Age and Size as Determinants of Firm Growth in the IT industry

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Communication to

European Meeting on Applied Evolutionary Economics

7 - 9 June 1999, Grenoble, France

Organised by the Institute for Energy Politics and Economics
Organisé par l'Institut d'Economie et de Politique de l'Energie /
IEPE, BP 47, 38040 Grenoble Cedex 9, France

And the INRA-Unit of Sociology and Economics of Research and Development
Et l'unité Sociologie et Economie de la Recherche Développement de l'INRA
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The Experimentally Organised Economy and Competence Blocs – A test of Age and Size as Determinants of Firm Growth in the IT industry[#]

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Preliminary

7 May, 1999

Abstract: The paper introduces the theory of the Experimentally Organised Economy and Competence Blocs. From the theory we derive the hypotheses that firm age and firm size have a negative effect on firm growth and test them empirically. An extensive data set including *all* Swedish IT firms in 1993 to 1997 is used. The empirical analysis supports the theoretical conclusion that old firms grow slower than young firms do. The results, however, do not show that smaller firms grow faster than larger firms. In line with theory, the results suggest that new entry (young firms) is important for industrial dynamics and industrial growth.

Keywords: Competence Blocs, firm growth, The Experimentally Organised Economy,

Industrial dynamics.

JEL Classification: D21, L63, L86

[#] Financial support from Kommunikationsforskningsberedningen (KFB) is gratefully acknowledged. I am grateful for useful comments and suggestions from Gunnar Eliasson, Niclas Berggren and Fredrik Bergström.
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1. Introduction

During the last decade, an increasing interest in explaining industrial dynamics and understanding the processes that generate the macro aggregates such as GDP growth and total unemployment can be noted. Many researchers think that the neoclassical description of the economy as static is less adequate and consequently turn to more evolutionary approaches. The new and fast-growing high-tech industries based upon information technology and biotechnology underpin the usefulness of theories that view the economic system as a dynamic process rather than as a static equilibrium. Parallel to the theoretical development, we also observe an increasing interest in empirical micro-based studies, e.g. on the importance of new entry, the size distribution of firms and innovative behaviour for firm growth; see e.g. Audretsch (1995) and Geroski (1995).

This paper takes its starting point in the theory of the Experimentally Organised Economy (EOE) and Competence Blocs (Eliasson 1996, Eliasson & Eliasson 1996) - an evolutionary theory that emphasises the role of information, knowledge, competence and entrepreneurship. The purpose of the paper is to test hypotheses derived from this theory. We test the effects of firm size and firm age on firm growth in the IT industry - one of the most dynamic and important industries at the moment.

The paper is organised as follows: The theory of the EOE and Competence Blocs is introduced in the next section (section 2). Section 3 discusses the data and the econometric model. We use an extensive data set including individual data on *all* firms classified as IT firms. The data set comprises financial as well as non-financial information. Among other things it is possible to take into account if the individual firm belongs to an enterprise group and if the individual firm

is privately or governmentally owned. The data cover the period 1993 to 1997 and we carry out a cross-sectional time-series analysis. The results are presented and commented upon in section 4. Section 5 concludes the paper.

2. The Experimentally Organised Economy and Competence blocs

The best way to introduce the theory of the experimentally organised economy and Competence blocs is to use the fundamental problem of resource allocation as a starting point. Firms managed by entrepreneurs use the factors of production - land, capital and labour - to produce goods and services. To produce preferred products efficiently requires information, knowledge and competence. It is a business opportunity to produce more preferred products in a more efficient way than the competitors, i.e. to improve the allocation of resources. This is the same thing as introducing what Schumpeter (1934) called new combinations (innovations) into the economy. Eliasson (1996) defines the business opportunity set as the sum of all business opportunities (potential innovations) in the economy. To introduce something new (to explore the business opportunity set) is, however, assigned with uncertainty. One can never *ex ante* know if the new product, organisation etc. will succeed or fail and the innovations are thus *tested* on the market. Eliasson consequently characterises every venture as a business experiment and describes the whole economic process as a process of continuous experimentation. Due to bounded rationality (Simon 1955, 1990) and tacit knowledge (Polyani 1967), no single person or entity has the ability to get a complete overview of or control this process. The economy is, in other words, experimentally organised. Industrial dynamism and growth therefore requires an efficient process of search (creation), selection and industrialisation of new knowledge (innovations). This is, according to Eliasson & Eliasson

