by 40%, which is more than 10 percentage points less than the IT sector.

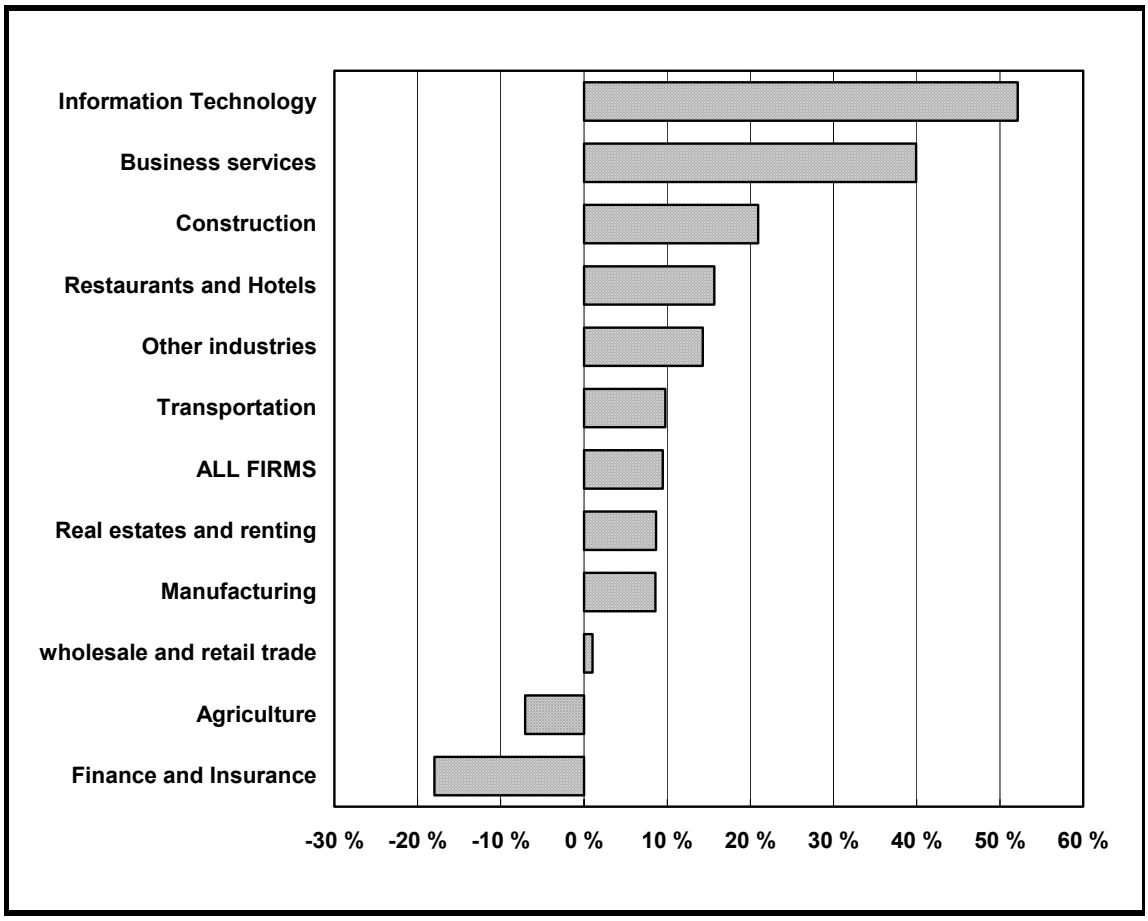

Figure 1. Change in employment by sector, 1993-1997

In terms of firm size categories, the IT sector has outgrown other sectors particularly among the largest firms (Figure 2). Among these firms, employment in the IT sector grew by more than 70%, whereas the largest firms of all sectors in Finland only grew by 15%. Excluding the middle-sized firms, the IT sector outperformed other firms in each size category. Note, however, that this result does not reveal how much individual firms grow, as in Figure 2 one middle-sized firm in 1994 may have contributed to the growth

of the largest firms if it reached the 200-employee-limit by 1998. Nevertheless, this result implies differences in firm size distribution between the IT sector and other firms.

