REGIONAL ECONOMIC GROWTH AND ACCESSIBILITY: THE CASE OF THE NETHERLANDS

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Abstract

Since the early 1970s, a certain shift has appeared in the contribution of the various Dutch regions to the national economy. There has been a decline in the contribution of the urban agglomeration of Western Holland to the national economy. This decline, together with a relative strong increase outside this western part of the Netherlands, resulted in a decrease in regional disparities. To analyse these disparities between the regional and national growth rates, a shift-share analysis for labour volume and value added has been used. The analysis encompasses 40 so-called COROP-regions in the Netherlands over four sub-periods for the two decades (1973-1993). It is shown that the development over time of the shift-share effects for labour volume and value added are much the same. The relationship between regional economic growth and congestion is investigated as well. As economic development is not only the result of a proper combination of private production factors, but also of infrastructure in general and accessibility in particular, the role of accessibility in location processes of firms is often regarded to be important. We accordingly determine, on the basis of the available data, whether relationships exist between the three shift-share effects and the accessibility of regions. Our calculations, however, show that a relationship between regional economic growth and accessibility for the Netherlands is, on the basis of the available data, not supported empirically.

1. Introduction

Between 1973 and 1993 labour volume in the Netherlands increased gradually from 4.1 million jobs to 4.7 million jobs, while value added grew from 178 billion guilders to 575 billion guilders. Those are national figures. But, to what extent do the various Dutch regions contribute to these figures, and is this spatial pattern stable or is it changing? Nijmeijer (1995) has pointed out that the contribution of the urban agglomeration of Western Holland (i.e., the Randstad, see Appendix I) to the national economy declined between 1973 and 1982. He concludes that this shift of the spatial-economic centre in the direction of the eastern part of the Netherlands continued during the period 1987 to 1993. Bosman and Van der Velden (1995) note that since the 1970s a certain shift has occurred in the contribution of the various Dutch regions to the national economy. Due to the relatively strong increase in the regions outside the urban agglomeration of Western Holland, regional disparities within the Netherlands have decreased.

In general, the observed convergence is explained by aspects that are considered as exogenous factors. Examples of these aspects are congestion and lack of space, which results in high prices of land. So in this context, regional disparities exist due to spatial circumstances. It should be noted, however, that spatial factors can only be regarded as a possible explanation of regional disparities in economic growth if these spatial factors vary between regions. In the Netherlands, the importance of factors that traditionally influence locations of economic activities, such as transportation costs, has diminished through the years. Traffic congestion may have an opposed effect on transportation costs. On the other hand, additional factors play now a more important role, such as school facilities and housing conditions. But, explaining the differences in economic growth between regions consists of more than only taking the factors of location into account. Nowadays, specific 'regional' factors, such as presence of a university, the presence of a certain infrastructure or the availability of high-skilled employees, are for the explanation of dissimilarities in economic growth less important than they were several decades ago. Conversely, the importance of competitive positions, the existing production structures and industrial organisations is often regarded as being increased [Lambooy *et al.* (1997)].

So, regional economic growth depends on many – mostly interrelated – factors. The complexity involved with economic growth makes it impossible to analyse it exhaustively in one article. Therefore, we focus only on one aspect that is associated with economic

growth, namely accessibility. Why accessibility? Economic development is not only the result of a proper combination of private production factors, such as labour and capital, but also of infrastructure in general and accessibility in particular. The role of accessibility in (re)location processes of firms is often regarded to be important. This importance seems to hold true for the (re)location of various economic activities, such as production plants, offices and service providers [Rietveld and Bruinsma, (1998)]. In this context, entrepreneurs make a plea to the government to increase the accessibility of the location of firms. However, although accessibility plays an important role in the decision-making of entrepreneurs,[1] one can wonder whether economic development can be steered in desired directions by investments in accessibility. The relationship between accessibility and economic growth is important both from a scientific and a policy view. If it is shown that accessibility is one of the critical success factors for the economic growth of a region, then it becomes interesting to improve the accessibility – with a view to giving economic development a new impetus – of certain regions [Bruinsma (1997); Rietveld and Bruinsma (1998)]. Of course, as mentioned earlier, a complete analysis of economic growth implies that, besides accessibility, many other factors should be taken into account. Nevertheless, we decided to exclude these other factors and to narrow our focus to a partial approach. A partial analysis can be thought of as facilitating matters on two accounts. First, it allows us to keep the size of this article manageable. Second, a partial analysis envisages the impact of accessibility on the economic growth in isolation from all other factors, which may 'distort' the actual relationship between accessibility and regional economic growth.

For measuring regional economic growth, we use a shift-share analysis. Accessibility on the other hand, is measured by using the length of traffic jams. We are nevertheless aware of the fact that accessibility can be measured in many ways [cf. Rietveld and Bruinsma, (1998) for a review]. So, because accessibility is used in several contexts, the meaning of the term may lead to confusion. In our approach, the relationship between accessibility and economic growth plays the central role. This obviously leads to a demand for detailed network data. In order to overcome this bottleneck, we use the length of traffic jams as an indicator for accessibility.

The aim of this paper is twofold. First, we carry out a shift-share analysis for labour volume and value added. This analysis facilitates the examination of regional growth by partitioning it into three components. In addition to the shift-share analysis for the so-called

COROP[2]-regions over four sub-periods of the larger period 1973-1993, we present the results with the help of GIS. Second, the relationship between the outcomes of the shift-share analysis and the queue of cars is investigated. However, we investigate not only the relationship between queue of cars and economic growth, but we also try to determine what the influence of the number of inhabitants on accessibility is. It seems logical to assume that entrepreneurs want to locate their firms in regions were they can take advantage of the presence of other firms. An agglomeration of firms may lead to positive effects, such as increasing returns to scale and a cost-reduction in research and development. Therefore, entrepreneurs often have a preference for regions that, from an economic point of view, are considered to be large. We use the number of inhabitants as a criterion for the preferences of entrepreneurs to (re)locate their firms in a certain region. The number of inhabitants does not only have a direct impact on the location decisions of firms, but also indirectly. After all, we expect that in regions where the number of inhabitants is high, a lot of traffic jams occur. To test this hypothesis, we investigate the relationship between the number of inhabitants per square kilometre and the queue of cars.

