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1. INTRODUCTION

In an earlier study Groenewegen & Van der Zee (1985 a,b,c, 1987, 1988) performed an analysis of regional variation in hospital admission rates in Belgium and the Netherlands on 1974 and 1979 data.

Three important conclusions were:

- analysis of regional variation is a suitable tool for the international comparison of health care systems, usually hampered by the relatively few numbers of units of analysis (Groenewegen and Van der Zee, 1988).
- in the model used, the number of hospital beds per 1000 population is the only variable that influences admission rates in both countries in both years.
- age standardized death rates (used as a rough indicator for the health status of the population) also had a significant and independent influence on the admission rates, one year in one country excepted.

In the model constructed both above mentioned variables were considered as 'universal' elements while the rest of variables were classified as 'system-specific'.

As the method chosen proved to be suitable for comparative analysis of health care systems, research activities were extended in the following direction.

- regional extension of the study to the North of France with data for 1982.
- new data for Belgium and the Netherlands for 1982.
- extension of the variables in the model; inclusion of the available number of long-term hospital beds in the region.

This paper contains a report of an attempt to include (the north of) France in our study. It is a working document rather than a complete report. It contains:

a. a short summary of the previous study (section 2)
b. a description of the French health care system and of the most striking differences and resemblances between the health care systems of France, Belgium and the Netherlands (section 3)
c. an account of the variables and the choice of the units of analysis and the first descriptive results (section 4)

This document is for reference purpose only, the final results of the study will be published in articles.

Data collection in France was carried out by CRESGE (Centre de Recherches Economiques, Sociologiques et de Gestion). Michel Verhasselt did the pioneering job of data collection, supervised by mrs. Therese Lebrun (head of the research department) and professor Jean Claude Sailly.
As usual, the vital part of the Belgian data were obtained from the Service d'Etudes socio-économiques de la Santé of the Catholic University of Louvain (by Xavier Leroy and professor Dénise Deliège-Rott). (Leroy, 1987).
For the Netherlands data collection was organized by ourselves. We are obliged for their cooperation to:
- The Central Bureau of Statistics
- National Hospital Institute
- Chief Medical Office
- Association of Sick Funds

1.1. Short summary of the previous studies to explain regional variation in hospital admission rates in Belgium and the Netherlands

Groenewegen & Van der Zee published in 1985 their first report with data for 1974. It was an exercise inspired by a publication by Xavier Leroy, who collected regional data for Belgium as part of the Belgian National Social Science research programme (Leroy 1978, 1981,a,b). Belgian data for 1979 were published in Leroy, 1983.
From the Canadian economist Robert Evans the authors derived a framework for the analysis of health care systems (Evans, 1981) in general.
Evans distinguishes between **1) consumers of health care,** 2) **first-line** (that is directly accessible) and **3) second line health care** providers, **4) health care insurers** and **5) the government** as five major actors in the health care domain. Government and insurers provide the conditions under which health care consumers and providers perform their transactions.
With Evans' five 'actors' a good descriptive analysis of health care systems is possible.
Such a descriptive analysis is still far from constructing a causal model suitable for the analysis of regional variation in hospital admissions rates.
Therefore the authors divided the independent variables in this

model into two categories:
Universal variables that (are supposed to) exert their influence irrespective of the specific conditions of the health care system.
Specific variables that, as the term indicates, are either universal in appearance but derive their meaning from specific conditions (like the specialists/population rates that mean a different thing in a system where specialists are directly accessible or by referral only) or are specific in appearance too (like the proportion of privately insured persons in the Netherlands; they do not exist apart from Dutch health care system). The universal variables were included in a model valid for all regions; residual regression analysis per country took place to estimate the explanatory power of the specific variables. The results are summarized in tables 1.1 and 1.2.

Table 1.1.: Summary table of the results of a general model to explain regional variations in hospital admission rates for the Netherlands and Belgium (data from 1974 and 1979; generalized least-squares regression analysis). Presented are B-coefficients (T-value)*.