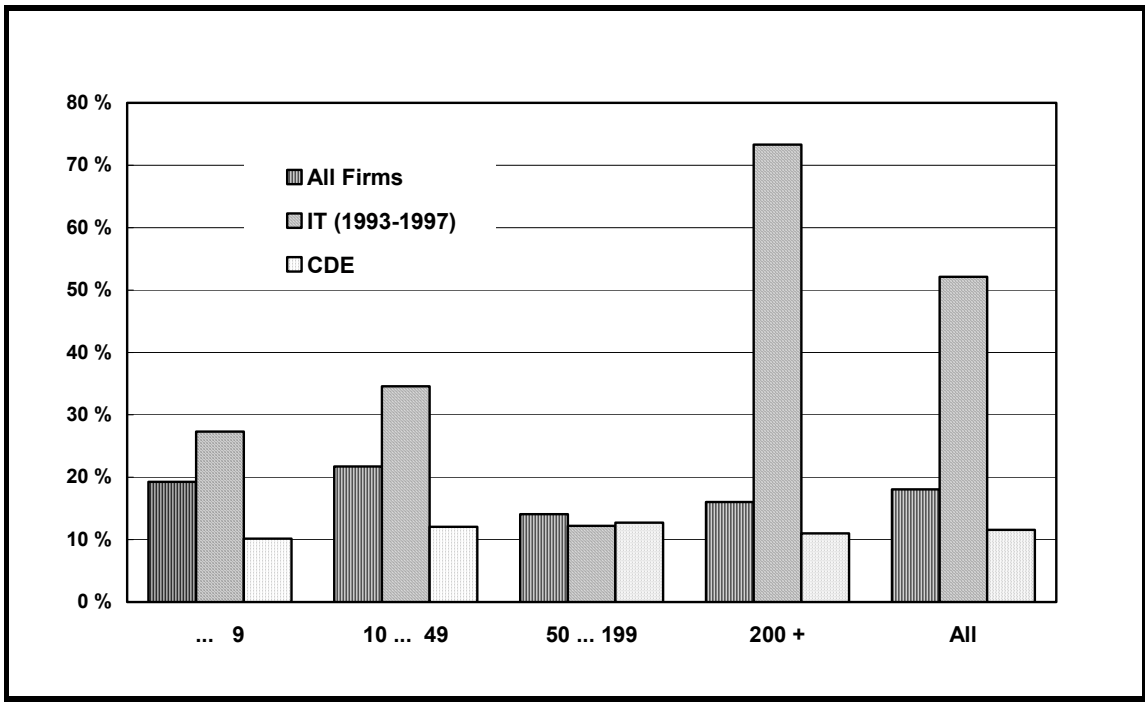

Figure 2. Growth in the number of employees by firm size category, 1994-1998

Within the IT sector, manufacturing accounts for the largest proportion of the job increase. From the total of 35 202 new jobs, the proportion in manufacturing was as high as 56%. This is mainly explained by the fact that manufacturing also has the largest proportion of existing jobs in the sector. In relative terms, the transportation of telecommunications was the best job provider (Table 9). The proportion of net job increase of the sub-sector was 25%, whereas its proportion of existing jobs was 18%. Services appear to be the most modest job provider, since their proportion of net job increase was 11% while their proportion of existing jobs was 18%.

The net figures above hide important information on gross job flow, however. Between 1993-1997, growing firms in the sector created 43 035 and new firms 32 269 jobs (Table 10). Some of the jobs were not truly created, however, since firms may also grow by mergers, acquisitions and takeovers. Nevertheless, the number of jobs created by growing and new (real or otherwise) firms was 75 304 during the period. Meanwhile, the number of jobs lost in declining and exiting firms was 40 102, indicating that the net number of jobs grew altogether by 35 202 from 1993 to 1997. An interesting nuance is that the number of jobs lost in declining firms was lower than that in exiting firms. This

is partially due to the fact that some of the exits were not real exits, but mergers with other firms.