(1996), conditioned upon the competence of the economic actors. The competence bloc defines the minimum set of economic actors with different but supplementing competencies necessary for the identification, selection, expansion and exploitation of business opportunities. It is impossible to define the exact content of the competencies in the competence bloc. It is, however, possible to define their economic *function* in the process of industrial dynamism and economic growth. The present definition comprises six functional competencies required to create industrial dynamism.

- Active, competent and resourceful *customers*. This is not an ordinary customer who solely buys the product. It is rather a strategic partner that takes on an active part in the development of products and commercialisation of the products. The active customer serves as a channel of information and gives the firm information about the market and specific customer demands and act as a catalyst for innovation. The active customer has a decisive influence on the development and final design of the new products. Sometimes the competent customer also finances the development of the product.
- *Innovators* who integrate technical specialities. The innovator integrates different technologies into products. In so doing he solves advanced technological problems. It is notable that the innovator in the competence bloc fulfils a more advanced function than the Schumpeterian inventor. The innovator puts large-scale technologies together into technically advanced products (or systems of products) like aeroplanes and cars. His role is more like an administrator of innovative activities than an inventor.
- The *entrepreneur* selects innovations that satisfy economic criteria and introduces them into the economy. He has a most crucial function since he organises the commercialisation of the innovations.
- The *industrialist* carries the idea to large-scale production. He integrates a number of competencies: corporate managing, finance and marketing. Compared to the traditional

Schumpeterian theory, the industrialist in the competence bloc fulfils some of the functions of the entrepreneur, namely the later stages of commercialisation. In traditional Schumpeterian theory the entrepreneur introduces new ideas into the economy as well as scales them up to large business. In the theoretical framework of the EOE and Competence Blocs the entrepreneur still introduces new combinations, but the industrialist scales them up. That is to say, the industrialist is the main organiser of firm growth.

- Competent *venture capitalists* that provide (venture) capital, i.e. recognise and finance viable business opportunities organised and presented by the entrepreneur. This includes an assessment of the competence of the entrepreneur and other managers of the venture. Venture capitalists put their personal networks and experiences at disposal. Among other things they may provide managing competence. According to Eliasson they have a key role for industrial development. Incompetent venture capitalists will not understand the potential of the business idea (or the competence of the entrepreneur). Accordingly, they will require too large a risk premium that will terminate many projects or give poor incentives for entrepreneurs.
- *Actors on the secondary market* provide a secondary market and thus accommodate exit availability for venture capitalists as well as entrepreneurs and other early investors. An important function is to continuously evaluate managers. In case of bad management there are potential profits in new management. Actors on the secondary market will realise these potential profits by replacing the management team.

The EOE and the theory of Competence Blocs strongly emphasise the importance of openness and variety for innovations, flexibility and the ability to adjust. According to Eliasson older and larger firms are more hierarchical and more petrified than smaller and younger firms and will

therefore, *ceteris paribus*, grow more slowly than smaller and younger firms. Thus, two testable hypotheses are that the age and the size of firms have a negative effect on firm growth.

3. Data and econometric model

Definition of the IT industry

The literature offers no unambiguous definition of the IT industry. Porat (1977) made an early definition of the IT industry according to occupation that was later used by the OECD (1987). In an early study of the Swedish IT industry Eliasson (1990, p. 13 and Table I), on the other hand, defined the potential IT industry according to the fundamental information activities performed, that is co-ordination, innovation, selection and learning.

This paper uses the definition of Statistics Sweden (SCB) and defines the IT industry as the aggregate of firms in the economy that base their business on information technology. Statistics Sweden (1992, p. 5) uses the following definition:

> «By information technology is meant technology that utilises microelectronics for collecting, storing, working upon and retrieving as well as the communication and presentation of data, text, pictures and sound.»