	1974		1979	
	Belgium	Netherlands	Belgium	Netherlands
- Age adjusted death rates	5.46 (1.92)	5.79 (1.98)	14.74 (3.76)	1.552 (0.40)
- Population over 65 years	-0.85 (-0.76)	0.15 (0.18)	-1.37 (-1.14)	-0.62 (-0.54)
- Income of population (Z-scores)	-4.69 (-2.08)	-0.81 (-0.58)	-2.95 (-0.11)	-0.12 (-0.10)
- Population density x .001	0.40 2.67	-0.01 (-0.10)	0.830 (4.25)	-0.218 (-1.07)
- Hospital beds per 0/00	4.23 (3.56)	12.47 (4.58)	6.81 (3.30)	8.82 (3.02)
Length of stay per admission	-1.38 (-0.94)	(-2.21) (-1.81)	0.32 (0.10)	-1.55 (0.81)
R^2	.32	.44	.53	.42
Nr of regions	43	42	43	42

* ___: $p \leq .05$

The only variable that exerts it's influence in both years and both countries is the relative number of hospital beds. Age-adjusted death rates are significant in 3 out of 4 cases, the Netherlands in 1979 being an exception.
Population density is a significant predictor in Belgium only. There are more admissions in urban areas.
The number of available hospital beds and the age-adjusted death rates were taken as universal variables in the general model; residuals were calculated after the influence of these variables had been eliminated.
The following variables were chosen as 'specific' for each health care system: in fact there are two subsets of variables (as has been stated) a set of variables that are present in both countries but have a different meaning and a set of 'unique' variables. They are presented in table 1.2, together with the reason of inclusion (an elaborate account of this inclusion can be found in Groenewegen & Van der Zee, 1986, 1987, 1988) and a rough indication of their influence on the residual admission rates.

Table 1.2.: Summary of expectations* and (roughly indicated) results of the regression of factors that represent unique features of the Belgian and Dutch health care systems on residual admission rates.

	expected value	observed value 1974	observed value 1979
Belgium			
-non-actives (have higher reimbursement rates for health care costs)	0	0	0
-% special health insurance scheme (non-wage earners; usually hospital costs insurance only)	-	0	0
-percentage hospital beds owned by health insurance funds (vertical integration of health care financers)	-	0	0
-birth rate (all deliveries in hospitals)	+	+	0
-ratio primary medical providers (general practitioners, gynaecologists, paediatricians, internists)/other medical specialists	-	-	-
The Netherlands			
-% publicly insured	0	0	0
-birth rate	0	0	0
-ratio primary medical care providers/ other specialists	?	0	0
-ratio general practitioners/medical specialists	0	0	0

* +: positive effect
-: negative effect
0: no effect

For Belgium and the Netherlands we had included the variable proportion of the population that receives either complete (the Netherlands) or almost complete (Belgium) reimbursement for health care costs. Various research reports (see Mootz 1984, 1985) and

Vuylsteek and others, 1985) gave rise to the expectation that after the inclusion of an indication of the health status of the population the insurance-variables would show no effect (as indeed, proved to be the case).
For Belgium, the ratio of primary medical care providers (general practitioners, gynaecologists, paediatricians and internists) versus other specialists seems to influence the admission rates negatively. For the Netherlands this ratio is too heterogeneous; general practitioners are directly accessible; medical specialists are not.
For the Netherlands the ratio general practitioners/medical specialists showed no relationship with admission rates. Although (theoretically) a similar result as in Belgium would be found, former empirical studies in the Netherlands gave no indication for an expected negative relationship between the g.p./specialists ratio and admission coefficients.
For Belgium the expected relation between birth rate (all clinical deliveries) and admission rates was found in 1974 but not in 1979. It is not clear why.

1.2. Conclusion

As has been pointed out in Van der Zee & Groenewegen (1987), both countries have strong reasons to continue or even intensify their hospital bed reduction schemes. The other results are more ambiguous, all be it that a relatively strong numerical position of primary medical care providers versus other medical specialists seems to form in Belgium a certain counterbalance against the influence of the hospital based specialists.
Another conclusion is methodological in character. It is possible to analyse differences between health care systems by means of studying regional variation in (in this case) hospital admission rates.
The number of regions per system (approximately 40) however, limits the opportunity to analyse factors, specific for each health care system; the character of the 'confirmed' and 'refuted' expectations is a bit arbitrary (Groenewegen & Van der Zee, 1988).
Further extension of the model by inclusion of other relevant factors and other health care systems seems to be promising. In chapters 3 and 4 an extension of former analyses will be described.

