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INNOVATIONS IN THE NETHERLANDS: A TIME DYNAMIC ANALYSIS

Abstract: This article covers several aspects of innovations within firms in the Netherlands. First of all the innovativeness of the Dutch industry is investigated. This is done by means of a measuring scheme developed by the Faculty of Spatial Sciences of the University of Groningen. The next step will be to analyze the spatial distribution of innovative firms in the Netherlands. A special feature of this investigation is the possibility to compare the present situation with the one in 1983 when a comparable research was conducted. In this way the spatial temporal pattern can be analyzed. Furthermore some attention is paid to employment implications of innovations.

Key words: economic development, regional policy, technological change.

1. INTRODUCTION

1.1. Innovation in a time and labour market perspective

In the eighties the theme of technological change and innovation within companies was a popular one, according to the number of scientific publications on the subject. Recently this line of research has experienced a new upswing. This development is for a significant part justified by the mere fact that there are still many unanswered questions related to innovations within companies. Some of these partly unanswered questions are the relationship between the output of innovations and the economic situation, the analysis of innovations from a spatial point of view and the relationship between innovations and the labour market. In the perspective of the economic recession in the beginning of the 1990s, it is obvious that industrial policy makers have the tendency to focus on

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technological change as an instrument for economic development. One of the most annoying problems of an economic recession is the unemployment issue. The question whether technological change and innovation is able to make a significant contribution to solve this problem has not yet been (fully) answered.

The main purpose of this article is to link innovation to the state of the economy and to explore the employment effects of innovations in general way. In section 1 of the paper the method by which innovations are measured is discussed. In section 2 the main theme is the innovativeness of the private sector in the Netherlands. A comparison is made between the years 1983 and 1993. Furthermore attention is paid to the differences in innovativeness between the different economic sectors and innovations are discussed from a spatial point of view. In section 3 this paper comes to an end with a theoretical and empirical reconnaissance of some labour market implications of innovations.

1.2. Theoretical framework

The measurement of innovations can be done using several different methods. A method which has often been used is to count the number of patents in a certain period of time. After a while the 'patentkeepers' can be traced back and it is possible to establish what has been done with the patents (KLEINKNECHT, REIJNEN and SMITS, 1992). Another possibility, especially applicable to bigger firms, is to measure the R&D intensity of the private sector. KLEINKNECHT, REIJNEN and SMITS (1992) try to measure the output of innovations by using information published in professional journals.

In 1984 KOK, OFFERMAN and PELLENBARG used a telephone inquiry to get direct information about the innovativeness of the private sector in the Netherlands. At the time the main target of the research were the small and medium-sized firms (up to 100 employees). This restriction was made because these firms constitute a sector of the economic system where quick reactions to changes in demand and technology are possible, and at the same time the dependence on the local environmental conditions is rather great. The repetition of this line of research offers the possibility to compare the results of 1983 with those from 1993.

The investigation of the innovativeness of the smaller firms of the Dutch private sector is done by means of a measuring scheme developed during the 1983 research. Because of the diversity of the types and levels of innovations it is impossible to find one general definition of an innovation. The connection between the 'economic weather' and innovations or technological change, however, serves as a key concept in solving the operationalisation problem. SCHUMPETER (1934) tries to make a connection between the Kondratiev

cycle and instabilities caused by technical changes. These changes arise from what Schumpeter calls "the sphere of industrial and commercial life". Within the Schumpeterian economic theory innovations play an important role as clusters of basic innovations indicate the beginning of a new economic cycle. This author describes innovations as "[...] new combinations of materials and forces [...]" which can take the following different shapes.

1. The introduction of a new product or the addition of new qualities to an already existing product.
2. The introduction of a new production method.
3. Opening up a new market.
4. The use of new resources.
5. The introduction of a new organization.

