Intraregional income distribution and poverty; some investigations for the Netherlands between 1960 and 1981

Rietveld, P.; Ouwersloot, H.

1987

SERIE RESEARCH MEMORANDA

Intraregional Income Distribution
and Poverty;
Some Investigations for the Netherlands between
1960 and 1981

Piet Rietveld
Hans Ouwersloot

Research Memorandum 1987-37

VRIJE UNIVERSITEIT
FACULTEIT DER ECONOMISCHE WETENSCHAPPEN
EN ECONOMETRIE
AMSTERDAM

Intraregional Income Distribution and Poverty; Some Investigations for the Netherlands between 1960 and 1981

Piet Rietveld

Hans Ouwersloot

October 1987

Department of Economics

Free University

Amsterdam

PR/865/bc

Abstract

This paper is addressed to intraregional income inequalities in the Netherlands. Various concepts are used to measure the degree of regional poverty. In addition, dissimilarity between intraregional income distributions is studied. At the provincial level, relatively small and decreasing dissimilarities are observed. However, at lower spatial levels (especially within metropolitan areas) much larger dissimilarities in mean income and income distribution occur.

1. Introduction

In regional economic policies, equity issues are usually dealt with at the interregional level. The national average income per capita, or the national unemployment rate are often used as a reference point to decide whether special policy measures are necessary for a particular region. The aim of the present paper is to point out that intraregional inequalities should not be disregarded in this respect.

In most countries interregional income inequalities are rather small compared with intraregional inequalities. Focussing on one rather small component of total income inequality while neglecting the other components may have adverse effects on total inequality. A simple numerical example may be helpful to illustrate this. Consider two equally large regions with two equally large groups of income earners (see Table). In order to reduce the gap between the mean incomes of the two regions, special policies are carried out with respect to region 1 leading to an increase of mean income in region 1

	before policy	after policy
region 1		
group A income	100	102
group B income	240	246
mean income	170	174
region 2		
group A income	120	117
group B income	240	235
mean income	180	176
mean income (both regions)	175	175
interregional variance	25	1
intraregional variance	4250	4332
total variance	4275	4333

and a decrease in region 2, leaving the national mean unchanged. Both groups in region 1 receive benefits from the policy, but the high income group's benefit is relatively larger. Comparing the interregional variances one observes a substantial reduction of inequalities. Total variance has increased, however, since the decrease of interregional variance has been more than off-set by the increase of intraregional variance. It may be concluded that for the

design of appropriate regional policies, intraregional equity issues are important. Such policies must be sufficiently focussed to ensure that intraregional inequalities are not affected in a perverse way.

Intraregional inequalities have received most attention at the urban level. Urban poverty is a topic in most textbooks on urban economics. This does not mean to say that poverty is always most severe or wide-spread in urban areas. In developing countries, poverty is usually much more intense in rural areas, but in urban areas it is often more concentrated and visible as reflected among others by slum areas with low quality housing and a low quality of public services.

Intraregional income distribution is also important for locational patterns in the tertiary sector. Purchasing power is a key concept in the analysis of market areas for private sector activities. In a spatial context, purchasing power relates to the total income of all residents of a certain area. In addition to total income, also the income distribution must be taken into account, however. Consumption quotes may differ substantially among income groups, so that the branch composition of retail activities in a certain area will depend on the income distribution in the area.

There is still another reason to pay attention to intraregional inequalities. In his well-known article on regional inequality, Williamson (1965), has formulated the hypothesis that as the national economy develops from a low level, interregional income inequality intensifies up to a certain stage of development, after which mean regional incomes start to converge. The debate about this hypothesis and the search for empirical findings for various countries has never fully stopped. For many countries indeed a convergence process has been observed after some stage of development. One may wonder, however, whether convergence of mean regional incomes also implies convergence of intraregional income distributions. There is no logical reason why this should be the case. This point has been addressed by Fisch (1984) who has formulated a number of indicators for the dissimilarity between regional and national income distributions.

In the present paper the development of intraregional income inequality and poverty will be investigated for the Netherlands from 1960 to 1981. The analysis will be carried out at two spatial levels (the province and the so called Corop region, which is substantially smaller). In section 2 some concepts will be introduced to measure regional poverty as well as the dissimilarity between the intraregional and national income distribution. Empirical results are presented in sections 3 and 4.

2. Concepts

2.1. Poverty

Poverty analysis is a way of looking at the income distribution with special attention for its lower tail.
When one wants to measure the degree of poverty in a certain population, two steps must be made:

- the formulation of a standard level of income, below which people are considered as poor (the poverty line)
- the construction of an index to indicate to which extent the incomes of people fall below the poverty line.

In this paper we will not discuss the first step. We will assume that analysis or government target setting has led to the fixation of the poverty line. Then, the question remains how to measure the degree of poverty in a certain population, given the poverty line.

The index which is most frequently used is the head count ratio H, defined as the percentage of income earners below the poverty line (see e.g. Mills and Hamilton, 1984). However, as indicated by Sen (1976), the head count ratio has some weak properties. If the income of a person below the poverty line is reduced, the head count ratio remains unchanged. This is an unattractive feature, since one feels that the intensity of poverty is increased by this change.

Another poverty measure which is sometimes used is the income gap ratio I. The income gap g of a certain individual i is defined as the difference between the poverty line z and his income y_i:

$$g_i = z - y_i \qquad (1)$$

The income gap ratio is defined as the mean income gap of people below the poverty line divided by the poverty standard:

$$I = (\sum_i g_i)/\ q.z \qquad (2)$$

where summation takes place over all persons below the poverty line; q is the total number of persons below the poverty line. Also this poverty measure is not without its problems, however. For example, it is insensitive to the number of people below the poverty line.

Sen (1976) shows that on the basis of a number of axioms another poverty index can be derived which takes into account the information contained in H and I, as well as information on the distribution of incomes below the poverty line. This index is:

$$P = H[I + (1-I)G] \qquad (3)$$

where G is the Gini index of the distribution of incomes below the poverty line. In the exceptional case that all incomes below the poverty line are equal, G will be equal to zero, so that P is the product of the head count ratio and the income gap ratio (P = H.I). Data requirements for empirical computation of P are relatively modest, so that P can also be used for regional applications. Empirical applications of these concepts will be given in section 3.

