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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 differences. To analyse these differences 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 subperiods 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. We also investigate whether congestion is an important reason for the shifting of economic growth from the western part of the Netherlands to the eastern part of the country. We accordingly determine, on the basis of the available data, whether relationships exist between the three shift-share effects and the accessibility of regions.

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. 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 [Wever according to Nijmeijer (1995)]. 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 differences within the Netherlands have decreased. The observed convergence is due to the disadvantages of locating in the western part of Holland, such as congestion and the high price of land, which make locations outside this region seem more attractive. However, although it seems logical that a shift of industries from the western part of the Netherlands to the eastern part of the country is related to the increasing prices of land and the increasing length of traffic jams, there have been no studies for the Netherlands concerning this relationship.[1]

In this article, we focus on the relationship between regional economic growth and accessibility. We do not investigate the connection between the prices of land and economic growth due to the lack of appropriate data on land prices for several years. We try to determine whether a relationship between economic growth and accessibility exists, using shift-share analysis for measuring regional economic growth. Accessibility on the other hand, is measured by using the length of traffic jams.

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 a shift-share analysis for the so-called COROP[2]-regions over four subperiods of the larger period 1973-1993, we also carry out a GIS analysis. Second, the relationship between the outcomes of the shift-share analysis

and a few variables, such as the queue of cars and the number of inhabitants, are investigated. These variables are not economic variables per se, but are dealing with the accessibility of regions.

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 a reversed production function, whether the results of the shift-share analysis for labour volume and value added are related. In section 4 the statistical relationships 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] 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 is the major economic activity. The manufacturing sector is supplanted by services as economic development progresses further [Berzeg (1978)]. 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 [Berzeg (1978)].

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 is 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.

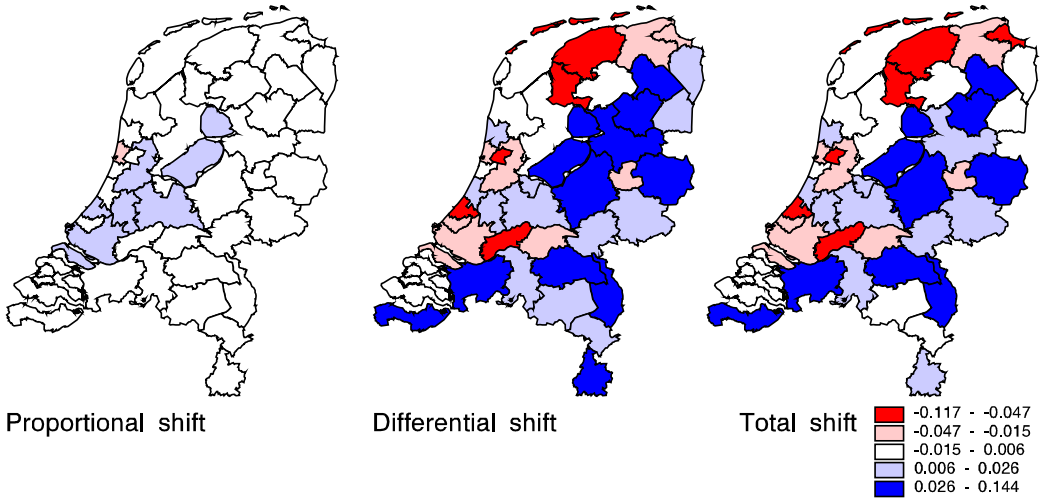

Figure 1 The three shift-share effects of labour volume between 1983 and 1987.

First, 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", still stares us in the face. Nonetheless, this question can be addressed by using the deviation of the two shifts 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 variables are required:

$Prop.\ Shift_{(MD)}$ = (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 differential shift, equations (12) and (13) can be reformulated into:

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

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

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 mean 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 [Gazel and Schwer (1998)].