The organisation of this paper is as follows. Section 2 gives a concise introduction to shift-share analysis. In section 3 a conventional shift-share analysis for the Netherlands is carried out, and a relation to GIS is established. Shift-share analysis partitions regional growth into various components, and we determine which component constitutes the main part of the total change. We also examine, using correlation coefficients, whether the results of the shift-share analysis for labour volume and value added are related. In section 4 the correlation between the outcomes of the shift-share analysis, the number of inhabitants and accessibility are scrutinised. Section 5 contains the conclusions of this article.

2. Principles of shift-share analysis

The relationship between industrial structure and regional economic growth is often analysed and decomposed into various effects by means of a shift-share analysis.[3] Shift-share analysis is a method to provide calculations of regional economic activity with a minimum of available data. The method is a useful tool for analysing growth patterns and provides a decomposition of the difference between the growth rate in a particular region and the growth rate in a standard region, usually the nation [Nijkamp *et al.* (1986)]. Theoretically, shift-share is a coalescence of two concepts [Berzeg (1978)]. The first concept is based on the relationship between the level of economic development attained and the sectoral composition of the gross output proposed by economic development theory. The theories portray underdeveloped economies as dominated by agriculture, whereas in developed countries industry and services are the major economic activities. The manufacturing sector is supplanted by services as economic development progresses further. The second concept is based on structural dissimilarities among the economies of different regions. Although these regional disparities are often explained in terms of the variation in initial resource endowments, the locational distribution of economic activities may be better understood in terms of transportation costs. Transportation costs are incurred not only in moving natural resources and the primary factors of production, but also in the transportation of intermediate and final goods. Also, the cause of disparities between regional economies may lie in institutional factors, such as taxation.

The shift-share technique essentially uses three components to explain the disparity between regional and national growth. The national growth component n_{ij} measures the expected growth, in employment or income or any other aggregate indicator, if the region had grown at the national rate over the period.[4] The proportional shift m_{ij} represents the amount of change the region would have experienced had each of its industries grown at their national rates. If a region has a predominance of industries which are growing faster than the national economy, then the region will register a positive proportional shift component. The differential shift r_{ij} is generally calculated as a residual. It reflects differences between the region's industrial growth rates and their national counterparts, and is conventionally interpreted as that part of the regional growth performance which is attributable to regional specific factors and comparative advantage [Holden *et al.* (1989)]. In other words, the differential shift component is that part of the region's growth that

remains unexplained. As a matter of fact, it can include all kinds of factors such as different endowment of regions with local advantages and disadvantages, entrepreneurial ability, and effects of regional policy [Tervo and Okko (1983)]. The three components sum to the regional growth c_{ij}:

$$c_{ij} = n_{ij} + m_{ij} + r_{ij} \tag{1}$$

where the subscript i represents a sector or industry, and j a spatial unit. For employment E[5], each component is given as follows [see also Knudsen and Barff (1991)]:

$$c_{ij} = E_{ij}^{t} - E_{ij}^{t*} \tag{2}$$

$$n_{ij} = E_{ij}^{t*} g \tag{3}$$

$$m_{ij} = E_{ij}^{t*} (g_i - g) \tag{4}$$

$$r_{ij} = E_{ij}^{t*} (g_{ij} - g_i) \tag{5}$$

with the superscript t (= 1, 2, ..., T) refers to discrete time periods, and t* indicates the base year. Furthermore, g is the growth rate for total employment in the nation, g_i is the employment growth rate in the nation in sector i and g_{ij} is the regional growth rate for sector i. These growth rates are given by [see also Knudsen and Barff (1991)]:

$$g = \frac{1}{\sum_{i,j} E_{ij}^{t*}} \left(\sum_{i,j} E_{ij}^{t} - \sum_{i,j} E_{ij}^{t*} \right) \tag{6}$$

$$g_i = \frac{1}{\sum_{j} E_{ij}^{t*}} \left(\sum_{j} E_{ij}^{t} - \sum_{j} E_{ij}^{t*} \right) \tag{7}$$

$$g_{ij} = \frac{1}{E_{ij}^{t*}} \left(E_{ij}^{t} - E_{ij}^{t*} \right) \tag{8}$$

Of course the same components and the same national, sectoral en regional sectoral growth rates can be calculated for the value added.

In principle, it is always possible to break down a region's employment growth – or income growth – into a proportional shift component and a differential shift component per region. For that reason, equations (4) and (5) have been redefined by dividing the effects by the regional sectoral employment in the base year:

$$m_j = \frac{\sum_i \left(E_{ij}^{t*} \left(g_i - g \right) \right)}{\sum_i E_{ij}^{t^*}} \tag{9}$$

$$r_j = \frac{\sum_i \left(E_{ij}^{t*} \left(g_{ij} - g_i \right) \right)}{\sum_i E_{ij}^{t^*}} \tag{10}$$

so that:

$$s_j = m_j + r_j \tag{11}$$

where m_j is the proportional shift, r_j is the differential shift, and s_j is the total shift. The national growth effect, which is given in absolute terms in equation (3) is deliberately not included in equation (11) because this component is not regionally differentiated.