2.2 Dissimilarity of Regional Income Distributions

As emphasized by Fisch (1984), convergence of mean regional incomes does not necessarily imply that the distribution of incomes within regions converges to the national income distribution. To measure the dissimilarity between the income distribution of a certain region and of the nation, one can proceed as follows:

P_{ij} denotes the number of households in income class j in region i

P_{i*} denotes the number of households in region i

e_j denotes the nation's proportion of households in income class j.

Then $e_j P_{i*}$ is the number of households in income class j and region i if the (groupwise) income distribution in region i is identical with the national income distribution. Fisch (1984) proposes to measure the dissimilarity between the regional and national income distribution as:

$$m_{i*} = \frac{1}{2} \sum_j |P_{ij} - e_j P_{i*}| / P_{i*} \qquad (4)$$

This measure indicates the proportion of the regional population that has to move in order for the region to achieve the nation's distribution.

Another approach would be to measure the proportion of regional income which moves with the population between income classes in order for the region to achieve the nations distribution. For this approach one needs information on mean income per income class and per region:

$\bar{y}_{*j}$: mean income in incomeclass j

$\bar{y}_{i*}$: mean income in region i

$\bar{y}_{**}$: mean income in nation

Then, after neutralizing for the difference between the regional and national income average, one obtains for the abovementioned measure:

$$n_{i*} = \frac{1}{2}[\sum_j \bar{y}_{*j} |P_{ij} - e_j P_{i*}| - P_{i*} |\bar{y}_{i*} - \bar{y}_{**}|] / P_{i*} \bar{y}_{i*} \qquad (5)$$

The second term within square brackets is added to neutralize for the

difference between $\bar{y}_{i*}$ and $\bar{y}_{**}$. An unattractive property of n_{i*} is that it may in certain cases become negative, whereas zero would be the natural minimum value for a dissimilarity measure[1].

We will now show that the measures m_{i*} and n_{i*} may give rise to counter-intuitive results. Consider for example Table 1.

Income class j	case a Region i: 1	2	case b Region i: 1	2	Nation
1	10	30	20	20	40
2	30	30	40	20	60
3	30	30	20	40	60
4	30	10	20	20	40
total	100	100	100	100	200

Table 1. Hypothetical regional distributions of households among 4 income classes.

In case (a), the dissimilarity between the national distribution and the regional distributions occurs in the tails, whereas in case (b) it occurs in the middle income classes. This is not taken into account in the dissimilarity measure m_{i*}, which is equal to .10 for both regions in both cases. Yet, the transfer of households in case (a) is between income classes which are much further removed than in case (b). When the income distributions of Table 1 are formulated in a cumulative way, one arrives at Table 2. This table clearly shows that

Income class j	case a Region i: 1	2	case b Region i: 1	2	Nation
1	10	30	20	20	20
2	40	60	60	40	50
3	70	90	80	80	80
4	100	100	100	100	100

Table 2. Cumulative distributions of income (in %).

in case (b) the regional distributions are much closer to the national distribution than in case (a). Therefore one would say, intuitively, that the intraregional income distributions in case (a) are less similar to the national distribution than in case (b).

Do the measures n_{i*} take into account this point? Assume that the average income in the 4 income classes amounts to 1,2, 4 and 8, respectively. Then, in case (a) one obtains: $n_{1*} = .023$ and $n_{2*} = .034$, whereas in case (b) the corresponding values are: .059 and .053, respectively. Thus, according to the measure n_{i*}, the regional distributions in case (b) are clearly <u>less</u> similar to the national distribution than they are in case (a), which is just the opposite of our statements above. We conclude that situations may occur where m_{i*}, and especially n_{i*} yield counter-intuitive results.

The background of this problem is that the type of scale used for income is <u>cardinal</u>. As a consequence, one knows that an exchange between classes 1 and 4 implies a larger step than an exchange between classes 2 and 3. There would not be a basis to say this if the distribution would be studied of a <u>nominal</u> variable. Note that the field where these dissimilarity indices are most intensively used, is residential segregation: here, the variable studied (ethnicity) is indeed nominal. A transfer of these indices to a field where a cardinal variable is studied leads to an incomplete use of the available information which may easily yield counter-intuitive results as the above example shows.

Is it possible to develop alternative measures for m_{i*} or n_{i*} which take into account the cardinal character of income? A natural way to do this is to make use of information on the distances between the various income classes. For example, using the mean incomes per class already mentioned above, case (a) would involve a transfer between income classes with a difference in mean income which is equal to 7, whereas in case (b) this difference is only 2. In general, let $x_{jj'}$ be the number of households transferred from income class j to j' to let the intraregional income distribution coincide with the national distribution. Thus for region i:

$$\begin{aligned} \sum_{j} x_{jj'} &= e_{j'} P_{i*} \\ \sum_{j'} x_{jj'} &= P_{ij} \end{aligned} \qquad (7)$$

The income difference covered by a transfer $x_{jj'}$ amounts to

$$|\bar{y}_{*j} - \bar{y}_{*j'}|.$$

Then the total income transfer is equal to

$$a_i = \sum_{jj'} |\bar{y}_{*j} - \bar{y}_{*j'}| x_{jj'} \qquad (7)$$

Obviously, the values of $x_{jj'}$ are not uniquely determined by (6). Therefore one could use the minimum values of a_i as a measure for

the dissimilarity between the regional and national income distribution. This would lead to solving the following transportation problem:

$$\begin{aligned} \min_{x_{jj'}}! \quad & a_i = \sum_{jj'} |\bar{y}_{*j} - \bar{y}_{*j'}| x_{jj'} \\ \text{subject to} \quad & \sum_{j} x_{jj'} = e_{j'} P_{i*} \\ & \sum_{j'} x_{jj'} = P_{ij} \\ & x_{jj'} \geq 0 \quad \text{for all } j, j' \end{aligned} \tag{8}$$

There is no need to use an LP package to find the minimum value of a_i. As shown in Appendix I, this value (which will be denoted as b_i) is equal to:

$$\begin{aligned} b_i = & |P_{i1} - e_1 P_{i*}| \cdot |\bar{y}_{*1} - \bar{y}_{*2}| \\ & + |(P_{i1} + P_{i2}) - (e_1 + e_2) P_{i*}| \cdot |\bar{y}_{*2} - \bar{y}_{*3}| \\ & + \ldots \\ & + |(P_{i1} + P_{i2} + \ldots + P_{i,J-1}) - (e_1 + e_2 + \ldots + e_{J-1}) P_{i*}| \cdot \\ & \qquad |\bar{y}_{*J-1} - \bar{y}_{*J}| \end{aligned} \tag{9}$$

Note that in (9), the left hand side in each term indicates the dissimilarity in the cumulative income distribution of the region i and the nation.

