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**THE GEOGRAPHICAL DISTRIBUTION OF GENERAL PRACTITIONERS IN THE NETHER-
LANDS; AN EXPLANATION OF REGIONAL VARIATION**

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1. INTRODUCTION

Although the Netherlands is a small country there are considerable differences in the density of general practitioners, defined as the number of general practitioners per 10.000 of the population per region. These differences form the central theme of this article.

I have restricted myself to the geographical distribution of general practitioners. A restriction that would be difficult to defend in health care systems where general practitioners and other physicians, such as general internists, pediatricians and gynaecologists, operate in a competitive market. In the Netherlands, however, there is no parallel access to general practitioners and medical specialists; people can only consult with a medical specialist after referral by a general practitioner.

The question I pose in this article is: how can regional differences in the density of general practitioners be explained? Before I answer this question I will describe the regional disparities in general practitioner density to show that there is indeed something to explain (in section 2). In section 3 a theoretical model will be described to explain the regional differences, while in the next section the results will be given of an empirical analysis of the regional differences in general practitioner density at two points in time, 1969 and 1979. The closing section contains a discussion of the theoretical and empirical results of the analysis.

2. A DESCRIPTION OF THE GEOGRAPHICAL DISTRIBUTION OF GENERAL PRACTITIONERS

The density of general practitioners is defined as the number of general practitioners per 10.000 of the population. To describe and analyse the regional variation the Netherlands are divided in 181 regions, which amounts to circa 75.000 inhabitants. This low level of aggregation is in correspondence with the small scale of general practitioners services. The 181 regions are constructed on the criterion of socio-economic homogeneity, based on a standard division in 129 regions of the Central Bureau of Statistics.

For the Netherlands as a whole the number of general practitioners per 10.000 of the population amounts 3.40 in 1969 and 3.69 in 1979.

The geographical variation in density in 1979 and 1969 is depicted in map 1 and 2 respectively. For readers not acquainted with the geography of the Netherlands these maps are perhaps difficult to appraise. I will comment on a few things only. The southern part of the Netherlands - the provinces of Noord-Brabant and Limburg - have seen a marked increase in general practitioner density as can be concluded from a comparison of both maps. The low density in Twente and parts of rural Zuid-Holland has stayed the same. At the other side, in the northern provinces, the density of general practitioners is high in both years for which the density is mapped. The same can be said about the traditionally wealthy areas in the centre of the country and parts of the North Sea coast.

3. A THEORETICAL MODEL TO EXPLAIN THESE REGIONAL VARIATIONS

In the study of (aspects of) physician density two traditions may be distinguished (1), the ecological approach and the behavioral approach.

In the ecological tradition (2) differences in the size of the population of physicians are attributed to the process of environmental selection. In a stable situation regions have a certain carrying capacity, to which the number of physician tends. This tendency to an equilibrium state is influenced by certain characteristics of the regions such as the supply and concentration of resources and the stability and homogeneity of the environment (3).

In the individualistic or behavioral tradition one can place on the one side the empirical research in the reasons physicians state for their location choice (4), while on the other side research can be placed that starts from the theoretical model of micro-economics (rational choice theory) and supposes a priori that physicians try to maximize certain goals, such as income, through their practice location (5).

In the individualistic tradition the step from the behavior of physicians to the explanation of regional differences in physician density - which is after all a collective characteristic of regions - is more often than not implicit. This has led some authors to believe that the ecological and behavioral approach are incompatible (6). This

is not necessarily so.

To bridge the gap between the behavioral and the ecological approach, or in other words between the individual and the collective level, I propose a two step explanation of regional variation. The first step is the explanation of the choice of a practice location by application of rational choice theory. The second step - also called the transformation step (7) - has as a starting point the results of the first step: the prediction that one or more physicians will locate their practice in a certain area. To deduct differences in physicians density, apart from the definition of physician density, a number of conditions must be specified, such as the number of retiring physicians and differences in the size of the population of regions.

The explanation of location choice

Rational choice theory states that out of the possible behavioral alternatives in a given situation people will choose the alternative that gives the highest expected net utility. To apply this theory to the choice of practice location of general practitioners a number of assumptions and specifications must be made.