Van DUIJN (1979) argues that the Schumpeterian basic innovation serves as the starting point of the product life cycle or the innovation life cycle. This innovation life cycle is influenced by the way in which the markets for a product develop. Furthermore one may argue that as the markets evolve the type and level of innovations change. At first when a basic innovation occurs it is not very clear how the demand will develop. To adjust the product according to the (expected) demand a derived kind of innovation arises. This innovation could be called a primary innovation. After that an increased acceptance by the consumer takes place. The exchange of information is very important in this stage. The adjustments to the product(s) which are now taking place are what we call secondary innovations. In this stage of the innovation cycle the number of primary innovations tends to decrease. Furthermore this stage is characterized by a standardization process. The number of suppliers is growing and product differentiation and renewal is taking place. The third stage comes with process innovations in the shape of labour-saving large scale operations. The markets are completely open. The next stage is characterized by a stagnation of the demand. The private sector tries to avoid saturation of the markets by changes in the basic technology. In addition to this further labour-saving operations are carried out. The innovations that are developed in the last two stages are called tertiary innovations. During the development of the innovation cycle a diffusion process takes place. It was argued that information is important in the 'triangle' firm – markets – competitors. Knowing that the target of this paper is the small and medium-sized firms which can be characterized as extremely 'information dependent', the information concept could be an argument to look at the innovativeness from a spatial point of view. For instance the centre-periphery concept is strongly linked to the importance and regional differences in information availability.

The foregoing gives us a tool for developing an operationalisation scheme for measuring innovations in the private sector. First, we have the 'Schumpeterian' types of innovation and second, we have different levels of in-

novations, as derived from the product life cycle, at our disposal. The result is summarized in figure 1.

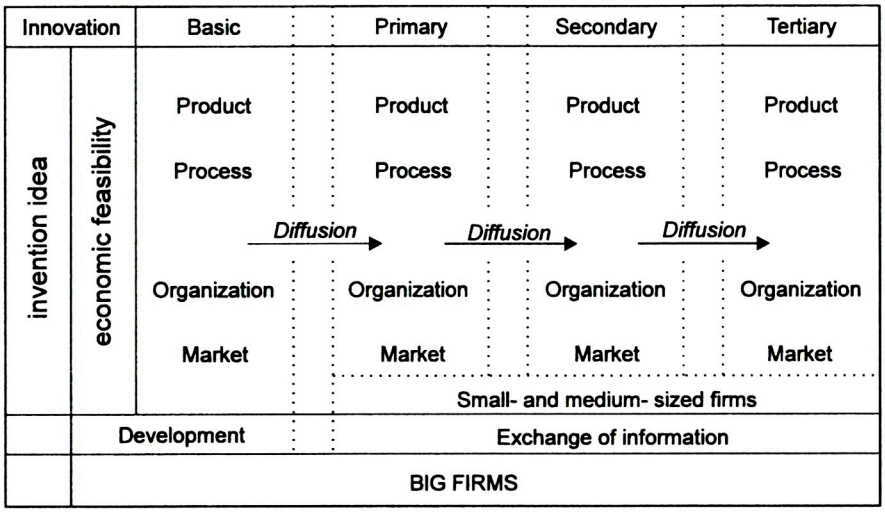

Fig. 1. Types and levels of innovation

2. INNOVATION IN THE NETHERLANDS, A COMPARISON BETWEEN 1983 AND 1993

2.1. Description of the data

To get an impression of the innovativeness of the private sector in the Netherlands in 1983 as well as in 1993 a sample is taken at random from the target population of companies. In this case the target population consisted of the following economic sectors:

- industry;
- wholesale;
- service companies for the transport sector;
- business services.

Of course this is a sub-set of the total population. For instance, sectors like the retail business and agriculture are left out.

In both years the sample was taken from the database of the Dutch Chamber of Commerce. In 1983 the size of the sample was 1% out of the total while in 1993 the size was 2%. The main reason for using a larger sample in 1993 is that it permits us a more detailed analysis. In the following table the characteristics of both samples are summarized.