Second, 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 can be formulated as:

$$\textit{labour volume} = f(\textit{value added}) \tag{16}$$

or, more elaborately:

$$LV_{.S} = c + \alpha \cdot VA_{.S} \tag{17}$$

where the letter c refers to the constant and α to an employment-coefficient. $LV_{.S}$ and $VA_{.S}$ indicate one of the three possible shift-share effects for labour volume and value added respectively. The dot in the subscripts of equation (17) means that the equation applies to the three shift-share effects. The three types of subscripts which refer to these three effects and whereby the dot is replaced by a letter, are *DS*, *PS* and *NS*. These subscripts denote the differential shift, the proportional and the total shift respectively. Each value of a particular shift for value added is associated with a single value of the same shift for labour volume. Because there are 40 COROP-regions, each shift for labour volume and value added contains 40 values per time period.

The values of c and α are calculated for the four different time periods using the statistical program LIMDEP. The results are presented in Table 2. In addition to the employment-coefficient and the constant, the table also shows whether the employment-coefficient and the constant are statistically significant.

For the proportional shift, the employment-coefficient fluctuates considerably during the twenty years investigated. It reaches a high of 1.96 during the second period, whereas it is only 0.21 one time period later. The employment-coefficient of the proportional shift is positive and statistically significant in each time period. The value of the constant is low and negative for each time period, and statistically significant in the second and third period. The adjusted R-squared is 0.46 for the first period but is progressively lower in the other three periods.

For the differential shift, the contrast between the four time periods is even more striking. The employment-coefficient is quite low (0.067) for the first period and not statistically significant. The employment-coefficient for the second period (0.63) is almost

Table 2 Results of the regression equation $LV_{.S} = c + \alpha \cdot VA_{.S}$. *The symbols are explained in the text above.*[a]

			1973-1977	1978-1982	1983-1987	1988-1993
Prop. shift	Coefficient	α	0.53820	1.9613	0.21213	0.33309
		c	-0.001017	-0.00435	-0.00368	-0.00167
	Stand. error	α	0.092723	0.37531	0.05131	0.10453
		c	0.002239	0.00181	0.000995	0.001886
	t-ratio	α	5.804*	5.226*	4.134*	3.187*
		c	-0.454	-2.406*	-3.696*	-0.884
	Adjusted R^2		0.45600	0.40284	0.29210	0.19012
Diff. shift	Coefficient	α	0.067414	0.63318	0.18459	0.42477
		c	0.016603	0.01330	-0.003239	0.008595
	Stand. error	α	0.083496	0.11468	0.059461	0.072617
		c	0.011619	0.0094864	0.0067604	0.00693
	t-ratio	α	0.807	5.521*	3.104*	5.849*
		c	1.429	1.402	-0.479	1.241
	Adjusted R^2		-0.00901	0.43054	0.18131	0.45995
Total shift	Coefficient	α	0.079388	0.65623	0.15888	0.41997
		c	0.011951	0.007816	-0.00590	0.007556
	Stand. error	α	0.086700	0.11043	0.055599	0.07520
		c	0.011980	0.009202	0.00672	0.007216
	t-ratio	α	0.916	5.943*	2.858*	5.585*
		c	0.998	0.849	-0.878	1.047
	Adjusted R^2		-0.00416	0.46804	0.15522	0.43635

[a] Significance level is indicated by * for the 0.01 level.

ten times larger than for the first period and is statistically significant. The same is also true for the next two periods: the employment-coefficients for the third and fourth periods are both statistically significant. The employment-coefficient for the third period is 0.18 and for the fourth period it is 0.42. The constant however is not significantly different from zero. The adjusted R-squared is higher in the second and the fourth period (0.43 and 0.46 respectively).

Lastly, the connection between the total shift of labour volume and the total shift of value added has been calculated. Just as in the case of the statistical outcomes of the differential shifts, the employment-coefficient and the constant for the total shift for the first period are rather small and not statistically significant. During the second period the employment-coefficient amounts to 0.66, and is statistically significant. In comparison with the employment-coefficient in the second period the one for the third period is low (but still statistically significant). The adjusted R-squared is low (0.16) compared to the second period (0.47). The results of the fourth period are almost identical to those of the second period except for the employment-coefficient, which is approximately 0.42. The constant is not significantly different from zero in all the periods.