Table 9. Job reallocation by industry

Sub-sector	Growing firms	Declining firms	All firms
	Share of job increase (%)	Share of job decrease (%)	Net change (%)
Manufacturing	54	51	56
Telecommunications	18	12	25
Wholesale	8	9	8
Services	20	28	11
All firms	100	100	100
		Stock of employees	
	Share of employment	Share of employment	Share of employment
Manufacturing	58	46	55
Telecommunications	18	18	18
Wholesale	10	11	10
Services	15	25	18
All firms	100	100	100

Table 10. Job reallocation by size and age of firms

	Change in the number of jobs	Average total employment per year
Growing firms	43035	55479
Entering firms	32269	4028
Growing and entering	75304	59506
Declining firms	15402	21704
Exiting firms	24700	3087
Declining and exiting firms	40102	24791
Net change:		
Continuing firms	27633	33775
Entering and exiting firms	7569	941
All firms	35202	34716

On the one hand, declining firms are smaller in size than growing ones. The average size of growing and new firms was nearly 60 000, whereas that of declining and exiting firms was about 25 000, a feature included in the model by Jovanovic, for example. On the other hand, the number of jobs lost was higher relative to the size in declining and exiting firms than the corresponding number of created jobs in growing and new firms.

Small firms are good job providers (Table 11). Small firms employing less than 50 people accounted for 28% of the total number of jobs created, although their share of existing jobs was only 19%. On the other hand, in small firms more jobs were lost than their share of existing jobs in declining firms would suggest. Nevertheless, small firms accounted for 23% of the net job increase in the IT sector, whereas their share of all existing jobs was 21%. The largest firms are even better job providers than small firms are. Their proportion of net job increase was as high as 70%, whereas their proportion of all existing jobs was 61%. In contrast, middle sized firms are poor job providers. They accounted for 7% of the net job increase, whereas their proportion of all existing jobs was as high as 18%.

Table 11. Job creation and destruction by firm size class

	Growing firms	Declining firms	All firms
Size class	Share of job increase (%)	Share of job decrease (%)	Net change (%)
Less than 50	28	31	23
50-250	15	21	7
More than 250	57	47	70
Total	100	100	100
	Share of employment (%)	Share of employment (%)	Share of employment (%)
Less than 50	19	26	21
50-250	17	22	18
More than 250	64	52	61
Total	100	100	100

What could lie behind the inferior job record of the middle-sized firms? One reason is that the number of jobs lost due to exiting middle-sized firms was higher than that created by entering ones. Among continuing middle-sized firms the number of jobs increased by 3607 during the period, whereas among entering and exiting firms the stock decreased by 1118 jobs. This feature may be accounted for by the large number of organizational changes, mergers, takeovers and acquisitions among the middle-sized firms.

Medium-sized firms are also found to be inferior job providers in cohort investigation (Table 12). Let us take the operating firms in each successive year and follow their growth for one period. When the changes in each period are summed, we find that employment decreased in firms that were medium-sized, whereas that in other firms increased.

Table 12. Net change in jobs, excluding the entry of firms

	Change in the number of jobs	Average total employment per year
Less than 50	1019	3714
50-249	-2095	3886
250+	4009	23088
Sum	2933	30688

Does job creation and destruction only depend on size of firms, or do other characteristics of firms also matter? This is the question we will address in the next section.

5. DETERMINANTS OF FIRM GROWTH

5.1 Variables

We have followed firms operating in 1993 and 1995 for two years. Thus, the periods of investigation are from 1993-1995 and 1995-1997. The reason for this split in the study period is twofold. First, the use of two two-year sub-periods enables us to employ panel data methods. Second, we do not want to shorten the periods (increase the number of sub-periods) any further, since the evolution of firm size becomes more random in shorter periods.

We study the effect of firm size on the net job creation using two measures. First, we measure net job creation in absolute terms, meaning the absolute change in the number of employees between 1993 and 1995 as well as 1995-1997. This enables us to study the extent to which firm size accounts for the emergence of growth in employment in the IT sector. Second, we determine the proportion of the change in the employment stock for each firm in question. This relative measure is used to reveal whether smaller firms have a different growth rate to others.