Table 1. The samples of 1983 and 1993 compared

Year	Size of sample (%)	Number of firms	Response (%)	Remaining firms in data-set
1983	1	607	76	461
1993	2	1 624	45	738

Table 1 indicates that in 1993 the total number of firms in the used sub-set is higher compared to 1983. However in both years the sample was representative for the different economic sectors as well as for the size of the firms.

In both years the firms were approached with the request to answer some questions by telephone. It must be stressed that the firms were not aware of the fact that the survey was about innovativeness. This was done deliberately to rule out the possibility of selective non-response.

The fact that the response in 1993 is some 30% lower compared to 1983 is probably explained by the phenomenon of 'questionnaire tiredness' occurring in the Dutch private sector.

In both years the companies were asked the same questions concerning their innovativeness, while in 1993 some additional questions about developments within the companies like employment, turnover and investments were asked. The questions about the innovativeness of the firm concerned the two-year period before 1983 as well as 1993. The main advantage of using the same questions again is that the results are very comparable.

2.2. Innovativeness in general

When the results are compared in an overall picture the following striking differences arise. In 1983 one out of every three companies was innovative and from those innovative companies one out of every three executes an innovation of the primary or secondary level. This means that in 1983, 60% of all the innovative companies are just adapting to new developments. In 1993 the picture is somewhat different. Now two out of every three companies claim to be innovative and again from the innovative companies one out of every three executes an innovation of primary or secondary level. The percentage of adapters is with 60% quite stable. However, when the number of high level innovative companies is related to the entire group, we find that in 1983 about 10% of all companies is active on a high innovation level whereas in 1993 this percentage is about 25%.

When the number of innovations within the single company is analysed, the picture of much more innovative behaviour in the second period is confirmed.

In 1983 the average number of innovations within the single firm is 1.2, while in 1993 it is 3.2.

Table 2 gives a complete overview of frequencies of the different numbers of innovations within the single firm and the total number of innovations in 1983 and 1993.

The global conclusion so far is that in 1993 not only more firms claim to be innovative but that within the single firm the average number of innovations is significantly higher too. When the effect of more firms in the sample (2.7 times) is ruled out, both effects together make the total number of registered innovations in 1993 about 4 times as high as in 1983.

Table 2. Frequencies of the number of innovations within Dutch firms in 1983 and 1993

Number of innovations	Frequency		Total number of innovations	
	1983	1993	1983	1993
1	122	100	122	100
2	18	120	36	240
3	7	125	21	375
4	–	103	–	412
5	–	64	–	320
6	–	37	–	222
7	–	17	–	119
8	–	4	–	32
Total	147	570	179	1 820

2.3. Analysis of the differences in innovativeness

This striking increase of the innovativeness might be explained by the health of the economy in the periods the companies were questioned. In the two year period before 1983 the economy was in a deep recession, while in the same period before 1993 the economy was more healthy. These differences in economic climate account, at least partly, for the way entrepreneurs experience their relevant (economic) environment. Of course in the second period the environment looked much more stable, which might be an explanation for the high levels of innovativeness.

Furthermore, some other comments can be made. The period of ten years between the two surveys is about as long as the Juglar economic cycle (7–11 years). SCHUMPETER (1939) relates the upswing of such a Juglar cycle also to

innovations. The emergence of the long Kondratiev wave is more or less related to basic innovations. Schumpeter indicates that the Juglar wave could experience an upswing due to innovations of a lower level. Van DUIJN (1979) uses the following quote of SCHUMPETER (1939):

> Innovation is possible without anything we should identify as invention, and invention does not necessarily induce innovation, but produces of itself [...] no economically relevant effect at all.

One may conclude that innovations might influence the course of the economic *conjuncture*. On the other hand, it is possible to argue that the *conjuncture* has a significant influence on the innovativeness of the private sector. In a recession or depression an economic situation exists where entrepreneurs, just to survive, are forced to consider doing things differently (MENSCH, 1975). This might stimulate the tendency for new investments which might lead to innovations of some kind.

