Exit and Entry Over the Product Life Cycle: Evidence from the Swedish Manufacturing Industry

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ABSTRACT. In this paper the process of exit and entry of firms in the Swedish manufacturing industry is investigated within the framework of the product life cycle. The product life cycle theory explains how the high degree of uncertainty, as regards product designs and production methods, which is connected to the early stages of the product life cycle requires a high level of knowledge-intensity. Since uncertainty decrease over the product life cycle, less knowledge is needed in production during later stages of the product life cycle. This implies that knowledge-intensity differs for firms that exit and enter in different stages of the product life cycle. Four hypotheses regarding these relationships are stated and empirically tested in this paper, using data at the 5-digit SIC-level for the Swedish manufacturing industry during 1990–1996. The empirical results show that entrants in the early stages of the product life cycle are more knowledge-intensive than incumbent firms. It is also found that firms exiting in early stages of the product life cycle are more knowledge-intensive than firms exiting in later stages.

1. Introduction

Exit and entry of firms are fundamental elements of the structural development of different industries. Innovations and technical change are very important for a firm's decision to exit or enter the market. The mechanism of innovation and technical change can be explained by three activities. A firm can introduce a new technology, imitate a existing technology or remove an obsolete technology. New technologies are often embodied in physical capital and hence the exit and entry of firms are fundamental aspects of industrial structural change. The establishment of new firms/plants may, for example, be the result of entrepreneurs commercialising their innovations, entrepreneurs imitating other entrepreneurs' innovations, or entrepreneurs discovering new opportunities, due to changes in demand and profit opportunities. These forces are also important for the exit decisions of firms. When the production technique and/or the product becomes obsolete, demand declines, profits decrease and eventually firms has to consider exiting the market.

The process of structural change can be investigated in connection with the framework of the product life cycle theory. Aspects the life cycle concept was introduced during the early decades of the 20th century (e.g. Kuznets, 1929; Schumpeter, 1939), but the probably most important contributions were made during the 1960s by economists such as Vernon (1966) and Hirsch (1967). The product life cycle describes the development of a product from innovation and introduction to the death of the product. During the life of a product, demand for different types of inputs such as knowledge and labour skills changes (Vernon, 1966). Firms that recently introduced a new technology or product are, for example, expected to need more qualified personnel than firms producing standardised products. This implies that firms that enter and exit the market in different phases of the product life cycle reveal different characteristics concerning the knowledge-intensity and skills of their employees. The objective of this paper is to analyse the exit and entry of firms within a product life cycle theory framework with special reference to innovation and knowledge-intensity.

This paper is organised as follows: Section 2 presents the theoretical framework. In particular

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the dynamics of exit and entry are connected to theories of the product life cycle and the labour skill characteristics over the cycle. The theoretical discussion results in five hypotheses regarding the connection between exit, entry and knowledge-intensity of firms. Section 3 describes the method, data and the empirical analysis. Conclusions and suggestions for future research are finally presented in Section 4.

2. The entry and exit of firms – a product life cycle framework

The purpose of this section is to analyse the theoretical aspects of entry and exit in relation to the product life cycle. Subsection 2.1 discusses the product life cycle from a knowledge-intensity perspective. This is followed by a description of the pattern of exit and entry over the product life cycle.

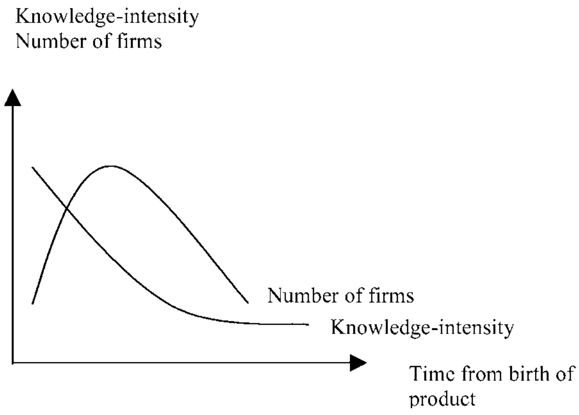
2.1. *Knowledge-intensity over the product life cycle*

