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Typologies of Innovation
in Small and Medium Sized
Enterprises in Norway

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Table of contents

Index of figures and tables

1. Introduction: typologies of SMEs

This paper asks whether we can find regularities, or typologies, of innovation within the extremely complex mix of small firms which is found in all market economies. The population of firms in advanced economies usually consists of a relatively small number of large enterprises - which are responsible for a relatively large share of output, employment and R&D - and very large numbers of SMEs. Policy-makers are interested in SMEs for two main reasons. First, the SME sector is, in many OECD economies, a net job creator. Second, it is often argued that SMEs are actual or potential sources of radical innovation and growth. At the same time, SMEs may face problems and obstacles which justify policy support.

However major problems for analysis and policy arise from the fact that SMEs, in all economies, exhibit a great deal of diversity and heterogeneity. For policy-makers, diversity gives rise to fundamental difficulties about the appropriate target groups for policy. One important but often neglected fact is that highly-innovative SMEs are not necessarily found only in so-called high-technology sectors of the economy. Although SMEs in high-tech industries are usually innovative and technologically advanced, it is also possible for a firm to possess these qualities in a so-called 'low-tech' or mature industry. There is usually considerable variety among the firms within any industry, and many economic activities can give rise to high-performing and innovative firms. This suggests the possibility of identifying innovative small firms by looking at the innovation-relevant characteristics of such firms, rather than focusing only on the industries or activities in which they operate.

From the point of view of policy design it is important to reduce the amount of variety in the SME population in sensible ways, so that different types of innovative firms can be identified across whatever sectors they are operating in. This is particularly the case for Norway, which has many SMEs operating in sectors which are often regarded as low-technology or traditional, and which do not receive much policy attention.

How can we make a reasonable typology of SMEs? When this problem is approached at all, it is usually either on the basis of case studies, which are not necessarily generalisable, or more simply on the basis of pure speculation. Our view is that the problem of firm typologies should be approached via careful empirical analysis of the small firm population, based on analysis of large and properly-constructed samples. It is this which is attempted in this paper. This paper offers an empirical approach to identifying different modes of innovation activity among small and medium sized enterprises (SMEs). We use data from the Norwegian Innovation Survey to look at the real patterns of diversity and variation which can be found in both innovating and non-innovating SMEs in Norway.

2. The data

In this paper we focus on innovation activity in the form of expenditures of innovation inputs in the Norwegian manufacturing sector. The data are from the Norwegian innovation survey of 1993. The main focus of the paper is on the relationship between innovation costs, their level and composition, and firms size: a key issue here is whether and to what extent small firms differ from large firms in their innovation expenditures and inputs. The analysis will be conducted at the firm level, based on a classification or typology of firms on the basis of innovation costs characteristics.

However, as an introduction to this analysis, we will first compare innovation costs across *industries*, using the *industries* as units of analysis.

Thus, the paper is divided into three parts. First there is an analysis comparing the level and composition of innovation costs across industries, conducted at the industry level. Second, we turn to the firm level of analysis and try to classify the firms on the basis of the level and composition of their innovation costs. We then see how all firms, regardless of size or industry, are distributed across the categories defined by this classification. Third, we examine how the distribution of firms according to this innovation cost classification varies across firm size categories.

These analyses should be extended to a comparison of industries at the firm level of analysis, where we examine how the distribution of *firms* according to the innovation cost classification varies across *industries*. Furthermore, we should proceed to a multivariate analysis, looking at the variation across combinations of industries and firm size categories. This, however, will not be done in the present paper. We will come back to these more complex relationships in a later paper.

We will distinguish between three types of innovation costs. First, there are R&D expenditures, or, more precisely, current expenditures on R&D. Second, there are current innovation expenditures which are not comprised under the heading R&D, or current non R&D innovation costs. These include product design, trial production, training and tooling-up, acquisition of products and licences, market analysis and other expenditures. Third, there are investments in relation to innovation, as for instance the acquisition of new technology through investment in new machinery and equipment.

Thus, our three principal innovation cost categories are current R&D costs, current non R&D innovation costs and investment costs. Investment costs may be thought of as representing a more passive way of innovating than the activities represented by the current innovation expenditures. In the case of innovative investment costs, the innovation or the new technology is *embodied* in the new equipment which is bought from others who have developed it, whereas the current innovation expenditures cover the innovative activities of people.

We should note that the investment figures we are dealing with here specifically refer to investments related to innovations. They do not cover all investment costs. In our sample as a whole, these innovative investments cover only about 25 per cent of all investments. Obviously, the remaining 75 per cent of investments are judged by the firms not to be connected with innovations.

In our data there are 873 firms of which we have information on both current R&D expenditures, current non R&D innovation expenditures and innovative investment expenditures. These 873 firms will constitute our sample in the following. Of these, 516 firms or 59.1 per cent, have no innovation costs at all. Consequently, 357 firms or 40.9 per cent of the firms in the sample report that they have innovation costs. We will mostly concentrate on these 357 firms, of course, but we will also in different ways include the rest of the firms in the sample in the comparisons we make. All innovation costs are for the year 1992, as are most other data in the survey.

3. Industry level analysis of variation in innovation costs across industries

We start with a comparison of innovation costs across industries, with the industries as the units of analysis.

We will divide the manufacturing sector into 15 different industries. In Table 1 below these industries are named, and the number of firms in each industry in our sample is given, as well as each industry's share of both total number of firms, of total sales and of total employment in the sample. Also, number of employees per firm in each industry is given. The sales figure is sales for 1992, the employment figure is number of people employed, in full-time equivalents, by the end of 1992.

Table 1. Number of firms in each industry, each industry's share of total number of firms, of total sales and of total employment, number of employees per firm in each industry.

		N	share of firms	share of sales	share of employ- ment	employ- ment per firm
1	Food, beverage and tobacco	166	19.0	21.6	15.5	87
2	Textiles, clothing	47	5.4	1.1	2.0	39
3	Wood products	99	11.3	3.4	4.4	42
4	Pulp and paper	17	1.9	7.1	5.8	315
5	Graphical industry	107	12.3	5.9	6.5	56
6	Chemicals	36	4.1	12.2	8.1	210
7	Pharmaceuticals	3	0.3	2.4	1.6	505
8	Mineral products	38	4.4	2.3	3.0	74
9	Metals	24	2.7	13.3	11.2	432
10	Metal products	114	13.1	3.3	7.2	58
11	Machinery	77	8.8	13.6	19.1	230
12	Transport equipment	75	8.6	8.1	8.3	102
13	Electronics	23	2.6	2.5	2.9	117
14	Electrical machinery, etc.	31	3.6	2.9	3.6	108
15	Other manufacturing	16	1.8	0.4	0.9	53
	Total	873	100	100	100	106

As we see from Table 1, the relative size or importance of the industries appears rather different when looked at from the point of view of the industries' shares of total sales or total employment than when looked at from the point of view of their shares of the firms. This obviously reflects variation in average size of firms across industries. This is most easily seen in the case of the share of employment, where we have also reported the average number of employees per firm in each industry. We find more similarity when we compare the different industries' share of sales to their share of employment. The distribution of total sales, though, has more complex

5

determinations, reflecting, among other things, differences in the composition of inputs across industries. Unfortunately, we have no value added figures.

It should be stressed that in this note we are characterizing the particular sample of firms which we are working with and do not try to generalize to the population of Norwegian manufacturing firms. In this connection it should be noted that large firms are systematically better represented in our sample than small firms, which means that industries in the population with a relatively high share of large firms will be better represented in the sample than industries with a relatively low share of large firms.

Note that there are only three firms in the pharmaceuticals industry in our sample. This, of course, makes it not very meaningful to characterize this industry statistically. However, the manufacturing industry is so special that we did not want to merge it with any other industry. Also, note that in terms of *sales*, the pharmaceuticals industry is not the smallest in the sample (and not even in terms of employment).

Let us now look at innovation costs. We will first look briefly at R&D expenditures, which is a classical indicator of innovation activities. We will focus on *R&D intensities*, which will be defined as R&D expenditures as a proportion to sales (since we do not have value added figures), expressed in percentages. The R&D intensity of all firms in the sample taken together is 1.4 per cent. Note that this is *not* the average R&D intensity across all the firms, but the total R&D expenditures as a proportion to total sales in the sample. In fact, it is a *weighted* average of R&D intensities across all firms, where the weights are defined by the sales figures. The *average* or *mean* R&D intensity is much smaller, namely 0.5 per cent, reflecting the fact that there is a clear tendency for R&D intensities to be higher for large firms than for small firms.

Let us now look at R&D intensities by industry, where again the intensities are the intensities of each industry as a whole, *not* the mean R&D intensity in each industry. These figures are reported in Table 2, below.

Table 2. R&D intensity by industry, R&D expenditures as a proportion to sales, per cent.

Pharmaceuticals	11.2
Electronics	8.5
Metals	2.0
Chemical products	1.6
Electrical machinery	1.3
Transport equipment	1.2
Machinery	1.0
Pulp and paper	0.9
Metal products	0.8
Other manufacturing	0.5
Food, beverage and tobacco	0.5
Mineral products	0.4
Textiles and clothing	0.3
Wood products	0.1
Graphical industry	0.1

We see that there are very substantial differences in R&D intensity across industries. The pharmaceuticals and electronics industries lie very much above the others. But the variation across the others is also very substantial, the metals industry having an R&D intensity about 20 times the R&D intensity of the wood products and the graphical industries. The mean of the distribution in Table 2 is 2.0 per cent, the standard deviation is 3.1 per cent, the coefficient of variation consequently 1.6.

Let us now broaden the perspective and consider these R&D expenditures in relation to the other innovation costs defined above. We define *total innovation costs* as the sum of current R&D expenditures, current non R&D innovation expenditures and innovative investment costs. In Figures 1a and 1b below we see how the industry R&D intensities reported in Table 2 are related to the share of total innovation costs which R&D expenditures represent.

Figure 1a. Share of R&D expenditures in innovation costs, per cent (x-axis) and R&D intensity, per cent (y-axis), by industry.
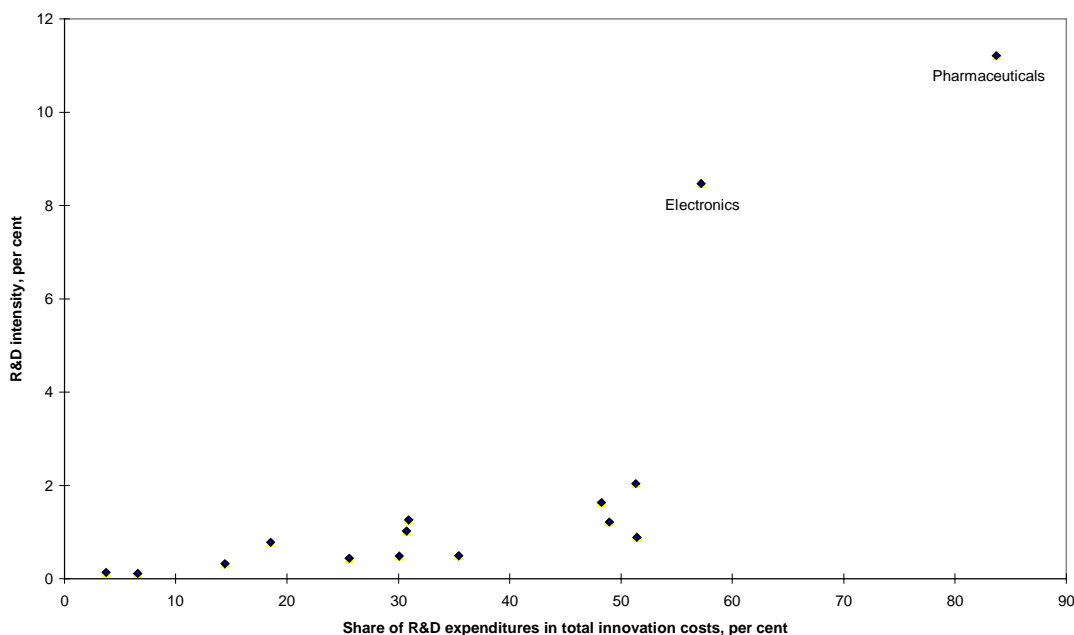
Since two of the industries, pharmaceuticals and electronics, are so different from the rest, we reproduce Figure 1a, but enlarge the scale on both axis to get a closer look at the other industries, in Figure 1b below.

Figure 1b. Share of R&D expenditures in innovation costs, per cent (x-axis) and
R&D intensity, per cent (y-axis), by industry. Detail of Figure 1a, electronics
and pharmaceuticals excluded.
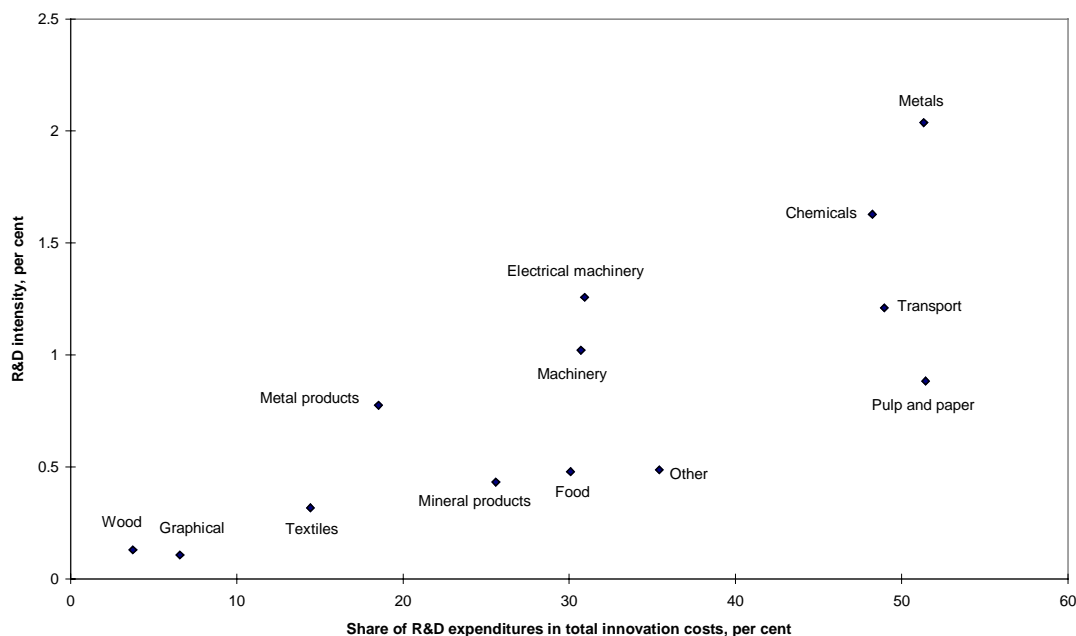
Figures 1a and 1b show that there is substantial variation across industries in the share of R&D expenditures in total innovation costs. There also emerges a clear tendency for R&D intensity and share of R&D expenditures in innovation costs to be positively correlated at the industry level. In fact, we have a correlation coefficient (r) between these two variables which is quite high, namely 0.77. For instance, for the three industries with the lowest R&D intensities, graphical industry, wood products and textiles and clothing, R&D expenditures also make up a very low share of their total innovation costs, in all three cases less than 15 per cent, in two of the cases less than 7 per cent. This means that just looking at R&D expenditures as an indicator will give a rather one-sided and thereby distorted picture of innovation activity at the industry level. To get a more accurate picture of innovation activities in different industries, we can start by looking at the *composition* of innovation costs, as well as their level or intensity.

Let us first just present the information contained in Figures 1a and 1b in another form, namely by looking at the R&D intensity and the intensity of the sum of the non R&D innovation costs, current and investment, at the industry level. The latter intensity is defined as the sum of innovation costs other than R&D as a proportion to sales. Figures 2a and 2b below show the relationship between R&D intensity and intensity of the remaining innovation costs at the industry level.

Figure 2a. R&D intensity, per cent (y-axis), and intensity of innovation costs other than R&D, per cent (x-axis).
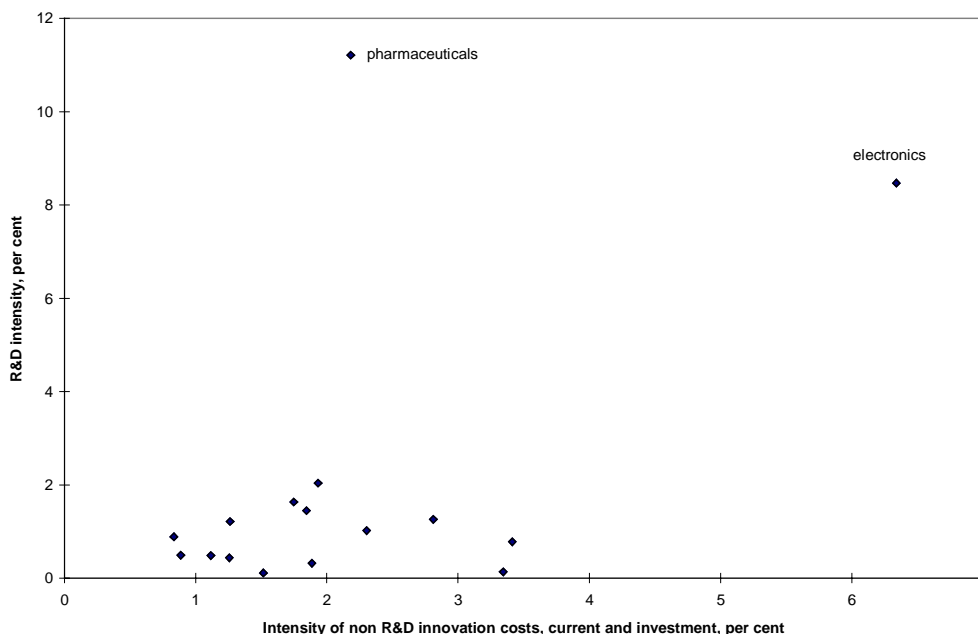
Again we choose to reproduce the above chart, but with enlarged scales, to get a closer look at industries other than the outliers electronics and pharmaceuticals. This we do in Figure 2b, below.