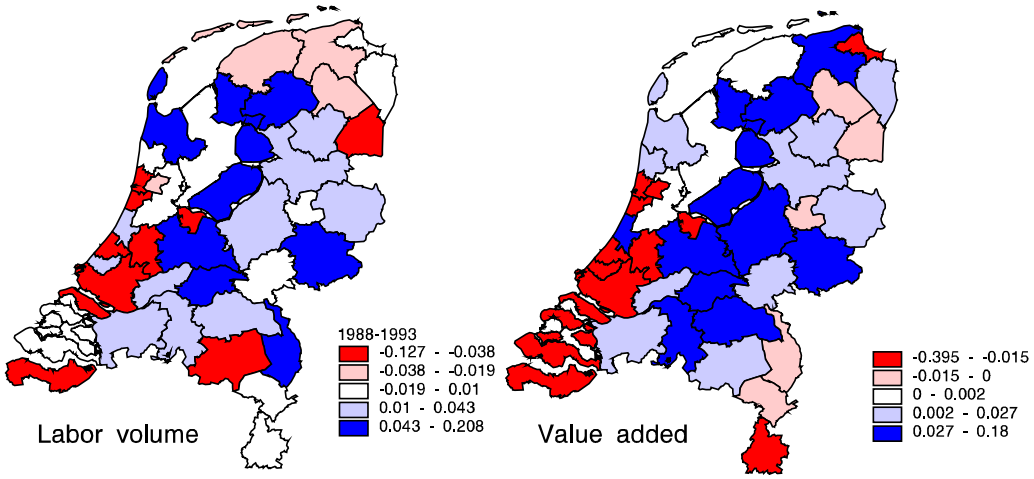

Figure 2 The total shift of labour volume and the total shift of value added in the fourth time period (1988-1993).

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 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

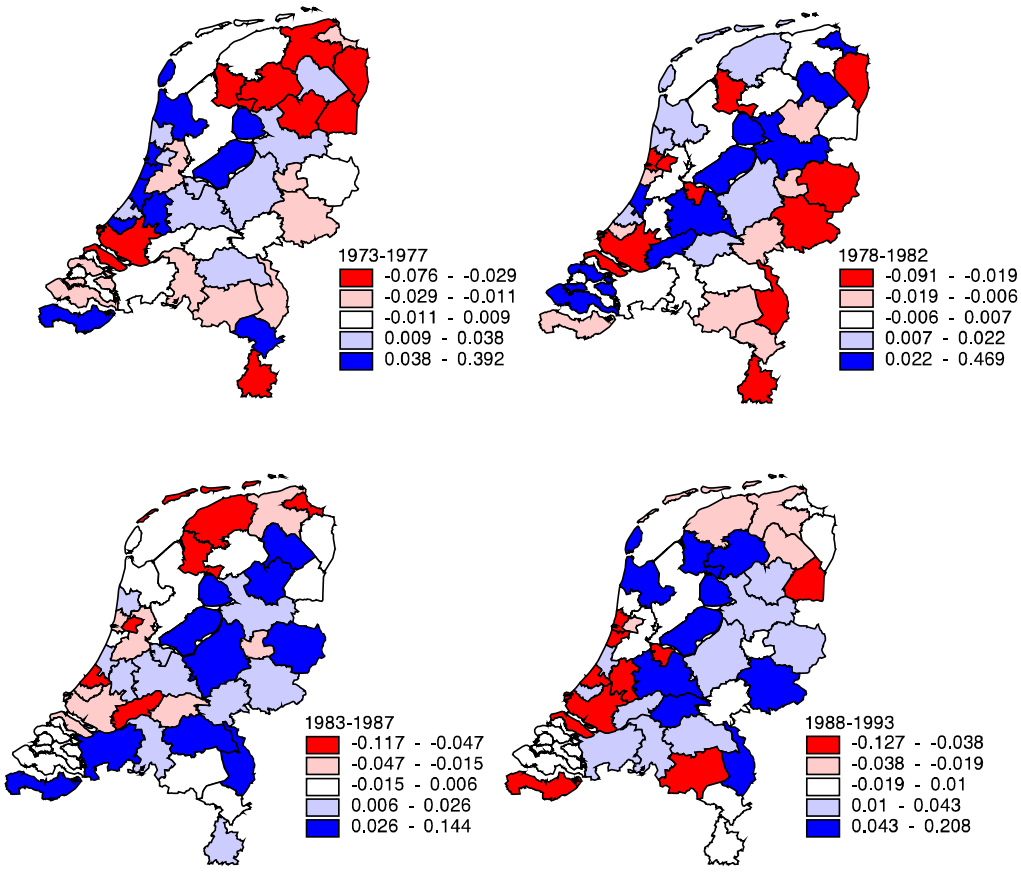

Figure 3 The development of the total shift of labour volume between 1973 and 1993.