The introduction of a new product on the market can basically be made in two different ways. A product can be either totally new to the market or it can be the result of a major change in an existing product. Irrespectively of the causes of the product innovation, the act of innovation is connected with fundamental uncertainty about, for example, customers' reactions and input requirements. When an innovator or early imitator enters the market he does not know which product design that is going to be the dominant design. The uncertainty connected to various aspects of the production and sales of a new product influence the characteristics and optimal structure of a firm within an industry in the early stage of the product life cycle. Magee (1977) clearly describes different aspects, such as information creation, skill intensities, other characteristics of production, the nature of the market, and appropriability, over the life cycle. In the early stages competition is intense and firms are usually small. The capital intensity in production is low and a lot of resources are instead devoted to R&D, customer contact, marketing, design improvements and equipment design. The intensity of skilled labour is of great importance during this stage.

In the early stages of the product life cycle customers have few possible suppliers to choose between and the demand for the product is therefore high in relation to what can be supplied by the market. Demand also tends to be both price and income inelastic. This, in connection to the absence of substitutes and perhaps the presence of patents, implies that the firms entering early in the product life cycle can benefit from market power and monopoly profits. However, some of the firms entering during early stages of the product life cycle, may not succeed in producing the dominant design and therefore might have to exit already before the product mature. The major force of competition during this early stage of the product life cycle is product competition, i.e. competition based upon product characteristics (Karlsson, 1988). The products in this early stage of the product life cycle can be characterised as non-standardised and the production and distribution tend to be non-routinised (Johansson and Andersson, 1998). We therefore expect the knowledge-intensity of innovating firms and imitators in the early stage of the product life cycle to be high.

The presence of monopoly profits creates incentives for more firms to enter the market. When the product becomes more and more standardised, firms can no longer entirely compete with product characteristics. When the new product and its characteristics becomes known to customers, the market expands gradually. In this stage customers become more and more sensitive to price, and over time the price decreases. During this later stage of the product life cycle the major type of competition is price competition (Karlsson, 1988). In order to compete with price most of the innovations during the later stages have the character of process innovations. The presence of economies of scale tend to result in larger firms, higher capital intensity, and a more concentrated industry structure (Magee, 1977). Initially the process innovation activities also require skilled labour but eventually the process technique also becomes standardised. Since process innovations often result in production techniques that can be operated by less skilled labour, we could expect knowledge-intensity also for this reason, to decrease over the product cycle. As the frequency of process innovations increases, earlier used production technologies become obsolete. For some of the more knowledge-intensive firms, variable cost of producing might be higher than price, and they have to consider the necessity of exit.

Figure 1 illustrates the process of the product life cycle in relation to the knowledge-intensity needed for production during different stages. To summarise the discussion above, this means that knowledge-intensity tends to be high in the early stage of the product life cycle, and that it decreases over time (Johansson and Karlsson, 1987).



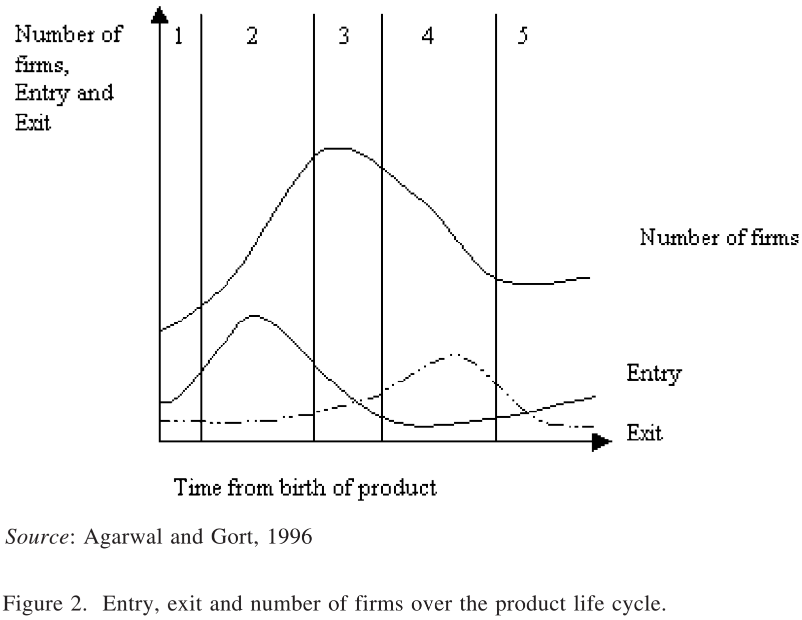
Source: Johansson and Karlsson, 1987

Figure 1. Number of firms and knowledge-intensity in a product life cycle perspective.