First, the goals (or utility arguments or maximants) of general practitioners relative to the choice of a practice location must be specified. I assume that the relevant goals are income, living in an attractive environment and professional contacts and that income is the most important of these (8). Secondly, the behavioral alternatives of general practitioners are to locate their practice in one region or in another.

Thirdly, the subjective probability of attaining the goals is identical with the actual possibilities to gain an income and to have professional contacts and the actual attractiveness of the environment. In the fourth place it is assumed that general practitioners do not differ in the value they place in these goals, or - which amounts to the same - that differences in valuation level out in the aggregate.

Given these assumptions the following hypothesis on the location choice of general practitioners can be formulated:

the greater the possibilities to gain an income in a certain region are and/or the greater the attractiveness of the environment is and/or

the greater the possibilities to have professional contacts are, the more general practitioners will locate their practice in that area. The next step in the explanation is to identify the characteristics of regions where the possibilities to attain these goals are greater.

Characteristics of regions favorable to goal-attainment

The possibilities to gain an income are determined by the institutional structure of the health care system that is studied. The income of general practitioners in the Netherlands is composed of the capitation fees for publicly insured patients (70% of the population), the fees for the services rendered to private patients (30% of the population) and other income sources. Of the other income sources I take into account income out of dispensing pharmaceutical prescriptives (a quarter to a fifth of the Dutch general practitioners mainly in rural areas have a dispensary), income out of home deliveries (some two fifths of the general practitioners mainly in rural areas where no midwife is available do home deliveries or policlinical deliveries) and income from patients who consult another general practitioner than the one on whose list they are (e.g. during holidays).

An important point for the comparison of the density of general practitioners in 1969 and 1979 is that in the late nineteen sixties the capitation fees for publicly insured patients were raised considerably. Therefore the relative importance of private patients for the income of general practitioners has diminished (in addition also the income security of capitation fees is higher than that of fees for services). It is hypothesized that as a result demand characteristics and the prosperity of the population of a region are less important for the income possibilities in 1979 than in 1969 (unlike the situation in the UK capitation fees are undifferentiated).

The effects of these institutional arrangements on regional differences to gain an income can be summarized as follows:

the possibilities to gain an income are greater in regions where:

- the prosperity of the population is higher (situation in 1969);
- the number of much care demanding patients (e.g. elderly) under the private patients is higher (situation in 1969);
- the number of publicly insured patients is higher (situation in

1979);

- the number of dispensing chemists and/or midwives is lower;
- the number of temporary (holiday) visitors is higher.

As far as the attractiveness of the environment is concerned, it is hypothesized that this is higher in regions with a higher level of provisions (schools, shops, culture), in regions with a greater area of woods and parks and a smaller industrial area.

It is more difficult to connect the possibilities to have professional contacts with regional characteristics. It seems to me that the most important characteristic would be the supply of post-graduate courses for general practitioners (and more important organized by general practitioners), but unfortunately there are no data at hand that allow for a regional differentiation. As a second best I have chosen the presence of a general hospital in a region. At the one side a lot of postgraduate education is centered in hospitals (clinical lessons), but on the other side hospitals are less important for general practitioners in the Dutch situation than in countries where general practitioners can dispose of hospital beds to treat their own patients. The last hypothesis on the possibilities to have professional contacts is that these are greater in regions where a greater number of members of the Dutch College of General Practitioners (Nederlands Huisartsen Genootschap) is located.

I have now formulated a number of hypotheses on the characteristics of regions favorable to goal-attainment. The number of general practitioners that choose to locate their practice in a more favorable region in this sense will be greater than the number of general practitioners that choose to locate in a less favorable region. The next step is to state the effects on physicians density.