2.4. Types of innovation

In section 1.2 of this article four different types of innovation were mentioned. A distinction was made between: product, process, organization and market innovations. Furthermore three different levels could be recognized (primary, secondary and tertiary).

In table 3 the distribution of the innovations according to the different types and levels in 1983 and 1993 is summarized.

It is clear that the proportions in the table show some shifts in the types and the levels of the innovations. In 1993 the proportion of process innovations is somewhat smaller compared to 1983, while the market innovations show an increase of 9%. The 'level' proportions in table 3 show a shift from secondary towards tertiary level. Within the class of tertiary innovations the product and the market innovations show the highest increase. The latter imply minor adjustments to existing products and extensions of existing markets. It is likely that market extensions often require small adjustments to the existing product(s).

These two kinds of innovations are likely to occur together within the same firm. The same holds for the primary product innovations and the primary market innovations. The introduction of a new product will simultaneously create a new market. In 1983 the primary market innovations are considered to be synonymous with primary product innovations (KOK, OFFERMAN and PELLENBARG, 1984). This might however not be the absolute truth. The years before 1993 are dominated by the increasing inclination to look for new international

Table 3. Distribution of innovations according to the types and levels in 1983/1993

Type of innovation	Levels of innovation %							
	primary		secondary		tertiary		total	
	1983	1993	1983	1993	1983	1993	1983	1993
Product	6	4	13	3	13	24	32	35
Process	0.6	0.7	4	2	18	12	23	15
Organization	0	0	3	1	25	23	28	24
Market	0	2	7	6	9	17	17	26
Total	7	7	27	16	66	77	100	100

markets (Europe, 1992). The 1993 data show that more than 50% of the firms which claim to have been engaged in a primary market innovation do not mention a primary product innovation. This outcome is in contrast with the conclusion of KOK, OFFERMAN and PELLENBARG (1984). The above might underline the importance of a growing export 'mindedness' within the Dutch private sector. This process might partly account for the higher levels of innovativeness in 1993.

2.5. Innovations within different economic sectors

In this section attention is paid to differences in innovativeness between the different sectors of the economy. In table 4 the outcomes are summarized.

Table 4 makes clear that in 1983 the industry in the Netherlands was the most innovative sector. All three industrial sub-groups show a level of innovation activity that outweighs the national average. The other sectors: wholesale, transport services and business services are characterized by a lower level of innovation activity compared to the national average. It is obvious that in 1993 all the different sectors in the table show a higher level of innovativeness compared to 1983.

Table 4. Percentages of innovative companies within the different industrial sectors in the samples of 1983 and 1993

Sector	Innovative firms in %	
	1983	1993
Traditional industry	36	63
Chemical, metal and electronic industry	45	64
Other industry	48	58
Wholesale	21	73
Transport services	26	54
Business services	29	66
Total	32	68

Nevertheless, when the individual levels of activity are linked to the national average a changed picture emerges. This is shown in table 5 where an innovation concentration index is constructed for each sector in the two different years (total = 100).

In 1993 all three industrial sub-groups show lower levels of innovation activity than the national average. For the transport services and the business services nothing changed, these sectors are still below the national average.

Table 5. Innovation concentration index of the different industrial sectors in 1983 and 1993 (total = 100)

Sector	Index 1983	Index 1993
Traditional industry	113	93
Chemical/metal and electronic industry	141	94
Other industry	150	85
Wholesale	66	107
Transport services	81	79
Business services	91	97
Total	100	100

The most striking outcome concerns the wholesale sector. In 1983 this group of firms showed the lowest innovation activity (index = 66) while in 1993 the wholesale trade, with an index score of 107 is the number one on the list. The product innovation is the most important innovation within this sector.