2.2. *Entry and exit of firms over the product life cycle*

In this section we present a theoretical framework that makes it possible to identify in which stage of the product life cycle different industries are positioned. A first step towards connecting the exit and entry of firms to the product life cycle perspective is to determine the patterns of entry and exit over the cycle. Figure 2 describes market development, exit and entry during the five phases that can be identified during the product life cycle (Gort and Klepper, 1982; Agarwal and Gort, 1996). In the first stage a new product is introduced and the number of producers is low. Net entry is positive and increasing. Eventually demand and supply increases rapidly (stage 2) and the number of producers increases significantly. By the end of the period, exits increase due to stronger price competition. Stage 3 is characterised by a temporal equality of entrants and exits. In stage 4 exits exceed entry and this stage is known as the "shakeout period". In stage 5 the market is considered as mature.

To summarise the above it seems as if net entry tends to be positive in early stages and negative in later stages of the product life cycle. This



Source: Agarwal and Gort, 1996

Figure 2. Entry, exit and number of firms over the product life cycle.

assumption makes it possible for us to identify the position of various industries in the different stages of the product life cycle.

2.3. *Hypotheses*

The description above can be concluded by stating some hypotheses about what to expect concerning the knowledge-intensity of firms during different stages of the product life cycle. We claimed that innovating firms need a high share of skilled labour to be able to handle the high degree of uncertainty connected to the early stages of the product life cycle. We also claimed that the major force of competition during early stages of the product cycle is product competition, and in order to outcompete existing firms by means of more advanced products, new firms must be more knowledge-intensive. We can therefore state the following hypotheses:

Hypothesis 1: Firms that enter the market during the early stages of the product life cycle are more knowledge-intensive than incumbents.

It is important here to note that this hypothesis concerns product and/or technology renewal. If the product was totally new on the market there would be no incumbent firms and we would therefore not be able to compare the knowledge-intensity between these two types of firms. The product life cycle approach can be applied to industries that in most cases would be considered as mature, since they still exhibit different evolutionary stages. For example, the obsolescence of a design or a change in technology used to produce a good, in a basically mature industry, may still initiate a new evolutionary stage (van Dijk, 2000).

During later stages of the product life cycle firms mainly compete with the product price. In order to outcompete existing firms new firms must compete with lower costs and one way to accomplish that is to use less qualified employees in the production. We therefore expect that:

Hypothesis 2: Firms that enter the market during later stages of the product life cycle are less knowledge-intensive than incumbents.

Due to the product competition, and the development of a dominant design, in the early stages of the product life cycle we also expect that:

Hypothesis 3: Firms that exit in earlier stages of the product life cycle are more knowledge-intensive than firms that exit in later stages.

For the same reasons we predict that:

Hypothesis 4: Firms that enter in earlier stages of the product life cycle are more knowledge-intensive than firms that enter in later stages.

At this stage it might be motivated to say a few words to clarify the differences and similarities between the four hypotheses. Hypotheses 1 and 2 *compare the group* of entrants with incumbent firms, while hypotheses 3 and 4 compare the knowledge-intensity *within the group* of entering and exiting firms respectively.

3 Data and empirical analysis

3.1. *Method and data*

The data used in this paper is collected by Statistics Sweden and covers all plants in the Swedish manufacturing industry with more than 10 employees. For plants with less than 10 employees a sample of plants is included. The dataset includes, for example, data on the number of employees, sales value, value added and labour costs. The data is collected for plants on a 5-digit SIC-code level. The disaggregated industrial classification on 5-digit level corresponds to a great extent to what would be called a product and not a industry. Some examples might help us to understand how disaggregated the data is on the 5-digit level. Manufacture of cutlery and manufacture of pumps and compressors are examples of industries that are reported separately on the 5-digit SIC-level. The dataset consists of about 280 different sectors and the total number of observations counts to about 8000 plants each year. The data covers the period 1990–1996. Comparable data for the years before 1990 and after 1996 does unfortunately not exist because of changes in industrial classification and data collection methods. This relatively short time span for the data does not make it possible for us to investigate the full evolution over the product life cycle. Quite the contrary, it is most likely that most of the sectors studied would have reached the maturity stage in terms of the product life cycle.