The effects on physician density: the transformation rule

Thusfar an explanation is given of the choice of a practice location. This is the individualistic part of the explanation. The outcome of this - the greater number of general practitioners that choose a certain region as a location compared to other regions - has to be connected with differences in the density of general practitioners. The rule connecting the two phenomena is called the transformation rule (7). It runs as follows:

- given the explanation of location choice a greater number of general practitioners will have chosen region A in favor of a region B as their practice location
- if a greater number of general practitioners have chosen a region A in favor of a region B as their practice location, if the number of inhabitants of region A is less or equal to the number of inhabitants of region B, if the number of retiring general practitioners in region A is less or equal to that in region B and if general practitioner density is defined as the number of general practitioners per 10.000 inhabitants, then the density of general practitioners is higher in region A than in region B.

Of course there is a number of possible combinations of the initial conditions of the transformation rule that result in the same ordering of regions.

The explanation given here only takes into account differences between regions in the possibilities to attain the above distinguished goals. There are, however, circumstances that leads one to expect a greater or smaller number of general practitioners than would be expected on the basis of the possibilities of goal attainment alone. These circumstances may be formulated in a few conditioning hypotheses.

The first of these circumstances has to do with the influence of the distance of region to a medical school. The tendency to locate practice in the vicinity of medical school is known in the literature as the effect of 'prior exposure' (9). The hypothesis is: given the possibilities to attain the above distinguished goals, it applies that: if a region is closer to a medical school and if the number of graduates of this medical school is greater, then the number of general practitioners that will have chosen this region as a practice location will be greater than would be expected on the basis of the possibilities of goal-attainment.

The second of these circumstances has to do with the development of the population size in the decade before the year to which the analysis applies. It is hypothesized that population growth through migration surplus leads to a greater number of general practitioners than would be expected on the basis of the possibilities of goal-attainment (through anticipation by general practitioners who choose a location). Population growth through a birth surplus will lead to less

than the expected number of general practitioners. It is argued that population growth through birth surplus leads to a gradual increase in the list size of general practitioners and with some delay to the starting of partnerships with new general practitioners. Population decline will lead to a greater number of general practitioners than would be expected (through the inertia of already established general practitioners).

The third of these circumstances has to do with the organisation of already established general practitioners to prevent the entrance of new ones. When the remuneration of general practitioners has the character of a capitation fee, the total amount of money to be divided by the general practitioners is a constant (10). Each new establishment of a general practitioner lowers the mean income of all general practitioners in a region. It does not follow necessarily that the established general practitioners will organize to secure their collective good, but the probability that they will do is greater the smaller the number of general practitioners is in the regional branch of the Dutch Medical Association (11).

4. RESULTS

4.1. Data and Methods

To test some implications of this explanatory model, data have been gathered for a cross-section of 1969 and 1979. The chosen implications are on an aggregate level. First regression equations will be estimated with the density of general practitioners as the dependent variable and indicators of the possibilities to attain the above distinguished goals as the independent variables. In a second analysis the ratio of the actual general practitioner density and the expected density as computed on the basis of the regression equations of the first step will be the dependent variable, while indicators of the three conditions - distance to medical school weighted for the number of graduates, development of the population size and the size of the regional branch of the Dutch Medical Association - are the independent variables. The reasons why only aggregate implications will be tested are:

1. testing the theory of rational choice is more the task of psycholo-

- gy than of sociology or social geography;
2. testing the assumptions made on the individual level (e.g. those on the goals relevant to location choice or the valuation of these goals) are interesting scientifically, but less so from a policy point of view. Individual goals cannot be easily manipulated and are in principle no direct targets of policy in democratic/liberal society;
 3. the implications of the explanatory model concerning the relation between the possibilities to gain an income and general practitioner density relate to the institutional structure of the health care system, which is susceptible to policy manipulation.

The sources of the regional data used in the analysis are extensively described elsewhere (12). For reasons of space I refer the interested readers to these publications.

4.2. A cross-sectional analysis of regional variation in 1969 and 1979

To avoid problems with the interpretation of the regression results due to multicollinearity not all independent variables could be taken in the regression equations. Strong correlations exist between the prosperity of the population (mean income) and the percentage of the population that is publicly insured. For theoretical reasons the prosperity of the population has been chosen in the analysis of the situation in 1969 and the percentage publicly insured in the analysis of 1979.

Other strong correlations exist between the density of midwives and dispensing chemists (who are competitors for part of the income of general practitioners) and the level of provisions. Only the density of midwives has been chosen in the regression analysis.