2. GENERAL CHARACTERISTICS OF THE BELGIAN, DUTCH AND FRENCH HEALTH CARE SYSTEMS

In this section we will describe the general characteristics of the French, Belgian and Dutch health care system as far as they are relevant for our study.
An elaborate description of the Dutch and Belgian health care systems can be found in Groenewegen & Van der Zee (1985): France is new here and we will focus on the differences between France and Belgium.
The French and the Belgian health care systems have much more in common than a border, but there are differences though.
For our study the situation in 1980-1982 is relevant (our data refer to 1982). Major changes since 1979 are briefly indicated. In this section we present general information for the countries as a whole; for the Netherlands and Belgium this coincides with the areas included for analysis; for France however it does not, only the north of France forms part of our study. If possible we will present information for France as a whole and the north of France separately.
The structure of our presentation has (as in our previous study) been derived from Evans; the first subsection is about characteristics of **consumers** of health care - the health status of the population; the second about **providers** of care and the third about **financial and legal conditions** that form the backbone of a health care system. Data for this section were generally derived from the OECD-publication Measuring Health Care (1985).

2.1. Consumers

In our previous study we chose the following (indirect) indicators of the health status of a population:
- Life expectancy;
- infant mortality rates;
- (age standardized) death rates;
- demographic composition;
- life style indicators (smoking habits, alcohol consumption).

2.1.1. Life expectancy

Table 2.1 shows the life expectancy figures for all countries.

Table 2.1.a: Life expectancy figures for Belgium, The Netherlands and France (1970/1980)

Life expectancy	Belgium				The Netherlands				France			
	M		F		M		F		M		F	
	'70	'80	'70	'80	'70	'80	'70	'80	'70	'80	'70	'80
al birth	67.8	69.8	74.2	75.5	70.9	72.5	76.6	79.2	69.1	70.1	76.7	78.3
at age 40	31.7	32.0	36.9	37.5	33.7	34.7	38.7	40.7	32.7	33.2	39.1	40.2
at age 60	15.3	15.5	19.2	20.0	16.9	17.5	20.7	22.7	16.6	17.2	21.4	22.3

Source: OECD Measuring Health Care 1960-1983; 1985 table F.1

Table 2.1.b.: Life expectancy figures, Index-rates

	Index (Belgium, 1970 = 100)							
	France				The Netherlands			
	M		F		M		F	
	'70	'80	'70	'80	'70	'80	'70	'80
at birth	102	100	103	104	105	104	103	105
at age 40	103	104	106	107	106	108	105	109
at age 60	109	111	109	112	111	113	108	114

Source: OECD Measuring Health Care 1960-1983; 1985 table F.1

The Dutch figures are slightly better than the French and Belgian, respectively. For all countries life expectancy increased between 1970-1980; differences between males and females remain more or less stable.

2.1.2. Mortality

In table 2.2 both infant mortality rates and general mortality rates are presented, as they are important indicators of the health status of a population.

Table 2.2.a.: Infant mortality rates in the Netherlands, Belgium and France (1970/1982)

Infant mortality per 1000 live births	Belgium	The Netherlands	France	Index (Belgium, 1970 = 100)		
				B	F	NL
1970	21.1	12.7	18.2	100	86	60
1982	11.7	8.3	9.3	55	44	39

Table 2.2.b.: Crude and age-standardized mortality rates in The Netherlands, Belgium and France

Crude/age adjusted[1] death rates per 1,000 population	Crude death rates			Standardized death rates		
	Belgium	The Netherlands	France	Belgium	The Netherlands	France
1970	12.3	8.4	10.6	10.87	8.99	-.--
1980	11.3	8.2	9.9	9.19	7.85	8.25

1 In this case, a standard population has been constructed for each country separately. Ideally one has to construct one standard population by averaging the proportional division of age/sex categories in all three countries.

Table 2.2.c.: Age-standardized mortality rates: index-rates

	Index (Belgium, 1970 = 100)		
	Bel-gium	The Netherlands-	France
1970	100	83	--
1980	85	72	76

Source: OECD Measuring Health Care 1960-1983; 1985 table F.14
OECD Financing and Delivering Health Care; 1987 table 15
EUROSTAT, Yearbook of Regional Statistics, 1983
Belgium and the Netherlands: 1984; France : 1983; N.France: 1982

As with the life expectancy figures, these data indicate a 'better' health status for the Dutch population as compared to the French and Belgian population (in this order).
The downward trend is obvious for all countries; both in France and Belgium infant mortality rates almost halved.