In line with the reasoning of van Dijk (2000), as mentioned in Section 2, industries that could be considered as mature still exhibit different evolutionary stages and our aim is to investigate our hypotheses from this perspective.

In the dataset information on individual plants are reported and each plant is assigned an individual identification number. It is therefore possible to identify gross entry and exit of plants. There can be many reasons for a new plant to enter. First of all a totally new firm might enter (greenfield entry) or an already existing firm might want to increase their production capacity, expand the geographical market, or diversify their activities. An exit is reported when the identification number disappear. This is something that happens when a plant ceases to exist (closedown exit). When a plant totally changes production/ activity to an activity that is not covered by the collection method used for this data source this is also reported as an exit. An example of this is when a manufacturing plant becomes a plant involved in producing services. It is important to note the distinction between a firm, which is a legal entity, and a plant which refers to a production entity. This means that the plants identification number is connected to the geographical location of the plant and therefore the identification number will not change even if firms are merging or changing owners, which is an advantage in our empirical analysis since we are interested in analysing the dynamics of the production. In line with most of the product life cycle literature we will talk about firms when discussing these issues further, even though our operationalisation of the theory in the empirical analysis consist of plant data.

The measure for knowledge-intensity available is the value of salaries to white collar workers as a percentage of total labour costs. The higher share of white-collar salaries of total labour costs, the higher the expected knowledge-intensity. In order to analyse how this measure of knowledge-intensity performs in relation to other measures of knowledge-intensity used in the empirical work, a regression with our knowledge-intensity measure as dependent variable and the share of university educated employees at the 5-digit SIC-level was performed. The regression showed at significant relationship between those two measures. The result of this regression is presented in appendix B.

In order to identify the different stages of the product life cycle, all industries at the 5-digit SIC-code level in the manufacturing sector were allocated to one of 6 groups. This is one way of operationalising the five stages in the product life cycle described in Section 2.2. The characterisation was made according to the assumption stated earlier, that different stages of the product life cycle show different patterns of exit and entry. Early phases of the product life cycle show a positive net entry whereas entries are less than exits in the later stages of the product life cycle. Hence, it is possible to allocate industries into six different groups depending upon their different patterns of net entry. Group 1 had positive net entry all but one year during the studied period. Group 2 had positive net entries all but two years, and so on. Group 6 is corresponding to industries that had a negative net entry during the whole period. Group 1–3 is regarded as industries working in the earlier phases of the product life cycle and group 4–6 are supposed to be declining industries. What kind of industries do we identify in the different stages of the product cycle? Among the industries in the early stage we find, for example, sectors within the publishing, printing and reproduction of recorded media industry (SIC-code 22). Less successful are sectors, for example, in the manufacture of fabricated metal products and manufacture of machinery and equipment (SIC-code 28 and 29). Appendix A provides an overall description of the data material.

It is important to note that the Swedish economy experienced an exceptional period during the 1990s. The early 1990s were characterized by a deep recession whereas the economy was recovering from the mid 1990s. The result of this turbulent times in terms of plant entry and exit can be seen in Appendix A and is also the reason for why we have chosen to study each year separately in our analysis.

3.2. *Empirical results*

To test our hypotheses we use regression analysis using ordinary least squares (OLS). Breusch-Pagan tests for the different equations showed that the regressions suffered from hetroscedasticity and therefore Whites hetroscedasticity consistent estimator was applied (Greene, 1997). In this section the specification of the regressions and the empirical results from testing the hypotheses are presented.

Our first hypothesis stated that firms that enter the market during the early stages of the product life cycle are more knowledge-intensive than incumbents. This proposition can be empirically tested by applying the relationship formulated in Equation 1, where the subset of industries that were identified as being in the initial stages of the product life cycle (stage one to three) was included in the regression.

$$KI_{ij} = \beta_1 + \beta_2 D + \beta_3 \overline{KI}_j + \varepsilon \qquad (1)$$

were KI_{ij} is the knowledge-intensity in firm i in industry j, where j represent an industry at the 5-digit SIC-level, D is a dummy variable taking the value 1 if the firm is an entering firm, 0 otherwise and $\overline{KI}_j$ is the average knowledge-intensity in industry j. This variable intends to control for industry specific differences in knowledge-intensity. Since entrants are expected to be more knowledge-intensive than incumbents, we expect a positive sign for the entry dummy variable parameter. ε is the error term and $\varepsilon \sim N(0, \sigma^2)$.