As far as our variable of interest is concerned, firm size could be measured as either a continuous or a discrete variable. Since the effect of firm size on growth is not necessarily linear in the sense that one extra employee would raise the growth rate by the same magnitude irrespective of the firm size, we prefer the dummy variable technique. Firm size distribution has been divided into four categories. Micro-sized firms are those having less than 10 employees, other small firms have at least 10 but less than 50 employees, the employment in medium-sized firms ranges from 50 to 250, and that in the largest firms is more than 250.

As noted above, the age and size of firms are highly correlated so that the youngest firms tend to be the smallest. Therefore, the age of firms is another crucial variable. We also divide age into four categories. The youngest age group consists of firms that are less than two years old. The second group is formed by firms whose age ranges from two to five years, the third group are those between six and ten years. The oldest group consists of firms that are more than ten years old.

A third set of variables consists of industrial sub-sectors within the IT sector. We consider sub-sectors to matter for growth due to the fact that the evolution of efficiency may differ between manufacturing and services, although the aggregate demand would grow at the same rate. Thus, we categorize the firms into manufacturing, wholesale, services and transportation sub-sectors.

Fourth, engagement in external trade should affect the growth rate. We are able to use three dummy variables to capture the type of external trade. The first dummy is one if the firm concerned exports goods or services, and null otherwise. The second dummy is treated the same way according to the import activity of firms. Finally the third dummy is one if the firm both exports and imports. Naturally, our expectation is that firms engaged in foreign trade should experience faster growth than those operating in the domestic market only.

Fifth, we test whether the number of plants within firms matters for growth. The literature, reviewed above, suggests that (ceteris paribus) the management of multi-plant firms is harder to organize. Therefore, among otherwise similar firms, those firms with several plants should grow at a lower pace than those with one plant only.

Finally, there are certainly unobserved factors which may be correlated with our variable of interest. Thus, the omission of these variables causes bias in the estimate of the firm size variable. We alleviate the problem using a fixed effect estimator that removes all growth factors that may differ between firms but remain constant over time (over a two-year period). These growth factors include the skill, motivation and education of the management, and the suitability of the location. Furthermore, the growth of firms may be auto-correlated. In the panel data method employed here, any effect of this becomes negligible, however, due to the large number of cross-sectional observations (4658) relative to the time periods (2).

5.2 The effect of size on the growth rate of firms

As noted above, the net employment change was the most positive in the largest firms (Table 13). On average, large firms grew by 26 employees during the two-year periods. The employment record of the medium-sized firms was the worst. On average, medium-sized firms lost 6 employees during the two-year periods. The effect of size does not markedly change when the other observed covariates are added to the OLS regression. Due to the exit of some firms, we cannot estimate the possible effects of unobservables on growth.

Accordingly, when the effect of size on the rate of growth is measured, the exit of firms must be taken into account. This is carried out by Tobit analysis. It turns out that while the middle-sized firms grow at a slower pace than the large ones, smaller firms grow faster (Table 13). For instance, the mean growth rate of micro-sized firms is nine percentage points faster than that of the largest firms.

Table 13. The mean change in the size of all firms by firm size category during 1993-1995 and 1995-1997

	Size category			
	Micro (1-10)	Small (10-49)	Medium 50-249)	Large (249-)
Occurred change in the number of employees	0	0	-6	26
Compared to the largest				
Effect of size on the number of employees	-26	-26	-32	
+ observed covariates*	-26	-29	-36	
Unconditional change in growth rate (%-points)**	9	7	-4	
+ observed covariates (%-points)**	41	20	-2	

Note: * denotes results that are based on OLS estimates and ** denotes results that are based on Tobit analysis. Complete results of estimations are available upon request.