2.1.3. Demographic composition

Table 2.3.: Age/sex distribution of the Dutch, Belgian and French population (1974/1982)

	Belgium				the Netherlands				France		
	M		F		M		F		M	F	M+F
	74	82	74	82	74	82	74	82	80		82
0-14	23.4	21.0	21.4	19.1	26.3	22.2	24.9	20.8	23.4	21.4	22.0
15-45	42.9	44.6	39.8	41.1	45.3	48.5	42.4	45.3	44.7	40.9	
45-64	22.2	22.7	22.6	22.8	19.2	19.6	20.4	19.9	20.7	20.9	64.4
65	11.4	11.6	16.2	17.0	9.2	9.7	12.3	13.9	11.2	16.8	13.5

Sources: Belgium: Regionaal Statistisch Jaarboek 1983 (National Institute of Statistics)
The Netherlands: Statistisch Jaarboek 1982 (Central Bureau of Statistics)
France: Institut National de la Statistique et des Etudes Economiques (INSEE) (National Institute of Statistics and Economy studies)
Eurostat, yearbook of Regional Statistics, 1983
Eurostat, Review 1975-1984

The Belgian population has the highest proportion of elderly, followed by the French. The Dutch population still is relatively young.

2.1.4. Life style

Data about health threatening habits are not easy to obtain. Two well known risks are smoking and the consumption of alcohol. The most widely used indicator for these health threatening habits consist of consumption statistics. For the sake of comparability we will only present the figures in the OECD publication, Measuring Health Care 1960-1983; 1985 (table 7, 8 and 12, 13).

Table 2.4.a.: Alcohol and tobacco consumption in the Netherlands, Belgium and France (1982)

	Belgium	The Netherlands	France	Index (B=100)	
				F	NL
Alcohol (estimated total alcohol consumption per head of population in litres of 100%)	11.1	8.7	15.5	140	78
Tobacco (consumption per person aged 15 years and over in grammes)	3726	3508[1]	2247	60	94
Alcohol and Tobacco consumption (0/00 GDP)	3.3	2.3	2.0	61	70

[1] 1979

Table 2.4.b.: Liver Cirrhosis and malignant Trachea-, Broncho- and Lung-neoplasm mortality trend in the Netherlands, Belgium and France (1982)

	Belgium[1]		The Netherlands		France		Index (B=100) F		NL	
	F	M	F	M	F	M	F	M	F	M
liver cirrhosis (death rate 0/000)	10.2	16.8	3.8	7.1	15.3	38.0	150	226	37	42
T-B-L-neoplasm (death rate 0/000)	10.5	112.8	10.5	101.4	7.7	60.1	73	53	100	90

[1] 1980

The French drinking habits seem to have their price. The alcohol related death rates are above the Dutch and Belgian rates. Belgium takes a second place.
As with smoking, the figures show the highest rates for Belgium, followed at a small distance by the Netherlands.

Summary
For most of the mentioned health status indicators the Belgian figures are worse than the French and Dutch figures respectively (crude death rates, life expectancy, infant mortality). The Belgian population is also older than the French and Dutch population. As for the health treatening habits, the Belgian drink more than the Dutch, but not nearly as much as the French. Therefore one can expect a greater need for health care in Belgium. From the limited set of data available for the north of France we may conclude that the health status of the population in this part of France is worse than the average.

2.2. Providers of health care

Providers of health care can be classified according to the degree of accessibility. The concept of first line care is usually

defined as directly accessible, ambulatory and generalistic whereas providers that can only be consulted after a referral by a (primary) health care provider can be considered as second line providers. To this respect there are considerable differences between the Netherlands on the one hand and Belgium and France on the other. The most striking difference has to do with the accessibility of medical specialists.
In France and Belgium all ambulatory specialistic medical care is directly accessible. In the Netherlands on the other hand patients have to see a general practitioner before they can consult a specialist.
Hospital services, the services of supporting medical specialists (such as radiologists and pathologists) are in all countries only accessible after referral. Table 2.5 shows the figures for all three countries.