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).

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 relationship between the total shifts of labour volume and value added is statistically significant (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 differences between regions with regard to the structure of the sector (i.e., the proportional shift) has decreased over time. Considering all regions and in comparison with the proportional shift of employment, the proportional shift of value added seems less consistent. However, a closer look indicates that this proportional shift is rarely extremely positive or negative. In most regions the weighted sectoral growth rates are approximately equal to the growth rate of the national economy most of the 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.

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. A few northern and southern regions and the Randstad 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 relationship between value added and labour volume, there is another possible relationship 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, calculated by means of LIMDEP and 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 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

Table 3 Results of the regression equations $LV_{.S} = c + \beta \cdot jam$ *and* $VA_{.S} = c + \beta \cdot jam$, *where* β *is the coefficient of the queue of cars and other notations as before.*[a]

			$LV_{.S} = c + \beta \cdot jam$		$VA_{.S} = c + \beta \cdot jam$	
			1983-1987	1988-1993	1983-1987	1988-1993
Prop. shift	Coefficient	β	0.0038998	0.00508	0.00829	0.00597
		c	-0.0074378	-0.009204	-0.00764	-0.01336
	Stand. error	β	0.000916	0.00130	0.00260	0.001887
		c	0.001346	0.00209	0.00381	0.003033
	t-ratio	β	4.255*	3.908*	3.195*	3.164*
		c	-5.528*	-4.407*	-2.006	-4.404*
	Adjusted R^2		0.30490	0.26790	0.19105	0.18774
Diff. shift	Coefficient	β	-0.00815	-0.00527	-0.00741	0.00115
		c	0.011939	0.012661	0.0455	-0.00398
	Stand. error	β	0.006499	0.007536	0.01612	0.012288
		c	0.009544	0.012115	0.02367	0.019755
	t-ratio	β	-1.253	-0.699	-0.460	0.094
		c	1.251	1.045	1.923	-0.201
	Adjusted R^2		0.01443	-0.01329	-0.02064	-0.02608
Total shift	Coefficient	β	-0.004246	-0.000189	0.000886	0.007125
		c	0.004500	0.00346	0.03786	-0.01734
	Stand. error	β	0.006490	0.00769	0.01728	0.012241
		c	0.009530	0.01236	0.02537	0.01968
	t-ratio	β	-0.654	-0.025	0.051	0.582
		c	0.472	0.280	1.492	-0.881
	Adjusted R^2		-0.01488	-0.02630	-0.02624	-0.01725

[a] Significance level is indicated by * for the 0.01 level.

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 the coefficients of the car queue are statistically significant. During the third period the coefficient of the queue of cars increases by 0.004 when the proportional shift of labour volume increases by 1 percent. In the last time period a 1 percent increase in the proportional shift leads to an increase of the coefficient of the queue of cars of 0.005.

Before investigating in greater detail the relationship between the queue of cars and the differential shift, the remaining part of Table 3 will be reviewed. The results on t-values and adjusted R-squared for the third and fourth periods do not support a strong relationship between the total shift and the traffic jams. The statistical outcomes regarding the relationship between the queue of cars and the three shift-share effects for value added are similar to that for labour volume. For the proportional shift, the coefficient of the queue of cars is significant at any level for both time periods. The adjusted R-squared is 0.19 for both the third and the fourth time periods, and relatively higher compared to the other two shift-share effects of value added and traffic jams. Because the adjusted R-squared is negative and the t-value is low for both these cases, again little store can be set by the outcomes of the statistical calculations. The similarity between the relationship of the car queue with the three effects of labour volume on the one hand and with the three effects of value added on the other is not startling. After all, the relationship between the three shift-share effects of labour volume and value added is perfectly clear (see Table 2).

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 the coefficients are not statistically significant from zero and that the adjusted R-squared is almost zero in each period.[8]

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 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 relationship with the proportional shift of labour volume.