2.5. Innovations from a spatial perspective

In section 1.2 of this article it was argued that information is important in the innovation process especially for the smaller firms. Because for smaller firms this information comes, at least in large part, from external sources, the quantity, quality and the ability of the entrepreneur to select and use the information could be an important factor in the innovation activity of the firm. Assuming that information is not equally distributed over space, as the concept of concentrated development in space (e.g. PRED, 1977) implies, a discussion of innovations from a spatial perspective is interesting. In the case of the Netherlands however one remark must be made. Because of its small size one may suggest that information is equally distributed over space, or in the words of Pred;

[...] almost the whole physical area of the Netherlands lies within a 100 mile radius, or the urban field, of the Randstad metroplitan complex, and can therefore benefit from its external economies to some extent.

Table 6. Spatial pattern of innovative companies in the Netherlands in 1983

Province	Number of firms	Innovative firms		High level innovative firms	
		number	%	number	%
NORTH					
Friesland	19	5	26	2	10
Groningen	11	4	36	1	9
Drenthe	10	3	30	0	–
EAST					
Overijssel	29	13	45	8	28
Gelderland	59	24	41	9	15
SOUTH					
Noord-Brabant	68	17	25	6	8
Limburg	30	12	40	2	7
Zeeland	13	2	15	1	8
WEST					
Zuid-Holland	102	36	35	16	16
Noord-Holland	85	23	27	5	6
Utrecht	35	9	26	2	6
NETHERLANDS	461	147	32	52	11

Table 7. Spatial pattern of innovative companies in the Netherlands in 1993

Province	Number of firms	Innovative firms		High level innovative firms	
		number	%	number	%
NORTH					
Friesland	16	12	75	5	31
Groningen	20	13	65	3	15
Drenthe	18	13	72	4	22
EAST					
Overijssel	57	39	68	12	215
Gelderland	79	51	66	17	21
SOUTH					
Noord-Brabant	133	85	64	29	22
Limburg	36	25	69	6	16
Zeeland	10	8	80	2	20
WEST					
Zuid-Holland	168	109	65	45	26
Noord-Holland	121	85	70	37	31
Utrecht	64	45	70	19	30
Flevoland	16	14	87	2	13
NETHERLANDS	738	499	67	174	24

Tables 6 and 7 give an overview of the number of innovative companies per province (note however that the province called Flevoland did not yet exist in 1983). The main problem of the spatial approach concerns the small number of firms in some of the provinces. This implies that some of the conclusions do not have a solid statistical base. To meet this problem it is possible to aggregate the figures to a meso level, i.e. the North (N), the East (E), the South (S) and the West (W) part of the country known as the Randstad.