In general there are more physicians in Belgium than in France and the Netherlands. This applies both to general practitioners and medical specialists. Compared to France as a whole, the North of France has a relatively low doctor density. There is a striking contrast between the high density rates in the south of France and the low figures in the North (see Adréané a.o., 1987).
There is also a striking difference in the relative number of pharmacies. The Belgian pharmaceutical density is extremely high, not only compared to the Netherlands (which used to have one of the lowest rates in the world for this profession) but also compared to France. However, the low Dutch rates do not imply that large areas of the country are without pharmaceutical provisions. Especially in the country side, general practitioners often provide this service (in 1983 18,2% of all Dutch GP's had a small dispensary).
Another difference is related to the relative number of geriatric (longstay)beds. In the Netherlands there are 2.63 times more longstay beds as in Belgium, calculated per 10.000 inhabitants and 3.2 times as many if calculated per 10.000 inhabitants of 65 years and older.
The French figures are comparable with the Dutch. For our analyses, the differences in the number of physicians and the number of geriatric beds are important; the difference in the pharmaceutical density is less relevant in this respect. Belgium has the highest doctors density but relatively few longterm hospital beds. In the Netherlands it is the other way around. The

Table 2.5.: Number of health care providers and hospital beds in the Netherlands, Belgium and (Northern) France (rate 0/000) in 1982

	Belgium		The Netherlands		France		N.-France	
	number	rate	number	rate	number	rate	number	rate
GP	9.097	9,22	5.492	3,83	46.606	8,58	6.607	7,20
All specialists	10.147	10,29	9.813	6,84	45.085	8,30	5.311	5,79
Common specialists[1]	2.926	2,97	2.628	1,83			932	1,02
Supporting specialists	2.107	2,14	1.951	1,36			1.143	1,24
Other specialists	5.114	5,19	5.234	3,65			3.236	3,52
Pharmacists	10.177	10,32	1.601	1,12	21.263	3,93		
Dentists	5.132	5,21	5,781	4,03	28.924	5,32		
Acute medical and surgical beds	54.749	55,54	64.076	44,69	214.497[2]	40,09	51.496	56,15
Longterm (geriatric)	12.449	12,63	47.647	33,23	182.423[3]	32,50	32.598	35,54
idem per 10.000 inh. over 65 years		87,96		282,25				296,67

1 Gynaecologists, paediatricians, internists
2 1980 ('short-stay' beds)
3 1984 (only 'medical beds')

Sources:

Belgium:

- X. Leroy. 'L'access aux soins medicaux.' Tome IV 1987, table 83, 86-88
- Regionaal Statistisch Jaarboek 1983. National Institute of Statistics table l.c. (Regional Statistical Yearbook, 1983)
- Ministry of Public Health - First and principal statistical results of the inquiry into institutions for health care. 1.1.82 (premiers et principaux resultats statistiques de l'enquete dans les établissements de soins)

The Netherlands:

- Statistisch Zakboek 1984. Central Bureau of Statistics, table 18
- NZI-medische specialisten in Nederland 1977-1983, table 9 (NZI-medical specialists in the Netherlands, 1977-1983)
- NZI-instellingen voor intramurale gezondheidszorg per 1-1-82 (NZI-institutions for in-patients care, basic data 1.1.82)

France:

- Ministère des affaires sociales et de la solidarité nationale. Santé Sécurité Sociale. Statistiques et commentaires, no. 6 - 1983
- Centre de Recherches Economiques Sociologiques et de Gestion (CRESGE).

north of France counts less specialists than Belgium or the Netherlands, while its GP density is halfway between Belgium and Holland. Compared to France as a whole, the north of France has more shortterm hospital beds (here the Netherlands has the lowest number while Belgium follows the north of France).

2.3. Insurance

This section is mainly devoted to health care insurance in France, the relevant features of the Dutch and Belgian situation will be mentioned briefly. More details can be found in Groenewegen en Van der Zee (1985). The situation described refers to 1980/1982. Major changes since that date will be indicated in shorthand.

2.3.1. The Netherlands

Dutch patients are insured against the costs of illness in the following ways:

a. Compulsory public insurance for all employees with an income below a certain level (per 1-1-1980: Hfl. 40.250).
b. Voluntary insurance for non-wage earners under a certain income level (self employed and those receiving general assistance).
c. Private insurance for all above the in a. mentioned income level.

Beside these insurance schemes the Exceptional Medical Expenses Act (AWBZ) covers exceptional financial risks since 1976 (e.g. a stay of more than one year in a hospital). This Act covers the exceptional medical cost of the whole population. Premiums are paid by the employers.