The minimum value b_i found for the date in Table 1 is 70 for both regions in case (a), and 2o for both regions in case (b). This is clearly in agreement with the intuitive notion already mentioned above.

One can standardize the index b_i by dividing it through regional income, so that one arrives at:

$$c_i = b_i / P_{i*} \bar{y}_{i*} \tag{10}$$

Aggregate indicators of dissimilarity can easily be derived from the dissimilarity indicators pertaining to particular regions. Thus, the aggregate of the m_{i*}'s can be formulated as:

$$m_{**} = \sum_{i} (P_{i*} / P_{**}) \, m_{i*} \tag{11}$$

The formula for n_{**} is given by Fisch (1984). Finally, the appropriate expression for c_* would be:

$$c_* = \sum_i (P_{i*}\bar{y}_{i*})/(P_{**}\bar{y}_{**})\, c_i \qquad (12)$$

Empirical applications of these concepts will be given in section 4.

3. Empirical Analysis of Regional Poverty

In this section, empirical results will be presented on regional poverty in the Netherlands since 1960. Data on regional income distribution have been published regularly by the Central Bureau of Statistics (CBS). These data are based on income-tax records; they refer to persons living in the Netherlands who receive an income. Married couples have been regarded as one income earner. The data display several weaknesses, which must be taken into account. To mention some of them:

- Income earners may display a tendency towards underrating their incomes vis à vis fiscal authorities. There are strong indications that the informal sector - implying unreported incomes - has grown substantially during the past 15 years in the Netherlands.
- In the course of the years the CBS has repeatedly applied slight changes in the definition of income.
- Not all categories of income earners have been treated in the same way during the period since 1960. For example, holidayworkers have been excluded in the more recent years.
- The procedures used in regard of persons who only earned an income during part of the year (e.g. because of emigration), have not remained the same during the period since 1960 (for a fuller account, refer to Bartels, 1977, CBS, 1979 and 1983).

Results will be reported for the years 1960, 1969, 1978 and 1981. The income concept used is: "total income earned before taxes", except for the year 1981, where disposable income is used.

Some computational matters deserve our attention before empirical results will be given. For the computation of the Gini index, one usually employs a piecewise linear Lorenz curve, which implies that all incomes in a certain income class are assumed to be equal to the mean income in that class. This is not entirely satisfactory, especially when the number of income classes is not so large, as is sometimes the case with regional data. Therefore, we have used two interpolation techniques described by Kakwani (1980), one in which the Lorenz curve is piecewisely approximated as a polynomial function of degree 3, and one where the Lorenz curve is based on a probability density function which is piecewisely linear. It appeared that the two approximations are usually quite near.

The poverty line is computed as the minimum wage as established by law by the Dutch government in 1981. To make results comparable be-

tween periods, the ratio of the poverty line and mean income is taken as a constant for all years. Some experiments have been carried out to investigate the sensitivity of the results for the choice of the poverty line. It appears that the relative positions of the regions are only slightly affected by a shift of the poverty line (see also Atkinson, 1987).

The poverty lines obtained do not coincide with the boundary of one of the income classes. Therefore, poverty indices cannot be computed directly. An interpolation of the income distribution in the income class in which the poverty line falls is necessary first, to approximate the share of income earners in that class which is below the poverty line. For this purpose we have used again the abovementioned interpolation techniques.

In Table 3, the developments of inequality and poverty indicators at the national level are presented[2]. The table shows a declining trend of income inequality and poverty indicators in the Netherlands.

	1960	1969	1978	1981
Gini index	.449	.410	.335	.261
Head count ratio	-	.326	.254	.175
Income gap ratio	-	.407	.328	.216
Sens poverty index	-	.183	.117	.053

Table 3. National development of income inequality and poverty.

Of course, intertemporal comparisons are hampered by the data problems mentioned above[3]. Yet, in this case the main trends are so clear that it seems safe to state that the observed decrease of inequality and poverty is genuine, and not just the result of data peculiarities. This is not a surprising result: The system of social welfare payments, implying a considerable degree of income redistribution, developed rapidly in the Netherlands since 1960.

We will now turn to interregional comparisons. If we may assume that all regions are affected to the same degree by data problems, interregional comparisons remain valid. The interregional analysis will be carried out at two spatial levels, i.e. the province (of which there are 11), and the so-called corop region (of which there are 40). We start with the provincial results of 1981 (see Table 4). The national level of the variables is set equal to 100. The table shows that interprovincial differences in mean income and poverty are modest in the Netherlands for 1981.

High average incomes are found in the Western, most highly urbanized provinces of the Netherlands (Utrecht, North Holland and South

Holland).

province	mean income	Gini index	head count ratio	income gap ratio	Sen index
Groningen	94.6	99.7	110.7	107.1	119.5
Friesland	94.6	94.9	106.0	100.0	106.4
Drenthe	97.1	96.9	100.8	101.7	102.9
Overijssel	96.1	97.3	106.4	100.2	107.0
Gelderland	98.3	98.8	103.2	100.7	104.6
Utrecht	104.4	100.7	88.3	99.3	88.1
N Holland	102.0	102.3	97.7	99.2	96.4
Z Holland	102.3	101.9	99.1	96.5	94.7
Zeeland	99.8	96.6	95.3	95.0	91.0
N Brabant	100.0	99.8	99.4	105.0	104.6
Limburg	97.3	96.8	102.1	100.6	103.2

Table 4. Provincial income inequality and poverty, 1981 (the Netherlands = 100).