Figure 2b. R&D intensity, per cent (y-axis), and intensity of innovation costs other than R&D, per cent (x-axis). Detail of Figure 2a, electronics and pharmaceuticals excluded.
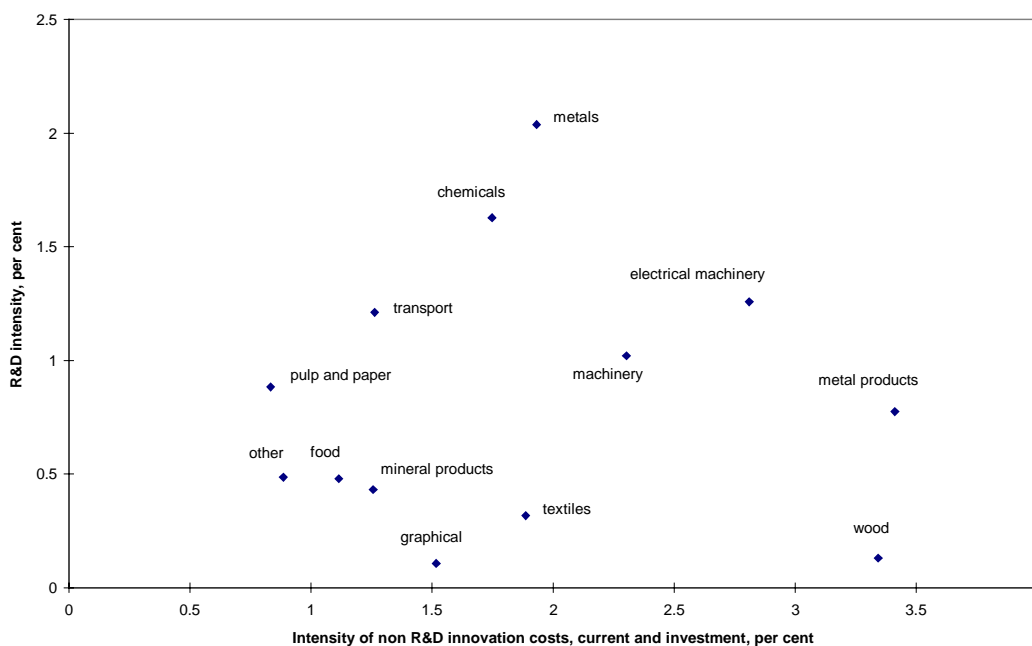
If we start with the two outlier industries, we see that the electronics industry is special also in that it has a very high intensity of innovation costs other than R&D,

almost twice as high as any other industry. Compared to the other industries, the pharmaceuticals industry, on the other hand, has a medium intensity of innovation costs other than R&D.

Turning to the 'normal' industries in Figure 2b, we see that none of the industries with relatively high R&D intensities have very low intensities of innovation expenditures other than R&D, but they do not have especially high intensities of innovation costs other than R&D either. Rather, industries with relatively high R&D intensities, such as metals and chemicals, tend to have medium intensities of innovation costs other than R&D. The wood products industry combines a high intensity of innovation costs other than R&D with a very low R&D intensity, while the metal products industry is high on innovation costs other than R&D and relatively low on R&D intensity. The electrical machinery and machinery industries tend towards medium-high on both dimensions, while the transport industry is medium on R&D intensity and relatively low on intensity of innovation costs other than R&D. Textiles and clothing and graphical products are medium on innovation costs other than R&D and very low on R&D, while food, beverages and tobacco, mineral products, pulp and paper, and the residual category other industries tend to be fairly low on both dimensions.

In the same manner as with the intensities already commented upon, let us define *innovation cost intensity* as total innovation costs as a proportion to sales. The above suggests that the distribution of total innovation cost intensities across industries is not as unequal as the distribution of R&D intensity. In Table 3, below, we have ranked the industries according to innovation cost intensity.

Table 3. Innovation cost intensity by industry, total innovation costs as a proportion to sales, per cent.

Electronics	14.8
Pharmaceuticals	13.4
Metal products	4.2
Electrical machinery	4.1
Metals	4.0
Wood products	3.5
Chemical products	3.4
Machinery	3.3
Transport equipment	2.5
Textiles and clothing	2.2
Pulp and paper	1.7
Mineral products	1.7
Graphical industry	1.6
Food, beverage and tobacco	1.6
Other manufacturing	1.4

The mean of this distribution is 4.2 per cent and the standard deviation is 4.0 per cent, which gives a coefficient of variation of 0.95. Thus, although the standard deviation is higher here than in the case of the R&D intensity distribution from Table 2, it has risen relatively less than the mean, which means that the coefficient of variation has gone down, from 1.6 to 0.95. Also, if we exclude the two outlier electronics and pharmaceuticals industries from both distributions, the relative

reduction in the coefficient of variation from the R&D intensity distribution to the innovation cost distribution is even more substantial, from 0.68 to 0.38.

In Table 4, below, the industries are also ranked according to their total innovation cost intensity. But here we have also given their rank number on all three components of the innovation cost intensity, namely R&D intensity, non R&D current innovation cost intensity (non R&D intensity) and innovative investment intensity.

Table 4. Ranks of industries according to, respectively, total innovation cost intensity, R&D intensity, non R&D current innovation cost intensity and innovative investment intensity.

	innovation cost int.	r&d int.	non r&d int.	investment int.
Electronics	1	2	1	4
Pharmaceuticals	2	1	4	9
Metal products	3	9	2	2
Electrical machinery	4	5	6	3
Metals	5	3	7	7
Wood products	6	14	9	1
Chemical products	7	4	15	5
Machinery	8	7	3	8
Transport equipment	9	6	8	14
Textiles and clothing	10	13	5	12
Pulp and paper	11	8	14	13
Mineral products	12	12	12	10
Graphical industry	13	15	11	6
Food, beverage and tobacco	14	11	13	11
Other manufacturing	15	10	10	15

We can compare this table to Figures 2a and 2b, where investment intensity and current non R&D innovation cost intensity where added together to form the x-axis. Some industries rank comparatively equally high on both these components, but this in no way applies to all. Wood products and chemical products rank very much higher on investment intensity than on current non R&D intensity, and to a lesser extent this also applies to graphical industry, and also to electrical machinery. On the other hand, textiles and clothing, transport equipment, machinery, pharmaceuticals and other manufacturing rank substantially higher on current non R&D intensity than on investment intensity. This also applies, to a lesser extent, to electronics.

Let us now try to summarize the innovation cost characteristics of the different industries by focusing, on the one hand, on the *level* of overall innovation costs, or more precisely on their intensity, and, on the other hand, on the *balance* between current innovation costs and innovative investment costs. This time, that is to say, we add together current R&D expenditures and current non R&D innovation expenditures, and contrast this with investment expenditures. In Figure 3a, below, we have located each industry according to its total innovation cost intensity and to the share of investment costs in total innovation costs. Thus, the lower the share of investment costs in total innovation costs, the higher the share of innovation costs which finances *disembodied* innovation activities, i.e. the innovation activities of people. Conversely, the higher the share of investment costs in total innovation costs,

the more innovation has the character of acquisition of new technology through the purchase of new machinery and equipment. Thus, in Figure 3a we may say that we contrast the *disembodied* and the *embodied* mode of innovation.

Figure 3a. Share of investment costs in total innovation costs, per cent (x-axis), and innovation cost intensity, per cent (y-axis), by industry.
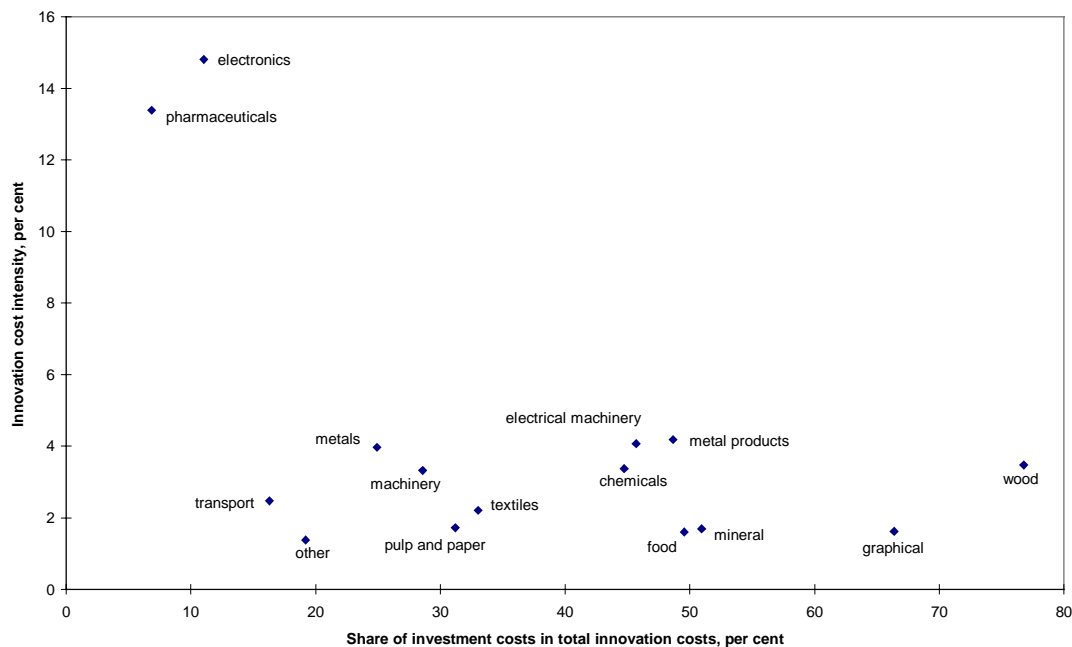
Once again, we choose to reproduce the above figure with enlarged scales (this time especially along the y-axis, only marginally along the x-axis), so as to get a closer look at the industries other than electronics and pharmaceuticals. This is done in Figure 3b, below.

Figure 3b. Share of investment costs in total innovation costs, per cent (x-axis), and innovation cost intensity, per cent (y-axis), by industry. Detail of Figure 3a, electronics and pharmaceuticals excluded.
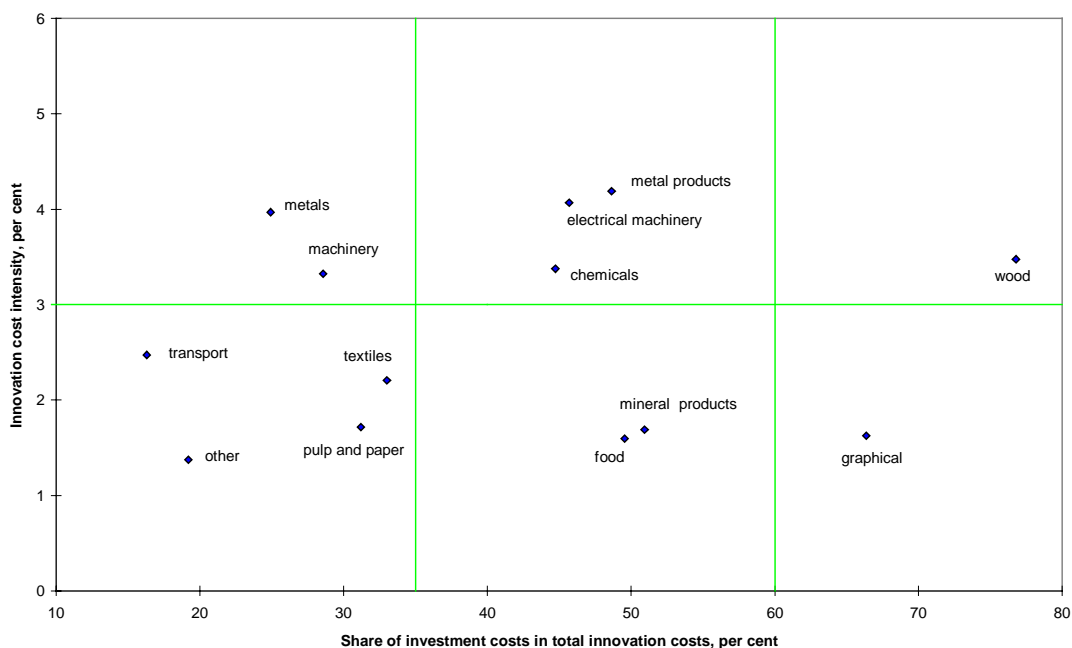
Let us try roughly to classify the industries according to their location on these two dimensions. As is evident from Figure 3a, electronics and pharmaceuticals immediately stand out as a separate group, both having very high innovation cost intensities, and both having their innovation costs very much dominated by expenditures covering disembodied innovation activities. We now turn to Figure 3b and look closer at the remaining 13 industries. Along the x-axis, we choose to divide the industries into three groups. There are five industries with a share of investment costs in their total innovation costs which is close to 50 per cent. Then there are two industries where this share is substantially higher, more than 65 per cent. Then there is a third group of six industries (in addition to electronics and pharmaceuticals) where this share is low, less than one third. Along the y-axis, we choose to divide the remaining industries into two groups. Setting the dividing line at an innovation cost intensity of 3 per cent, we get six industries with a medium innovation cost intensity and seven industries with a low innovation cost intensity.

By combining these classifications along both dimensions, we get a classification of the 15 industries into seven groups. These emerge from Figures 3a and 3b, above, and are summarized in Table 5, below.

Table 5. Classification of industries according to innovation cost intensity and according to share of investment costs in total innovation costs. Figures at industry level.

	innovation cost intensity	dominating mode of innovation	industries	N	share firms	share sales
1	very high	disembodied	electronics pharmaceuticals	26	3.0	4.9
2	medium	disembodied	metals machinery	101	11.6	26.9
3	medium	equal balance	metal products electrical machinery chemicals	181	20.7	18.5
4	medium	embodied	wood products	99	11.3	3.4
5	low	disembodied	transport equipment textiles and clothing pulp and paper other manufacturing	155	17.8	16.6
6	low	equal balance	mineral products food, beverage and tobacco	204	23.4	23.9
7	low	embodied	graphical industry	107	12.3	5.9
total				873	100	100

In the first group we have the two outlier industries *electronics* and *pharmaceuticals*. They have very high innovation cost intensity, and their innovation costs are dominated by expenditures on disembodied innovation activities. This group contains only 3 per cent of the firms in our sample, but 4.9 per cent of the sales. It is the smallest group in terms of the number of firms.

Turning now to the industries with medium innovation cost intensity, the second group consists of the industries with medium innovation cost intensity and with innovation costs dominated by expenditures on disembodied innovation activities. In this group we find two industries, *metals* and *machinery*. This is the largest group in terms of its share of the sales in the sample, with 26.9 per cent of all sales. However, because the average size of firms is quite large in this group, its share of the firms is far less, only 11.6 per cent.

The third group consists of industries with medium innovation cost intensity and with innovation costs having a roughly equal balance between expenditures on disembodied innovation activities and investment costs. Here we find three industries, *metal products*, *electrical machinery*, and *chemicals*. With 20.7 per cent of the firms and 18.5 per cent of total sales in the sample, it is the second largest in terms of number of firms and the third largest in terms of sales.

The fourth group consists of industries with medium innovation cost intensity and with innovation costs dominated by investment costs. There is only one industry here, *wood products*. This group is the smallest in terms of sales with only 3.4 per cent of total sales. Its share of the firms is much higher though, 11.3 per cent, the difference expressing that the average size of firms is very small here.

We now come to the industries with low innovation cost intensity. In the fifth group we have the industries with low innovation cost intensity and with innovation costs dominated by expenditures on disembodied innovation activities. They are four: *transport equipment*, *textiles and clothing*, *pulp and paper* and *other manufacturing*. The group's share of the firms in the sample is 17.8 per cent, its share of total sales is 16.6 per cent.

In group six we have the industries with low innovation cost intensity and with innovation costs having a roughly equal balance between expenditures on disembodied innovation activities and investment costs. There are two industries here, *mineral products* and *food, beverage and tobacco*. This is the largest group in terms of its share of the firms in the sample with 23.4 per cent, the second largest in terms of its share of total sales with 23.9 per cent.

Finally, in the seventh group we have the industries with low innovation cost intensity and with innovation costs dominated by investment costs. Here we also only have one industry, namely *graphical industry*. This group is very small in terms of its share of total sales, with 5.9 per cent, though not nearly as small in terms of its share of the firms in the sample, which is 12.3 per cent. Again, this discrepancy reflects the fact that the average size of firms is small in this group.

Thus, three of the seven groups are very small. This applies to the very high innovation cost intensity group containing the *electronics* and the *pharmaceuticals* industry. It also applies to the two groups whose innovation costs are dominated by investment costs. The bulk of the firms, and especially of the sales, are in the remaining four groups.

That not a very large share of the sales should come from industries where the innovation costs are dominated by investment costs, is perhaps not so surprising considering that in the sample as a whole only 32 per cent of the innovation costs are investment costs. Current innovation costs thus account for the remaining 68 per cent, of which 44 per is current R&D expenditures and 24 per cent is current non R&D innovation expenditures. On the other hand, it would not at all have been impossible for the 32 per cent of innovation costs represented by investment costs to have been distributed in such a way that a far larger share of total sales were represented by industries whose innovation costs were dominated by investment costs.

As we pointed out, in the classification of Figures 3a and 3b and Table 5 above, we have only distinguished between investment expenditures and expenditures on disembodied innovation activities. Thus, among industries with an equal share of their innovation costs accounted for by expenditures on disembodied innovation activities, we should also keep in mind that there may be substantial differences as to what extent these 'disembodied' expenditures are made up of R&D expenditures and

to what extent they are made up by non R&D innovation expenditures. For instance, *metals* and *machinery* both are in group 2 and thus have medium innovation cost intensity and innovation costs dominated by expenditures on disembodied innovation activities. However, in the *metals* industry 68 per cent of these 'disembodied' expenditures are R&D expenditures while 32 per cent are non R&D expenditures, whereas in the *machinery* industry only 43 per cent of these expenditures are R&D expenditures and 57 per cent are non R&D expenditures. Similarly, to take another example, the *pulp and paper* and *textiles and clothing* industries are in group 5 and consequently both have low innovation cost intensity and innovation costs dominated by expenditures on disembodied innovation activities. In the *pulp and paper* industry, 75 per cent of these 'disembodied' expenditures are R&D expenditures while 25 per cent are non R&D expenditures, whereas in the *textiles and clothing* industry only 22 per cent of these expenditures are R&D expenditures and 78 per cent are non R&D expenditures.