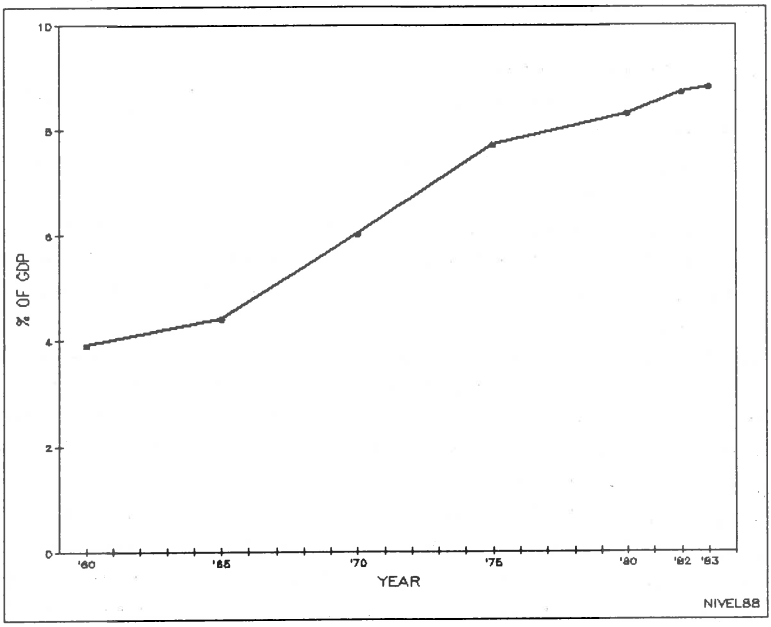
About two third of the population is covered by the public health insurance funds and one third is privately insured. The financing of the public health insurance funds is mainly based upon the (equal) contributions of employers and employees (about 86%). Governmental subsidies cover about 13% of the costs. In 1986 the AWBZ was financed as follows:

86.6% by premiums
2.7% by governmental grants
10.3% by private contributions
0.4% by other sources of income (De Klein and Collaris, 1987).

The share of health expenditures on the National expenditures is relatively high, as compared to other EC-countries (8,7% of the GDP) (OECD, 1985; see fig. 2.1). The Dutch have the third position in Europe preceded by the Sweden and the French only.

Since 1985 the above mentioned voluntary public health insurance has been abolished; approximately half of the voluntarily insured population (especially those who receive some kind of public benefits) moved over to the compulsory scheme; the other half to private insurance. The proportion of publicly insured dropped to 62%. The private health insurance contains a wealth of insurance arrangements. The most important varieties are: GP-services included or excluded possibly combined with a low or high (voluntary) copayment rate.

Figure 2.1.: Percentage of total expenditure on Health in GDP the Netherlands from 1960 to 1983



In 1986 the total medical consumption was financed as follows:
43% by the public health insurance schemes
27,6% by the AWBZ
27,0% by private contributions and private insurance funds
4,4% by governmental grants
1,0% by other sources of income (De Klein and Collaris, 1987).

The type of insurance can influence the medical consumption. Under

the public insurance scheme, there were (until recently) no financial transactions between consumers and providers; all services are delivered in kind. Privately insured patients however, have to pay first and get a reimbursement afterwards, according to their insurance conditions.
The public sick fund insurance contains, among other things, free hospital care (up to a maximum of one year), dental care, GP-services, ambulatory obstetric care, paramedical care, co-payment for pharmaceuticals and maternity care. The AWBZ covers exceptional costs (hospital treatment after one year, treatment in nursing homes, homes for the mentally retarded from the first day) and private insurance companies offer variable benefits (privately insured patients can choose various rates of co-payment).
There is a proportional contribution for the costs of home-helps.

Remuneration
The GP is remunerated by means of a capitation fee for his publicly insured patients, and on a fee-for-service basis for his 'private' patients. A GP generally practices his profession as an independent contractor.
The medical specialists practice usually in close partnership with hospitals (with the exception of opthalmologists and independent psychiatrists) but, as a rule, are not employed by the hospital. This close connection implies extended out-patient departments in hospitals, narrowing the gap between the every day world and the hospital.
The health insurance funds, as administrators, are not directly involved in the ownership or management of health care facilities, contrary to the Belgian and French insurance funds as we shall see. Medical specialists are not directly accessible, but only after a referral by a GP.