As already stated, the proportional shift will be positive if high-productivity growth industries are concentrated in the region, or if high-productivity industries that have increasing employment shares are concentrated in the region [Ledebur and Moomaw (1983)]. In the concept of this article, the proportional shift (or industry-mix effect) is positive whenever the weighted sectoral growth rates in a certain region exceed the growth rate of the national economy. The weights are the regional sectoral employment levels and the regional sectoral level of income in the base year. Likewise, the proportional shift will be negative in a region with above-average employment in sectors with static or declining growth at the national level [Herzog Jr. and Olsen (1977)]. The proportional shift for the *i*th sector will either vanish or turn negative if the weighted sectoral growth rates in region *j* are equal to or smaller than the growth rate of the national economy.

The differential shift for sector *i* in the *j*th region will be positive, zero, or negative depending on whether the weighted sectoral growth in this sector is faster than, equal to, or slower than employment growth in the same industry at the national level. Hence, a positive differential shift reveals that productivity grows faster for each industry in the region than for its national counterparts. However, the differential shift will also be positive if employment is redistributed to high-productivity industries faster in the region than in the nation or if the interaction between employment shares and productivity growth is stronger for the region than for the nation [Ledebur and Moomaw (1983)]. A

negative differential shift implies the opposite: regional employment grows slower than the proportional shift would suggest [Herzog Jr. and Olsen (1977)].

Finally, a positive total shift indicates that the region's share in national employment grows. Again, the same applies to the proportional shift, the differential shift, and total shift of value added.

3. GIS and some statistical relationships

We undertake conventional shift-share analysis with data on employment and value added for the Netherlands.[6] The data are first disaggregated into 6 sectors (agriculture, manufacturing, building, trade, services and government), 4 time periods (1973-1977, 1978-1982, 1983-1987 and 1988-1993), and 40 regions (the so-called COROP-regions). By means of a GIS, created in an ArcView environment[7], the per region total shift and the proportional and differential shifts are visualised.

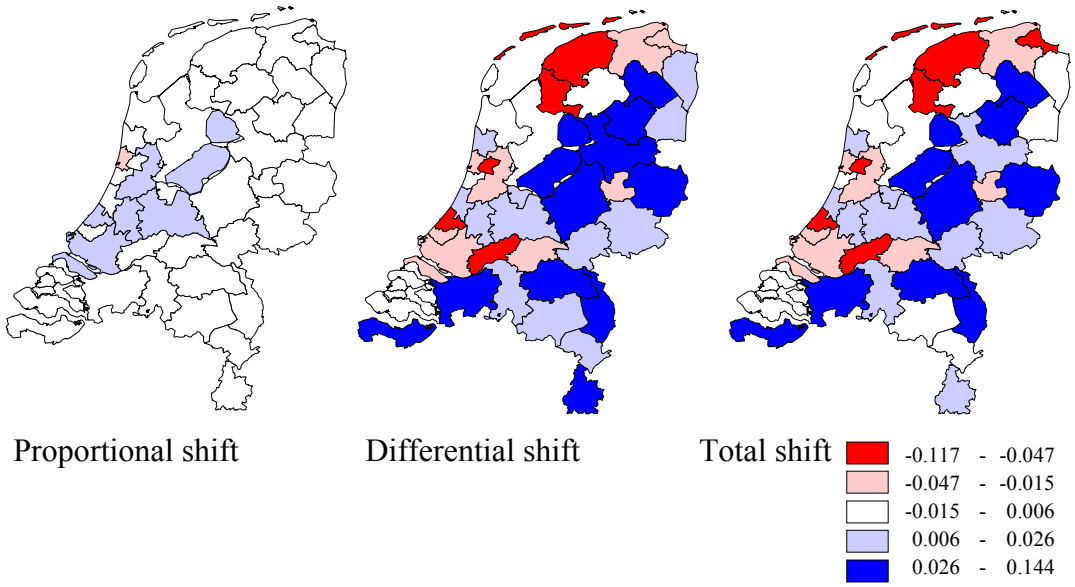

Figure 1 The three shift-share effects of labour volume between 1983 and 1987.

The total shift is equal to the sum of the proportional shift and the differential shift. Figure 1 illustrates that the differential effect is responsible for the major part of the total shift. The share of the proportional shift is of marginal importance. Although Figure 1 refers solely to the labour volume, it needs to be said that the same concerns the value

added as well. However, the question "how much do the proportional shift and the differential shift exactly contribute to the total shift", is still left open. Nonetheless, this question can be addressed by using the deviation of the two shift compared with the total shift. After all, the value of the proportional shift reflects how much the differential shift differs from the total shift. In the same way the value of the differential shift describes the deviation between the proportional shift and the total shift. To express these contributions of the proportional and differential shifts to the total shift, the following concepts are defined:

$Prop.\ Shift_{(MD)}$ = (mean deviation of the) proportional shift (from the total shift)
$Diff.\ Shift_{(MD)}$ = (mean deviation of the) differential shift (from the total shift)
$Tot.\ Shift$ = total shift
n = number of regions, in this case $n = 40$.

With these definitions the contributions to the total shift may be written as:

$$Prop.\ Shift_{(MD)} = \frac{\sum_{n} \left(|Tot.\ Shift| - |Prop.\ Shift| \right)}{n} \tag{12}$$

$$Diff.\ Shift_{(MD)} = \frac{\sum_{n} \left(|Tot.\ Shift| - |Diff.\ Shift| \right)}{n} \tag{13}$$

As the total shift is the sum of the proportional shift and the differential shift, equations (12) and (13) can be reformulated into:

$$Prop.\ Shift_{(MD)} = \frac{\sum_{n} \left(|Diff.\ Shift| \right)}{n} \tag{14}$$

$$Diff.\ Shift_{(MD)} = \frac{\sum_{n} \left(|Prop.\ Shift| \right)}{n} \tag{15}$$

Table 1 shows the mean deviation of the proportional and the differential shifts for the four time periods. These deviations have been calculated for the labour volume as well as the value added.