The results for the situation in 1969 and in 1979 are given in tables 1 and 2 respectively.

In 1969 the density of general practitioners is greater in regions where:

- the mean income of the population is higher;
- the percentage of elderly people is higher;
- the density of midwives is lower;
- the industrial area is smaller.

These results are in concordance with the hypotheses, although the percentage of elderly people, as an indicator of demand, is strictly spoken not the ideal indicator because extra income may only be expected when the higher demand for general practitioners services is from private patients. There are, however, no regional data on the age structure of the private patients. Furthermore, the indicators of the possibilities to have professional contacts do not influence general practitioner density. This may be due to imperfect operationalization. The standardized regression coefficients show that the indicators for the possibilities to gain an income are most important (together they explain 44% of the variance).

In 1977 the density of general practitioners is greater in regions where:

- the percentage of publicly insured people is higher;
- the percentage of elderly people is higher;
- the density of midwives is lower;
- the percentage of members of the Dutch College of General Practitioners is lower.

As far as the possibilities to gain an income are concerned, these results are grosso modo in concordance with the hypotheses (13). The regression coefficient of the percentage of elderly is smaller than in 1969 which reflects the greater importance of capitation fees in 1979 and therefore the diminishing influence of demand characteristics. Nevertheless, it still has an important influence, that was not expected on the basis of the explanatory model. The attractiveness of the environment does not have any influence on general practitioner density in 1979. This may be caused by the increase in the number of graduates from medical school between 1969 and 1979 which may have influenced the relative importance of the goals relevant to location choice.

One of the indicators for the possibilities to have professional contacts has an influence on general practitioner density in 1979, but the sign of the coefficient is contrary to the hypothesized sign. This is due to the fact that the membership rate of the College of General Practitioners is lower for young (and therefore more recently settled) general practitioners.

All in all the results reflect the changing importance of the income

gained out of private and publicly insured patients.

On the basis of these regression equations the expected density of general practitioners is computed, given the possibilities of goal-attainment. The ratio of actual and expected density is used as the dependent variable in a regression analysis to test the three conditioning hypotheses. For the situation in 1969 these conditions do not influence the ratio of actual and expected density. For the situation in 1979 the correlations are somewhat stronger. A regression analysis was made with the independent variables size and kind of population growth during the decade 1969-1979, the size of the regional branch of the Dutch Medical Association and the change in the distance to medical school weighted for the number of graduates (this change is entirely due to an increase in the number of graduates). The regression results (not presented here) showed that the general practitioner density is higher than expected in regions where:

- population increase is greater;
- the size of the local branch of the Dutch Medical Association is greater
- the increase in the number of graduates is greater.

The kind of population growth - migration surplus or birth surplus - did not have the expected influence on the ratio of actual and expected density.

The fact that these conditions only have an influence in the situation in 1979, is probably due to the increased pressure on the market of general practices, caused by a greater number of aspirant general practitioners.

5. DISCUSSION

In this article I have presented a model to explain regional variations in the density of general practitioners. Its starting point is at the individual level: the location choices of general practitioners. These are connected with regional characteristics through hypotheses on the possibilities to attain certain goals, assumed to be relevant to the location choice, and with collective outcomes - differences in general practitioner density - through a transformation rule.

At least at a theoretical level this analysis shows that the two main research traditions in this field - the behavioral and the ecological tradition - are not necessarily incompatible.

The empirical analysis has been restricted to the aggregate level for different reasons. Therefore a lot of implications have remained untested.

The results on the aggregate level are promising. It may be concluded that the institutional structure of the health care system through the possibilities to gain an income influences the spatial distribution of general practitioners. In discussions on the system of remuneration of physicians and on the desirability of changes therein (e.g. differentiation of the capitation fee according to demand characteristics or a mixed system of a basic capitation fee with fees for certain services) these effects are generally not taken into account.