In the Northern part of the Netherlands (Groningen and Friesland) the lowest mean incomes are observed. Comparison with the results for the other years (see Appendix II) yields that the main pattern of inter-provincial differences has remained unchanged during the period considered. In all years, the three Western provinces had above average incomes. The size of the differences between the regions has become smaller, however. Within the group of below-average provinces, some provinces changed positions. The provinces of Drenthe, Gelderland and North-Brabant improved their positions at the expense of the other provinces, especially Groningen.

The income inequality as represented by the Gini index appears to be highest in the richer provinces. There is no intrinsic reason why this should be so: the Gini index is scale neutral, i.e. its value remains unchanged when incomes are multiplied with an arbitrary positive constant. Thus, in the richer Western provinces, income inequality is higher, both in absolute and relative terms. The correlation coefficient between mean income and the Gini index is rather high (.72) in 1981 (see Table 5).

Inequality indicators as such do not say much about poverty. A high degree of inequality may be due to extremes in both the upper and

lower tail of the distribution. Therefore, we also use the three poverty indices discussed in section 2. Indeed, rather moderate correlation coefficients are observed between the Gini index and the three poverty indices.

	1	2	3	4	5
1. mean income	1.00	.72	-.89	-.48	-.85
2. Gini index	+.72	1.00	-.36	+.03	-.27
3. head count ratio	-.89	-.36	1.00	+.55	+.93
4. income gap ratio	-.48	+.03	+.55	1.00	+.81
5. Sen index	-.85	-.27	+.93	+.81	1.00

Table 5. Correlation matrix, provincial poverty, 1981.

The correlation coefficient between the head count ratio and the Sen index is very high (.93), considerably higher than the correlation coefficient between the income gap ratio and the Sen index. This result holds true for each year of observation. This suggests that, although the head count ratio is subject to some methodological reservations, it is a reasonable alternative for the Sen index for many practical purposes. Correlation coefficients between mean income on the one hand and the head count ratio and the Sen index on the other hand are strongly negative in most years. Thus, the tendency can be observed that in provinces with high mean incomes, relatively little poverty occurs. These results imply that selecting regional development areas on the basis of below average mean regional income will yield approxi- mately the same outcome as selecting such areas on the basis of pover- ty indices such as the head count ration or the Sen index. In other words: with the given data, regions with a low mean income coincide with regions in which many poor people live. Thus, by focussing on mean income and ignoring intraregional income distribution at the phase of selecting regional development areas, not much harm is done. This does not mean to say that intraregional inequalities can be ignored altogether. In the phase of policy design, the distributional effects of policies deserve attention. As already indicated in section 1, what is good for the mean regional performance is not necessarily good for the region's poor.

Is it possible to explain the differences between income distributions of the various regions? The level of income is related among others to personal supply factors such as gender, age, educational level, as well as to the structure of labour demand in a region (see Rietveld, 1987b). A low level of mean income in a region may be for example due to the presence of a relatively large group of pensioners. From the perspective of regional labour market policies, this is very different from a situation where low incomes are due to a lack of well paid jobs.

The available data do not allow a detailed integrated analysis of

province	mean income	Gini index	head count ratio	income gap ratio	Sen index
Groningen	94.8	100.3	111.4	107.8	119.9
Friesland	95.8	94.7	104.9	92.3	101.8
Drente	97.2	96.5	102.6	99.9	103.3
Overijssel	96.4	96.8	105.5	96.3	104.3
Gelderland	98.6	98.4	100.6	102.1	101.9
Utrecht	104.2	100.8	90.9	93.2	87.5
N Holland	102.0	102.6	99.0	99.1	98.2
Z Holland	102.5	102.0	97.8	98.6	95.5
Zeeland	100.7	96.3	90.7	97.5	89.1
N Brabant	99.6	99.5	99.6	104.3	102.9
Limburg	96.2	97.1	106.3	101.7	106.8

Table 6. Provincial income inequality and poverty, 1981, after correction for differences in age composition (the Netherlands = 100).

the determinants of income. It is possible however, to carry out some partial analyses for individual factors. For example, by computing the regional income distribution which would arise if the income earners in the region would have the same age distribution as in the nation (see Table 6). Comparing Tables 6 and 4, we may conclude that differences in the age distribution of provincial populations only play a minor role in explaining interprovincial differences in mean income and poverty incidence. Unfortunately, such an analysis cannot be carried out for differences in educational level or ethnicity because of lack of data.

If one limits attention to the group of income earners being in

the labour market, thus leaving out groups of persons such as pensioners, poverty allowance recipients and disability allowance recipients, one arrives at Table 7. One would expect that the national social welfare system would lead to a high degree of interprovincial homogeneity among these groups being outside the labour market. Thus, one would arrive at higher interprovincial descrepancies for the labour force than for the group of all income earners as a whole.

province	mean income	Gini index	head count ratio	income gap ratio	Sen index
Groningen	96.4	100.4	106.6	102.8	110.0
Friesland	93.7	96.7	115.6	106.9	126.2
Drente	96.1	98.9	113.4	106.4	119.4
Overijssel	95.7	98.5	114.2	99.9	114.6
Gelderland	97.4	99.5	110.0	98.7	109.6
Utrecht	102.8	102.0	93.7	96.0	90.3
N Holland	102.8	101.5	91.1	96.6	88.4
Z Holland	103.1	100.4	93.0	99.5	92.0
Zeeland	101.1	95.9	89.4	106.8	93.7
N Brabant	99.0	100.2	106.0	102.3	107.8
Limburg	97.6	97.0	101.9	96.5	98.7

Table 7. Provincial income inequality and poverty, 1981, labour force only (the Netherlands = 100).

Indeed, such a tendency can be observed, although the differences between Tables 4 and 7 remain rather limited for mean income. For the poverty indices somewhat larger shifts can be observed. We may conclude that the Dutch social welfare system has a dampening effect on interregional differences in poverty incidence.