The core of the IT industry is data and telecommunication. Statistics Sweden, however, also includes firms that trade with IT goods. The IT industry can be divided into four sub-industries: manufacturing of IT goods, trade with IT goods, telecommunication carriers and data consulting and data services; see Appendix for a detailed description of the industries that

comprise the IT industry. The IT industry so defined employs about 170.000 persons in 1997, which is about 5 per cent of the total Swedish work force that year. Manufacturing of IT goods are the largest IT industry employing somewhat 58.000 persons. Data consulting and data services is the second largest employing a bit more than 46.000 persons in 1997. Trade with IT goods and telecommunication are the third and fourth largest industries, employing somewhat more than 37.000 and 28.000 persons, respectively.

Definition of data

We will use two sets of data. The first is relatively encompassing regarding the number of firms and includes all firms classified as IT firms. It is, however, limited regarding explanatory variables. The second data set is limited regarding the number of firms, but includes an extensive set of explanatory variables. The first data set is an extract from the Central Register of Firms and Establishments (CFAR). CFAR is a population register containing all Swedish firms in all industries, privately as well as governmentally owned. The information (variables) for each firm, however, is limited and CFAR is mainly used as a population register when conducting surveys on firms. We have therefore supplemented CFAR with »Finansstatistiken», a register containing financial variables (income statement and balance sheet) for individual firms. »Finansstatistiken» covers all firms in 1995, 1996 and in 1997, but not the other years. Financial data for 1997, however, was not available for this paper. Henceforth, we will test two models, the first based on the first data set (CFAR) and the second model based on the second data set (CFAR supplemented with »Finansstatistiken»). In 1997 the data include more than 25.000 firms with about 170.000 employees. Firms are identified through their unique organisational number that is given to all Swedish firms when they are founded.

In addition to age and size we include data on ownership (privately or governmentally owned), if the firm belongs to a group of enterprises and an interaction variable of age and size (for simplicity, we call these five variables structural variables). According to the theory of the experimentally organised economy ownership matters. In the free market there will be a selection according to the owners' ability to manage the firms. In a centrally planned economy, on the other hand, owners (politicians) are appointed because of their competence to win elections (manage voters). Firms in a group of enterprises can be expected to grow faster for two reasons. First, they can benefit from the network of the whole group and internalise external effects, such as education. Second, it has been shown that groups of enterprises are favoured compared to individual firms regarding taxes; see e.g. Henrekson (1996) and Henrekson & Johansson (1999). Dummies for time, industry and interaction of time and industry are included as well.

From the income statement and balance sheet we define a number of financial variables to be used in the second model, viz., productivity, profit, total debt, capital intensity, tax and turnover (reflecting the demand of the firm's products). To some extent tax reflects the institutional conditions. We, furthermore, include the changes in the financial variables. The first model is thus defined as:

(1) $GROWTH_{i,t} = a + b_1*AGE_{i,\,t-1} + b_2*SIZE_{i,\,t-1} + b_s*X^s_{\,i,\,t-1} + b_d*X^d$,

where GROWTH, AGE and SIZE are vectors on the growth, age and size of the IT firm i at time t or t-1 and X^s and X^d represent vectors with structural and dummy variables respectively.

The second model is defined as:

(2) $GROWTH_{i,t} = a + b_1*AGE_{i,\,t-1} + b_2*SIZE_{i,\,t-1} + b_s*X^s_{\,i,\,t-1} + b_{fin}*X^{fin}_{\,i,\,t-1} + b_{finch}*X^{finch}_{\,i,\,t} + b_d*X^d$,

where GROWTH, AGE and SIZE are vectors on the growth, age and size of the IT firm i at time t or t-1 and X^{fin}, X^{finch}, X^s and X^d represent vectors with financial variables, the changes in the financial variables, structural and dummy variables respectively.

The variables are defined as follows:

Dependent variable:

$GROWTH_{i,\,t}$: The change in the number of employees (per cent) in firm i between time t-1 and t.

Structural variables:

$AGE_{i,\,t-1}$: The age of firm i at time t-1. A firm established at time t-1 is defined as 1 year old, a firm established in time t-2 as 2 years old and so on.

$SIZE_{i,\,t-1}$: The size (number of employees) of firm i at time t-1.

$ENTG_{i,\,t-1}$: A dummy that takes on the value 1 if firm i belongs to an enterprise group at time t-1, otherwise 0.