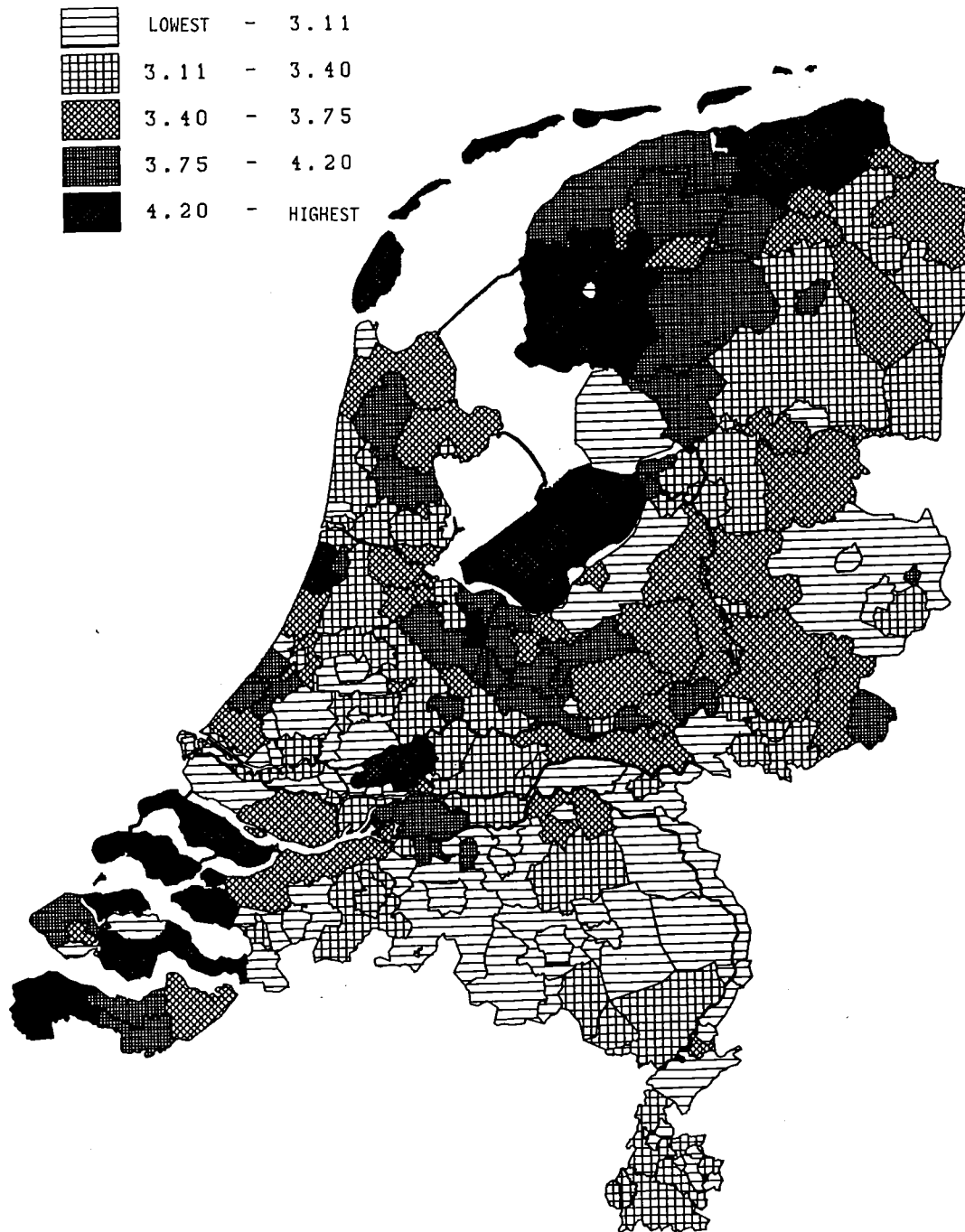
A result that is difficult to explain in the present model is the persisting influence of the percentage of elderly people in the population. In a health care system with undifferentiated capitation fees for general practitioners more elderly people in a region means more work for the same amount of money. In a rational choice theory of location this can only be explained by introducing ad hoc an 'ethical' utility argument that general practitioners will locate their practice where they are most needed. A possible solution is to incorporate it in the additional conditions that lead to a higher density than expected by assuming that longterm demographic processes of ageing of the population coincide with population decline and inertia at the side of already established general practitioners. The correlation at the regional and at the individual level between the percentage of elderly people and age of general practitioners supports this interpretation. Or is it simply the case that people grow older when they live in regions where there are a lot of general practitioners to take care of them?