The relatively small interregional differences observed in the above tables obviously have to do with the low degree of spatial disaggregation implied by the use of provincial data. For 1978, data on the interregional income distribution are available at the level of so called Corop regions, being considerably smaller than provinces. In the Netherlands there are 40 Corop regions with an average population size of 350,000 persons. The results are shown in Table 8. Comparing

province	Corop region	mean income	Gini index	head count ratio	income gap ratio	Sen index
Groningen	1	89.3	88.8	105.3	96.1	101.7
	2	96.1	91.7	95.4	97.2	92.6
	3	93.7	98.7	110.4	100.2	110.9
Friesland	4	93.8	95.1	104.3	94.4	99.1
	5	93.7	95.8	105.1	96.9	102.2
	6	94.0	94.8	102.4	95.8	98.5
Drente	7	102.0	100.9	98.4	94.1	92.9
	8	92.2	90.2	100.7	100.4	102.3
	9	95.3	93.4	100.2	94.9	96.3
Overijssel	10	96.5	97.9	101.8	102.6	104.4
	11	96.5	96.3	102.5	96.3	99.2
	12	94.8	94.1	98.8	98.9	98.1
Gelderland	13	97.0	96.6	101.7	99.7	101.2
	14	96.7	97.0	98.3	98.7	97.4
	15	97.6	99.6	101.3	105.8	106.9
	16	94.0	96.3	107.6	100.8	108.8
Utrecht	17	106.9	104.3	93.9	102.6	95.9
N Holland	18	98.5	96.7	97.6	111.1	108.3
	19	107.3	99.6	87.1	100.9	88.3
	20	107.5	95.9	83.8	99.7	83.8
	21	108.5	106.3	93.8	93.0	87.7
	22	101.6	94.2	90.2	105.2	93.6
	23	97.2	104.1	112.4	103.5	113.5
	24	117.8	114.4	87.4	98.1	85.5
Z Holland	25	105.4	107.7	102.3	104.2	104.8
	26	107.4	107.5	98.0	97.6	94.9
	27	106.7	104.5	95.9	102.4	98.1
	28	108.1	102.3	92.3	99.8	92.6
	29	99.7	99.4	102.9	99.0	101.5
	30	103.7	95.7	89.6	97.7	88.2
Zeeland	31	97.9	95.8	97.9	93.6	91.7
	32	98.4	95.8	98.0	93.8	93.1
N Brabant	33	100.5	96.7	94.1	103.0	97.2
	34	97.4	96.4	98.7	100.7	99.2
	35	99.5	98.5	96.9	106.3	102.8
	36	101.4	100.8	97.4	104.4	101.8
Limburg	37	96.8	97.8	102.4	100.2	103.1
	38	96.4	96.6	100.7	101.9	103.4
	39	94.4	94.5	102.7	98.8	102.6
Gelderland	40	106.0	86.9	71.0	120.2	84.8

Table 8. Income inequality and poverty at the Corop level, 1978 (The Netherlands = 100)

Table 8 with Table A.II.3 from the appendix, we observe that inter-regional differences are much larger at the Corop level than at the provincial level.

The region with the lowest mean income is Corop 1, being part of the province of Groningen in the Northern part of the country; this area is characterized by a stagnating regional economy and an infavourable economic structure. An interesting region is Flevoland (Corop 40), which combines a high level of mean income with a low Gini index. This region consists of newly reclaimed land (used for agricultural and residential purposes) to which mainly younger people move, which gives rise to a relatively rich and homogeneous population. The highest mean income is found in Corop 24, which is generally considered as an attractive residential area, with a location not far from the city of Amsterdam.

The main cities in the Netherlands (Amsterdam, Rotterdam, The Hague and Utrecht) are parts of the Corop regions 23, 29, 26 and 17, respectively. For the Corop regions containing the two largest of these cities (23 and 29), mean incomes are found which are among the lowest in the Western provinces. Table 8 also shows that the poverty incidence in these regions is above the national average. Thus, above average poverty incidence is not only a feature of rural areas in the periphery, but also of metropolitan areas in the highly urbanized Western part of the country.

region	mean income	Gini index	head count ratio	income gap ratio	Sen index
urban core:					
Amsterdam	90.6	101.9	122.8	103.7	123.4
Rotterdam	91.6	99.4	119.0	98.9	116.6
The Hague	99.1	103.9	108.6	96.0	103.1
Utrecht	92.5	97.8	111.5	106.8	117.6
suburban ring:					
Amsterdam	116.6	103.6	81.6	103.3	84.5
Rotterdam	109.0	96.9	84.3	99.3	84.0
The Hague	129.0	109.8	70.7	104.0	73.5
Utrecht	113.0	105.8	86.6	101.0	87.4

Table 9. Urban income inequality and poverty, 1978 (the Netherlands = 100).

An even more impressive picture of urban poverty is obtained when the Corop regions containing the four main cities are divided into two parts: the central city and the rest (the "suburban ring"). As Table 9 shows, the large cities have on average low mean incomes, comparable with the most unfavourable rural areas. The degree of poverty observed is even considerably more serious than in rural areas. In the Netherlands, urban poverty has become a more serious phenomenon than rural poverty. In addition, since the population size of the main cities is much larger than that of the low income rural Corop regions, urban poverty can also be said to be more widespread than rural poverty.

The suburban rings are invariably characterized by high mean incomes and low degrees of poverty incidence. The aggregate indicators for metropolitan areas as represented in Table 8 hide a considerable degree of dissimilarity between urban cores and suburban rings. In the economic landscape of metropolitan areas, spatial proximity and similarity of income distribution do not go hand in hand.

4. Dissimilarities in Intraregional Income Distributions

For the analysis of dissimilarities in intraregional income distributions use will be made of the concepts presented in section 2.2. In Table 10 the aggregate results are given for the period from 1960 to 1981.

	1960	1969	1978	1981
dissimilarity index				
m**	.047	.036	.029	.025
n**	.065	.049	.037	.030
c*	.078	.057	.035	.025
interregional inequality indicator				
Gini index	.040	.034	.012	.011
coefficient of variation	.081	.063	.039	.028

Table 10. Dissimilarity indicators for intra-provincial income distributions.

As indicated by the Gini index and the coefficient of variation, a clear convergence of mean provincial incomes has taken place during this period. A decrease of interregional differences between mean

incomes does not necessarily imply that the income distributions of regions have become more similar, however. To check this, the measures m_{**}, n_{**} and c_* have been computed. The figures in Table 10 clearly show that with the convergence of mean incomes also the income distributions have converged: the regional income distributions have become more similar to the national income distribution. Comparing these outcomes with Fisch's results for the USA, we find that the degree of interregional dissimilarity is much higher in the USA than in the Netherlands.