Table 1 The mean deviations of the proportional shift and the differential shift compared with the total shift for the four time periods.

	Labour volume		Value added	
	Prop. Shift$_{(MD)}$	*Diff. Shift*$_{(MD)}$	*Prop. Shift*$_{(MD)}$	*Diff. Shift*$_{(MD)}$
'73-'77	0.040552	0.015918	0.103866	0.028172
'78-'82	0.032507	0.013406	0.06306	0.004845
'83-'87	0.033579	0.007199	0.080653	0.013778
'88-'93	0.043044	0.011141	0.071367	0.016356

Table 1 clearly shows that which has already been illustrated by Figure 1. The mean deviation of the proportional shift is in all cases much *larger* than the deviation of the differential shift. So the differential shift constitutes the main part of the total shift. This is consistent with the expectations, because most shift-share studies that address domestic growth find that the proportional shift usually explains only a small part of the growth; that is, the differential shift is usually larger than the proportional shift [Richardson, (1972); Gazel and Schwer (1998)].

An interesting aspect in this survey is the relationship between labour volume and value added. After all, employment is chiefly determined by the level of national income. When the Netherlands produces a lot of commodities and services, the national income and value added is high. In such a favourable economic climate a large work force is needed. Conversely, a low level of national income leads to a low level of production of commodities and services and therefore to a decrease in employment.

The above-mentioned connection between labour volume and value added has been investigated by using correlation coefficients. The results are presented in Table 2. The correlation coefficient between the differential shift of labour volume and the differential shift of value added for the first period is rather low (0.130). The same applies to the correlation coefficient between the total shifts of the two economic variables (0.147). In comparison with the correlation coefficients in the second period, the ones for the third period are low, especially the correlation coefficients between the differential and total shifts. For the proportional shift, the correlation coefficient between labour volume and value added reaches a high of 0.686 during the first period, whereas it is 0.459 in the fourth period.

Table 2 The correlation coefficients between the three shift-share effects of labour volume and value added.

1973-1977	Pr. shift value add.	Diff. shift value add.	Tot. shift value add.
Prop. shift labour vol.	0.686	0.158	0.273
Diff. shift labour vol.	-0.276	0.130	0.084
Total shift labour vol.	-0.099	0.163	0.147
1978-1982	**Pr. shift value add.**	**Diff. shift value add.**	**Tot. shift value add.**
Prop. shift labour vol.	0.653	0.060	0.097
Diff. shift labour vol.	0.083	0.667	0.667
Total shift labour vol.	0.201	0.688	0.694
1983-1987	**Pr. shift value add.**	**Diff. shift value add.**	**Tot. shift value add.**
Prop. shift labour vol.	0.557	-0.257	-0.146
Diff. shift labour vol.	0.105	0.450	0.438
Total shift labour vol.	0.201	0.413	0.421
1988-1993	**Pr. shift value add.**	**Diff. shift value add.**	**Tot. shift value add.**
Prop. shift labour vol.	0.459	0.187	0.266
Diff. shift labour vol.	-0.354	0.688	0.627
Total shift labour vol.	-0.257	0.716	0.671

The relationship between employment and value added is visualised in Figure 2. The picture of the total shift of value added corresponds in broad outline to the picture of the total shift of labour volume. So, most COROP-regions are characterised either by a positive total shift of both labour volume and value added or a negative total shift of labour volume as well as value added. Figure 2 relates only to one time period; however, it is possible to portray comparable pictures for the other three time periods.

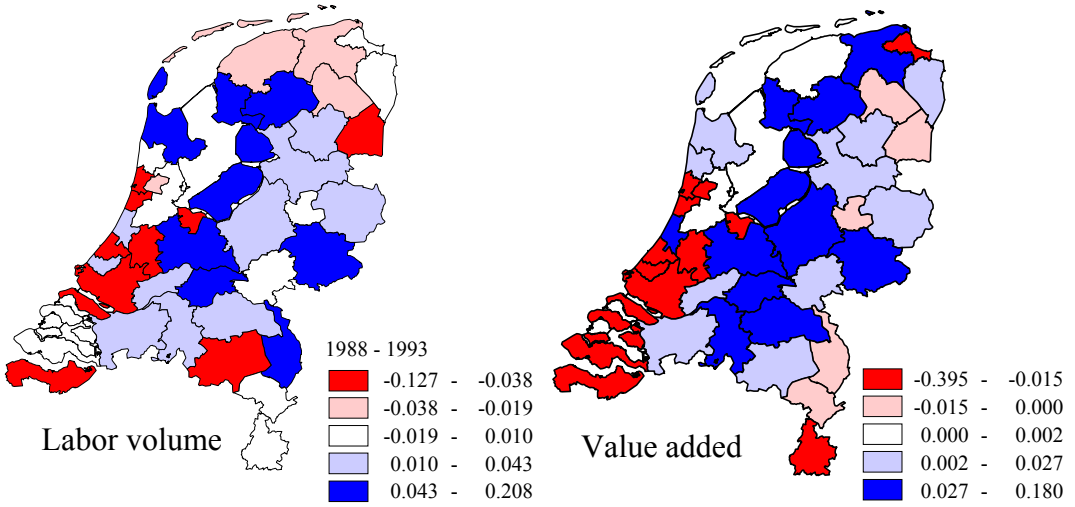

Figure 2 The total shift of labour volume and the total shift of value added in the fourth time period (1988-1993).