4. A classification of firms on the basis of innovation cost characteristics

Up to this point, we have carried out the analysis at the *industry* level. We have looked at innovation cost intensities and of the share of different innovation cost components in total innovation costs for each industry as a whole. Now, if these industry (weighted) averages were a result of most of the firms in each industry being relatively close to the respective industry averages, these figures at the industry level would describe each industry fairly comprehensibly in this respect. However, as we shall see, there is substantial *intra-industry variation* in these matters, i.e. there are substantial differences among firms in the same industry. Thus, for instance, from Figure 3b we see that for the *food, beverage and tobacco* industry as a whole there is roughly an equal balance between 'disembodied' and 'embodied' innovation costs. But how does this total come about? Does it come about because an overwhelming majority of the firms do have such a rough balance between these two components? Or do we rather have a very polarized situation, where half the firms have their innovation costs very much dominated by the 'disembodied' component and the other half an equal dominance of the investment component? Or are the firms more evenly distributed throughout this continuum (if, indeed, it is a continuum)? To what extent are these components complementary or alternative *at the firm level*?

Obviously, to answer these kinds of questions, the industry level of analysis is inadequate. Therefore, we now turn to the firm level of analysis. Thereby, we will also be able to give a more thorough charecterization of the different industries.

When we turn to the firm level, we will focus especially on the firms which have innovation costs. As we mentioned briefly at the beginning of the paper, almost 60 per cent of the firms in the sample have no innovation costs at all. There are 357 firms with innovation costs in the sample, and these make up 40.9 per cent of all firms.

Now, the different innovation cost intensities given above relate the different innovation costs to sales. Thus, to the sales of all firms is related the innovation costs of only a share of these firms. This means that if we wanted to know the innovation cost intensities among only those firms which have innovation costs, we would find higher intensities than the ones reported above. However, they would not be so much higher as the fact that only 40.9 per cent of the firms have innovation costs might make us believe, because the firms which have innovation costs are on average much larger than the firms which do not, so that while the 357 firms which have innovation costs only make up 40.9 per cent of the firms in the sample, they represent 79.2 per cent of all sales.

The share of firms which have innovation costs and the share of total sales which these firms represent both vary across industries. Table 6 below reports these shares.

Table 6. Firms with innovation firms, all firms, share of firms with innovation costs of all firms (per cent), and share of total sales represented by firms with innovation costs (per cent).

		firms with innovation costs	all firms	share of firms in industry with innovation costs	share of sales in industry by firms with innovation costs
1	Food, beverage and tobacco	61	166	36.7	79.9
2	Textiles and clothing	14	47	29.8	54.3
3	Wood products	29	99	29.3	43.8
4	Pulp and paper	11	17	64.7	94.4
5	Graphical industry	39	107	36.4	64.3
6	Chemical products	25	36	69.4	97.3
7	Pharmaceuticals	3	3	100	100
8	Mineral products	16	38	42.1	66.6
9	Metals	15	24	62.5	94.9
10	Metal products	41	114	36.0	70.4
11	Machinery	39	77	50.6	70.4
12	Transport equipment	27	75	36.0	46.8
13	Electronics	16	23	69.6	96.6
14	Electrical machinery	16	31	51.6	93.0
15	Other manufacturing	5	16	31.3	45.5
	Total	357	873	40.9	79.2

We said that for the manufacturing sector as a whole the firms with innovation costs represent a substantially higher share of total sales than of total firms. We now see that this also holds for each single industry (the only exception, of course, being *pharmaceuticals*, where all three firms have innovation costs).

We also see that both shares vary substantially across industries. The variation across industries in the share of sales accounted for by firms with innovation costs in no way, however, means that variation across industries in total innovation cost intensity is 'explained' by the variation in the share of sales represented by the firms which have innovation costs in each industry. In other words, even if we look at only firms with innovation costs, we still find substantial variation in innovation cost intensity across industries. Indeed, the correlation at the industry level between the share of sales represented by firms with innovation costs and innovation cost intensity is far from perfect. For instance, the industry with the lowest share of its sales accounted for by firms with innovation costs is *wood products*, where this share is 43.8 per cent. But having medium innovation cost intensity this industry is far from being the one with the lowest innovation cost intensity. Thus, if we were to include only the firms with innovation costs at the industry level analysis, the ranking of the industries according to innovation cost intensities would be somewhat different from the ones presented above. (For instance, the *wood products* industry would have ranked *third* behind *electronics* and *pharmaceuticals*.) However, a very important point in this connection is that there is very substantial intra-industry variation in innovation cost intensities, also among the firms which have innovation costs.

Let us then turn to the firm level. Mostly, we will here delimit the analysis to the 357 firms which have innovation costs. However, we will also in some of the analyses operate with the whole sample of 873 firms, where the firms without innovation costs will constitute one category.

We will now classify the firms with innovation costs according to the intensity of all the three components of innovation costs which we defined at the beginning of the paper: (current) R&D expenditures, (current) non R&D innovation expenditures and (innovative) investment expenditures. Let us refer to the corresponding intensities as R&D intensity, non R&D intensity and investment intensity, respectively.

We choose to dichotomize these three variables, each of them getting the two values *high* and *low*.

As the value which distinguishes between high and low, we have in each case chosen the cost intensity of the manufacturing sector as a whole, i.e. the total amount of the innovation cost in question as a proportion to total sales for all the firms in our sample taken as a whole. The R&D intensity for the sample as a whole is 1.44 per cent, the non R&D intensity is 0.79 per cent and the investment intensity is 1.05 per cent. Consequently, we have defined as having *high* R&D intensity those firms which have an R&D intensity of 1.5 per cent or more, as *high* non R&D intensity those firms which have a non R&D intensity of 0.8 per cent or more, and as *high* investment intensity those firms with an investment intensity of 1.1 per cent or more.

Table 7, below, shows how many firms have high R&D intensity, high non R&D intensity and high investment intensity, respectively. Their shares of firms with innovation costs and of all firms are also given.

Table 7. Number of firms with high R&D intensity, high non R&D intensity and high investment intensity. Their share of firms with innovation costs and of all firms.

	number of firms	share of firms with innovation costs	share of all firms
high R&D intensity	83	23.2	9.5
high non R&D intensity	185	51.8	21.2
high investment intensity	195	54.6	22.3

As we see, the distribution of R&D intensity appears to be far more unequal than both the distribution of non R&D intensity and of investment intensity. Only 23 per cent of the firms with innovation costs and 9.5 per cent of all firms have an R&D intensity above the weighted average of the sample as a whole, while the corresponding figures for both non R&D intensity and investment intensity are slightly above 50 per cent and slightly above 20 per cent, respectively.

Now, let us combine all three dichotomous variable into a simple typology. This gives a classification consisting of eight categories, as summarized in Table 8, below.

Table 8. Typology based on structure of innovation cost intensities, eight categories.

Category no.	R&D intensity	Non R&D intensity	Investment intensity
1	high	high	high
2	high	high	low
3	high	low	high
4	high	low	low
5	low	high	high
6	low	high	low
7	low	low	high
8	low	low	low

Only firms with innovation costs of some kind are included in this classification. *Low* intensity of any of the innovation cost types means that the innovation cost in question may be zero, subject to the condition that it cannot be zero on all three cost items, in which case the firm is either not included in the analyses or is included in a separate category consisting of the firms without innovation costs.

Now, since we are trying to construct a simple typology here, let us refer to these categories as *types*. Thus, in types 1, 2, 3 and 4 are found the firms with high R&D intensity, in types 1, 2, 5 and 6 are found the firms with high non R&D intensity, and in types 1, 3, 5 and 7 are found the firms with high investment intensity.

However, it turns out that the eighth type, consisting of firms with low intensity on all three cost dimensions, becomes quite large. We therefore choose to split this type in three new categories, types 8, 9 and 10. All have low intensity on all three cost dimensions, but with additional characteristics as follows:

In type 8, the costs are dominated by the "disembodied" dimension: the share of investment costs in total innovation costs is less than or equal to 30 per cent. In type 9, there is roughly an equal balance between "disembodied" and "embodied" costs: the share of investment costs in total innovation costs is more than 30 per cent but less than or equal to 60 per cent. In type 10, the "embodied" dimension dominates: the share of investment costs in total innovation costs is more than 60 per cent. The full classification is summarized in Table 9, below.

Table 9. Typology based on structure of innovation cost intensities, ten types.

Type no.	Structure of innovation cost intensities	Additional characteristic
1	HHH	
2	HHL	
3	HLH	
4	HLL	
5	LHH	
6	LHL	
7	LLH	
8	LLL-D	disembodied dimension dominates
9	LLL-B	rough balance disembodied/embodied
10	LLL-E	embodied dimension dominates

Let us now look at the distribution of firms with innovation costs firms according to this 10 type classification. In Table 10, below, the number of firms in each type as well as the share which these represent of all firms with innovation costs are given.

Table 10. Number and share of firms with innovation costs in each type.

Type no.	characteristics	number of firms	share, per cent
1	HHH	43	12.0
2	HHL	22	6.2
3	HLH	9	2.5
4	HLL	9	2.5
5	LHH	73	20.4
6	LHL	47	13.2
7	LLH	70	19.6
8	LLL-D	33	9.2
9	LLL-B	26	7.3
10	LLL-E	25	7.0
Sum		357	100

The same information is depicted graphically in Figure 4, below.

Figure 4. Share of firms with innovation costs in each type, per cent.
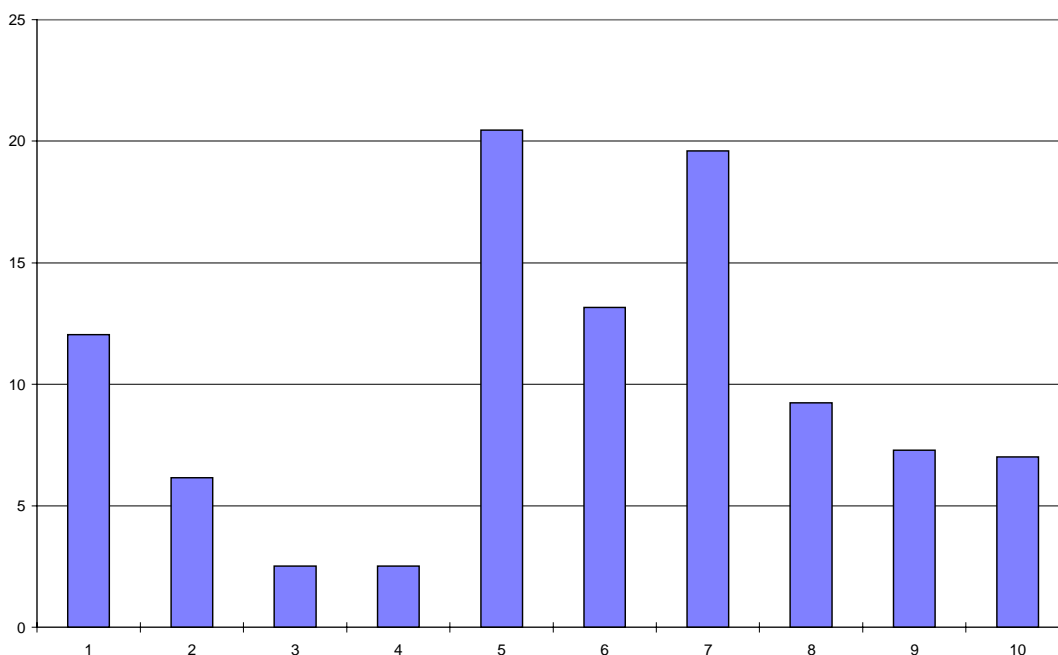
The two largest types, types nos. 5 and 7, both involve firms with high investment intensity. They are, respectively, the firms with high investment intensity *and* non R&D intensity (no. 5), and the firms with only high investment intensity (no. 7). Together they account for 40 per cent of the firms with innovation costs. The third largest type is type no. 6, firms which only have high non R&D intensity. The fourth largest type is no. 1, with the firms which have *high* on all three dimensions. If we had not split the type with *low* on all three dimensions, this would have been the largest type, with 23.5 per cent of the firms. Now, this type is divided into three types of roughly equal size, each with about 7-9 per cent of the firms. Type no. 2, with

high on R&D and non R&D, and low on investment, has about 6 per cent of the firms. The two smallest types, the two with high on R&D and low on non R&D, have only 9 firms or 2.5 per cent of the firms each.

Let us now see how large share of the firms are accounted for by the largest innovation cost types (in terms of number of firms). In Table 11, below, we have ranked the types according to number of firms, and we have shown the cumulative share of the firms accounted for by the successive types.

Table 11. Cumulative share of firms of innovation cost types ranked according to number of firms, all firms with innovation costs (N=357).

rank	type no.	character-istics	number of firms	share	cum. share
1	5	LHH	73	20.4	20.4
2	7	LLH	70	19.6	40.1
3	6	LHL	47	13.2	53.2
4	1	HHH	43	12.0	65.3
5	8	LLL-D	33	9.2	74.5
6	9	LLL-B	26	7.3	81.8
7	10	LLL-E	25	7.0	88.8
8	2	HHL	22	6.2	95.0
9	3	HLH	9	2.5	97.5
9	4	HLL	9	2.5	100

As we see, three innovation cost types account for over 50 per cent of the firms. With four types we have reached almost two thirds of the firms, with five times almost 75 per cent, and with six types more than 80 per cent.

Now, the picture gets somewhat altered if instead of the share of *firms* in each type we look at the share of *sales* which these firms represent. In Table 12, below, we compare the share of firms with the share of sales in each type.

Table 12. Number of firms, share of firms (per cent) and share of sales (per cent) in each type.

Type no.	characteristics	number of firms	share of firms, per cent	share of sales, per cent
1	HHH	43	12.0	11.6
2	HHL	22	6.2	15.6
3	HLH	9	2.5	7.5
4	HLL	9	2.5	2.3
5	LHH	73	20.4	4.4
6	LHL	47	13.2	3.8
7	LLH	70	19.6	13.7
8	LLL-D	33	9.2	18.3
9	LLL-B	26	7.3	9.8
10	LLL-E	25	7.0	13.0
Sum		357	100	100

Figure 5, below, makes the same comparison graphically.

Figure 5. Share of firms and share of sales in each type.
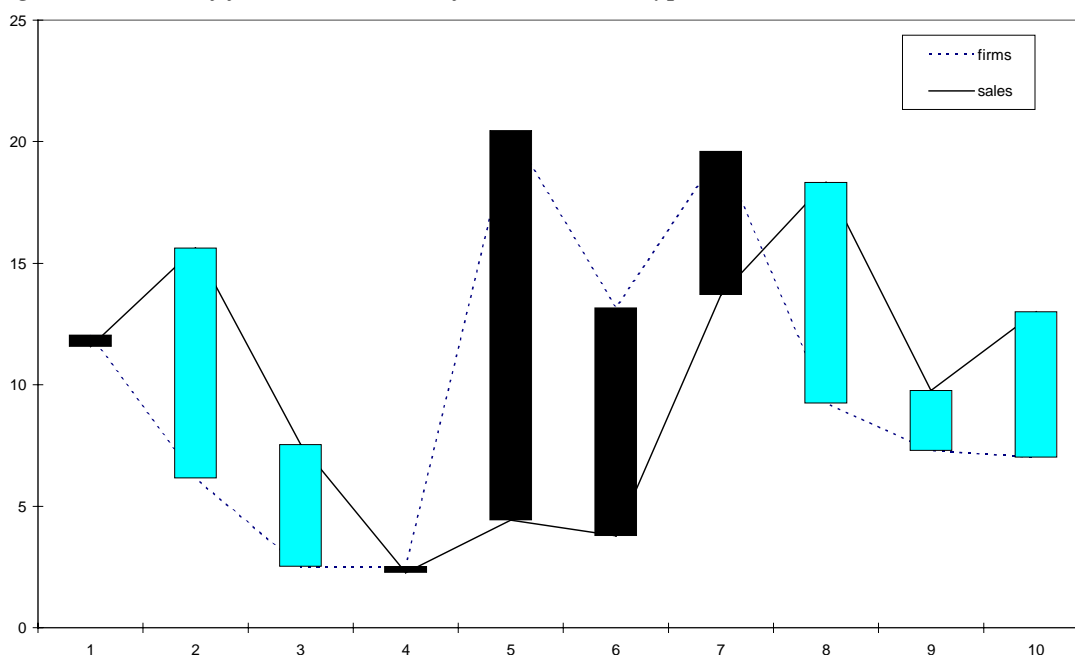
We find a number of striking differences when we compare the share of firms to the share of sales in each type. Three of the types are substantially smaller when considered by their share of sales than when considered by their share of firms. These are types 5, 6 and 7, the three types with low R&D intensity but with either high non R&D intensity (6), high investment intensity (7), or both (5). Most dramatically this is the case for type no. 5, with high non R&D intensity *and* high investment intensity, which has 20.4 per cent of the firms but only 4.4 per cent of the sales. Next, type no. 6, with high non R&D intensity only, has 13.2 per cent of the firms but only 3.8 per cent of the sales. In fact, these two types, which were the largest and the third largest with respect to share of firms, become the third and second *smallest* with respect to share of sales. Also type no. 7, where there is high investment intensity only, has a substantially smaller share of sales than of firms, 13.7 and 19.6, respectively.