Does this result also hold true for each individual region? Numerical results on the indicators m_{i*}, n_{i*} and c_i, as well as on $\bar{y}_{i*}/\bar{y}_{**}$ (the ratio of regional and national income) are given for each province in Appendix III. It is found that in all provinces except Groningen and Utrecht a clear convergence process has taken place. The indicators usually display rather parallel developments. The index n_{i*} is the one which most frequently is not in agreement with the tendencies indicated by the other indices.

For a more accurate account of the similarity between the indicators, cross-sectional correlation coefficients have been computed (see Table 11). The correlations are rather high. Especially $|\bar{y}_{i*}-\bar{y}_{**}|/\bar{y}_{**}$ and c_i are highly correlated.

	m_{i*}	n_{i*}	c_i	$\lvert\bar{y}_{i*}-\bar{y}_{**}\rvert/\bar{y}_{**}$
m_{i*}	1.00	.92	.87	.74
n_{i*}	.92	1.00	.64	.45
c_i	.87	.64	1.00	.96
$\lvert\bar{y}_{i*}-\bar{y}_{**}\rvert/\bar{y}_{**}$	.74	.45	.96	1.00

Table 11. Correlation coefficients between dissimilarity indicators (1981).

The index n_{i*} is the one which is least similar to the other indicators.

Comparing correlation coefficients for the various years, one observes a tendency that they become higher as convergence has proceeded further. Thus, the higher the degree of similarity in a multiregional system, the stronger the indicators are correlated. This suggests that in highly converged systems the choice of a certain dissimilarity index is not such a critical issue. With a low average degree of similarity, the choice of a certain index may considerably

influence the outcomes, however.

Williamson (1965) mentions four factors which play a main role as determinants of increased or decreased interregional disparities: migration of labour, migration of capital, interregional linkages and central government policy. All of them appear relevant for an explanation of the developments in the Netherlands since 1960.

In the 1960's the labour market was very tight in the Western provinces, so that many firms decided to relocate or to open new plants in other parts of the country. This process of capital migration has stimulated a more even interregional distribution of incomes.

In addition, large changes took place in the fields of interregional linkages and labour migration. The improvement and extension of the Dutch road network enabled many people to move to more attractive regions of residence, while at the same time continuing their work in the region of origin. As a result, many people moved to the provinces near to North and South Holland: Utrecht, Gelderland and North Brabant. These migrants earned relatively high incomes so that a shrinking gap can be observed between the region of origin and of destination.

Another aspect of labour migration pertains to foreign labour. Foreign migrants who earn relatively low incomes usually located in the cities of the Western provinces, thus contributing to a decrease of mean incomes in these areas.

Also the government has played a role in the convergence process. The public sector has grown at very high rates between 1960 and 1980. The interpersonal equity implied by the social welfare arrangements has also led to a higher degree of interregional equity (see Molle and Beumer, 1984 for a more detailed analysis of determinants of the decrease of interregional income disparity).

We will only shortly discuss the results obtained when dissimilarity indices are computed for Corop regions[5]. The results are completely in line with those of the preceding section: in Corop regions with a mean income which is far removed from the national average, one observes high values of the dissimilarity indices. When in the metropolitan Corop regions a division is made between urban core and suburban ring, high dissimilarity scores are found for both of them: the former because its incomes are clearly below the national average and the latter for the opposite reason.

5. Concluding Remarks

It must be emphasized that due to data weaknesses already mentioned above the empirical results are less exact than they may seem to be. Some other limitations of our approach deserve attention.

First, the income data used pertain to individual years only. Thus the results on inequality and poverty have an instantaneous character, which is a pity, since individual incomes may vary considerably from year to year: not all of the present poor will be poor in the future. A life time perspective on income would be more appropriate, therefore. In Creedy (1985) an effort is made to use such a perspective.

Second, income inequalities do not necessarily coincide with welfare inequalities, since welfare depends on much more than income only. Environmental quality and the availability of infrastructure will for example also be important. This problem is addressed in Rietveld (1987a) at the interregional level by using a welfare profile approach.

A related problem is that no distinction has been made between voluntary and onvoluntary poverty. Voluntary poverty may be the consequence of people working part time so that they have enough time for education in order to obtain higher qualifications and better paid work in the future. Voluntary poverty may also have a permanent character since some people may have a strong preference for leisure or for a non-materialistic life-style.

Another problem is that the data used relate to individual income earners. There is no way to combine these data in order to arrive at household income. Neither is it possible to relate the income data to the number and kind of persons being dependent on it.

Notwithstanding these problems and limitations, we believe that the empirical results give a meaningful contribution to our knowledge about regional income and poverty. A convergence of mean incomes has been observed for most provinces in the Netherlands during the 1960's and 1970's. This convergence of mean incomes has been concomitant with a convergence of regional income distributions. Large discrepancies can be observed at a lower spatial level, i.e. between urban cores and suburban rings as regards mean income and poverty. Poverty has become most intense and wide-spread in urban areas. If regional economic policy is aiming at alleviating poverty concentrated in particular areas, urban areas deserve more attention than they did before in the Netherlands. The developments in urban incomes are unfavourable for many tertiary sector activities in cities. In fact, as also noted by Kruyt (1983) the residentiary sector in the larger cities is doubly hurt, i.e. not only by a (relative) decrease in mean income of urban residents but also by a decrease of the total number of residents.

Footnotes

1. Formula (5) differs slightly from the one given by Fisch in that a factor (1/2) has been added. The index n_{i*} may become negative when the mean income per income class is not equal for all regions.

2. For 1960 no reliable values of poverty indices could be computed due to the limited number of income classes distinguished below the poverty line.

3. Comparability is also obviated by the varying number of income classes used per year (respectively 17, 12, 19 and 19) and by the fact that 1981 data relate to disposable rather than total income.

4. This method is similar to computing the regional component in shift-share analysis; in this case population is distinguished according to age groups.

5. For one Corop region a negative value of the n_{i*} is found. As already indicated in section 2.2, this is an unattractive property for a dissimilarity index.

References

Atkinson, A.B., On the Measurement of Poverty, Econometrica, vol. 55, pp. 749-764, 1987.