$OWNER_{i,\,t-1}$: A dummy for ownership at time t-1, 1 if firm i is governmentally owned and 0 if it is privately owned.

$AGESIZE_{i,\,t-1}$: An interaction variable that is the product of the age and the size of firm i at time t-1.

Financial variables:

$PRODUCTIVITY_{i,\,t-1}$: Labour productivity of firm i at time t-1, defined as the total value added of firm i divided by the total number of employees of firm i.

$PROFIT_{i, t-1}$: The profit (per cent) of firm i at time t-1. Profit is defined as profit (or loss) after financial income and expenses/(equity + 0.7 of untaxed reserves).

$TAX_{i, t-1}$: Firm i's paid taxes in relation to profit (per cent) at time t-1. The tax variable is defined as paid tax divided with profit (or loss) after financial income and expenses

$TotDebt_{i, t-1}$: The total debt (per cent of the total balance sheet) of firm i at time t-1

$CapInt_{i, t-1}$: The capital intensity (per cent) of firm i at time t-1, defined as (1 – total labour costs/total value added).

$TURNOVER_{i, t-1}$: Turnover per employee at time t-1 in firm i.

PRODUCIVITYCh, ProfitCh, TaxCh, TotDebtCh, CapIntCh and TURNOVERCh represent the change (per cent) in productivity etc. between time t-1 and t.

Dummy variables:

ITman: A dummy taking on the value 1 if firm i manufactures IT goods, otherwise 0.[1]

DATA: A dummy variable taking on the value 1 if firm i is a data consult or a data service firm, otherwise 0.[2]

Telec: A dummy variable taking on the value 1 if firm i is a telecommunication carrier, otherwise 0.[3]

TD94: A dummy variable taking on the value 1 in 1994, otherwise 0.

TD95: A dummy variable taking on the value 1 in 1995, otherwise 0.

TD96: A dummy variable taking on the value 1 in 1996, otherwise 0.

ITman94: An interaction dummy variable: the product of ITman and TD94.

ITman95: An interaction dummy variable: the product of ITman and TD95.

ITman96: An interaction dummy variable: the product of ITman and TD96.

[1] That is, if firm i is classified within industry code 30010, 30020, 32100, 32200, 32300, 33200 or 33300; see Appendix.
[2] That is, if firm i is classified within industry code 72100, 72201, 72202, 72300, 72400, 72500 or 72600; see Appendix.
[3] That is, if firm i is classified within industry code 64201, 64202 or 64203; see Appendix.

DATA94: An interaction dummy variable: the product of DATA and TD94.

DATA95: An interaction dummy variable: the product of DATA and TD95.

DATA96: An interaction dummy variable: the product of DATA and TD96.

Telec94: An interaction dummy variable: the product of Telec and TD94.

Telec95: An interaction dummy variable: the product of Telec and TD95.

Telec96: An interaction dummy variable: the product of Telec and TD96.

We expect age, size, ownership and the interaction variable between age and size all to have a negative effect (sign) but belonging to an enterprise group to have a positive effect (sign) on firm growth (see motivation above). We expect productivity, profit and turnover to have a positive effect on firm growth. High productivity indicates large competitiveness and profitability enhances investments and firm growth. High turnover indicates a large demand of the firm's products. Taxes are expected to have a negative effect on firm growth. It is unclear whether capital intensity and total debt will have a positive or negative effect on firm growth. We also expect an increase in productivity, turnover and profit to have a positive effect and an increase in taxes to have a negative effect on firm growth. It is unclear whether increases in total debt and capital intensity should have a positive or negative effect. OLS estimation is used in the analysis. Extreme values, firms reporting a growth in the number of employees exceeding 500 per cent, are excluded. According to the previous discussion we particularly test the hypotheses:

H_0: $b_1 = 0$ and

H_0: $b_2 = 0$.