For other types, on the other hand, the opposite is true. This applies to all three types with *low* on all three dimensions (types 8, 9 and 10), as well as two of the types with high R&D intensity (types nos. 2 and 3). This especially applies to the type with low intensity on all three components and a dominance of the disembodied cost elements (type no. 8), which had only 9.2 per cent of the firms but is the largest type in terms of sales with 18.3 per cent. The second largest type in terms of sales is the type with high R&D intensity and non R&D intensity but low investment intensity (type no. 2), which has only 6.2 per cent of the firms but 15.6 per cent of the sales. Also the type with low intensity on all three components and with a dominance of the embodied cost element (type no. 10) increases its share substantially when we go from share of firms to share of sales, from 7.0 per cent to 13.0 per cent. There is less increase for type no. 9, with low intensity on all components and a rough balance between the disembodied and the embodied, when we go from share of firms to share of sales,

from 7.3 per cent to 9.8 per cent. Relatively speaking, the type with high R&D intensity and high investment intensity, but low non R&D intensity (type no. 3), is the one which increases its share the most when we go from share of firms to share of sales, but from a very low point of departure. It has only 2.5 per cent of the firms, but 7.5 per cent of the sales.

For the two remaining types there is virtually no change in the shares when we go from share of firms to share of sales. Type no. 1, with high intensity on all three components, has 12.0 per cent of the firms and 11.6 per cent of the sales, whereas type no. 4, which has high R&D intensity only, remains the smallest in both respects, having 2.5 per cent of the firms and 2.3 per cent of the sales.

Let us look at the cumulative shares of the largest innovation cost types also in terms of sales, as we did in terms of sales in Table 11, above. The cumulative shares in terms of sales are given in Table 13, below. To make comparison easier, we have added, in the last column, the cumulative shares of firms from Table 11.

Table 13. Cumulative share of sales of innovation cost types ranked according to share of sales, all firms with innovation costs (N=357).

rank	type no.	character-istics	share of sales	cum. share of sales	cum. share of firms
1	8	LLL-D	18.3	18.3	20.4
2	2	HHL	15.6	33.9	40.1
3	7	LLH	13.7	47.6	53.2
4	10	LLL-E	13.0	60.6	65.3
5	1	HHH	11.6	72.2	74.5
6	9	LLL-B	9.8	82.0	81.8
7	3	HLH	7.5	89.5	88.8
8	5	LHH	4.4	93.9	95.0
9	6	LHL	3.8	97.7	97.5
10	4	HLL	2.3	100	100

Note that the cumulative share of *firms* is the same as in Table 11, which means that it is not based on the same ranking as the cumulative share of sales. The ranking of types, with their respective characteristics, in Table 13, therefore *only* applies to the share of *sales*, not to the share of firms.

We see that by and large the distribution of sales according to innovation cost types is more equal than the distribution of firms. Three types only account for 47.6 per cent of the sales and four types only account for slightly over 60 per cent. However, with six types we have accounted for over 82 per cent of the sales, almost exactly the same as in the case of the share of firms.

In Figure 6, below, we have shown the cumulative distribution of both firms and sales of the innovation cost types, when the types are ranked according to share of firms and share of sales, respectively.

Figure 6. Cumulative share of firms and of sales of innovation cost types ranked according to share of firms and share of sales, respectively, all firms with innovation costs (N=357).
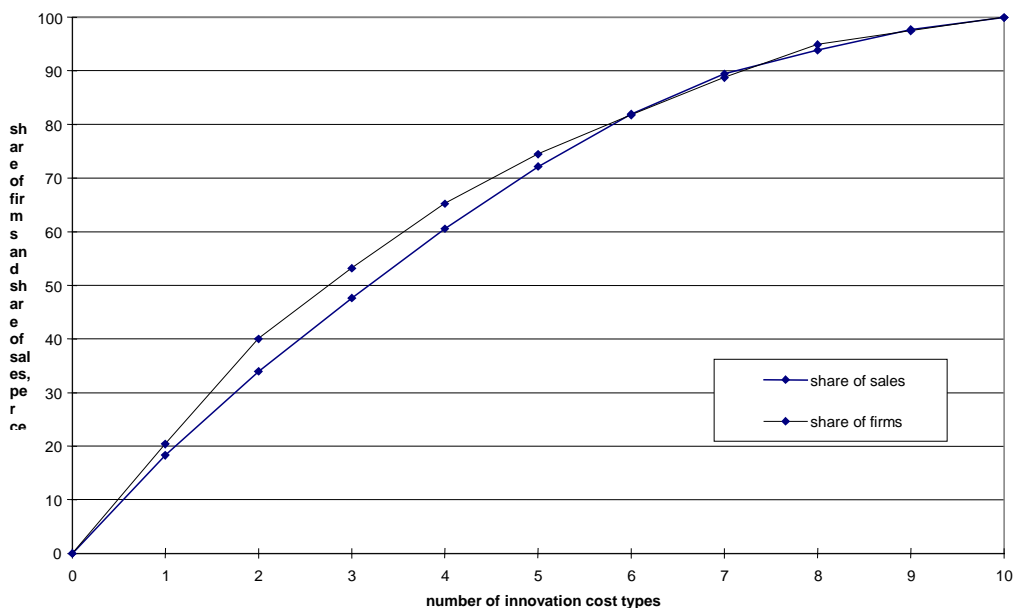
To get an overview of total production in our sample, let us include also the firms which have no innovation costs in a new type called type no. 20, and see how the sales are distributed across types. This is done in Figure 7, below.

Figure 7. Distribution of sales according to types. Firms without innovation costs included (as type no. 20). All industries.
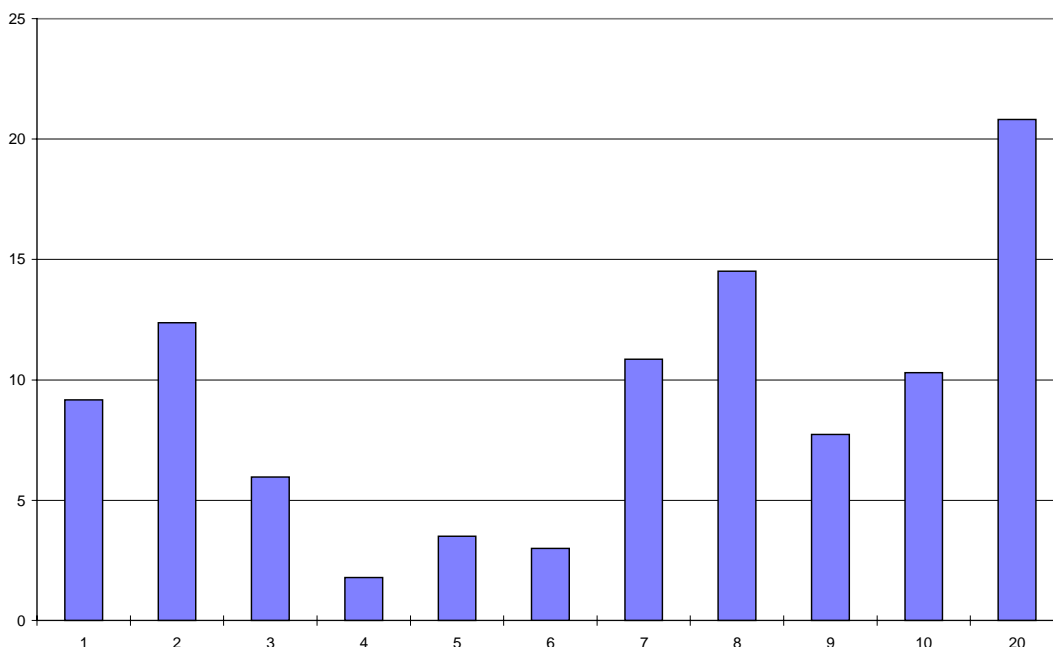
As the firms which have no innovation costs account for almost 21 per cent of all sales, the shares of all the other types become reduced by about 1/5 compared to what we had in Table 13 and Figure 5.

The difference between the share of the firms and the share of the sales for each type obviously reflects differences in the average size of firms across types. In Figure 8, below, we have shown the average size of firms, in terms of number of employees in each type and in all firms with innovation costs.

Figure 8. Average size of firms, number of employees, in each type. Firms with innovation costs. All industries.
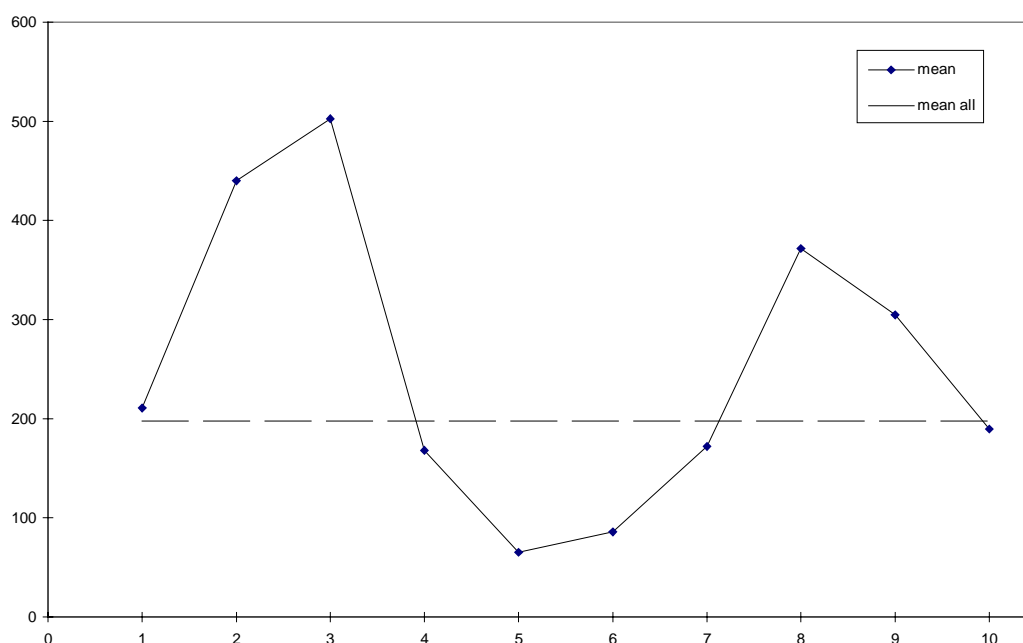
As we see, the types which have a larger share of the sales than of the firms also have on average *large* firms. Most notably, this applies to types 2, 3 and 8. The types where the opposite is true have on average *small* firms. Most notably this applies to types 5 and 6, and, to a lesser extent, type 7. Type 10 is something of an exception, having a substantially higher share of sales than of firms, but having an average size of firms below the average for all types taken together. The reason for this is that in type 10, *sales per employee* is much higher than in any of the other types.

However, we should also note that if we only use the *mean* as a measure of the typical size of firms in each type, we will miss some important characteristics of the variation in firm size across types. This is especially so because we are not at all dealing with normal distributions here. To illustrate the point, we have in Figure 9a, below, shown both the *mean* and the *median* size of firms in each type, as well as the mean and median of all firms with innovation costs.

Figure 9a. Mean and median size of firms (employees per firm) by type, and mean and median size of all firms with innovation costs.
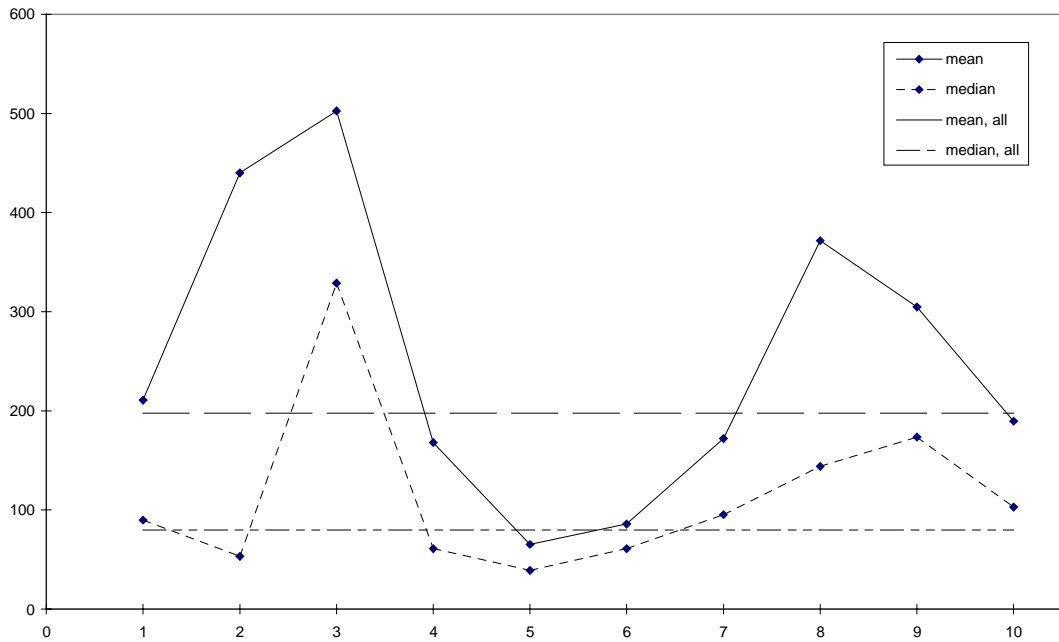
In Figure 9b, below, we have expressed both the mean and median size of firms in each type as a proportion to, respectively, the mean and the median size of all firms with innovation costs.

Figure 9b. Mean size of firms (employees per firm) as a proportion to mean size of all firms with innovation costs, median size of firms as a proportion to median size of all firms with innovation costs.
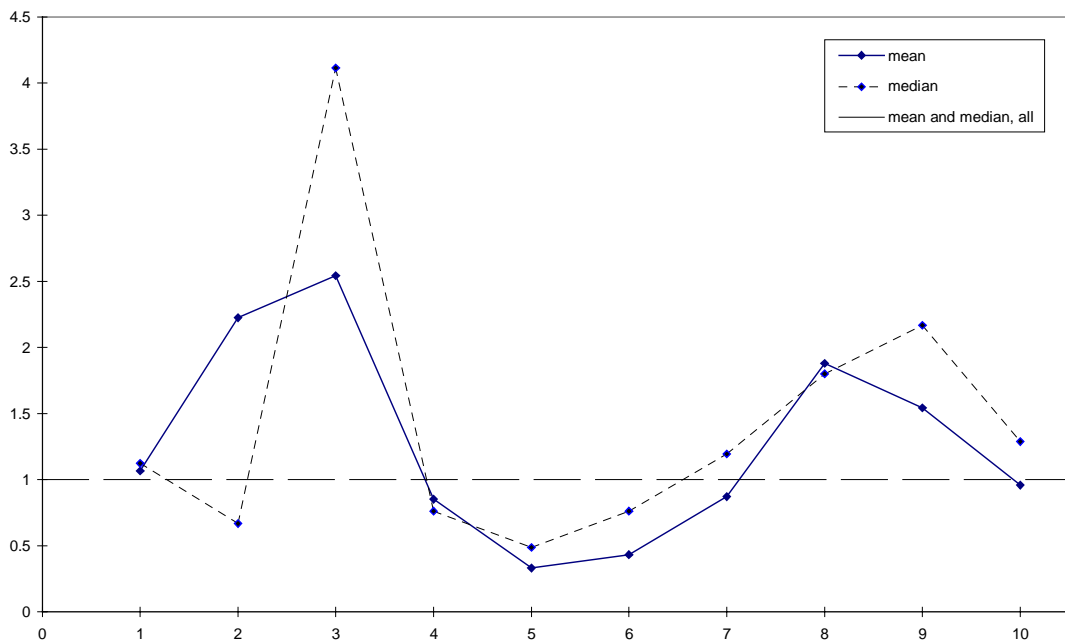
As we see from Figure 9a, the mean is without exception very much higher than the median, which reflects that there is a tendency for a relatively small number of relatively large firms to pull the mean upwards from where the bulk of the firms are. However, this tendency is more pronounced for some types than for others, as emerges clearly both from Figure 9a and Figure 9b. It is without comparison most pronounced for type no. 2, with high R&D intensity and non R&D intensity, but low investment intensity. This type has a mean size of firms which is much higher than the mean size of all firms with innovation costs, and this is reflected in the fact that this type's share of the sales is much higher than its share of the firms. However, this type's *median* size of firms is much *lower* than the median of all firms with innovation costs. This means that generally the firms in this type are not larger than in the other types, rather the contrary, but a small number of particularly large firms in this type pulls the mean well above the mean of most other types. This means that we will expect that in the industries where these few very large firms in type 2 are found, we will find that type 2 is larger in terms of its share of the sales than in terms of its share of the firms, whereas in the other industries the opposite will be the case.

5. Distribution of firms across innovation cost types by firm size

Let us now see how the firms are distributed across types in different *size categories*. We operate with four size categories. The smallest firms are those with less than 30 employees, the next are those with 30 or more but less than 100 employees, then comes those with 100 or more but less than 500 employees, and finally the largest firms are those with 500 or more employees.

The distribution of the total number of firms according to size categories is as shown in Figure 10, below.