Bartels C.P.A., Economic Aspects of Regional Welfare, M. Nijhoff, Leiden, 1977.

CBS, De Personele Inkomensverdeling naar Urbanisatiegraad, Sociale Maandstatistiek, 1979, pp. 657-668.

CBS, Inkomensontwikkeling in de grote steden, 1946-1978, Sociale Maandstatistiek, 1983/87, pp. 53-65.

CBS, Personele Inkomensverdeling, various years.

Creedy, J., Dynamics of Income Distribution, Basil Blackwell, Oxford, 1985.

Fisch, O., Regional Income Inequality and Economic Development, Regional Science and Urban Economics, vol. 14, 1984, pp. 89-111.

Kakwani, N.C., Income Inequality and Poverty, Oxford University Press, Oxford, 1980.

Kruyt, B., De Stedelijke Inkomens Ontwikkeling: een Benauwend Vooruitzicht, ESB, vol. 68, 1983, pp. 856-859.

Mills, E.S., and B.W. Hamilton, Urban Economics, Scott, Foresman and Company, Glenview, 1984.

Molle, W. and L. Beumer, Regional Income Disparity in the Netherlands, Tijdschrift voor Economische en Sociale Geografie, vol. 75, 1984, pp. 82-98.

Rietveld, P., On Multidimensonal Inequality Comparisons, Research Memorandum 1987-1, Dept. of Economics, Free University, Amsterdam, 1987a.

Rietveld, P., Interregional versus Intraregional Inequality: Are Regional Policies a proper way of Promoting Equity, Research Memorandum, Dept. of Economics, 1987b.

Sen, A., Poverty: an Ordinal Approach to Measurement, Econometrica, vol. 44, 1976, pp. 219-231.

Williamson, J.G., Regional Inequalities and the Process of National Development, Economic Development and Cultural Change, vol. 13, 1965, pp. 3-45.

Appendix I Solution of linear programming problem

The linear programming problem (8) has multiple optima. In the present context this property does not cause difficulties since we are only interested in the value of the objective function, not in the value of the $x_{jj'}$'s. It is not difficult to see that if a certain solution is optimal, there is another optimal solution where $x_{jj'} = 0$ for all j, j' satisfying $|j-j'| \geq 2$. This means for example, that the value of the objective function does not change when a transfer from class 3 to 1 is redefined as a combination of a transfer from class 3 to 2 and a transfer from class 2 to 1.

Another property of an optimal solution of (8) is that if $x_{jj'} \neq 0$ then $x_{j'j} = 0$. Thus, there is an optimal solution which only entails transfers between adjacent income classes and where cross-hauling does not occur.

The transfer between class 1 and 2 in this optimal solution is:

$$x_{12} = \max (P_{i1} - e_1 P_{i*}, 0)$$

$$x_{21} = \text{Max } (-P_{i1} + e_1 P_{i*}, 0)$$

Then, next the transfer between income classes 2 and 3 can be determined:

$$x_{23} = \max (P_{i1} - e_1 P_{i*} + P_{i2} - e_2 P_{i*}, 0)$$

$$x_{32} = \max (-P_{i1} + e_1 P_{i*} - P_{i2} + e_2 P_{i*}, 0)$$

Subsequent application of this approach will lead to (9) after some rearranging of terms.

Appendix II Provincial income inequality and poverty (1960, 1969, 1978)

provincie	mean income	Gini index
Groningen	93.6	93.9
Friesland	89.2	98.7
Drenthe	86.3	95.5
Overijssel	91.9	98.3
Gelderland	91.9	96.4
Utrecht	103.5	104.2
N Holland	108.8	103.5
Z Holland	108.3	97.2
Zeeland	95.7	99.7
N Brabant	92.3	101.7
Limburg	93.6	96.2

Table A.II.1. Provincial income inequality, 1960 (the Netherlands = 100).

province	mean income	Gini index	head count ratio	income gap ratio	Sen index
Groningen	93.0	96.3	104.5	97.1	102.4
Friesland	89.9	95.9	110.8	97.7	108.8
Drenthe	90.8	93.9	106.2	98.1	104.1
Overijssel	91.5	96.0	106.9	99.3	106.0
Gelderland	94.8	98.3	105.1	100.3	105.2
Utrecht	107.2	101.4	92.6	97.6	90.6
N Holland	104.5	101.6	96.5	99.5	96.5
Z Holland	106.9	101.7	93.8	100.8	94.6
Zeeland	98.6	97.0	99.5	95.2	95.0
N Brabant	96.6	99.8	104.3	102.3	105.4
Limburg	93.0	95.6	103.6	101.8	104.8

Table A.II.2. Provincial income inequality and poverty, 1969 (the Netherlands = 100).

province	mean income	Gini index	head count ratio	income gap ratio	Sen index
Groningen	92.9	95.3	107.2	98.1	105.6
Friesland	93.9	95.0	103.6	94.8	98.7
Drenthe	96.6	95.2	99.6	96.2	96.8
Overijssel	95.7	95.5	100.1	98.5	99.0
Gelderland	97.9	98.8	101.3	101.1	102.5
Utrecht	106.9	104.3	93.9	102.6	95.9
N Holland	102.3	103.4	101.1	101.6	101.7
Z Holland	103.8	102.4	98.8	98.5	96.9
Zeeland	98.3	95.8	98.0	93.2	92.1
N Brabant	99.9	98.3	96.7	103.4	100.2
Limburg	95.3	95.6	101.8	99.6	102.3

Table A.II.3. Provincial income inequality and poverty, 1978 (the Netherlands = 100).