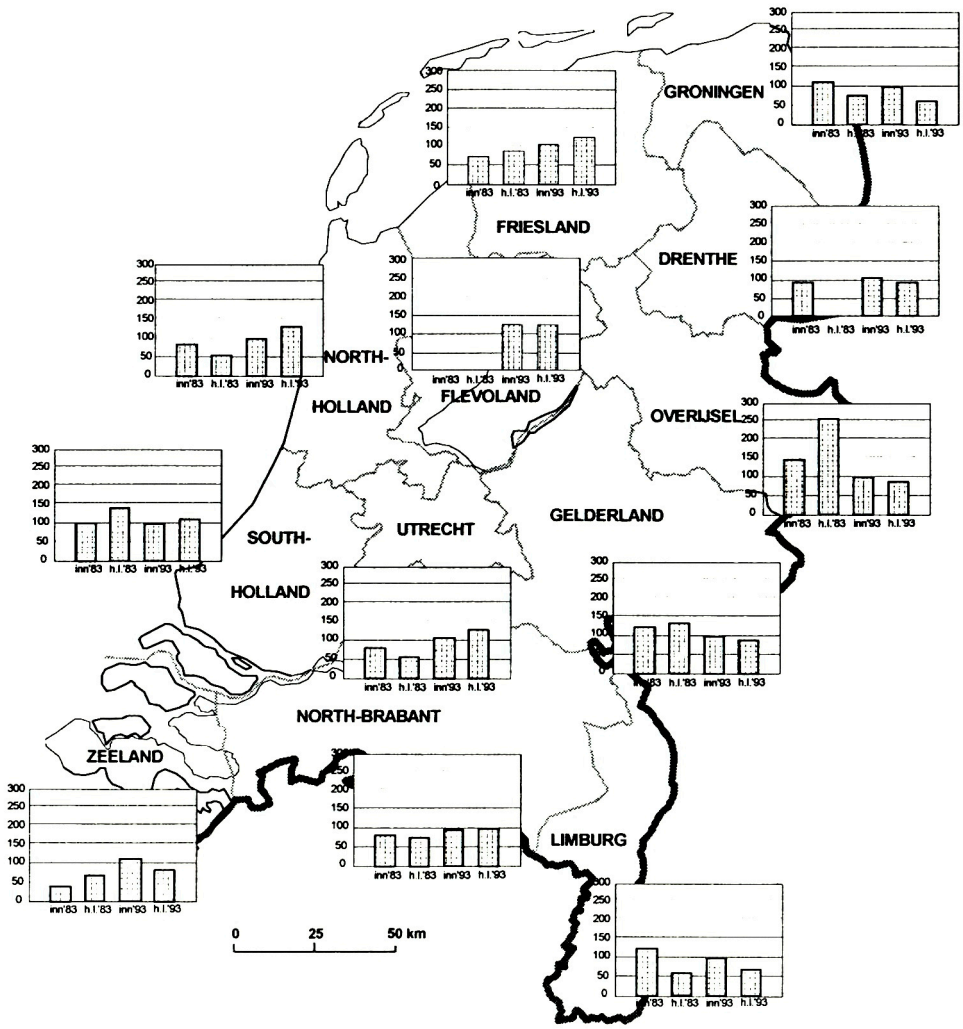

Fig. 2. Regional innovation concentration indices

In 1983 the innovativeness of the firms in the West and the North is almost equal to the national average. While the East part of the country shows a higher level of innovativeness, the South stays a little behind. The firms in the East part

of the country also show a high score when innovations of the primary and secondary level are concerned. The number of high level innovations in the North stays somewhat behind. In 1993 the differences in innovativeness between the different parts of the country are not as obvious as in 1983. It is surprising that in 1993 the Northern part of the country turns out to be the main 'runner up'. The rest of the country shows levels almost equal to the national average. The firms in the West are leading when high-level innovations are concerned.

For the different provinces innovation concentration figures are calculated too for both years (1983 and 1993; the Dutch average = 100). In this way it is possible to get an impression of spatial concentration differences as far as innovative companies are concerned. The four calculated indices are: an index for the innovativeness in general in 1983 (inn. 1983), an index for the high level innovations in 1983 (h.l. 1983), an index for the innovativeness in general in 1993 (inn. 1993) and an index for the high level innovations in 1993 (h.l. 1993). The indices of all the provinces are presented in the map (cf. figure 2).

The map shows that the distribution of innovative companies in the Netherlands in 1993 is more equal compared to 1983. The 1993 indices of all provinces show a tendency towards the national average of 100, while the 1983 ones show more variation. This tendency towards the national average is illustrated in figure 3 where the shift of the provinces is plotted on a two dimensional scale. The horizontal (x) axis stands for the innovativenes in general while the vertical (y) axis is the scale for the high level concentration index. The starting point of the arrows is the position of the provinces in 1983. The plot illustrates the tendency towards the national average, the crossing of the two axes (x = 100, y = 100).