Figure 10. Share of the firms in each size category (per cent), all firms, all industries (N=873).
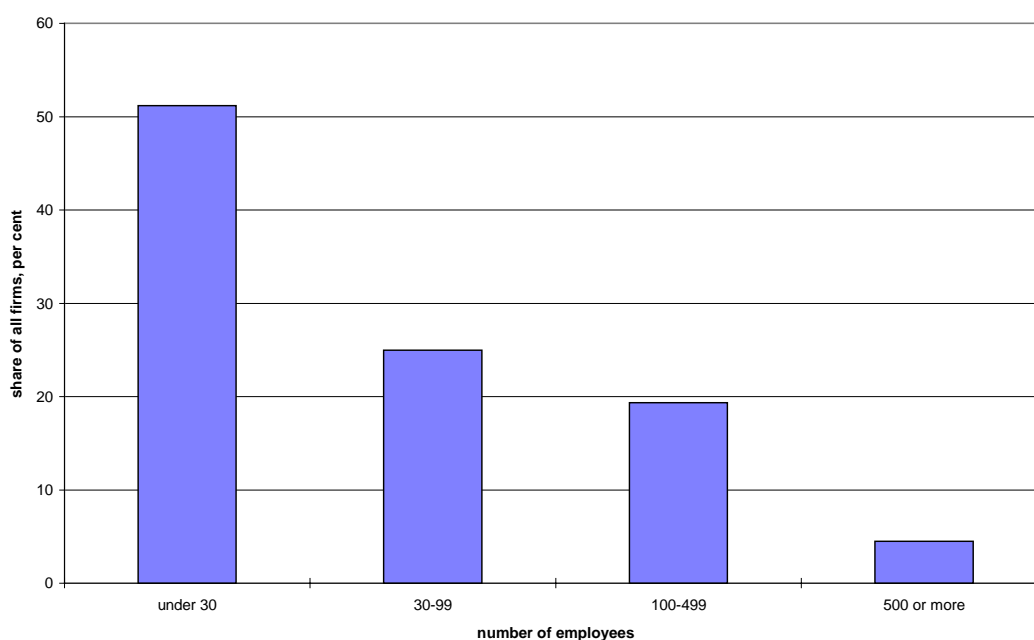
As we see, The majority of firms in the sample have less than 30 employees, and those with 500 employees or more account for less than 5 per cent of the firms. However, the share of the firms which have innovation costs varies sharply across size categories, as is evident from Figure 11, below.

Figure 11. Share of firms in each size category, and in all size categories together, which have innovation costs. Per cent.
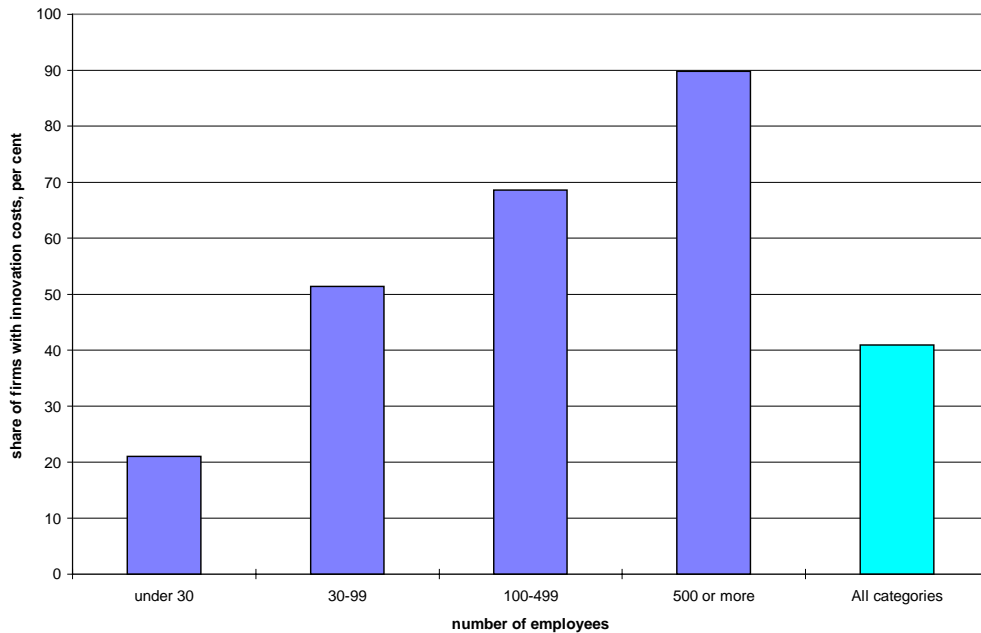
As we saw above, 40.9 per cent of all firms have innovation costs. But there is, as is evident from Figure 11, a very clear and consistent tendency for the share of firms which have innovation costs to increase when we go from the small firms to the large ones. This means that the shares of all firms of the different size categories differ systematically from their shares of firms *with innovation costs*. This is shown in Figure 12, below.

Figure 12. The different size categories' shares of all firms and of firms with innovation costs, per cent. All industries.
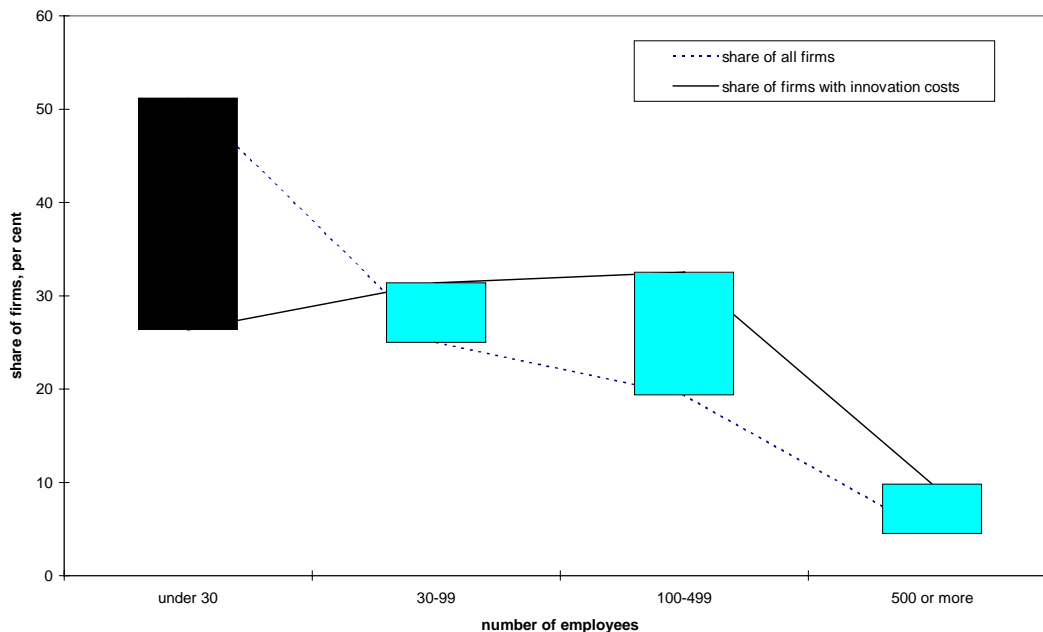
As we see, the category with less than 30 employees is no longer the most numerous when it comes to the firms with innovation costs. The category with 100-499

employees is the most numerous, followed by the category with 30-99 employees. The large firm category (500 employees or more) has increased its share from less than 5 per cent to almost 10 per cent.

The information in Figure 10, 10 and 11 is summarized in Table 14, below.

Table 14. Number of firms, share of total firms (per cent), number of firms with innovation costs, firms with innovation costs as a proportion to all firms (per cent), share of firms with innovation costs (per cent), by size category.

size category, number of employees	number of firms	share of firms	firms with innovation costs	firms with innovation costs as a proportion to all firms	share of firms with innovation costs
under 30	447	51.2	94	21.0	26.3
30-99	218	25.0	112	51.4	31.4
100-499	169	19.4	116	68.6	32.5
500 or more	39	4.5	35	89.7	9.8
total	873	100	357	40.9	100

Let us now look at the same kinds of distributions from the point of view of the share of *sales* instead of the share of firms. Figure 13, below, shows how large share of all sales the firms in each size category account for, when firms without innovation costs are included.

Figure 13. Share of the sales (per cent) accounted for by the firms in each size category, all firms, all industries (N=873).
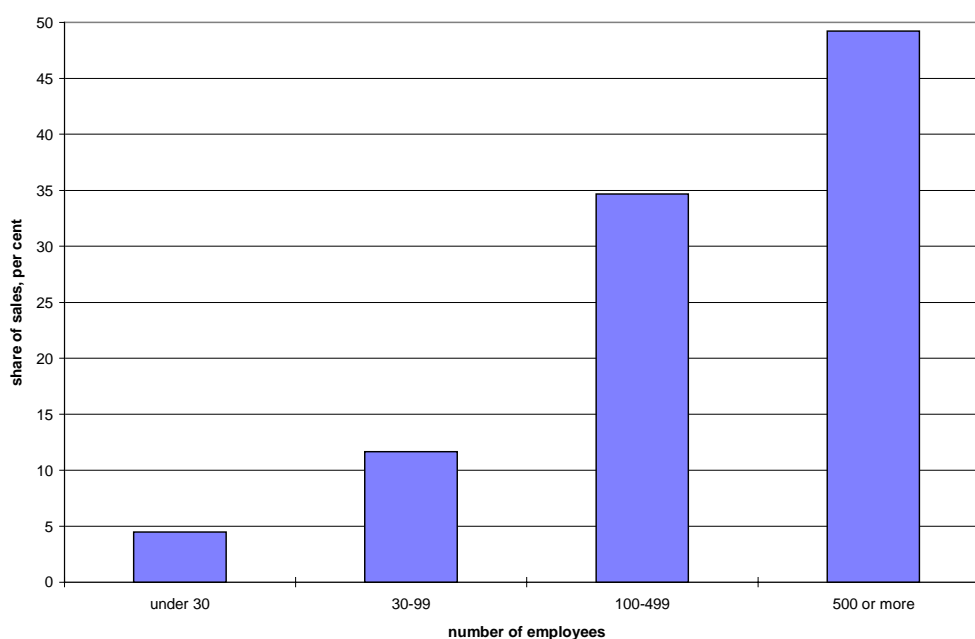
This figure is virtually the exact inverse of Figure 10. The firms with less than 30 employees, which accounted for 51 per cent of all firms, account for less than 5 per cent of all sales, while the firms with 500 employees or more, which accounted for less than 5 per cent of all firms, have 49 per cent of all sales.

Again, the share of sales in each size category accounted for by firms with innovation costs rises sharply as we go from the small firms to the large firms. This is shown in Figure 14, below.

Figure 14. Share of the sales in each size category, and in all size categories together, which is accounted for by firms with innovation costs. Per cent.
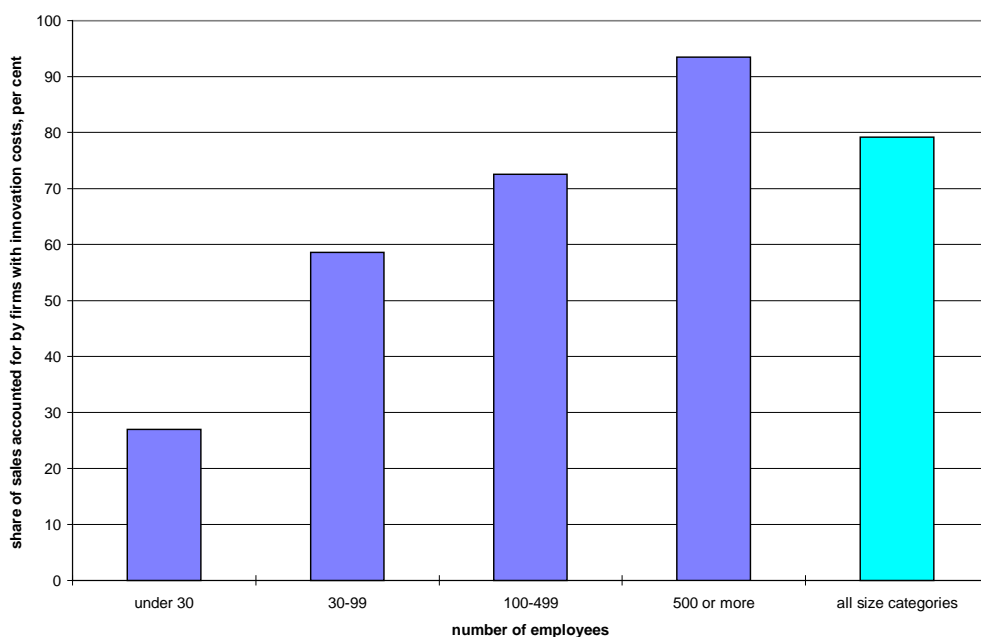
This means that the largest firms are even more dominating in terms of sales among the firms with innovation costs than among all firms. In Figure 15, below, we have compared these shares.

Figure 15. The different size categories' shares of the sales from all firms and from the firms with innovation costs, per cent.
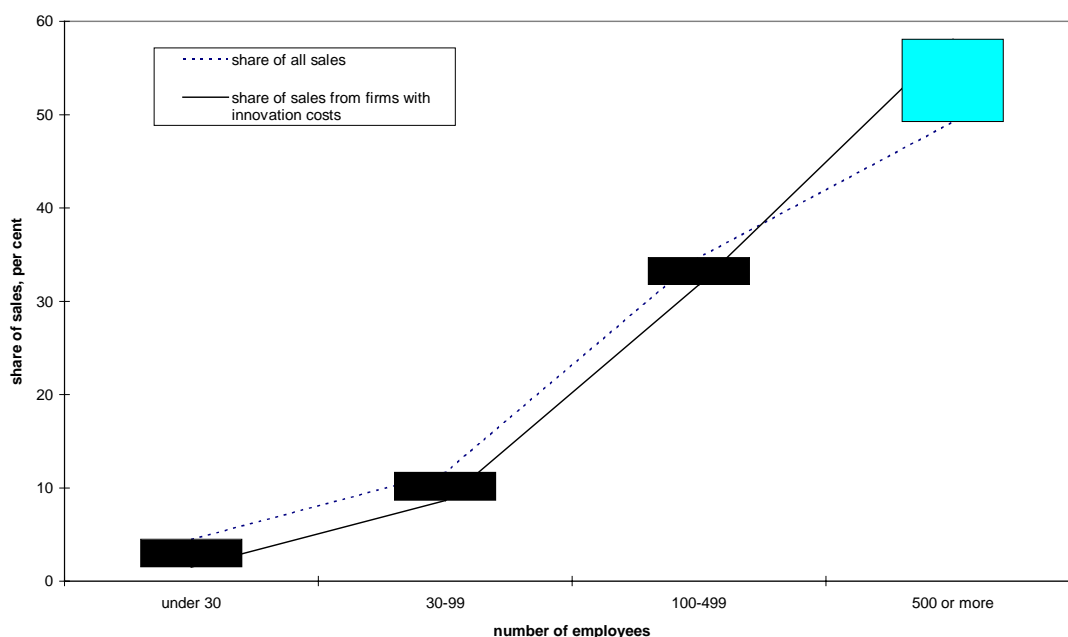
In Table 15, below, which extends Table 13 with data for the share of sales, the information contained in Figures 9-14 is summarized.

Table 15. Share of firms and share of sales, all firms (per cent); share of firms and share of sales accounted for by firms with innovation costs (per cent); share of firms and share of sales, firms with innovation costs (per cent); by size category.

size category	share of firms and share of sales, all firms		share of firms and share of sales accounted for by firms with innovation costs		share of firms and share of sales, firms with innovation costs	
	firms	sales	firms	sales	firms	sales
under 30	51.2	4.5	21.0	27.0	26.3	1.5
30-99	25.0	11.7	51.4	58.6	31.4	8.6
100-499	19.4	34.7	68.6	72.6	32.5	31.8
500 or more	4.5	49.2	89.7	93.4	9.8	58.1
total	100	100	40.9	79.2	100	100

Thus, we see that the firms with less than 30 employees, which account for 51.2 per cent of all firms, account for only 4.5 per cent of all sales and only 1.5 per cent of the sales from firms with innovation costs. Conversely, the firms with 500 employees or more, which account for only 4.5 per cent of all firms, account for 49.2 per cent of all sales and 58.1 per cent of the sales from firms with innovation costs.

Let us now go on to investigate how the firms are distributed across the 10 types defined on the basis of the intensity and composition of innovation costs for each size category separately. We start with the smallest firms, then look at the firms with

30-99 employees followed by the firms with 100-499 employees, and lastly we look at the largest firms.

Firms with less than 30 employees

In this size category we find 51.2 per cent of all firms, but only 26.3 per cent of all firms with innovation costs, and only 4.5 per cent of all sales and 1.5 per cent of the sales from firms with innovation costs.

In Table 16, below, we have shown the number and share of firms in each innovation cost type for firms with less than 30 employees, and compared these with the corresponding numbers and shares for all size categories taken together.

Table 16. Number of firms and share of firms in each innovation cost type, firms with less than 30 employees compared to all size categories.

		under 30 employees		all size categories		
Type no.	character-istics	numbers	share (per cent)	numbers	share (per cent)	difference from all size categories (per cent)
1	HHH	14	14.9	43	12.0	2.8
2	HHL	10	10.6	22	6.2	4.5
3	HLH	1	1.1	9	2.5	-1.5
4	HLL	2	2.1	9	2.5	-0.4
5	LHH	28	29.8	73	20.4	9.3
6	LHL	15	16.0	47	13.2	2.8
7	LLH	13	13.8	70	19.6	-5.8
8	LLL-D	5	5.3	33	9.2	-3.9
9	LLL-B	1	1.1	26	7.3	-6.2
10	LLL-E	5	5.3	25	7.0	-1.7
20	without innovation costs	353		516		
Sum firms with innovation costs		94	100	357	100	
Sum all firms		447		873		
Sum firms with innovation costs, their share of all firms		94	21.0	357	40.9	- 19.9

Note that the shares are of the firms with innovation costs. Now, only 21 per cent of all firms in this size category have innovation costs, whereas the corresponding share for all size categories is 40.9 per cent. Had we included the firms without innovation costs as a separate type, the under 30 employees size category would have a share of its firms far above the corresponding share for all categories in this type, whereas the other types would have had their shares reduced more in the less than 30 employees size category than in all size categories taken together.

The share of firms in each innovation cost type for firms with less than 30 employees and the corresponding shares for all size categories are also compared in Figure 16, below.