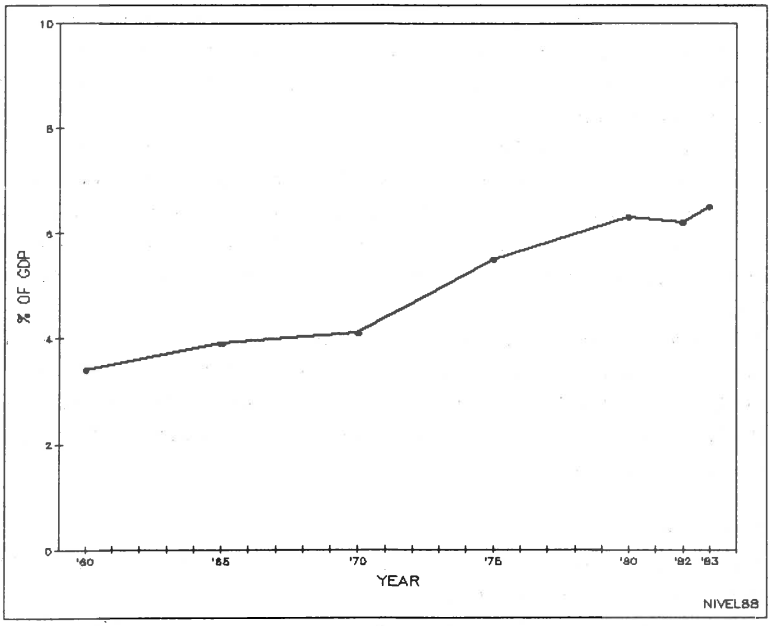
2.3.2. Belgium
The Belgian health care system differs in many respects from the Dutch health care system.
There are two public insurance schemes, which cover 99% of the population.
a. A general scheme, for all wage-earners and their dependents and pensioners, covering all medical costs (apart from co-payment, several prosthetic appliances are not covered).

b. A special scheme for non-wage-earners (mostly self-employed persons; 1/6 of the population), covering only substantial medical costs such as hospital stay. This can be supplemented with a voluntary insurance.

A second subdivision is between the so called 'active' and 'non-active' part of the population. 'Non-actives' (WIGW - widows, disabled, old age pensioners and orphans) have lower copayment rates or even receive care free of charge, if their income is below a fixed level

The financing of the insurance schemes is mainly based upon the contributions of employers and employees (60%) and state interventions (40%) (De Klein and Collaris, 1987).

Figure 2.2.: Percentage of total expenditure on Health in GDP Belgium from 1960 to 1983



The share of health expenditures on the National expenditures is strikingly low; 6,5% of the G.D.P. (in 1983) (OECD, 1985) (see also figure 2.2), comparable with highly organized health care systems like the British. Possibly the low degree of institutionalization (Philipsen, 1985) of the Belgian health care system in addition to a high density of personal health care

providers, has a moderating influence on health care expenditures. One might put a questionmark (as Heesters and Kesenne did in 1985) to the calculation of health care costs. Their estimate is 7.53% for Belgium and 8.26% for the Netherlands (Heesters & Kesenne, 1985). In 1980 total medical expenditure was financed as follows:
57% by the health insurance schemes
25% by direct governmental grants
18% by private contributions and voluntary supplementary insurances (De Klein and Collaris, 1987).

There is a system of fee for service and co-payment for ambulatory care. For specialistic in-patient care, fees are usually paid directly to the provider. The money is then reimbursed by the local branch of the insurance funds. The bills for hospital admissions are usually paid directly by the health insurance funds. The co-payment is charged directly to the patient.
The co-payment ('ticket modérateur') is initiated to prevent excessive demand of services.

The major co-payments are:
- a personal 25% contribution towards the costs of consultation of GP's and specialists, dental care, and for ambulatory care. 40% contribution towards the costs of physiotherapy.
- a personal 0, 25, 50 or 100% contribution for the costs of drugs (dependable on the type of drug; the division is based upon the so-called social and therapeutical value of the pharmaceutical).
- a charge for hospital care (for the WIGW's and 'non-actives' smaller than for other patients) (De Klein and Collaris, 1987).

Another feature of the Belgian health care system is the existence of rather socially active public insurance funds. They can own out-patient clinics, pharmacies, institutions for social work and hospitals.

The medical specialists in Belgium are directly accessible, without intermediation of the general practitioner. They are also less dependent on the hospital, because they have the choice of working in private surgeries, and independent out-patient clinics (unconnected to a hospital).

2.3.3. France

France, as compared to other E.C.-countries, was relatively slow to start a sort of **insurance** against the cost of medical care. Not until 1928 any initiative was taken in organizing limited coverage for the very poor. In 1945, all wage earners were included and the coverage was further extended in 1967 to cover 70% of the population under a general scheme of insurance.
There is no uniformity, so that patients contributions vary according to the category of worker (industrial, commercial and agricultural) and the degree of illness or the risk involved.