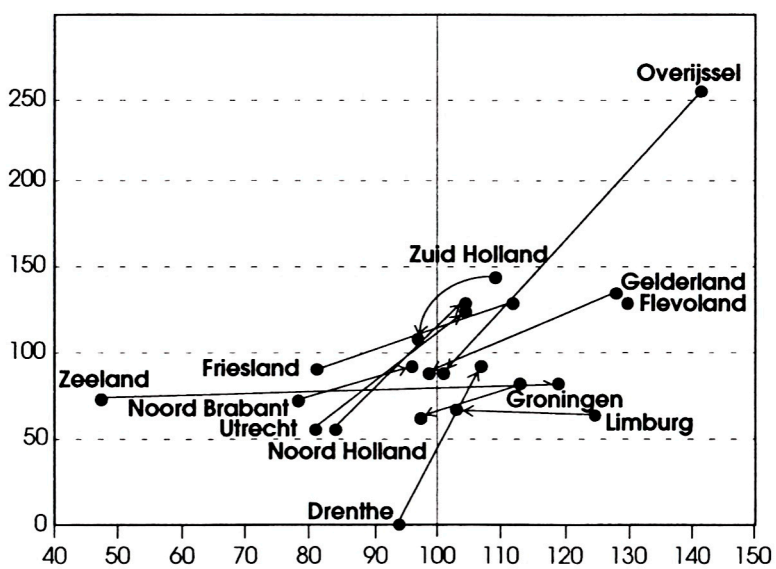

Fig. 3. Innovation plot 1983–1993

The general conclusion might be that the different parts of the country show no significant differences in innovativeness. This confirms the suggestion of PRED (1977) that the whole area of the Netherlands benefits from the external economies of the urban area in the western part of the Netherlands called the Randstad.

3. INNOVATION AND EMPLOYMENT – SOME GENERAL REMARKS

3.1. The theoretical perspective

A substantial amount of theory-orientated scientific work on the relation between technology and the labour market has been published. Within this conglomerate of publications a lot of different views are represented. One of two best known theoretical angles of incidence are the neo-classical view and the Schumpeterian view. Within the neo-classical view the production function occupies a central position. Within this function a factor which stands for technological change can be incorporated. In fact, this factor is a residual factor, explaining the growth of the total production which can not be explained by the factors of labour and capital. In this way, it is possible to relate technological change to the growth of the total production (output). In the neo-classical view, technological change is treated as an exogenous and 'disembodied' variable. This 'manna from heaven' view is not easily related to changes in employment, the possible impact on employment is always indirect, for instance as a result of increased turnover.

Of course investments in new machinery incorporate technological change as well. This 'embodied' technological change has a more direct impact on employment due to substitution effects. STONEMAN (1983) argues in his discussion of the neo-classical model that the absence of the source of innovations is a deficiency within this framework. Another shortcoming is the fact that the production function does not make the difference between a product and a process innovation into account. KATSOULACOS (1986) delivers formal (mathematical) proof for the different employment effects of the two types of innovation.

The 'Schumpeterian' way of thinking is in sharp contrast with the neo-classical view. Schumpeter argues that technological change or innovations are not continuous as within the neo-classical concept and that they are endogenous, meaning that they emerge within the private sector. Schumpeter treats technological change as an important determinant of economic growth, but he pays relatively little attention to labour market aspects of technological change. Within a Schumpeterian line of thinking, FREEMAN, CLARK and SOETE

(1982) link different types of innovation and the matching employment effects to the different stages of the economic cycle (Kondratiev).

It is clear that even from a theoretical point of view the relationship between innovations and employment is not very clear and indeed considerably complex. It is impossible to describe this relationship in terms of direct causality.

REIJNEN and KLEINKNECHT (1992) come up with a system of factors and their causal relationships which summarizes possible relations between technology (or innovations) and employment within the single firm.