Figure 16. Distribution of firms across innovation cost types, per cent. Firms with less than 30 employees.
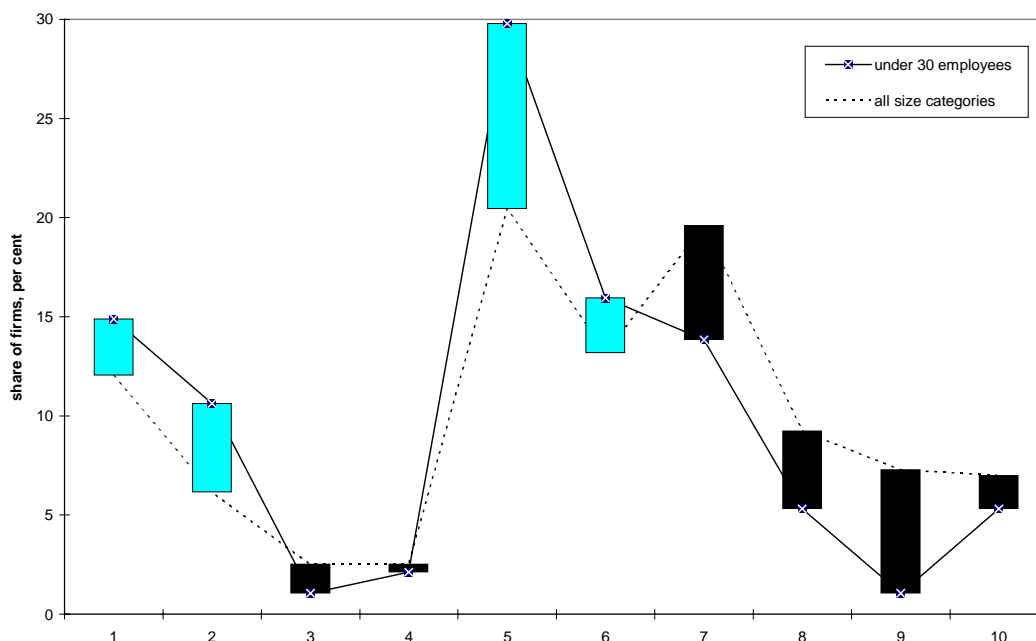
We note that types nos. 1, 2, 5 and 6 all have a larger share of the firms in the less than 30 employees size category than in all size categories combined. These are exactly the four types where the firms have high non R&D intensity. All these four types are among the five largest in the less than 30 employees category. By far the largest type here is type no. 5, where there is high non R&D intensity and high investment intensity, with nearly 30 per cent of the firms. The second largest is type no. 6, where there is high non R&D intensity only, with 16 per cent of the firms, followed by type no. 1, where all three cost types have high intensity, with 14.9 per cent. Then in fourth place comes type no. 7, where there is high investment intensity only. It has 13.8 per cent of the firms, which is some way below its share in all size categories combined. The types with low intensity on all three innovation cost dimensions (types nos. 8, 9 and 10) all have a small share of the firms in this size category.

In Table 17, below, we have ranked the innovation cost types according to their shares of the firms in the less than 30 employees size category, and we have shown the cumulative share of the firms represented by the types as we descend the ranking. We have also compared the cumulative shares to the corresponding cumulative shares for all size categories.

Table 17. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with less than 30 employees (N=94), compared to all firms with innovation costs.

rank	type no.	character-istics	number of firms	share	cum. share	cum. share, all size cat.
1	5	LHH	28	29.8	29.8	20.4
2	6	LHL	15	16.0	45.7	40.1
3	1	HHH	14	14.9	60.6	53.2
4	7	LLH	13	13.8	74.5	65.3
5	2	HHL	10	10.6	85.1	74.5
6	8	LLL-D	5	5.3	90.4	81.8
6	10	LLL-E	5	5.3	95.7	88.8
8	4	HLL	2	2.1	97.9	95.0
9	3	HLH	1	1.1	98.9	97.5
9	9	LLL-B	1	1.1	100	100

Again, note that the specific ranking of the types, with their characteristics, shown in Table 17, only applies to the less than 30 employees size category. The cumulative share of types of all size categories combined shown in the last column is based on the ranking of types according to number of firms among all size categories.

These cumulative shares for the less than 30 employees category and for all size categories are also shown in Figure 17, below.

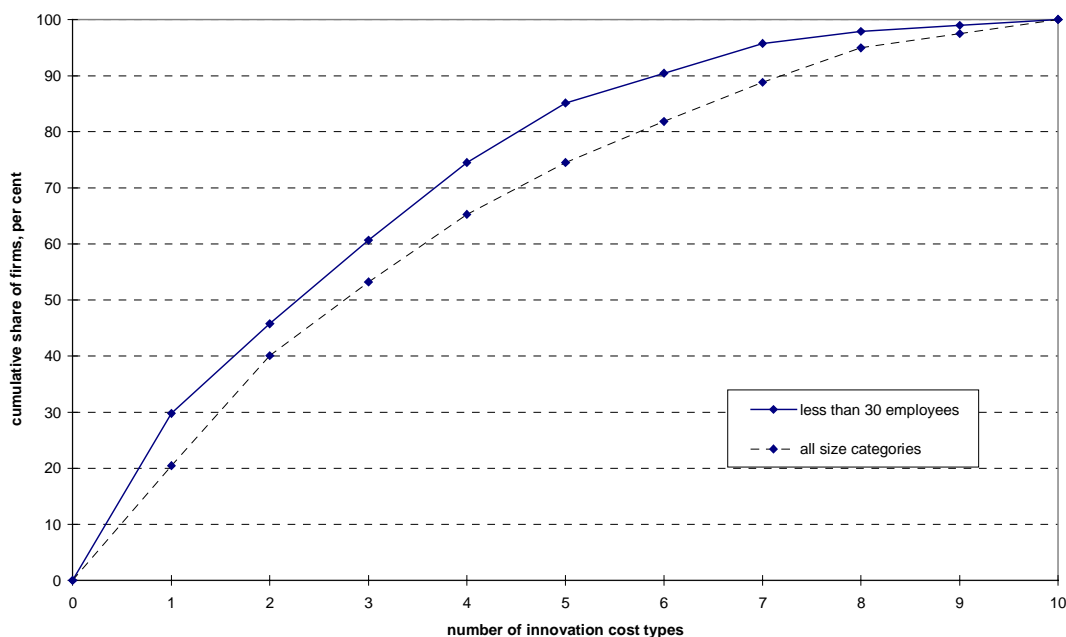*Figure 17. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with less than 30 employees (N=94), compared to all firms with innovation costs.*

As we see from Table 17 and Figure 17, the distribution of firms across innovation cost types more unequal for the less than 30 employees size category than for all size categories combined. In the less than 30 employees category, the three largest types account for 60 per cent of all firms. With four types we reach almost 75 per cent, and with five types we have 85 per cent.

Let us also briefly look at the distribution of the *sales* across innovation cost types in the less than 30 employees size category and compare with the corresponding distribution for all size categories. These shares are given in Table 18, below, together with the corresponding shares for the distribution of firms from Table 16, for comparison.

Table 18. Shares of firms and shares of sales accounted for by the different innovation cost types, firms with less than 30 employees and all size categories, firms with innovation costs.

Type no.	character-istics	less than 30 employees		all size categories		difference	
		share firms (%)	share sales (%)	share firms (%)	share sales (%)	share firms (%)	share sales (%)
1	HHH	14.9	12.8	12.0	11.6	2.8	1.2
2	HHL	10.6	10.3	6.2	15.6	4.5	-5.4
3	HLH	1.1	0.4	2.5	7.5	-1.5	-7.1
4	HLL	2.1	1.0	2.5	2.3	-0.4	-1.3
5	LHH	29.8	33.6	20.4	4.4	9.3	29.2
6	LHL	16.0	13.8	13.2	3.8	2.8	10.0
7	LLH	13.8	10.1	19.6	13.7	-5.8	-3.6
8	LLL-D	5.3	4.6	9.2	18.3	-3.9	-13.7
9	LLL-B	1.1	5.9	7.3	9.8	-6.2	-3.9
10	LLL-E	5.3	7.5	7.0	13.0	-1.7	-5.5
Sum firms with innovation costs		100	100	100	100	0	0
Share firms with innovation costs of all firms		21.0	27.0	40.9	79.2	- 19.9	-52.2

As we have shown before, in the less than 30 employees size category only 27 per cent of the sales come from firms with innovation costs, while the corresponding share for all size categories combined is 79.2 per cent. Thus, it is especially important to remember that the shares reported here are based on firms with innovation costs, not on all firms.

For the less than 30 employees size category, the shares of the sales of the different innovation cost types are fairly close to their shares of the firms. However, as we have seen further above, this is not the case for all size categories combined. The reason for this is primarily than inside each size category, there is, of course, much less variation in firm size than for all size categories combined. Especially for all size categories, the difference between the share of the firms and the share of the sales for each innovation cost type reflects whether the type is overrepresented among the

small firms or among the large firms, or whether it is roughly equally represented among all size categories. The distribution of the sales among innovation cost types for all size categories combined is especially influenced by the distribution of firms among innovation cost types in the large firm size category (500 or more employees). Thus, for instance, innovation cost type no. 5, the largest in terms of share of firms for both the less than 30 employees category and for all categories combined, has a 9.2 percentage points difference larger share of the *firms* in the less than 30 employees category than in all size categories combined. However, in terms of the share of *sales* it has a 29.2 percentage points difference larger share in the less than 30 employees category than in all size categories combined. This is because this innovation cost type is very much underrepresented among the large firms, and, consequently, among all size categories its share of the sales (4.4 per cent) is very much smaller than its share of the firms (20.4 per cent).

Firms with 30-99 employees
This size category accounts for 25 per cent of all firms and 31.4 per cent of the firms with innovation costs, but only for 11.7 per cent of all sales and 8.6 per cent of the sales from firms with innovation costs.

In Table 19, below, we have shown the number and share of firms in each innovation cost type for firms with 30-99 employees, and compared these with the corresponding numbers and shares for all size categories taken together.

Table 19. Number of firms and share of firms in each innovation cost type, firms with 30-99 employees compared to all size categories.

		30-99 employees		all size categories		
Type no.	character-istics	number of firms	share (per cent)	number of firms	share (per cent)	difference from all size categories (per cent)
1	HHH	10	8.9	43	12.0	-3.1
2	HHL	4	3.6	22	6.2	-2.6
3	HLH	2	1.8	9	2.5	-0.7
4	HLL	4	3.6	9	2.5	1.1
5	LHH	31	27.7	73	20.4	7.2
6	LHL	12	10.7	47	13.2	-2.5
7	LLH	25	22.3	70	19.6	2.7
8	LLL-D	9	8.0	33	9.2	-1.2
9	LLL-B	8	7.1	26	7.3	-0.1
10	LLL-E	7	6.3	25	7.0	-0.8
20	without innovation costs	106		516		
Sum firms with innovation costs		112	100	357	100	
Sum all firms		218		873		
Sum firms with innovation costs, their share of all firms		112	51.4	357	40.9	10.5

Again, the share of the firms of each innovation cost type is of the firms with innovation costs. 112 firms, or 51.4 per cent of all firms in this size category, have innovation costs.

The share of firms in each innovation cost type for firms with 30-99 employees and the corresponding shares for all size categories are also compared in Figure 18, below.

Figure 18. Distribution of firms across innovation cost types, per cent. Firms with 30-99 employees compared to all size categories.
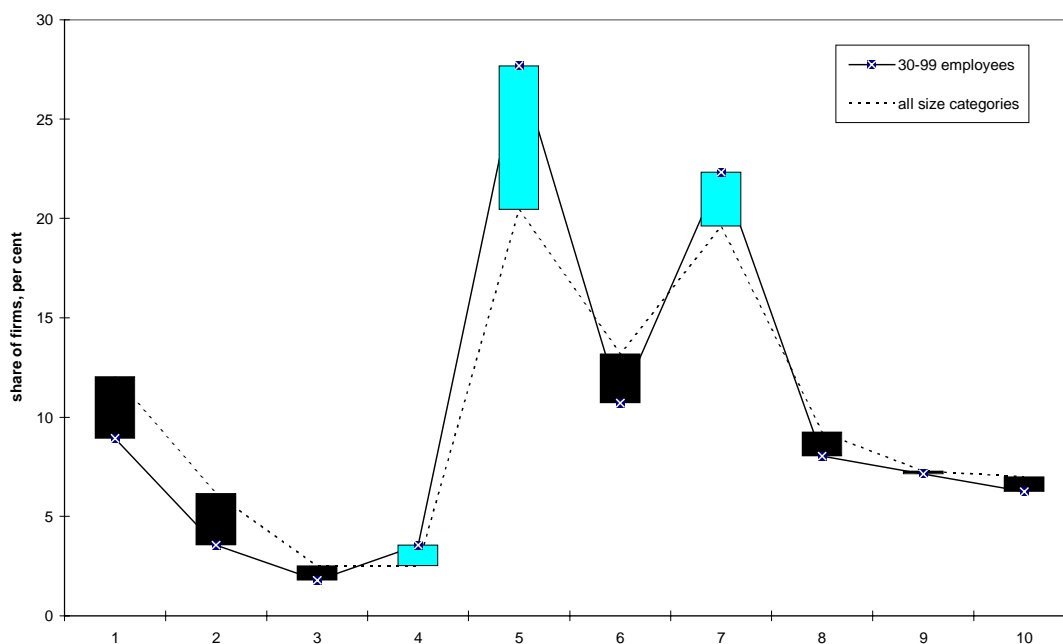
The profile of the distribution in the 30-99 employees category is fairly similar to the profile of the distribution for all size categories combined. However, the two innovation cost types which have the largest shares of firms in all size categories combined, both have an even larger share in the 30-99 employees category. This is especially so for the largest type, type no. 5. Both these types have high investment intensity, type no. 5 has also high non R&D intensity. The types with high R&D intensity (types nos. 1-4) generally have a smaller share in the 30-99 employees category than for all size categories combined (apart from type no. 4, but the absolute number involved are very small for this type). The three types with low intensity on all three cost dimensions (types no. 8, 9 and 10) lie very close to their shares in all size categories combined.

In Table 20, below, we have ranked the innovation cost types according to their shares of the firms in the 30-99 employees size category, and we have shown the cumulative share of the firms represented by the types as we descend the ranking. We have also compared these cumulative shares to the corresponding cumulative shares for all size categories.

Table 20. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with 30-99 employees (N=112), compared to all firms with innovation costs.

rank	type no.	character-istics	number of firms	share	cum. share	cum. share, all size cat.
1	5	LHH	31	27.7	27.7	20.4
2	7	LLH	25	22.3	50.0	40.1
3	6	LHL	12	10.7	60.7	53.2
4	1	HHH	10	8.9	69.6	65.3
5	8	LLL-D	9	8.0	77.7	74.5
6	9	LLL-B	8	7.1	84.8	81.8
7	10	LLL-E	7	6.3	91.1	88.8
8	2	HHL	4	3.6	94.6	95.0
8	4	HLL	4	3.6	98.2	97.5
10	3	HLH	2	1.8	100	100

Again, note that the specific ranking of the types, with their characteristics, shown in Table 20, only applies to the 30-99 employees size category. The cumulative shares for all size categories refers to the ranking for all size categories. In this case, though, the two rankings are very similar.

These cumulative shares for the 30-99 employees category and for all size categories are also shown in Figure 19, below.
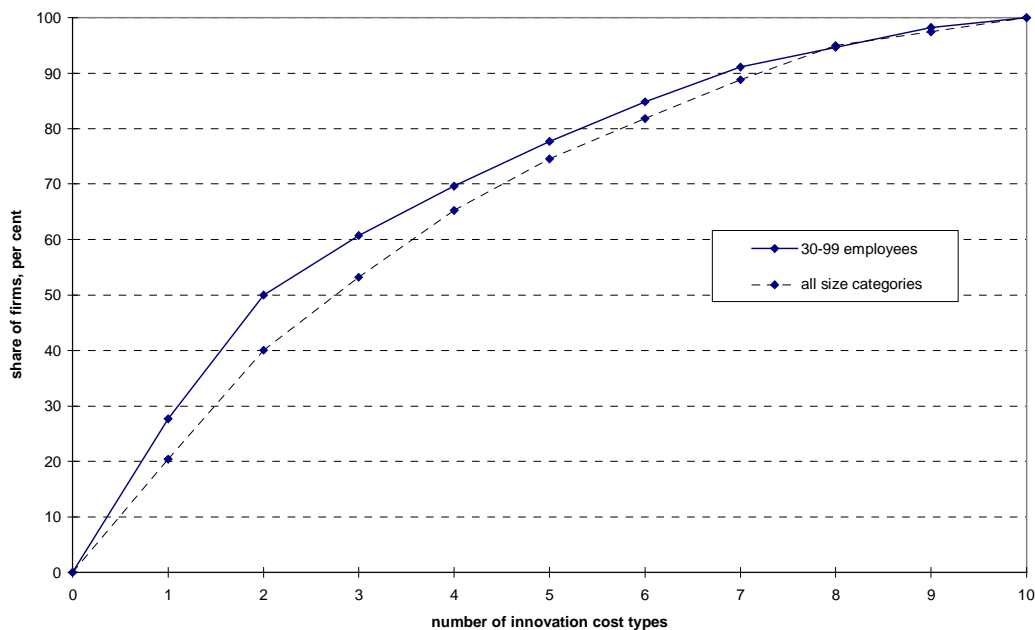
Figure 19. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with 30-99 employees (N=112), compared to all firms with innovation costs.

We see that the two largest innovation cost types account for 50 per cent of the firms, and in this respect this distribution is more unequal than in the less than 30 employees case. However, from there on the distribution is more equal, and we need six types to reach 85 per cent of the firms, whereas in the less than 30 employees case we needed only five.

Again, we will also look briefly at the distribution of *sales* across innovation cost types. We compare with the corresponding distribution for all size categories, as well as the distribution of *firms* across types. This is done in Table 21, below.

Table 21. Shares of firms and shares of sales accounted for by the different innovation cost types, firms with 30-99 employees and all size categories, firms with innovation costs.