The results of these calculations, obtained by means of LIMDEP and described in Table 4, show that in the third period it really does seem that a positive relationship exists between the number of inhabitants per square kilometre and the queue of cars. The coefficient of the queue of cars is 0.718 and is statistically significant, although the adjusted R-squared is only 0.298. The results are similar for the fourth period: a coefficient of 0.529 which is statistically significant, although the adjusted R-squared is low, that is 0.227.

Table 4 Results of the regression equation $INHAB = c + \chi \cdot jam$, *where INHAB is the number of inhabitants per* km^2 *and c is the constant. The symbol* χ *reflects the coefficient of the queue of cars.*[a]

		1983-1987	1988-1993
Coefficient	χ	0.71782	0.52922
	c	0.70800	0.88225
Standard error	χ	0.17126	0.14978
	c	0.25148	0.24080
t-ratio	χ	4.191*	3.533*
	c	2.815*	3.664*
Adjusted R^2		0.29815	0.22747

[a] Significance level is indicated by * for the 0.01 level.

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 5 only the relationship between the proportional shift of labour volume and the number of inhabitants per square kilometre is shown.[9] 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 5 the results of the regression equation are presented. During the four time periods the coefficient of the number of inhabitants is statistically significant (except in the first period) and ranges between 0.0029 and 0.0048. The adjusted R-squared ranges between 0.204 and 0.2696 in the last 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 5 Results of the regression equation $LV_{PS} = c + \delta \cdot INHAB$*, where* δ *is the coefficient of the number of inhabitants and other notations as before.*[a]

			1973-1977	1978-1982	1983-1987	1988-1993
Prop. shift	Coefficient	δ	0.00399	0.00478	0.00289	0.00429
		c	-0.01085	-0.01294	-0.00766	-0.01018
	Stand. error	δ	0.00184	0.00144	0.00074	0.00128
		c	0.00386	0.00292	0.00146	0.00247
	t-ratio	δ	2.166	3.31484*	3.9239*	3.3816*
		c	-2.815*	-4.4290*	-5.2567*	-4.1262*
	Adjusted R^2		0.0865	0.2039	0.2696	0.2111

[a] Significance level is indicated by * for the 0.01 level.

Taken together, the results from Tables 3, 4 and 5 suggest that the proportional shift of labour volume is positively related to 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 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 the 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 statistically. On the other hand, the available data show that a statistical 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 related to the length of traffic jams. After all, another relationship that is statistically significant is the one between labour volume and the value added for the proportional shift. This relationship between labour volume and value added (see equations (16) and (17)) applies to the differential shift as well as the total shift, except in the first period.

So, although the differential shift of labour volume as well as the differential shift of value added is responsible for the major part of the total shift, a relationship between these differential shifts and traffic jams 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 statistical 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 relationship seems also to exist between the proportional shift of labour volume and the number of inhabitants per square kilometre. Similarly, the traffic jams are related to 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. The relationships between the three effects of value added and labour volume are statistically significant except for the first time period. 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] Slob (1976) has examined the importance of accessibility with regard to the choice of the place of business made by companies. The researcher found that, based on the results of a questionnaire, most companies consider a place of business which is easy to reach a very important locational factor [Slob (1976)].

[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] Although attempts have been made to solve this problem of a negative adjusted R-squared, none of those produced the desired result. This may be because the regression equation we are estimating does not include all the relevant explanatory variables. It turns out that when the three shift-share effects are related only to traffic jams, a specification error occurs. However, although we are aware of the fact that besides traffic jams several other factors are of importance, due to lack of data it is difficult to include such variables. In addition, indiscriminately including other factors, such as investments, regional policy and economic growth may also lead to a misspecified equation [Maddala (1992)].

[9] 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 subperiods the differential shift of labour volume appears to be negatively related to the number of inhabitants. However, for the four periods, the values of the adjusted R-squared are quite low and in the first period even negative. In the fourth period on the other hand, the coefficient of the number of inhabitants is found to be statistically significant. The relationship between the total shift and inhabitants is, except for the first period, also negative. The adjusted R-squared, however, did not reach a value higher than 0.138. Again, only in the fourth period the coefficient of the number of inhabitants is statistically significant.

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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).