In other words, the smallest firms have higher growth rates than larger ones, whereas in absolute terms they grow less. These results accord with the findings above in that the largest firms have created more jobs in absolute terms than small firms, but in relative terms (when the number of jobs created are calculated as a proportion of the stock of employees) the figures for the smallest firms improve. The smallest firms out-perform the others even more strongly when other covariates are added to the estimated equations (Table 13). The results indicate that micro-sized firms having less than ten employees grow 41 percentage points faster than the largest firms, a result which partially reflects the fact that one extra employee in a micro-sized firm results in higher growth rate than one extra employee in a large firm. The growth rate of medium-sized firms remains inferior, however.

As noted above, there are likely to be growth factors that are not included in the present data set or are hardly included in any observational data set (such as the management's level of motivation). The bias caused by such factors can be removed by a fixed-effect estimator. This calls for consecutive observations for the same cross-sectional units. Consequently, we are able to run a fixed-effect estimation for just those firms that do not exit the market during the investigation period.

The results show that, just as among all firms, among continuing firms large firms created more jobs (in absolute terms) than other firms. During the two-year periods, continuing large firms grew by 184 employees on average, whereas the micro-sized firms grew by only one employee (Table 14). In contrast to the results for all firms, among continuing firms the medium-sized grew more than their smaller counterparts. This implies that real exits as well as mergers and takeovers are more common among medium-sized firms than elsewhere.

The rate of growth tends to increase with decreasing size class of firms, a result which is similar to that found for all firms (Table 14). The mean growth rate is particularly high for micro-sized firms. These firms exhibit 45 percentage points faster growth than the largest firms. During the two-year periods, micro-sized firms grew by 59% whereas the largest firms grew by 14% (not shown in the table). The addition of observed covariates does not markedly change the results for either the absolute change in the number of employees or for growth rates.

Table 14. The mean change in the size of continuing firms by firm size category during 1993-1995 and 1995-1997

	Size category			
	Micro	Small	Medium	Large
Actual change in the number of employees	1	3	13	184
Change relative to the largest firms:				
Change in the number of employees	-183	-181	-171	
+ observed covariates	-183	-184	-177	
+ unobserved covariates	94	91	84	
Change in the rate of growth (%-points)	45	3	1	
+ observed covariates (%-points)	45	11	4	
+ unobserved covariates (%-points)	228	120	39	

Instead, the effect of unobserved covariates shows up well in the results. Fixed effect estimation reveals that during the two-year periods, the micro-sized firms grew over two times faster than the largest firms. Furthermore, even in terms of absolute changes, growth becomes more positive with decreasing size-class of firms once the unobservables are controlled for. Other factors being constant, the micro-sized firms hire, on average, 94 employees more than the largest firms. These findings accord with those in other studies: the smaller firms that survive grow faster than larger ones.

Strong effect of size on growth suggests that the optimal size of firms in the information technology sector is larger than ‘micro’ or ‘small’. Other covariates, particularly unobservable covariates, tend to slow down this growth process towards the optimum. This is why the effect of size on growth strongly changes when unobservables are controlled. One implication of the result is that some features of firms, such as the ability of management, is lower in smaller firms compared to larger ones.

These panel data estimates are as close to the 'true' associate effect of size on growth rate as it is possible to get in the present analysis.[6] The marked difference in the results between cross-sectional and panel data estimations implies that the growth of firms is a product of various effects, only a small fraction of which are measurable in observational studies. Moreover, these unobserved variables are correlated with the set of firm size dummies, which biases the cross-sectional results. Therefore, there is a need for methods such as fixed-effect estimation that alleviate the effects of omitted and unobservable variables.

5.3 Other growth determinants of firms

Finally, we ask what are the effects of other covariates on the rate of growth? First and foremost, new firms tend to grow faster than their older counterparts providing that the firms remain in business (Table 15). The growth rate of 10-year-olds is 79 percentage points slower than that of new firms. This effect somewhat changes in fixed-effect estimation. While OLS estimations suggest that higher firm age tends to decrease the growth rate, our fixed-effect estimations show that the relationship is u-shaped, so that growth rate is highest for the youngest and oldest firms.

The coefficients for other variables are not statistically significant. For instance, the classification of firms into four sub-sectors does not capture any differences within the whole information technology sector. Similarly, orientation towards external trade does not make any difference. Neither does multiplicity of plants in firms.