Table I show that entrants are more knowledge-intensive than incumbents during four of the six years studied, since the entry variable have the expected positive sign and is significant at least at the 10 per cent level in three cases. As expected the average knowledge-intensity in the industry is a very important variable explaining the knowledge-intensity in the individual firm, a relationship that, as we shall see later, also can be observed in the regressions testing the other three hypotheses.

Equation 1 presented above can also be used when testing our second hypothesis stating that firms that enter the market during later stages of the product life cycle are less knowledge-intensive than incumbents. When testing this hypothesis we use the subset of industries identified as belonging to later stages in the product life cycle (stage four to six) For this subset we expect a negative sign for the entry dummy variable since knowledge-intensity is expected to be lower in entering firms in these stages of the product life cycle.

The result of this regression is presented in Table II. When interpreting these results we first of all observe that there are no consistent patterns regarding the signs of the entry variable parameter. Secondly we observe that the variable is only significant at the 5 percent level for one year (1993).

TABLE I
Knowledge-intensity in entering firms compared to incumbent firms during the early stages of the product life cycle

Coefficient	1991	1992	1993	1994	1995	1996
Constant	9.765×10^{-4}	1.597×10^{-2}	4.565×10^{-5}	-1.949×10^{-3}	-2.139×10^{-3}	-1.224×10^{-3}
Std. error	7.458×10^{-3}	6.944×10^{-3}	7.677×10^{-3}	7.298×10^{-3}	7.019×10^{-3}	6.139×10^{-3}
t-value	0.131	2.230	0.006	–0.267	–0.305	–0.200
p-value	0.8958	0.021	0.995	0.789	0.761	0.842
Entry	-1.035×10^{-2}	8.600×10^{-2}	-1.019×10^{-2}	1.779×10^{-2}	1.594×10^{-2}	9.470×10^{-3}
Std. error	6.024×10^{-3}	1.132×10^{-2}	9.708×10^{-3}	9.478×10^{-3}	8.402×10^{-3}	7.338×10^{-3}
t-value	–1.719	7.5947	–1.050	1.876	1.897	1.291
p-value	0.086	0.000	0.294	0.061	0.058	0.197
Average knowledge intensity	1.002	0.908	1.004	1.001	1.001	1.000
Std. error	0.034	0.029	0.031	0.030	0.029	0.027
t-value	29.513	30.960	32.167	33.528	34.031	37.627
p-value	0.000	0.000	0.000	0.000	0.000	0.000
R^2 (adj.)	0.316	0.436	0.376	0.372	0.373	0.408
N	2984	2845	2729	2826	3025	3201

TABLE II
Knowledge-intensity in entering firms compared to incumbent firms during the later stages of the product life cycle

Coefficient	1991	1992	1993	1994	1995	1996
Constant	-6.611×10^{-4}	-4.643×10^{-5}	1.031×10^{-3}	5.066×10^{-4}	2.125×10^{-4}	3.110×10^{-5}
Std. error	6.373×10^{-3}	6.518×10^{-3}	7.028×10^{-3}	6.459×10^{-3}	6.189×10^{-3}	5.824×10^{-3}
t-value	–0.104	–0.007	0.171	0.078	0.034	–0.005
p-value	0.917	0.994	0.864	0.937	0.973	0.996
Entry	6.308×10^{-3}	4.134×10^{-3}	2.024×10^{-2}	-7.374×10^{-3}	-2.684×10^{-3}	3.187×10^{-4}
Std. error	4.325×10^{-3}	7.933×10^{-3}	7.810×10^{-3}	6.229×10^{-3}	7.032×10^{-3}	6.996×10^{-3}
t-value	1.458	0.521	2.591	–1.184	–0.382	0.045
p-value	0.145	0.602	0.001	0.236	0.703	0.963
Average knowledge intensity	1.000	0.999	0.990	1.000	1.000	1.000
Std. Error	0.029	0.028	0.028	0.026	0.026	0.024
t-value	34.715	35.603	34.914	38.048	38.030	40.073
p-value	0.000	0.000	0.000	0.000	0.000	0.000
R^2 (adj.)	0.248	0.250	0.284	0.312	0.307	0.321
N	6122	5727	5227	5233	5291	5314

Therefore we conclude that there are no clear patterns regarding the knowledge-intensity of firms that enter during the later stages of the product life cycle.