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3. Rundall and McClain op. cit. have formulated a number of ecological hypotheses on physician density. Although they claim to explain differences in physician density with ecological hypotheses and criticise the use of individualistic hypotheses on the location choice of physicians, they implicitly use these hypotheses. See also P.P. Groenewegen, *Locatiekeuze en huisartsendichtheid; een verklaring van regionale verschillen en veranderingen*, NIVEL, Utrecht, 1985, pp. 35-41.
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6. Joseph and Phillips, op. cit. p. 63.
7. S. Lindenberg, *Individuelle Effekte, Kollektive Phänomene und das Problem der Transformation*, in K. Eichner & W. Habermehl (Hrsgs), *Probleme der Erklärung sozialen Verhaltens*, Hain, Meisenheim, 1977.

8. This specification is discussed more fully in Groenewegen op. cit. pp. 58-61.
9. There are different explanations for this effect. On the one side people are part of a network of medical doctors in which information on practice locations may disseminate; on the other side people may choose a certain medical school in view of their preferences for practice location. Compare for instance M.R. Haug, B. Lavin & N. Breslau, Practice location preferences at entry to medical school, in *Journal of Medical Education*, 55 (1980) 333-338. Data on the relation between practice location and place of medical school in the Netherlands are presented in Groenewegen, op. cit. pp. 148-156.
10. W. Kinston, The organization of doctors to serve whole populations given finite resources, in P. Svensson (ed.), *National health care systems in non-growth economies. Supplement 28, Scandinavian Journal of Social Medicine*.
11. Prevention of new establishment is possible by not doing deputy-services for a new general practitioner. For the size of the group as a boundary condition for the organization to secure collective goods, see M. Olson, *The logic of collective action; public goods and the theory of groups*, Harvard University Press, Cambridge, Mass., 1965.
12. Groenewegen, op. cit. and P.P. Groenewegen, *25 Jaren vestigingen van huisartsen, deel 2: regionale verschillen in huisartsendichtheid en veranderingen daarin*, NIVEL, Utrecht, 1985.
13. For the situation in 1979 I could also dispose of an indicator for the income possibilities out of patients who consult another general practitioner than the one on whose list they are, namely the area of a region used for holiday residences. This variable did not exert an influence on the density of general practitioners.

Map 1: Density of general practitioners (number of general practitioners per 10.000 inhabitants) in the Netherlands in 1969 (181 regions).



Map 2: Density of general practitioners (number of general practitioners per 10.000 inhabitants) in the Netherlands in 1979 (181 regions).