Figure 3 illustrates the changes in the total shift of labour volume. It shows that over time the positive total shift of employment moves from the western part of the Netherlands to the eastern part of the country. In the last time period, however, it is moving westward again. During the four time periods the COROP-regions of Utrecht and Flevoland (see Appendix I) obtain an increasing share of the nation's employment. On the other hand, we observe a decline in the share of the nation's employment for a couple of regions in the northern part of the Netherlands and the COROP-region of Groot Rijnmond (see Appendix I) during the time periods considered. Comparing the class boundaries in Figure 3, it appears that in the first two periods the differences in the total shift between the regions are larger than during the last two periods. In other words, the total shift in the Netherlands has levelled out over time and a more steady spatial balance has arisen.

The course of the total shift of value added (not shown here) is roughly comparable to the changes in the total shift of labour volume. Besides a negative total shift in the Groot Rijnmond region from 1973 to 1993, the number of regions with an increasing share in national value added grew in the intermediate regions of Brabant (the COROP-regions 33 up to and including 36) and Gelderland (the COROP-regions 13 up to and including 16).

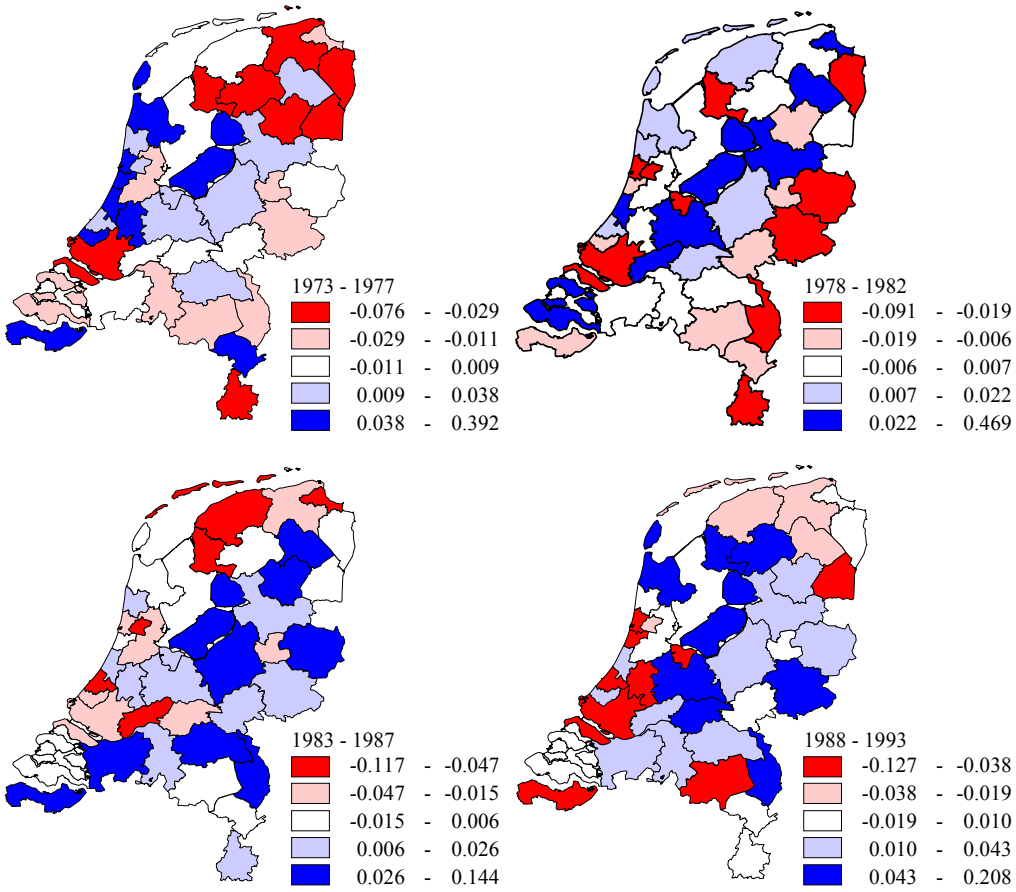

Figure 3 The development of the total shift of labour volume between 1973 and 1993.

The similarity between the development of the total shift of labour volume and the total shift of value added causes little sensation. After all, as already stated, the correlation coefficient between the total shifts of labour volume and value added is only for first time period very low, whereas it is 0.671 for the fourth time period (visualised in Figure 2).

As we explained earlier, the total shift is composed of the proportional shift and the differential shift. The differential shift determines to a large extent the total shift. However, when it comes to the proportional shift of employment, the regions with an above average proportion of employment in sectors with a high growth rate at the national level could in the recent past only be found in the urban agglomeration of Western Holland (i.e., the Randstad, see Appendix I). The positive proportional shift has in recent periods been much less widespread than in the 70s and early 80s. Bosman and Van der

Velden (1995) conclude the same. They state that the disparities between regions with regard to the structure of the sector (i.e., the proportional shift) has decreased over time.

Two very distinctive developments have taken place in the Randstad. One is the increase in regions with a favourable proportional shift, and the other the development of regions where the production environment is relatively adverse. The latter is in contrast with a vast area in the eastern part of the Netherlands where the production environment is relatively favourable. So for the Netherlands as a whole, the number of regions with a positive differential shift – indicating a favourable regional production environment – has increased over time. This increase relates to the differential shift of employment as well as to the differential shift of value added. Besides the Randstad, a few northern and southern regions are nevertheless exceptions to this trend. The decrease in the Randstad region could in part be explained as resulting from the congestion in the region.