One reason for this is that the information sector is such a close cluster with tight upward and downward linkages and network arrangements that features such as the sub-industry or export/import orientation do not differentiate between the firms. Instead, the firms experience approximately the same growth in demand and the differences between the growth rates are accounted for by the size and age of firms and unobservable effects, such as the level of motivation and skill of the management.

[6] Note however, that estimation of the 'true' associate effect would require a random sample of firms from other sectors to be included in the data set.

Table 15. Determinants of the growth rate of firms (number of observations 7448)

Explanatory variable	OLS	Fixed effects
Firm size (micro)		
Small	-0.340***	-1.080***
Medium	-0.414**	-1.893***
Large	-0.504**	-2.278**
Firm age (New)		
2-5 years	-0.464***	-0.310***
6-10 years	-0.700***	-0.371**
More than 10 years	-0.790***	-0.148
Sub-industry (wholesale)		
Manufacturing	-0.092	-0.311
Transportation	0.360**	-0.536
Services	-0.059	-0.605
Export orientation (none)		
Exporter	-0.007	-0.029
Importer	0.126	-0.183
Exporter and importer	0.070	-0.247
Number of plants (one)		
Several	0.128	0.162
Constant	2.053***	2.386***
Model diagnostics	R^2=0.02 F(13,7434)= 14.1***	Within-R^2=0.14 F(13,2777) = 3.5***

Note: *** denotes statistical significance at the 1% level, ** denotes statistical significance at the 5% level, and * denotes statistical significance at the 10% level. The reference group of each variable is given in parentheses.

6. CONCLUSION

This paper analyzed the role of small firms in the evolution of the information technology sector in Finland. The information sector consists of relevant manufacturing and transportation industries as well as relevant wholesale and service industries. The investigation period extends from 1993 to 1997.

Most of the firms in the sector are small in size. The proportion of all jobs in small-sized firms is 21% of the total employment in the sector, while their proportion of all firms is as high as 96%. In spite of this, the market share (proportion of sales) of small firms is only 4%. Furthermore, the jobs created in small firms are not as permanent as those provided in the largest firms, as the exit probability for the smallest firms is two times higher than that for the largest firms. The ability of small firms to create jobs is clearly higher than that in their medium-sized counterparts, however.

One reason for poor employment record for the medium-sized firms is a high number of takeovers and mergers when compared with those for small or large firms. On the one hand, medium-sized firms are more attractive sources of acquisition than small firms, since they have proved their potential by growing out of small firm class. On the other hand, the largest firms are less often victims of takeover or merger, since large size protects them against takeovers and mergers.

Our regression analysis suggests that after controlling for observed and unobserved covariates, the growth rate for the smallest firms is higher than that for the largest ones. We thus conclude that while large firms create more jobs on aggregate, the effect of larger size on the growth of individual firms is negative, providing that the other growth factors are controlled for.

Apart from the effect of size on growth, the age of firms appeared to be the only other observable characteristics that determines growth. This finding accords with those in other studies where the age and size of firms jointly determines growth of firms so that among those small firms that happen to survive, younger firms grow faster than older ones. In other words, small firms are typically younger than their larger counterparts.

We also find that the information technology sector is such a close cluster with tight upward and downward linkages and network arrangements that features such as the subindustry or export/import orientation do not differentiate between the firms. Instead, the firms experience approximately the same growth in demand and the differences in growth rates are accounted for by the size and age of firms and unobservable effects, such as the level of motivation and skill of the management.

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APPENDIX

Table A1. Coverage of industries in the data

SIC code	Name
Manufacturing	
3001-3002	Office machines and computers
3130	Conductors and cables
3210-3230	Radio and TV apparatus
3320-3330	Medical equipment, watches, optical instruments
Transportation	
642	Telecommunications
Sale	
51432	Wholesale of entertainment electronics
51641	Wholesale of computers and related machines
51652	Wholesale of telecommunication devices
Service	
7133	Rental of office machines etc.
72	Information processing services