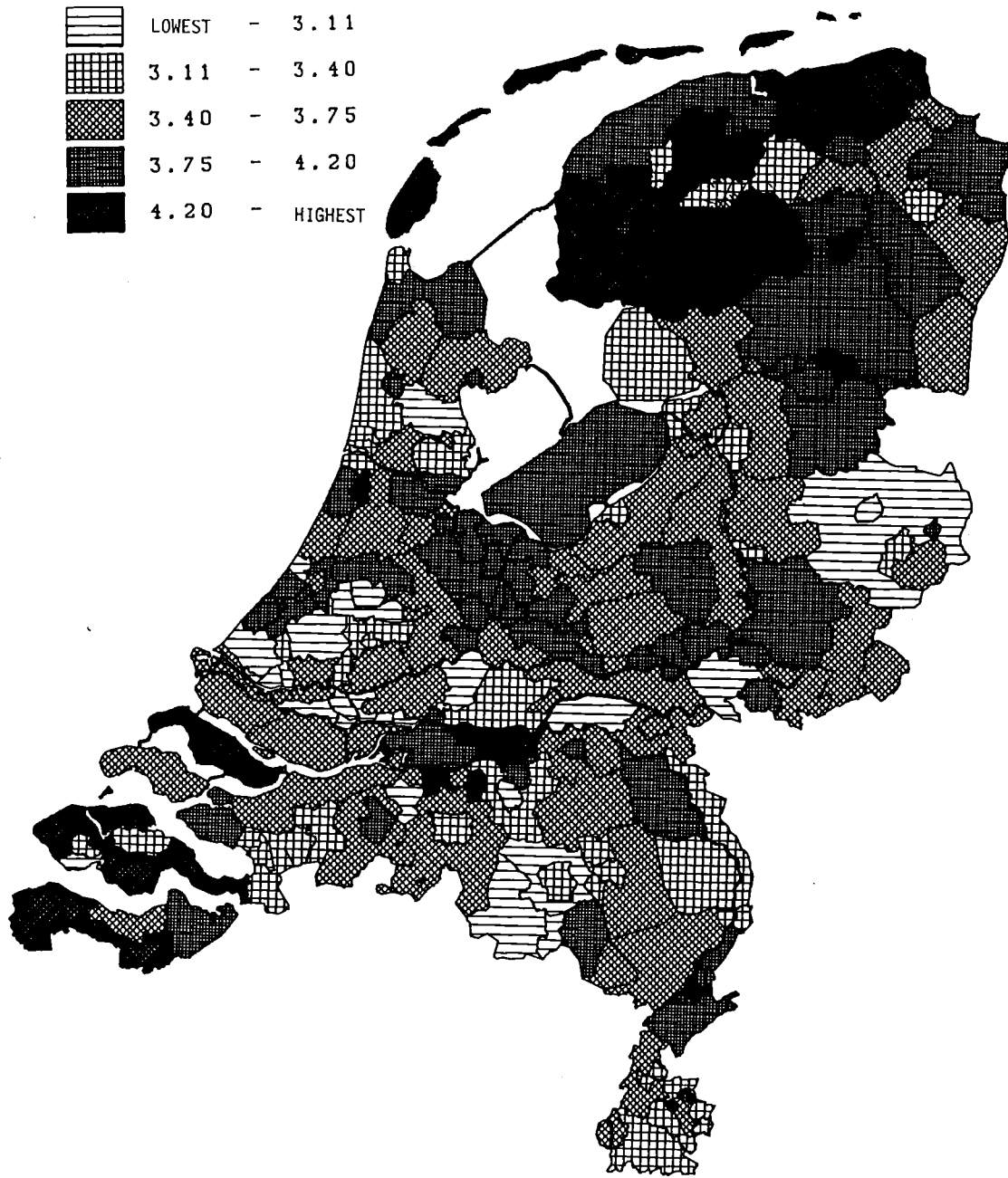


Table 1: Regression analysis (ordinary least squares) of the density of general practitioners in the Netherlands in 1969 (N = 181).

Independent variables	B-coefficient	Bêta	T-value*
Possibilities to gain an income			
mean income of the population	.48*10 ⁻⁴	.146	<u>2.45</u>
percentage of elderly in the population	.11	.508	<u>8.88</u>
density of midwives	-.11	-.207	<u>-2.85</u>
Attractiveness of the environment			
area wood	.0082	.016	.82
area industry	-.11	-.268	<u>-3.37</u>
Possibilities to have professional contacts			
percentage members of the Dutch College of General Practitioners	-.46*10 ⁻³	-.011	-.26
presence of a general hospital	-.017	-.011	-.24
R ²	.47		

* underlined T-values are significant at p .05

Table 2: Regression analysis (ordinary least squares) of the density of general practitioners in the Netherlands in 1979 (N = 181).

Independent variables	B-coefficient	Bèta	T-value*
Possibilities to gain an income			
percentage of publicly insured	.020	.150	<u>2.34</u>
percentage of elderly in the population	.059	.340	<u>4.68</u>
density of midwives	-.16	-.364	<u>-4.00</u>
Attractiveness of the environment			
area wood	.007	.041	<u>.23</u>
area industry	-.01	-.032	<u>-.32</u>
Possibilities to have professional contacts			
percentage members of the Dutch College of General Practitioners	-.006	-.178	<u>-2.78</u>
presence of a general hospital	.05	.050	.65
R ²	.27		

* underlined T-values are significant at p .05