4. Accessibility

As mentioned above, most of the Randstad regions possess a positive proportional shift. Therefore, in addition to the correlation between value added and labour volume, there is another possible correlation which may exist, namely the one between accessibility and the proportional shift of labour volume. Assuming that most traffic jams occur in the Randstad and that in the same regions the proportional shift is favourable, it is reasonable to assume that these two variables correlate positively. The results, presented in Table 3, show that the above-mentioned assumption is consistent with the facts. It should be mentioned however that data on the number of traffic jams are only available for the last 2 time periods (i.e., 1983-1993). Furthermore, these data are only obtainable at a provincial level. Nevertheless, the data can be converted into data at the level of the COROP-region. This is done by dividing the length of provincial traffic jams by the number of COROP-regions in a province. So every COROP-region within a province has the same length of traffic jams.

The proportional shift of the queue of cars may be used to show the relationship between the proportional shift of labour volume and the queue of cars. Unfortunately, it is not possible to calculate a proportional shift for the length of traffic jams because the data contain only one category, namely the length of traffic jams. If data contain only one

category, the outcome of equation (6) will be the same as the outcome of equation (7). Hence, the proportional shift (equation (4)) will be zero, and the total shift is equal to the differential shift. Another problem is that the results of a shift-share analysis refer to growth figures, whereas with regard to the traffic jams merely the length of traffic jams is

Table 3 The correlation coefficients between traffic jams and the three shift-share effects of labour volume and value added.

1983-1987		1988-1993	
	Traffic jams		Traffic jams
Prop. shift labour vol.	0.568	Prop. shift labour vol.	0.460
Diff. shift labour vol.	-0.199	Diff. shift labour vol.	-0.074
Total shift labour vol.	0.106	Total shift labour vol.	0.008
Prop. shift value add.	0.535	Prop. shift value add.	0.457
Diff. shift value add.	-0.113	Diff. shift value add.	0.015
Total shift value add.	-0.004	Total shift value add.	0.094

relevant and not the growth figures. After all, we started from the assumption that most queues of cars occur in the Randstad. But it appears that in this part of the Netherlands the number of car queues did not increase the most. Between 1983 and 1993 the length of traffic jams increased the most in the three northern regions. Consequently, instead of the proportional shift for the length of traffic jams, the proportion of the total length of traffic jams in a COROP-region to the mean length of a traffic jam in a COROP-region has been calculated. Thus COROP-regions with a lot of long traffic jams have values larger than 1, while COROP-regions with fewer long traffic jams have values smaller than 1.

Table 3 shows that in the third time period the correlation coefficient between traffic jams and the proportional shift of both labour volume and value added is higher than in the fourth time period. As already stated, besides a positive proportional shift the Randstad also reveal a negative differential shift. So, one would expect a negative relationship between the queue of cars and the differential shift. The results in Table 3 however, show that not only the differential shifts but also the total shifts of labour volume and value added seem to be uncorrelated with traffic jams. Furthermore, the

correlation coefficients between the queue of cars and the three shift-share effects for value added are similar to that for labour volume. This similarity is not startling. After all, the correlation between the three shift-share effects of labour volume and value added is perfectly clear (see Table 2).

Another interesting aspect might be the relationship between the number of inhabitants per square kilometre and the queue of cars. It may be expected that in COROP-regions where the number of inhabitants is high, a lot of traffic jams occur. To

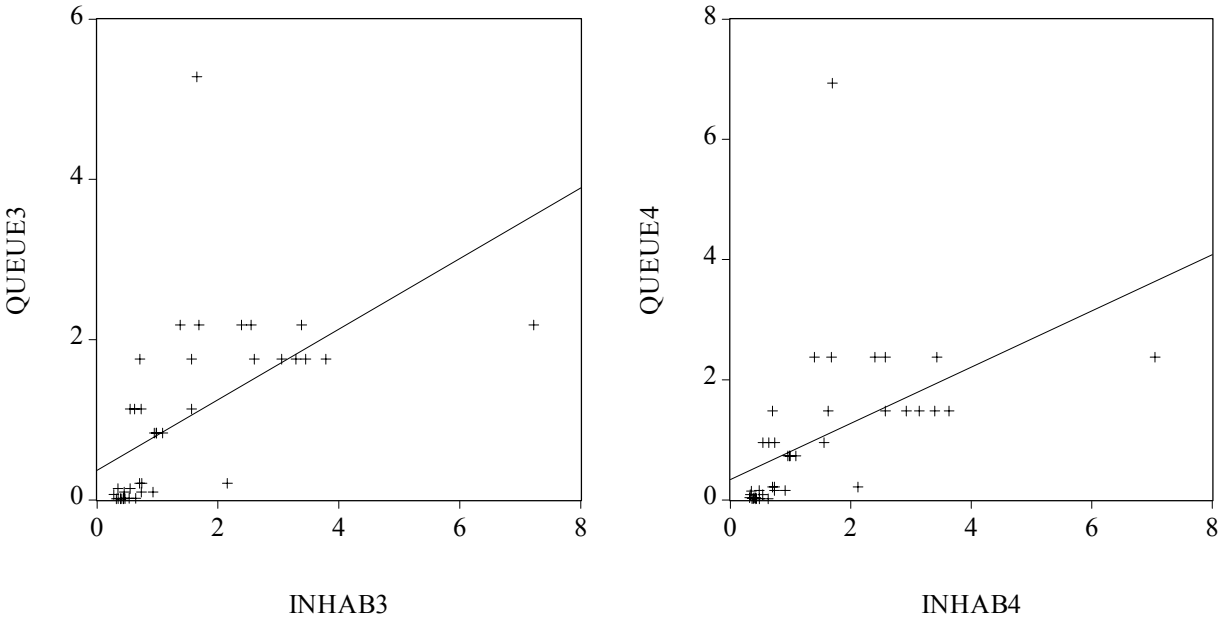

Figure 4 The relationship between the number of inhabitants per square kilometre and the queue of cars for the third time period (left) and the fourth time period (right).

check whether this corresponds with the facts, the proportion of the number of inhabitants in a COROP-region to the mean number of inhabitants in the Netherlands has been calculated. The reason for applying this approach is the same as in the case of the queue of cars and its correlation with the proportional shift of labour volume.