4. Results

The age of a firm shows a significant negative effect on firm growth in both regressions at the one per cent level (Table 1). The size of a firm, on the other hand, shows no significant effect on firm growth in either regression. We, thus, reject the hypothesis that age has no effect on firm growth and accept the hypothesis that size has no effect on firm growth. The former result supports the conclusions made in the theory of the EOE, but not the latter. The results suggest that new entry is important for the renewal and the growth of an industry. Moreover, »membership» in an enterprise group has a significant (at the 1 per cent level) and positive effect on firm growth in both regressions. This is in accordance with the fact that Swedish institutions favour enterprise groups and in line with economic theory emphasising knowledge spillovers and network externalities. It is interesting to note that governmental ownership show a negative effect on firm growth. The coefficient is negative in both regressions, but only significant at the 10 per cent level in the first one. The finding supports the emphasis of market knowledge that is made in the EOE. Productivity, profit and turnover all show the expected positive effect on firm growth (at the 10, 5 and 1 per cent level respectively). Taxes have a significant (at the 10 per cent level) negative effect on firm growth – a result that also is in line with our expectations. Total debt and capital intensity and the change in capital intensity have no significant effect on firm growth. The change in total debt, however, has a significant (at the 1 per cent level) effect on firm growth. Productivity changes have, a bit surprisingly, a significant (at the 10 per cent level) negative effect on firm growth. This is actually the only result (sign) that is not expected (disregarding the insignificance of the size variable). Increased profits, increased debt and increased sales have a significant (at the 1, 1 and 5 per cent level) positive effect. As expected, increased taxes show a significant (at the 5 per cent level) negative effect on firm growth. The regression coefficient, R^2, is low, 0.01 and 0.05 in the first

and second regression respectively. It clearly indicates that important explanatory variables have been left out. That R^2 is low is not surprising given the reasoning of the theory of the Experimentally Organised Economy and Competence Blocs. The EOE, as well as other theories, for example suggest that some measurement of firms' innovativeness and dexterity of management should be included as explanatory variables. The EOE, particularly, suggests that the skills of the actors in, and the function of, the competence bloc should be taken into account. All these variables are notoriously difficult to measure even at the quite disaggregated level that is studied in this paper.

Table 1. Regression results.

	Regression 1	Regression 2
Dependent Variable	GROWTH	GROWTH
AGE	-0.75*** (-13.45)	-0.89*** (-9.37)
SIZE	-0.0008 (-0.35)	-0.0008 (-0.30)
ENTG	6.36*** (7.56)	5.48*** (3.67)
OWNER	-5.77* (-1.67)	-0.22 (-0.03)
AGESIZE	-0.0004 (-0.23)	0.0005 (0.405)
PRODUCTIVITY	-	0.009*** (3.96)
PROFIT	-	0.003** (2.45)
TAX	-	-0.97* (-1.75)
TotDebt	-	0.018 (0.98)
CapInt	-	-0.14 (-1.48)
TURNOVER	-	0.008* (1.84)
PRODUCTIVITYCh	-	-0.022* (-1.70)
PROFITCh	-	0.0002*** (3.66)
TAXCh	-	-0.004**

		(-2.29)
TotDebtCh	-	0.065*** (4.07)
CapIntCh	-	0.00002 (0.83)
TURNOVERCh	-	0.017** (1.82)
ITman	1.42 (0.70)	12.91*** (2.73)
DATA	0.65 (0.46)	10.84* (1.74)
Telec	10.62 (1.10)	-14.82 (-1.52)
TD94	-4.11 (-3.04)	9.00** (2.06)
TD95	6.07*** (4.26)	12.19*** (3.42)
TD96	5.43*** (3.94)	-
ITman94	3.09 (1.02)	-7.24 (-1.07)
ITman95	-2.07 (-0.68)	-12.26** (-2.44)
ITman96	-0.42 (-0.14)	-
DATA94	-2.81 (-1.37)	2.51 (0.27)
DATA95	-7.48 (-3.56)***	-8.96 (-1.42)
DATA96	-5.73*** (-2.77)	-
Telec94	-0.076 (-0.006)	28.62 (1.34)
Telec95	-11.39 (-0.94)	24.41* (1.80)
Telec96	-3.89 (-0.33)	-
Constant	9.26*** (8.04)	-0.58 (-0.14)
R2	0.01	0.05
F-value	17.43	7.56
Number of observations	29393	7150

Note: Firms reporting a growth in the number of employees exceeding 500 per cent are excluded.
Source: Statistics Sweden and own calculations. t-values in parentheses. ***, **, * the coefficient is significant at the 1 per cent, 5 per cent and 10 per cent level respectively.