Hypothesis three stated that firms that exit in earlier stages of the product life cycle are more knowledge-intensive than firms that exit in later stages. A regression testing for this relationship can be formulated as follows:

$$KI_{ij} = \beta_1 + \beta_2 S_j + \beta_3 \overline{KI}_j + \varepsilon \tag{2}$$

where KI_{ij} is the knowledge-intensity in firm i in industry j, S_j is the variable describing the stage of the product life cycle in industry j and is defined as the average of the ratio between entry and exits during the 6 years in industry j. The value of this continuous variable is high (and larger than 1) if the industry is in an initial stage of the product life and low (less than zero) if the industry belongs to the later stages of the product life cycle. Also in this regression $\overline{KI}_j$, the average knowledge-intensity in industry j is included, capturing industry differences in knowledge-intensity. ε is the error term and $\varepsilon \sim N(0, \sigma^2)$. We expect a positive sign for the product life cycle stage parameter since we expect exiting firms in the initial stages to be more knowledge-intensive than in the later stages.

The empirical result presented in Table III show that during five of the six years the product life cycle variable has the expected positive sign. Three of these years the parameters are also significant at the 5 per cent level. Our conclusion is therefore that there is some evidence that exiting firms in initial stages are more knowledge-intensive than in later stages.

According to hypothesis four firms that enter in earlier stages of the product life cycle are more knowledge-intensive than firms that enter in later stages. This hypothesis can also be tested using Equation 2 presented above, including all entering firms in the regression. The parameter sign of the product life cycle stage variable is expected to be positive.

Table IV presents the results of this regression and show no clear results. The product life cycle stage parameter have ambiguous signs and are actually negative during four years but only negatively significant at the 5 percent level during one year.

4. Conclusions and suggestions for future research

In this paper we have investigated the patterns of knowledge-intensity in entering and exiting firms

TABLE III
Knowledge-intensity in exiting firms over the product life cycle

Coefficient	1991	1992	1993	1994	1995	1996
Constant	0.032	0.055	0.045	0.069	0.019	0.009
Std. error	0.015	0.016	0.014	0.024	0.024	0.021
t-value	2.183	3.336	3.286	2.916	0.775	0.429
p-value	0.029	0.001	0.001	0.004	0.438	0.668
Product life cycle stage	0.004	–0.007	0.023	0.059	0.048	0.019
Std. error	0.008	0.011	0.009	0.018	0.021	0.014
t-value	0.552	–0.628	2.622	3.214	2.329	1.287
p-value	0.581	0.530	0.009	0.001	0.020	0.198
Average knowledge intensity	0.808	0.709	0.715	0.688	0.813	0.987
Std. Error	0.063	0.062	0.058	0.089	0.091	0.068
t-value	12.785	11.395	14.700	7.705	8.952	14.505
p-value	0.000	0.000	0.000	0.000	0.000	0.000
R^2 (adj.)	0.169	0.141	0.227	0.168	0.255	0.314
N	1408	1212	1294	674	503	589

TABLE IV
Knowledge-intensity in entering firms over the product life cycle

Coefficient	1991	1992	1993	1994	1995	1996
Constant	0.134	–0.066	0.014	–0.0324	–0.034	–0.014
Std. error	0.013	0.020	0.015	0.018	0.016	0.014
t-value	9.969	–3.245	0.875	–1.804	–2.100	–0.947
p-value	0.000	0.001	0.381	0.071	0.036	0.343
Product life cycle stage	-1.252×10^{-3}	5.899×10^{-3}	-8.667×10^{-3}	-2.280×10^{-3}	4.426×10^{-3}	-3.525×10^{-4}
Std. error	1.224×10^{-3}	2.018×10^{-3}	2.047×10^{-3}	3.537×10^{-3}	2.467×10^{-3}	2.848×10^{-3}
t-value	–1.022	2.922	–4.233	–0.064	1.793	–0.123
p-value	0.306	0.003	0.000	0.519	0.073	0.901
Average knowledge intensity	0.455	1.242	1.052	1.144	1.108	1.073
Std. error	0.061	0.089	0.059	0.075	0.072	0.059
t-value	7.430	13.953	17.925	15.314	15.415	18.284
p-value	0.000	0.000	0.000	0.000	0.000	0.000
R^2 (adj.)	0.070	0.480	0.364	0.317	0.347	0.356
N	1182	676	688	743	788	791