The results of these calculations, visualised in Figure 4, show that in the third period as well as in the fourth period it really does seem that a positive correlation exists between the number of inhabitants per square kilometre and the queue of cars. The correlation coefficient between the two variables is 0.562 in the third period, whereas it is 0.497 in the fourth period. However, Figure 4 reveals period two *outliers* for each time period. These two outliers correspond to the COROP-regions 17 and 26 respectively. Recalculation of

the correlation coefficients with the outliers removed results in a greater positive correlation between the number of inhabitants per square kilometre and the queue of cars. That is, after discarding the regions 17 and 26 we would have a correlation coefficient of 0.756 for the third period and a correlation coefficient of 0.737 for the fourth period. However, the question is whether the deletion of the two observations is the correct procedure in this case. The answer is probably "no". The deletion of observations is only justified if these observations are generated by some 'unusual' factors [Maddala (1992)]. Here, such unusual factors can not be found.

It is also expected that a positive proportional shift of labour volume occurs in regions with a lot of inhabitants per square kilometre. After all, in the western part of the Netherlands the number of inhabitants per square kilometre is high and also in this part of the country the proportional shift of labour volume is positive. In the remaining part of the Netherlands, the opposite is true and the number of inhabitants per square kilometre is low while the proportional shift is close to zero. The results of Table 3, for only the proportional shifts of labour volume and value added had revealed a more or less unambiguous relationship with traffic jams. So in Table 4 only the relationship between the proportional shift of labour volume and the number of inhabitants per square kilometre is shown.[8] Again, the proportion of the number of inhabitants in a COROP-region to the mean number of inhabitants in the Netherlands is used as an indicator for the number of inhabitants per square kilometre.

In Table 4 the correlation coefficients are presented. In the third time period, the correlation coefficient between the number of inhabitants and the proportional shift of labour volume is greater than in the other three periods. As the three shift-share effects of labour volume and value added are related to each other, it is expected that approximately the same results apply to the relationship between the number of inhabitants and the three shift-share effects of value added.

Table 4 The correlation coefficients between the number of inhabitants per square kilometre and the proportional shift of labour volume for the four time periods.

	Inhabitants 1973-1977	Inhabitants 1978-1982	Inhabitants 1983-1987	Inhabitants 1988-1993

Prop. shift labour volume 1973-1977	0.332	0.331	0.339	0.353
Prop. shift labour volume 1978-1982	0.426	0.421	0.425	0.435
Prop. shift labour volume 1983-1987	0.525	0.527	0.537	0.555
Prop. shift labour volume 1988-1993	0.443	0.449	0.463	0.481

Taken together, the results from Tables 3 and 4 and Figure 4 suggest that the proportional shift of labour volume is positively (but not highly) correlated with traffic jams and the number of inhabitants per square kilometre. These last two variables are also positively related to each other. In other words, weighted sectoral growth rates in a certain region which exceed the growth rate of the national economy go hand in hand with large numbers of inhabitants per square kilometre and with large numbers of traffic jams. Such a relationship for labour volume cannot be found between the differential shift on the one hand and the number of inhabitants and the length of traffic jams on the other. The same holds for the relationship between these two last-mentioned variables and the total shift of labour volume. Therefore, it seems that for the Netherlands an unambiguous relationship between regional economic growth and accessibility can not be found, as only the minor part of the total shift, the proportional shift, reveals a positive relationship with congestion and the numbers of inhabitants per square kilometre.

5. Conclusions

In this paper a conventional shift-share analysis on data of employment and value added has been carried out for the Netherlands. A shift-share analysis has been used because it is a fairly pragmatic and relatively simple technique for analysing growth rates by region and by industry over a specific period. With the use of GIS the output of the analysis is conveniently displayed. The results of the analysis show that the number of COROP-regions with a positive total shift of labour volume remains almost unchanged during the twenty years investigated. On the other hand, it is shown by means of GIS that over the first three periods the positive total shift of employment moves from the western part of the Netherlands to the eastern part of the country. During the last period, the total shift moves westward again. The number of regions with a positive total shift of value added varies considerably more than in the case of labour volume between the years 1973 and 1993. The shifting of the positive total shift of value added, however, parallels the changes in the total shift of labour volume.

Because the value of the proportional shift reflects how much the differential shift differs from the total shift, and because the differential shift does the same for the variance between the proportional shift and the total shift, it is possible to demonstrate that the differential shift constitutes – without any exception – the main part of the total shift. This conclusion supports the so-called 'urban-field'-thought: in a small and relatively homogeneous country like the Netherlands, the differences in regional economic development are more and more being determined by specific circumstances and coincidence. These specific business circumstances and coincidence are, together with factors determining the location of a business, a part of the differential shift [Bosman en Van der Velden, (1995)]. But all in all, that does not alter the striking fact that in the Randstad area the differential shift is mostly negative, especially in the case of employment. The assumption that this could in part be due to congestion in the Randstad regions could not be shown. On the other hand, the available data show that a relationship exists between the length of traffic jams and the proportional shift of both value added and labour volume. It is not surprising however, that both the proportional shift of value added and the proportional shift of labour volume are positively correlated with the length of traffic jams. After all, another relationship that exists is the one between labour volume and the value added for the proportional shift. This correlation between labour volume and

value added applies also to the differential shift as well as the total shift, except in the first period.