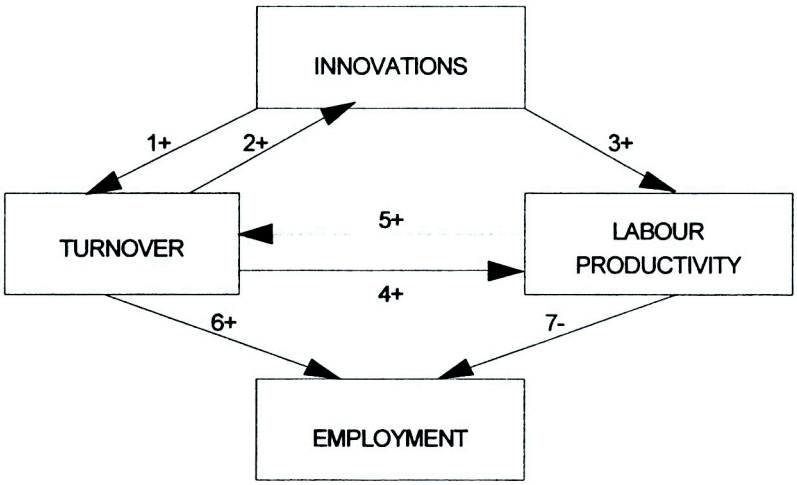

Fig. 4. Causal relationships between technology and employment.
Source: REIJNEN and KLEINKNECHT (1992); OECD (1988)

The numbered relationships in figure 4 are explained below:

1. When innovations result in a lead compared to competing firms this can result in a direct growth of the sales.

2. This is the 'demand pull' effect. SCHMOOKLER (1969) argues and proves that the intensity of the demand influences the intensity of patents within the American industry.

3. When innovation activities result in a more efficient production process, in general the labour productivity will rise.

4. Relationship 4 can be described as the law of Verdoorn, who argues that with a growing turnover a cumulation of know-how builds up which can have positive influence on the labour productivity.

5. An increase of the labour productivity can result in a saving of factor costs which can cause a decrease of prices and stronger market position and eventually increase of the turnover.

6–7. A change of labour demand is always the result of the changes in turnover and labour productivity.

3.2. Some general empirical data

In the 1993 survey about innovation in Dutch firms some questions about developments within the companies were asked. The questions related to employment, turnover and investments. However the central issue of this section concerns the employment effects of innovations it might be interesting to mention the other variables as well. Given the interrelations shown in figure 4 the turnover developments are important because they take a central position within the causal system described above. The following table describes the developments within the questioned firms and give a clear view of the differences between innovative and non-innovative firms.

It is clear that innovative firms perform much better on all three variables.

Table 8. Developments on employment, turnover and investments in %

Tendency	Innovative firms			Non-innovative firms		
	employ-ment	turnover	invest-ments	employ-ment	turnover	invest-ments
Increase	57	72	60	29	50	35
Decrease	9	6	4	12	10	5
Stable	32	16	30	57	36	52

The data in the table are not suitable for quantifying the relationships as shown in figure 4. However, there might be an indication for the fact that the relations 1 and 6 are important. The relations 3 and 7 should have a negative influence on employment. But an increase in labour productivity and the resulting decrease in employment holds mainly for process innovations (KATSOULACOS, 1986). In the foregoing, however, we saw that the importance of process innovations has diminished when compared to 1983. It is reasonable to assume that in this specific data-set the employment effects are dominated by the interrelations 1 and 6 which explains the obvious difference between innovative and non-innovative firms.

3.3. Concluding remarks

The most striking outcome of the survey is without doubt the increase in innovativeness in the Dutch private sector. In 1983 one out of every three companies claimed to be innovative while in 1993 two out of every three companies were engaged in an innovation of some sort. When looking at the number of innovations within the innovative firms another remarkable outcome appears. In 1983 the average number of innovations within the innovative firm is 1.2 while in 1993 the average increased up to 3.2.

Looking at the different types of innovation it can be stated that the proportion of process innovations is in 1993 somewhat smaller compared to 1993 while the market innovations show an increased proportion. Within the different levels of innovation a shift from the secondary towards the tertiary level is noticed.

For the different economic sectors it appears that the industrial sub-groups show lower levels of innovativeness in 1993 compared to 1983, while the wholesale sector shows a remarkable increase.

From a spatial point of view it is clear that in 1993 the differences between the different parts of the country are not as obvious as in 1983. It is however surprising that in 1993 the North turns out to be the main 'runner up'. The firms in the West (the economic centre of the Netherlands) show the highest level of high-level innovations. In general, the different parts of the country show no significant differences in innovativeness.

When innovations within the firm are related to the development of variables like employment, turnover and investments, it is clear that the innovative firms more often show an increase compared to the non-innovative firm.

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