over the product life cycle. The empirical results show that knowledge-intensity in firms in the initial stage of the product life cycle are higher than in incumbent firms, but that the knowledge-intensity in entering firms does not seem to decline over the product life cycle. There are at least two possible explanations to these results. A first interpretation concerns the importance of process innovations. It might be the case that product innovations to some extent are of great importance during the whole product life cycle, implying that process innovations are mainly made by incumbent firms. This is indirectly what Klepper (1996) suggests, since he states that the most recent entrants account for a disproportional large share of the product innovations made. This relationship is also supported by empirical studies by, for example, Utterback and Abernathy (1975). Also Baldwin and Johnson (1999), suggest that product innovation is equally important in new and mature markets, but that process innovation tend to be more important in mature markets. The importance of product innovations in all stages of the product life cycle can also be illustrated by the fact that we could not find empirical evidence supporting our fourth hypothesis, i.e the knowledge-intensity in entering firms does not seem to decrease over the product life cycle. The second explanation to why entering firms in later stages of the product life cycle are not less knowledge-intensive might be that costs and skill requirements during the start up stage of the firm are of such great importance that it tends to increase knowledge-intensity for entrants also in the later stages of the product life cycle. The presence of "learning by doing economies" would also give such results.

The empirical analysis of our third hypothesis confirmed our expectations that exiting firms in the initial stages of the product life cycle are more knowledge-intensive than those who exit in later stages. This result illustrates the importance for firms to produce the design that will become the dominant design. Firms exiting in the early stages have despite their investments in knowledge-intensive activities, such as product design, apparently not succeeded in producing a product that attracts customers.

Regarding future research there are some methodological refinements that would be interesting and perhaps necessary to do. Of course it would be interesting to study exits and entries over a longer time period. Another aspect of the method used is that it does not account for different lengths of the product life cycles.

According to earlier research some technologies do not follow the pattern of the product life cycle (e.g. Pavitt and Rothwell, 1976). Therefore it would be interesting, in the empirical analysis, to distinguish between industries that do follow the product life cycle, and industries that do not.

Appendix A: Number of observations incumbents, entries and exits 1991–1996

	Stage	1991	1992	1993	1994	1995	1996
Incumbents	1	54	63	56	83	87	103
Incumbents	2	445	447	429	443	476	554
Incumbents	3	2039	2015	1958	2022	2095	2163
Incumbents	4	2525	2537	2290	2212	2314	2367
Incumbents	5	1570	1559	1424	1406	1433	1428
Incumbents	6	1295	1246	1122	1126	1126	1114
Total incumbents		**7928**	**7867**	**7279**	**7292**	**7531**	**7729**
Entry	1	14	5	31	12	22	17
Entry	2	145	24	52	71	128	130
Entry	3	291	262	205	199	218	238
Entry	4	388	208	177	265	234	207
Entry	5	213	121	126	137	122	154
Entry	6	135	57	100	63	66	49
Total entry		**1186**	**677**	**691**	**747**	**790**	**795**
Exit	1	11	5	12	4	8	6
Exit	2	115	113	72	38	38	50
Exit	3	363	315	319	141	126	150
Exit	4	439	376	455	255	163	181
Exit	5	264	224	256	144	110	127
Exit	6	218	184	181	96	63	78
Total exit		**1410**	**1217**	**1295**	**678**	**508**	**592**

Appendix B: OLS estimate on the relationship between knowledge-intensity measures.

	Coefficients	Std. error	*t*-value	*p*-value	R^2 (adj.)	N
Constant	0.195	0.008	23.632	0.000	0.340	270
Share of employees with university degree	0.641	0.054	11.824	0.00		

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