Appendix III Dissimilarity indices, provincial level (1960, 1969, 1978 and 1981)*)

Groningen	1960	1969	1978	1981
m_{i*}	62	52	54	56
n_{i*}	42	35	36	39
c_i	64	71	74	63
$\bar{y}_{i*} / \bar{y}_{**}$	93.6	93.0	92.9	94.6
Friesland				
m_{i*}	73	66	59	45
n_{i*}	38	35	42	33
c_i	108	100	65	57
$\bar{y}_{i*}/\bar{y}_{**}$	89.2	89.9	93.9	94.6
Drenthe				
m_{i*}	76	51	34	34
n_{i*}	50	28	27	26
c_i	140	92	38	28
$\bar{y}_{i*}/\bar{y}_{**}$	86.3	90.8	96.6	97.1
Overijssel				
m_{i*}	54	52	35	35
n_{i*}	35	29	27	24
c_i	87	83	46	38
$\bar{y}_{i*}/\bar{y}_{**}$	91.9	91.5	95.7	96.1
Gelderland				
m_{i*}	50	32	18	17
n_{i*}	28	16	12	12
c_i	87	50	22	16
$\bar{y}_{i*}/\bar{y}_{**}$	91.9	94.8	97.5	98.3
Utrecht				
m_{i*}	13	33	42	37
n_{i*}	6	12	25	21
c_i	30	66	64	41
$\bar{y}_{i*}/\bar{y}_{**}$	103.5	107.2	106.9	104.4

N Holland	1960	1969	1978	1981
m_{i*}	43	28	21	19
n_{i*}	22	14	15	14
c_i	84	42	26	19
$\bar{y}_{i*}/\bar{y}_{**}$	108.8	104.5	102.3	102.0
Z Holland				
m_{i*}	53	42	30	25
n_{i*}	23	22	21	18
c_i	75	65	38	24
$\bar{y}_{i*}/\bar{y}_{**}$	108.3	106.9	103.6	102.3
Zeeland				
m_{i*}	44	22	22	35
n_{i*}	36	13	19	35
c_i	41	15	28	14
$\bar{y}_{i*}/\bar{y}_{**}$	95.7	98.6	98.3	99.8
N Brabant				
m_{i*}	40	23	19	18
n_{i*}	16	11	19	16
c_i	87	37	12	8
$\bar{y}_{i*}/\bar{y}_{**}$	92.3	96.6	99.9	100.0
Limburg				
m_{i*}	39	31	35	20
n_{i*}	38	13	24	15
c_i	70	66	50	27
$\bar{y}_{i*}/\bar{y}_{**}$	93.6	93.0	95.3	97.3

Table A.III.1. Dissimilarity indices at the provincial level.

*) The values of m_{i*}, n_{i*} and c_i have been multiplied with a factor 1000. The values of $\bar{y}_{i*}/\bar{y}_{**}$ have been multiplied with a factor 100.

1981-1	E. Vogelvang	A quarterly econometrie model for the Price Formation of Coffee on the World Market
1981-2	H.P. Smit	Demand and Supply of Natural Rubber, Part I
1981-3	R. Vos	The political Economy of the Republic of Korea; A proposal for a model framework of an open economy in the ESCAP-region, with emphasis on the Role of the State
1981-4	F.C. Palm	Structural Econometric Modeling and Time Series Analysis - Towards an Integrated Approach
1981-5	P. Nijkamp in co-op. with H. v. Handenhoven and R. Janssen	Urban Impact Analysis in a Spatial Context: Methodologie and Case Study
1981-6	R. Ruben	Primaire exporten en ekonomiese ontwikkeling
1981-7	D.A. Kodde	Het genereren en evalueren van voorspellingen van omzet en netto winst: een toegepast kwantitatieve benadering
1981-8	B. Out	Financiële vraagstukken onder onzekerheid
1981-9	P. van Dijck and H. Verbruggen	A Constant-Market-Shares Analysis of ASEAN Manufactured Exports to the European Community
1981-10	P. Nijkamp, H. de Graaff and E. Sigar	A Multidimensional Analysis of Regional Infrastructure and Economic Development
1981-11	P. Nijkamp	International Conflict Analysis
1981-12	A.J. Mathot	L'Utilisation du Crédit lors de l'Achat d' une Voiture
1981-13	S.P. van Duin en P.A. Cornelis	Onderzoek naar levensomstandigheden en opvattingen over arbeid bij mensen zonder werk, deel I
1981-14	W. van Lierop and P. Nijkamp	Disaggregate Models of Choise in a Spatial Context
1981-15	Hidde P. Smit	The World Vehicle Market
1981-16	F.C. Palm	Structural Econometric Modeling and Time Series Analysis: An Integrated Approach
1981-17	F.C. Palm and Th.E. Nijman	Linear Regression Using Both Temporally Aggregated and Temporally Disaggregated Data
1981-18	F.C. Palm and J.M. Sneek	Some econometric Applications of the exact Distribution of the ratio of Two Quadratic Forms in Normal Variates
1981-19	P. Nijkamp and P. Rietveld	Soft Econometrics as a Tool for Regional Discrepancy Analysis
1981-20	H. Blommestein and P. Nijkamp	Soft Spatial Econometric Causality Models
1981-21	P. Nijkamp and P. Rietveld	Ordinal Econometrics in Regional and Urban Modeling
1981-22	F. Brouwer and P. Nijkamp	Categorical Spatial Data Analysis
1981-23	A. Kleinknecht	Prosperity, Crises and Innovation Patterns: Some more Observations on neo-Schumpeterian Hypotheses
1981-24	Hidde P. Smit	World Tire and Rubber Demand

1982-1	Peter Nijkamp	Long waves or catastrophes in Regional Development
1982-2	J.M. Sneek	Some Approximations to the Exact Distribution of Sample Autocorrelations for Autoregressive-moving Average Models
1982-3	F.E. Schippers	Empirisme en empirische toetsing in de wetenschapsfilosofie en in de ekonomische wetenschap
1982-4	Piet van Helsdingen maart 1982	Mantelprojekt 'Management & Politiek': Produktiebeleid en overheid; een onderzoek naar de invloed van de overheid op het produktbeleid in de verpakkingsmiddelenindustrie
1982-5	Peter Nijkamp Jaap Spronk	Integrated Policy Analysis by means of Interactive Learning Models
1982-6	Ruerd Ruben (ed.)	The Transition Strategy of Nicaragua
1982-7	H.W.M. Jansen mei 1982	Een alternatieve modellering van het gedrag van een besluitvormer: 'satisficing' i.p.v. 'maximizing'
1982-8 mei	J. Klaassen and H. Schreuder	Confidential revenue and Profit Forecasts by management and financial analysts: some first results
1982-9	F. Brouwer and P. Nijkamp	Multiple Rank Correlation Analysis