Type no.	character-istics	30-99 employees		all size categories		difference	
		share firms (%)	share sales (%)	share firms (%)	share sales (%)	share firms (%)	share sales (%)
1	HHH	8.9	13.5	12.0	11.6	-3.1	1.9
2	HHL	3.6	3.2	6.2	15.6	-2.6	-12.4
3	HLH	1.8	1.2	2.5	7.5	-0.7	-6.3
4	HLL	3.6	4.5	2.5	2.3	1.1	2.2
5	LHH	27.7	16.2	20.4	4.4	7.2	11.7
6	LHL	10.7	5.7	13.2	3.8	-2.5	1.9
7	LLH	22.3	23.5	19.6	13.7	2.7	9.8
8	LLL-D	8.0	10.8	9.2	18.3	-1.2	-7.5
9	LLL-B	7.1	9.8	7.3	9.8	-0.1	0.0
10	LLL-E	6.3	11.5	7.0	13.0	-0.8	-1.5
Sum firms with innovation costs		100	100	100	100	0	0
Share firms with innovation costs of all firms		51.4	58.6	40.9	79.2	10.5	-20.6

In the 30-99 employees size category there appears to be larger differences between the shares of the *firms* of the respective innovation cost types and their shares of the *sales* than in the less than 30 employees category, but not as large as in all size categories combined. This partly reflects that the average size of firms varies across innovation cost types also *within* the 30-99 employees category. Thus for instance, in the 30-99 employees category innovation cost type no. 5 has 27.7 per cent of the firms but only 16.2 per cent of the sales. However, this discrepancy is not nearly as great as for all size categories combined, where type no. 5 accounts for 20.4 per cent of the firms but only 4.4 per cent of the sales. Consequently, whereas type no. 5 has a share of the firms which is 7.2 percentage points difference larger in the 30-99 employees category than in all size categories combined, this difference is not as large as the corresponding difference in terms of the share of sales, which is 11.7 per cent.

Concerning the 30-99 employees size category, we may also note that whereas type no. 5 is the largest in terms of share of firms with type no. 7 in second place, the opposite is true in terms of share of *sales*, where type no. 7 is the largest with a share of 23.5 per cent.

Firms with 100-499 employees
This size category accounts for 19.4 per cent of all firms and 32.5 per cent of the firms with innovation costs, and for 34.7 per cent of all sales and 31.8 per cent of the sales from firms with innovation costs. It is the largest size category in terms of the number of firms with innovation costs, which is 116.

In Table 22, below, we have shown the number and share of firms in each innovation cost type for firms with 100-499 employees, and compared these with the corresponding numbers and shares for all size categories taken together.

Table 22. Number of firms and share of firms in each innovation cost type, firms with 100-499 employees compared to all size categories.

		100-499 employees		all size categories		
Type no.	character-istics	number of firms	share (per cent)	number of firms	share (per cent)	difference from all size categories (per cent)
1	HHH	12	10.3	43	12.0	-1.7
2	HHL	4	3.4	22	6.2	-2.7
3	HLH	3	2.6	9	2.5	0.1
4	HLL	2	1.7	9	2.5	-0.8
5	LHH	13	11.2	73	20.4	-9.2
6	LHL	20	17.2	47	13.2	4.1
7	LLH	28	24.1	70	19.6	4.5
8	LLL-D	13	11.2	33	9.2	2.0
9	LLL-B	11	9.5	26	7.3	2.2
10	LLL-E	10	8.6	25	7.0	1.6
20	without innovation costs	53		516		
Sum firms with innovation costs		116	100	357	100	0
Sum all firms		169		873		
Sum firms with innovation costs, their share of all firms		116	68.6	357	40.9	27.7

Again, the share of the firms of each innovation cost type is of the firms with innovation costs. 116 firms, or 68.6 per cent of all firms in this size category, have innovation costs in this size category.

The share of firms in each innovation cost type for firms with 100-499 employees and the corresponding shares for all size categories are also compared in Figure 20, below.

Figure 20. Distribution of firms across innovation cost types, per cent. Firms with 100-499 employees compared to all size categories.
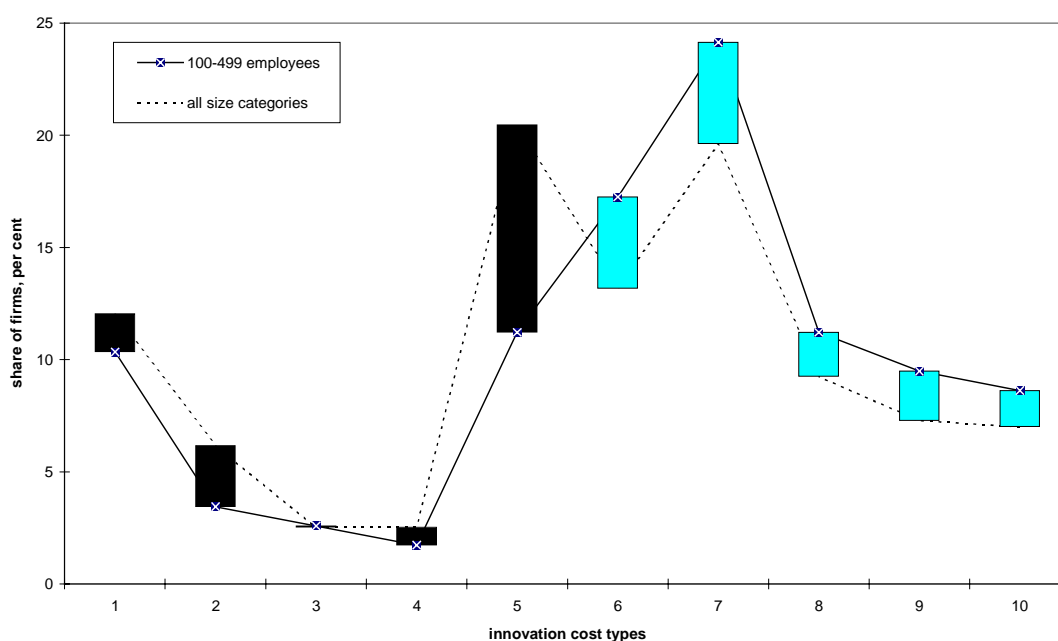
Here we especially note the position of the innovation cost type with high non R&D intensity and investment intensity but low R&D intensity, type no. 5, which is the largest in terms of number of firms for all size categories combined, and which also was the largest type in both the less than 30 employees category (here it was by far the largest) and in the 30-99 employees category. In the 100-499 employees category, by contrast, it has a share of the firms which is far below its share in all size categories combined with only 11.2 per cent of the firms, which ranks it in a shared third place, with type no. 8. The largest innovation cost type in this size category is type no. 7, where there is high investment intensity only, followed by type no. 6, where there is high non R&D intensity only. These two types both have a larger share in this size category than in all size categories combined. The innovation cost types with high R&D intensity in different combinations with the intensities of the two other innovation cost components (types nos. 1-4) generally have a smaller share of the firms in this size categories than in all categories combined (apart from type no. 3, whose share is equal to its share in all size categories combined). The three innovation cost types with low intensity on all three cost components, types nos. 8, 9 and 10, all have a share which is slightly higher than in all size categories combined.

In Table 23, below, we have ranked the innovation cost types according to their shares of the firms in the 100-499 employees size category, and we have shown the cumulative share of the firms represented by the types as we descend the ranking. We have also compared these cumulative shares to the corresponding cumulative shares for all size categories.

Table 23. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with 100-499 employees (N=116), compared to all firms with innovation costs.

rank	type no.	character-istics	number of firms	share	cum. share	cum. share, all size cat.
1	7	LLH	28	24.1	24.1	20.4
2	6	LHL	20	17.2	41.4	40.1
3	5	LHH	13	11.2	52.6	53.2
3	8	LLL-D	13	11.2	63.8	65.3
5	1	HHH	12	10.3	74.1	74.5
6	9	LLL-B	11	9.5	83.6	81.8
7	10	LLL-E	10	8.6	92.2	88.8
8	2	HHL	4	3.4	95.7	95.0
9	3	HLH	3	2.6	98.3	97.5
10	4	HLL	2	1.7	100	100

As usual, we note that the specific ranking of the types, with their characteristics, shown in Table 23, only applies to the 100-499 employees size category. The cumulative shares for all size categories combined refers to the ranking for all size categories.

These cumulative shares for the 100-499 employees category and for all size categories are also shown in Figure 21, below.

Figure 21. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with 100-499 employees (N=116), compared to all firms with innovation costs.
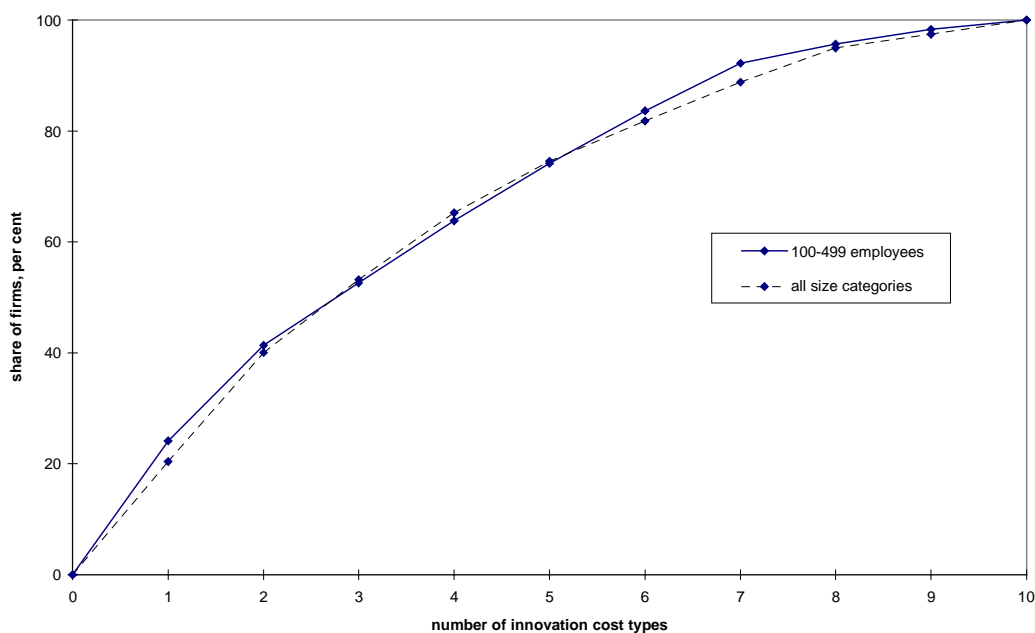
In this size category, the cumulative distribution of innovation types according to their shares of the firms is more equal than among the less than 30 employees and the 30-99 employees categories, and is, in fact, very close to the cumulative distribution among all size categories.

Lastly, we will also look briefly at the distribution of *sales* across innovation cost types. We compare with the corresponding distribution for all size categories, as well as the distribution of *firms* across types. This is done in Table 24, below.

Table 24. Shares of firms and shares of sales accounted for by the different innovation cost types, firms with 100-499 employees and all size categories, firms with innovation costs.

Type no.	character-istics	100-499 employees		all size categories		difference	
		share firms (%)	share sales (%)	share firms (%)	share sales (%)	share firms (%)	share sales (%)
1	HHH	10.3	11.0	12.0	11.6	-1.7	-0.6
2	HHL	3.4	6.0	6.2	15.6	-2.7	-9.6
3	HLH	2.6	4.0	2.5	7.5	0.1	-3.6
4	HLL	1.7	3.9	2.5	2.3	-0.8	1.6
5	LHH	11.2	5.6	20.4	4.4	-9.2	1.1
6	LHL	17.2	9.7	13.2	3.8	4.1	5.9
7	LLH	24.1	21.8	19.6	13.7	4.5	8.1
8	LLL-D	11.2	12.9	9.2	18.3	2.0	-5.4
9	LLL-B	9.5	7.7	7.3	9.8	2.2	-2.1
10	LLL-E	8.6	17.5	7.0	13.0	1.6	4.5
Sum firms with innovation costs		100	100	100	100	0	0
Share firms with innovation costs of all firms		68.6	72.6	40.9	79.2	27.7	-6.6

We see that, as in the case of all size categories combined, types nos. 5 and 6 have a substantially smaller share of the sales than of the firms. The opposite is true of type no. 10, which, as we saw above, has a particularly high average sales per employee ratio. Type no. 7, which was the largest in terms of share of the firms in this size category, is also the largest in terms of share of sales. Type no. 10 is the second largest in terms of sales. Type no. 6, which was the second largest in terms of the share of firms with 17.2 per cent, is in fifth place in terms of sales with only 9.7 per cent.

500 or more employees
In the 500 employees or more size category there are only 39 firms, but 35 of them, or 89.7 per cent, have innovation costs. This size category accounts for only 4.5 per cent of all firms, but for 9.8 per cent of the firms with innovation costs. In terms of sales it is by far the largest size category, with 49.2 per cent of all sales and 58.1 per cent of sales from firms with innovation costs.

In Table 25, below, we have shown the number and share of firms in each innovation cost type for firms with 500 or more employees, and compared these with the corresponding numbers and shares for all size categories taken together.

Table 25. Number of firms and share of firms in each innovation cost type, firms with 500 or more employees compared to all size categories.

		500 or more employees		all size categories		
Type no.	character-istics	number of firms	share (per cent)	number of firms	share (per cent)	difference from all size categories (per cent)
1	HHH	7	20.0	43	12.0	8.0
2	HHL	4	11.4	22	6.2	5.3
3	HLH	3	8.6	9	2.5	6.1
4	HLL	1	2.9	9	2.5	0.3
5	LHH	1	2.9	73	20.4	-17.6
6	LHL	0	0	47	13.2	-13.2
7	LLH	4	11.4	70	19.6	-8.2
8	LLL-D	6	17.1	33	9.2	7.9
9	LLL-B	6	17.1	26	7.3	9.9
10	LLL-E	3	8.6	25	7.0	1.6
20	without innovation costs	4		516		
Sum firms with innovation costs		35	100	357	100	0
Sum all firms		39		873		
Sum firms with innovation costs, their share of all firms		35	89.7	357	40.9	48.9

Again, the share of the firms of each innovation cost type is of the firms with innovation costs.

The share of firms in each innovation cost type for firms with 500 or more employees and the corresponding shares for all size categories are also compared in Figure 22, below.

*Figure 22. Distribution of firms across innovation cost types, per cent. Firms with
500 or more employees compared to all size categories.*
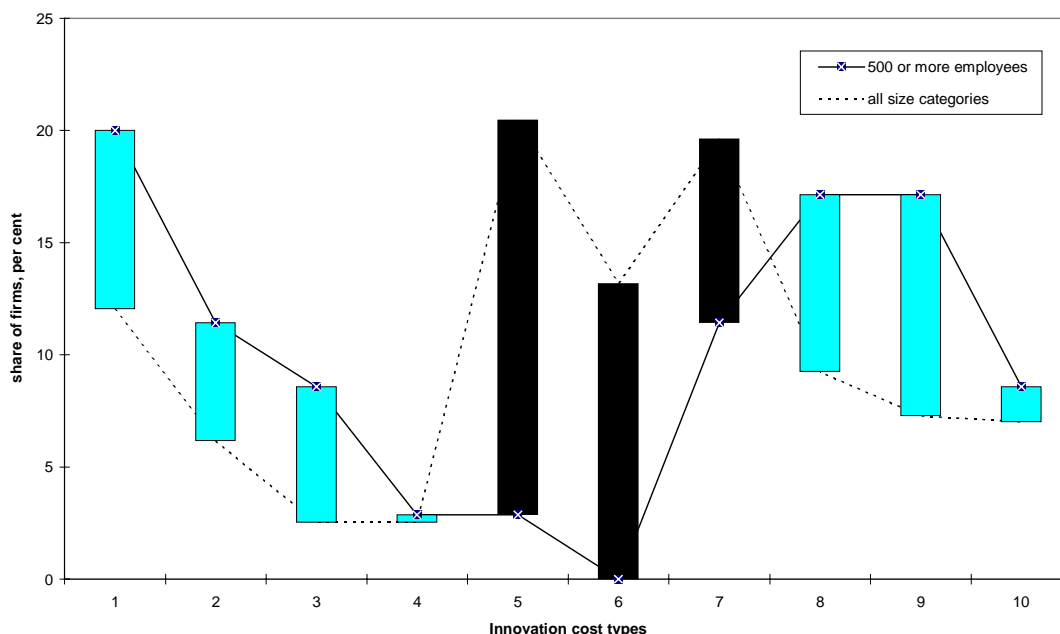
The distribution of firms across innovation cost types is very different in the 500 or
more employees category from the other firm size categories. The three innovation
cost types with low R&D intensity but with high intensity on one or both of the other
two cost dimensions, types nos. 5, 6 and 7, which are the three most numerous
innovation cost types for all size categories combined, have shares in the 500 or more
employees category which are far below their shares among all size categories
combined. This especially applies to the two types with high non R&D intensity,
types nos. 5 and 6, which, respectively, contain one single firm and no firm at all
among the 35 firms. Types nos. 1, 2, and 3, which all have high R&D intensity firms,
have shares which are well above their shares among all size categories combined.
The three types with low intensity on all three cost dimensions also lie above their
shares for all size categories combined. This applies only to a small degree for type
no. 10, where the embodied dimension dominates, but very much to types nos. 8 and
9, where the disembodied dimension dominates and where there is a roughly equal
balance between the disembodied and the disembodied, respectively.

The largest type among the 500 or more employees category is type no. 1, with firms
which have high intensity on all three cost dimensions, followed by, in a shared
second place, types nos. 8 and 9, consisting of firms with low intensity on all three
dimensions and with, respectively, a dominance of the disembodied element and a
rough balance between the disembodied and the embodied.