5. Concluding remarks

The paper introduces the theory of the Experimentally Organised Economy (EOE) and Competence Blocs, which emphasises the experimental character of the economic process and the role of human embodied knowledge. Industrial dynamism and economic growth requires the presence of human actors with different but supplementary competencies, e.g. entrepreneurs and venture capitalists, interacting in a competence bloc to identify, expand and exploit business opportunities. According to the theory small sized and younger firms have a more flexible organisation that make them better for adjusting to new conditions and exploiting new business opportunities. The paper tests the hypotheses that age (old firms) and size (large firms) have a negative effect on firm growth by the OLS estimation technique. The paper uses an extensive data set including all firms classified as IT firms in Sweden in 1993 to 1997. The data set includes financial (income statement and balance sheet) data as well as a number of other variables for the individual firms. Financial data were unfortunately not collected for all firms in 1993 and 1994. We therefore run two regressions: The first includes all firms but no financial variables. The second includes financial data, but not all firms. Almost all explanatory variables show the expected sign in the analysis, e.g. profit and increased profit have a significant positive effect while taxes and increased taxes have a significant negative effect on firm growth. Furthermore, the results point in the direction that governmentally ownership of firms seems to have a negative effect on firm growth. The results also show that age has a negative effect on firm growth. The hypothesis that size has no effect on firm growth is accepted, however. The results thus support the hypothesis that younger firms are more competitive but do not lend support to the idea that size is important for explaining firm growth. The results indicate that new entry (young firms) is important for industrial dynamism and expanding industries. The explanatory power, R^2, is low in both regressions. This is

perhaps not surprising, since the theory entails many factors that affect firm growth that cannot easily be measured. A more adequate model should for example include data on innovativeness, the ability of management and the function of the competence bloc.

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Appendix

Table The Swedish IT industry in 1997, definition and size.

Industry code	*Industry*	*# of Employees*	*Per cent of the IT industry*
Manufacturing			
30010	Industry for office machinery	1,978	1.17
30020	Industry for computers and other information processing equipment	2,146	1.27
32100	Industry for electronic valves and tubes and other electronic components	4,651	2.74
32200	Industry for television and radio transmitters and apparatus for line telephony and line telegraphy	32,695	19.29
32300	Industry for television and radio receivers, sound or video recording or reproducing apparatus and associated goods	2,886	1.70
33200	Industry for instruments and appliances for measuring, checking, testing navigating and other purposes, except industrial process control equipment	12,165	7.18
33300	Industry for industrial process control equipment	1,466	0.86
Total: Manufacturing		**57,987**	**34.21**
Services			
	Trade with IT goods		
2233	Industry for the reproduction of computer media	87	0.05
51142	Agents involved in the sale of office machinery and computer equipment	191	0.11
51432	Wholesale of radio and television goods	1,452	0.86
5164	Wholesale of office and machinery and equipment	21,485	12.68
51653	Wholesale of telecommunication equipment and electronic components	6,561	3.87
52452	Radio and television stores	4,304	2.54
52493	Stores for computers, office machinery and computer programmes	1758	1.04
52494	Stores for telecommunication equipment	626	0.37
7133	Companies for renting office machinery and equipment including computers	663	0.39
Total: Trade with IT goods		**37,127**	**21.91**
	Networking operators		
64201	Network stations	26,993	15.93
64202	Broadcasting stations	882	0.52
64203	Cable television companies	366	0.22
Total: Telecommunication carriers		**28,241**	**16.66**
	Data consulting and data services		
721	Companies for renting of other land transport equipment	2,005	1.18
72201	Software consulting companies	28,282	16.69
72202	Software supply companies	7,313	4.31

723	Data processing companies	5,598	3.30
724	Data base companies	937	0.55
725	Repair shops for office accounting and computing machinery	1,485	0.88
726	Other data service companies	505	0.30
Total: Data consulting and data services		**46,125**	**27.22**
Total: Services		**111,493**	**65.79**
Total: IT industry		**169,480**	**100**

Source: Statistics Sweden.