So, a relationship between traffic jams and the differential shift of both value added and labour volume can not be shown. The same applies to the total shifts of labour volume and value added and their connections with traffic jams. In other words, no relationship can be found both in the case when productivity grows faster for each industry in the region than for its national counterparts (a positive differential shift of labour volume), or when a region's share in the national employment grows (a positive total shift of labour volume). Weighted sectoral growth rates in a certain region which exceed the growth rate of the national economy (a positive proportional shift) are on the other hand positively related to traffic jams. Besides, a positive correlation seems also to exist between the proportional shift of labour volume and the number of inhabitants per square kilometre. Similarly, the traffic jams are positively correlated with the number of inhabitants. Whereas the differential shift and the total shift of labour volume do not seem to have any relationship with the length of traffic jams and the number of inhabitants per square kilometre, it is the proportional shift of labour volume – which explains the minor part of the total shift – that shows a positive relationship with these two variables. This is not only true for labour volume but also for the three shift-share effects of value added. A relationship between regional economic growth and accessibility for the Netherlands is therefore, on the basis of the available data, not supported empirically.

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Notes

[1] It is important to realise that in reality, information on locational alternatives will be far from perfect. Decisions are based on partial information only, since entrepreneurs are not informed about the pros and cons of all location sites, which are interesting as locations for his or her firm [Bruinsma (1997); Rietveld and Bruinsma (1998)].

[2] COROP stands for *Coördinatiecommissie Regionaal Onderzoeksprogramma*, which means Commission of co-ordination of the Regional Research programme. The division of the Netherlands into the 40 COROP-regions came into being in close consultation with this Commission of co-ordination. During the delimitation of the COROP-regions, the borders of the Provinces have been taken into account. See also Appendix I.

[3] This type of analysis was developed in the United States in the fifties. Over the past two or three decades it has become a very popular analytic tool among spatial scientists. But as already noted in 1979 "the shift-share fits the expectation that, when a technique is simple and apparently useful, it will be both widely used and heavily criticized" [Fothergill and Gudgin according to Barff and Knight (1988); for an enumeration of a number of challenging criticisms, see Markusen *et al.* (1991) and Armstrong and Taylor (1993)]. Also Knudsen and Barff (1991) point out that shift-share analysis, in spite of the criticisms of the technique, appears to be popular among geographers, regional scientists, and planners. The shift-share model has been criticised for its lack of an underlying theoretical context [Casler (1989)], its inability to predict [e.g., Kurre and Weller (1989)] and its limited ability to even describe regional economic growth. But other studies [Hellman (1976), Chalmers and Beckhelm (1976), Andrikopoulos (1980)] provide evidence in support of the model as a tool for analysing and to a certain extent predicting regional development and growth [Andrikopoulos *et al.* (1990)].

[4] The terminology used in the shift-share literature is somewhat diverse. The national growth effect is also referred to as the share effect or total share, the proportional shift is also termed the industry-mix effect or compositional effect, and the differential shift is also called the regional effect or competitive position effect [Herzog Jr. and Olsen (1977)].

[5] Throughout this article, economic growth will be measured simply in terms of employment growth *and* growth of value added, embodying the implicit assumption that employment and value added are good

measurements of regional welfare. Initially investments were also admitted as a regional variable. However, due to the lack of sufficient data, we decided to omit investments as a regional variable.

[6] The data used are taken from *Tijdreeksen Regionale economische jaarcijfers 1970, 1973-1993* which is used in a *CBSview 2.1* environment (Voorburg/Heerlen, Central Bureau for Statistics, 1996). Before applying a shift-share analysis, data on the value added have been converted into real terms – that is, terms adjusted for the effect of price changes. In other words, by using deflators these data are converted into the values of a selected base year (i.e. 1975).

[7] ArcView is considered to be a simple Geographic Information System and is a program for interactive consultation and analysis of spatial data [Ormeling en Van der Schans (1997)].

[8] For the sake of completeness the relationship between the other two shift-share effects and the number of inhabitants per square kilometre has also been examined. Over the four sub-periods the differential shift of labour volume appears to be negatively related to the number of inhabitants. However, in the first period, the correlation coefficient is around zero. In the fourth period on the other hand, it is found to be –0.504. The relationship between the total shift and inhabitants is, except for the first period, also negative. The correlation coefficient, however, did not reach a value lower than –0.400 in the fourth period.

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Appendix I The division of the Netherlands into the 40 COROP-regions.

Continued on next page.

Appendix I The division of the Netherlands into the 40 COROP-regions *(continued)*.

1. Oost-Groningen
2. Delfzijl and the surrounding area
3. The remaining part of the Province of Groningen
4. Noord-Friesland
5. Zuidwest-Friesland
6. Zuidoost-Friesland
7. Noord-Drenthe
8. Zuidoost-Drenthe
9. Zuidwest-Drenthe
10. Noord-Overijssel
11. Zuidwest-Overijssel
12. Twente
13. Veluwe
14. Achterhoek
15. The conglomerates of Arnhem and Nijmegen
16. Zuidwest-Gelderland
17. Utrecht
18. Kop van Noord-Holland
19. Alkmaar and the surrounding area
20. IJmond
21. The conglomerate of Haarlem
22. Zaanstreek
23. Groot-Amsterdam
24. Het Gooi and Vechtstreek
25. The conglomerate of Leiden and the bulb-growing area in Holland
26. The conglomerate of ‘s-Gravenhage
27. Delft and Westland
28. Oost Zuid-Holland
29. Groot Rijnmond
30. Zuidoost Zuid-Holland
31. Zeeuws-Vlaanderen
32. The remaining part of the Province of Zeeland
33. West Noord-Brabant
34. Midden Noord-Brabant
35. Noordoost Noord-Brabant
36. Zuidoost Noord-Brabant
37. Noord-Limburg
38. Midden-Limburg
39. Zuid-Limburg
40. Flevoland

The COROP-regions 17 and 19 up to and including 29 constitute the urban agglomeration of Western Holland (the Randstad area).