In Table 26, below, we have ranked the innovation cost types according to their
shares of the firms in the 500 or more employees size category, and we have shown
the cumulative share of the firms represented by the types as we descend the ranking.
We have also compared these cumulative shares to the corresponding cumulative
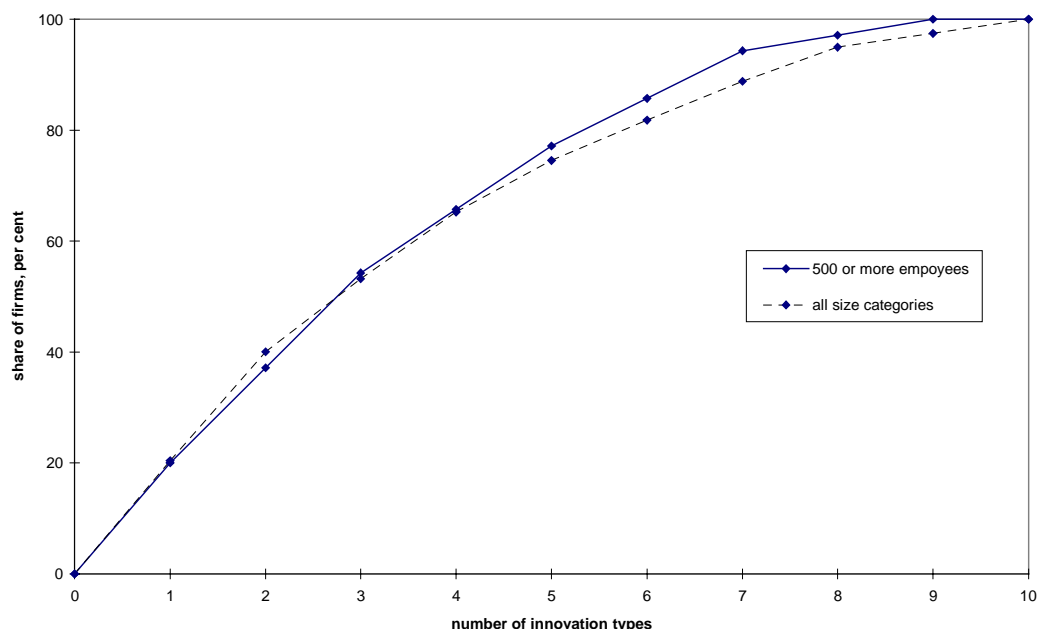shares for all size categories.

Table 26. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with 500 or more employees (N=35), compared to all firms with innovation costs.

rank	type no.	character-istics	number of firms	share	cum. share	cum. share, all size cat.
1	1	HHH	7	20.0	20.0	20.4
2	8	LLL-D	6	17.1	37.1	40.1
2	9	LLL-B	6	17.1	54.3	53.2
4	2	HHL	4	11.4	65.7	65.3
4	7	LLH	4	11.4	77.1	74.5
6	3	HLH	3	8.6	85.7	81.8
6	10	LLL-E	3	8.6	94.3	88.8
8	4	HLL	1	2.9	97.1	95.0
8	5	LHH	1	2.9	100	97.5
10	6	LHL	0	0	100	100

The usual note concerning the ranking of the types for all categories combined applies in this case, too.

These cumulative shares for the 500 or more employees category and for all size categories are also shown in Figure 23, below.

Figure 23. Cumulative share of firms accounted for by innovation cost types, ranked according to number of firms. Firms with innovation costs with 500 or more employees (N=35), compared to all firms with innovation costs.

In this size category, the cumulative distribution of firms according to innovation cost types is very close to the cumulative distribution for all size categories (although, of course, the *ranking* of types is very different). Only when we reach six,

and especially seven, types does the share of firms in the 500 or more employees category lie clearly above the corresponding share for all size categories combined. But this is not very surprising, since in the 500 or more employees case there are only 35 units to be distributed among 10 categories.

Lastly, we will also look briefly at the distribution of *sales* across innovation cost types. We compare with the corresponding distribution for all size categories, as well as the distribution of *firms* across types. This is done in Table 27, below.

Table 27. Shares of firms and shares of sales accounted for by the different innovation cost types, firms with 500 or more employees and all size categories, firms with innovation costs.

Type no.	character-istics	500 or more employees		all size categories		difference	
		share firms (%)	share sales (%)	share firms (%)	share sales (%)	share firms (%)	share sales (%)
1	HHH	20.0	11.6	12.0	11.6	8.0	0.0
2	HHL	11.4	22.9	6.2	15.6	5.3	7.2
3	HLH	8.6	10.6	2.5	7.5	6.1	3.1
4	HLL	2.9	1.1	2.5	2.3	0.3	-1.2
5	LHH	2.9	1.3	20.4	4.4	-17.6	-3.1
6	LHL	0	0	13.2	3.8	-13.2	-3.8
7	LLH	11.4	7.9	19.6	13.7	-8.2	-5.8
8	LLL-D	17.1	22.7	9.2	18.3	7.9	4.4
9	LLL-B	17.1	11.0	7.3	9.8	9.9	1.3
10	LLL-E	8.6	10.9	7.0	13.0	1.6	-2.1
Sum firms with innovation costs		100	100	100	100	0	0
Share firms with innovation costs of all firms		89.7	93.4	40.9	79.2	48.9	14.3

Since the 500 or more employees category is so dominant in terms of sales (accounting for well over 50 per cent of all sales from firms with innovation costs) but not at all in terms of firms (accounting for less than 10 per cent of all firms with innovation costs), the differences of the innovation cost types shares in this size category from their respective shares in all categories combined are much larger in terms of the share of firms than in terms of the share of sales. In terms of sales, types nos. 2 and 8 are the largest in the 500 or more employees category. As we remember, in type no. 2 there were a few very large firms which contributed to a particularly high average size of the firms, and these very large firms, of course, are found in the 500 or more employees category. Consequently, for this type the share of sales is very much higher than the share of firms in this category.

Conclusion

Let us in conclusion try to sum up how the relative importance of the different innovation cost types varies with firm size. Table 28, below, synthesizes the analyses in the firm size sections above, giving the distribution of firms across innovation cost types, in per cent, for all four size categories.

Table 28. Distribution of firms across innovation cost types, per cent, by size category.

		less than 30 employees	30-99 employees	100-499 employees	500 or more employees	all size categories
1	HHH	14.9	8.9	10.3	20.0	12.0
2	HHL	10.6	3.6	3.4	11.4	6.2
3	HLH	1.1	1.8	2.6	8.6	2.5
4	HLL	2.1	3.6	1.7	2.9	2.5
5	LHH	29.8	27.7	11.2	2.9	20.4
6	LHL	16.0	10.7	17.2	0	13.2
7	LLH	13.8	22.3	24.1	11.4	19.6
8	LLL-D	5.3	8.0	11.2	17.1	9.2
9	LLL-B	1.1	7.1	9.5	17.1	7.3
10	LLL-E	5.3	6.3	8.6	8.6	7.0
	Total	100	100	100	100	100

Two of the innovation cost types have only 9 firms each over all size categories combined. These are types nos. 3 and 4, both characterized by high R&D intensity and by low non R&D intensity, being distinguished by type no. 3 having high investment intensity and type no. 4 low investment intensity. Since they each have only 9 units to be divided among 4 size categories, we will not include them in the overview which follows.

The remaining 8 innovation cost types will be presented in three different groups. First we will look at innovation cost types nos. 1 and 2, which both have high R&D intensity and high non R&D intensity, but where type no. 1 has high intensity on all cost components, while type no. 2 has low investment intensity. The share of these two types of all firms with innovation costs inside each size category is shown in Figure 24, below.

Figure 24. Share of firms with innovation costs, per cent, by size category. Innovation cost types nos. 1 and 2.
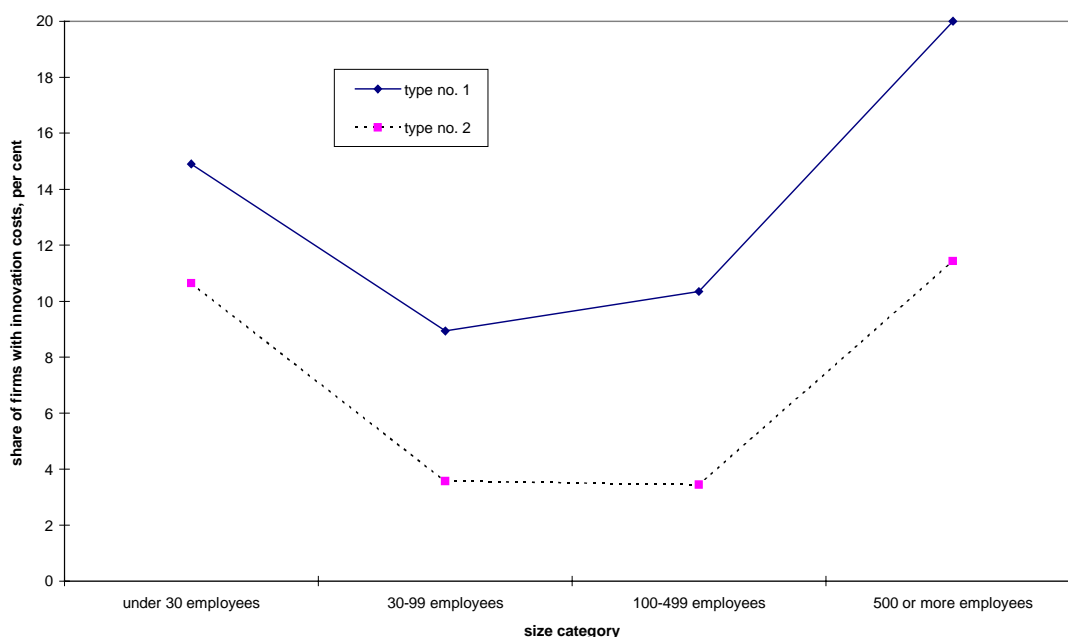

These two types appear to be comparatively most important among the smallest and the largest firms, with a substantially lower share in the two size categories in the middle. This may reflect that R&D expenditures on the one hand are highly concentrated in large firms with very sizeable resources, but that on the other hand there also is a small proportion of the very small firms which are highly resourceful when it comes to R&D, highly educated personnel, innovation activities, etc.

It is important to remember here, as we pointed out above, that the shares depicted in Table 28 and Figure 24, above, are computed on the basis of firms with innovation costs only. Had we included *all* firms instead, these shares would have been lower, and very much so among the smallest firms.

Second, we will look at innovation cost types nos. 8, 9 and 10, all characterized by low intensity on all three cost components, but where the disembodied element dominates in type no. 8, there is a rough balance between the disembodied and the embodied in type no. 9, and the embodied element dominates in type no. 10. The share of these three types of all firms with innovation costs inside each size category is shown in Figure 25, below.

Figure 25. Share of firms with innovation costs, per cent, by size category.
   *Innovation cost types nos. 8, 9 and 10.*
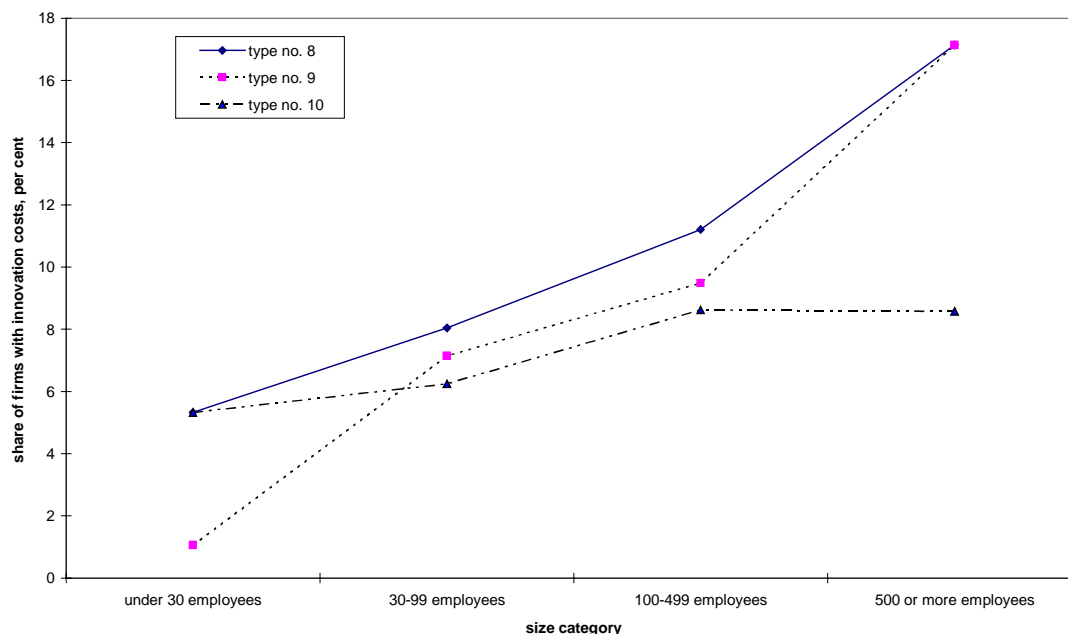
Here we find a different pattern, with a general tendency for the relative importance of these innovation cost types to increase with increasing firm size. For type no. 10, where the disembodied element dominates, this tendency is hardly discernible at all. For the two other types, however, where the disembodied element dominates and where there is a rough balance between the embodied and the disembodied, respectively, there is a very clear tendency for this share to increase with increasing firm size.

We should here also mention that although there are very few firms, namely nine, in innovation cost type no. 3, there seems to be a certain tendency for its share to increase with increasing firm size as well. The nine firms in this innovation cost type are distributed in the following way: It accounts for 1 of the 94 firms with innovation costs in the less than 30 employees category, 2 of 112 firms in the next, then 3 of 116 firms in the next, and lastly 3 of 39 firms in the 500 or more employees category.

Lastly, we look at innovation cost types nos. 5, 6 and 7, all with low R&D intensity, but with either high non R&D intensity, high non R&D intensity or both. Type no. 5 has both high non R&D intensity and high investment intensity, type no. 6 has high non R&D intensity and type no. 7 has high investment intensity. Figure 26, below, shows the share of these three types of all firms with innovation costs inside each size category.

Figure 26. Share of firms with innovation costs, per cent, by size category.
        Innovation cost types nos. 5, 6 and 7.
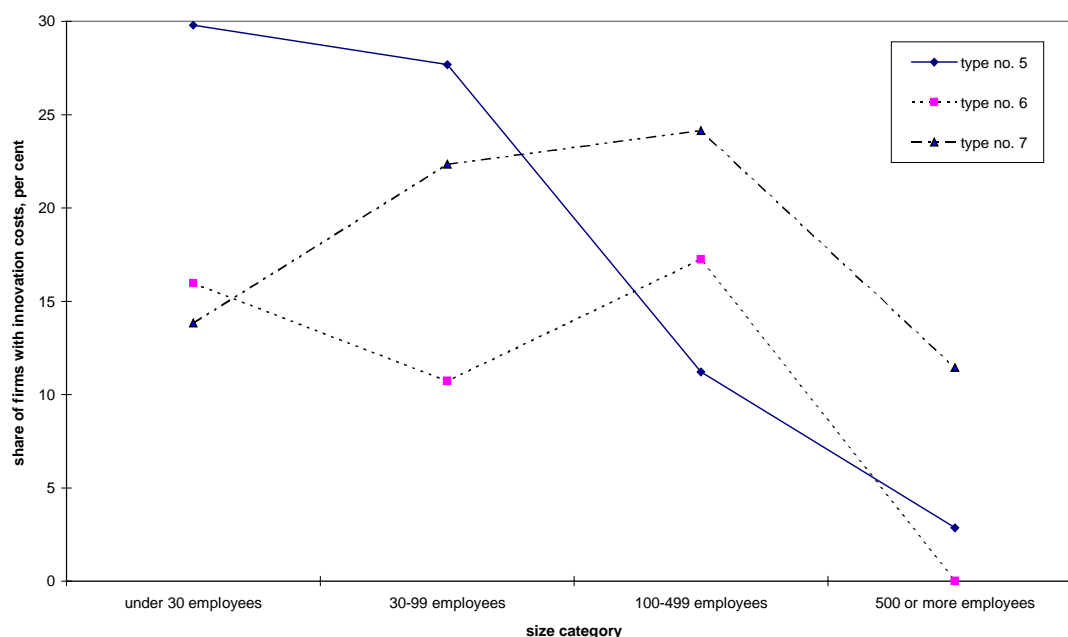
Again, we find a different pattern, or more accurately, three distinctive new patterns. They all have in common that the largest firms (500 or more employees) is low. For type no. 5, where there is both high non R&D intensity and high investment intensity, there is a very clear tendency for its share the firms with innovation costs to *decrease* with increasing firm size. Innovation cost type no. 7, where there is high investment intensity only, seems to be relatively most important in the two middle size categories, with substantially lower shares among the smallest and the largest firms. Type no. 6, where there is high non R&D intensity only, shows a more irregular pattern, although with a certain tendency for the share to be higher among the small than among the large firms. It has a relatively high share among the smallest firms, a somewhat lower share in the 30-99 employees category, then it has its highest share in the 100-499 employees categories, and lastly it has 0 among the largest firms. It would seem that high non R&D intensity, when not combined with high R&D intensity, is something which characterizes the small firms far more than the large firms

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STEP
group

STEP-gruppen ble etablert i 1991 for å forsyne beslutningstakere med forskning knyttet til alle sider ved innovasjon og teknologisk endring, med særlig vekt på forholdet mellom innovasjon, økonomisk vekst og de samfunnsmessige omgivelser. Basis for gruppens arbeid er erkjennelsen av at utviklingen innen vitenskap og teknologi er fundamental for økonomisk vekst. Det gjenstår likevel mange uløste problemer omkring hvordan prosessen med vitenskapelig og teknologisk endring forløper, og hvordan denne prosessen får samfunnsmessige og økonomiske konsekvenser. Forståelse av denne prosessen er av stor betydning for utformingen og iverksettelsen av forsknings-, teknologi- og innovasjonspolitikken. Forskningen i STEP-gruppen er derfor sentrert omkring historiske, økonomiske, sosiologiske og organisatoriske spørsmål som er relevante for de brede feltene innovasjonspolitikk og økonomisk vekst.

The STEP-group was established in 1991 to support policy-makers with research on all aspects of innovation and technological change, with particular emphasis on the relationships between innovation, economic growth and the social context. The basis of the group's work is the recognition that science, technology and innovation are fundamental to economic growth; yet there remain many unresolved problems about how the processes of scientific and technological change actually occur, and about how they have social and economic impacts. Resolving such problems is central to the formation and implementation of science, technology and innovation policy. The research of the STEP group centres on historical, economic, social and organisational issues relevant for broad fields of innovation policy and economic growth.