Patients can be insured in the following way:

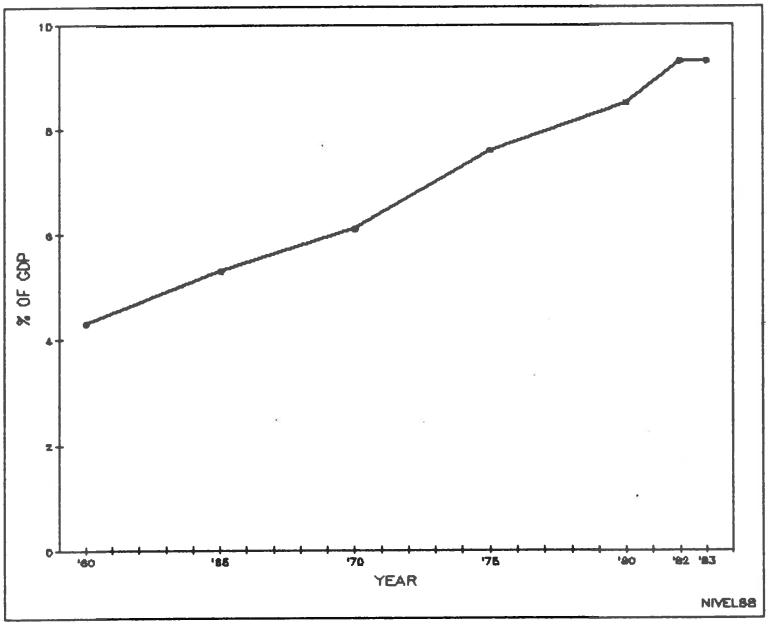
a. Compulsory insurance through the general scheme ('régime général'), including all employees, pensioners, unemployed persons and their dependents. In 1982, 80% of the population is covered by the general scheme.
b. Special schemes for agricultural workers, miners, seamen, civil servants and railway employees.
c. Mutual societies (private insurance) by which many people supplement their insurance. There are two types of private insurance companies; those which are aimed at profit making and the non-profit companies or the so-called mutualities. About 58% of the population is (supplementary) insured by the private mutualities. The mutualities have two important functions: in the first place they re-insure the copayments and in the second place they provide a supplementary insurance for those risks which are not covered by the public insurance.
d. Social aid programmes financed by the central and local government. These support about 1% of the population, enabling them to have completely free medical care.

The **financing** of the sickness insurance (the general scheme) is mainly based upon the contributions of employers and employees. The share paid by the employer is larger. In 1982 the sickness insurance schemes are financed as follows (First, 1985):

92.9% by contributions from employers and employees (resp. 68.2% and 24.7%)
0.5% by special taxes
3.5% by governmental subsidies
2.0% by transfers
1.6% by other resources

The share of the state is relatively small but has more than doubled between 1980 and 1983. The share of health **expenditure** in National expenditure in France is relatively high, as compared to other European countries (in 1982 9,3% of the G.D.P.; only Sweden had a higher percentage) (see also figure 2.3). The absolute expenditures on health care in 1983 is nearly thirty times as high as in 1960 (OECD, 1985).

Figure 2.3.: Percentage of total expenditure on Health in GDP France from 1960 to 1983



The total expenditure increased by 9% in 1978 and by an average of 16.4% in 1979-1980. The following two years were characterized by a more rapid increase of 17.7% and 18.4% respectively.
In 1982 health (care) expenditures were financed as follows (First,1985):
72% by the social health insurance schemes
6% by the state and the local governments
22% by direct private payments or private mutualities.

The French medical **benefits** contain (para)medical services, dental services, the cost of drugs and the cost of hospital services. The insurance system is based upon the reinbursement principle; the patients pay directly and then claim a refund. There are however exceptions to this rule. The cost of (public) hospital treatment is paid directly by the insurance funds. Reimbursement varies according to the type of care received.
The amount of **co-payment** (the so-called 'ticket modérateur') is set by the government. In 1986, medical costs are reimbursed as follows (De Klein and Collaris, 1987):

- 75% of the agreed tariff of fees of general practitioners and dentists;
- 65% of the cost of paramedical treatment;
- 100%, 70% or 40% of the costs of drugs (depends on the type of pharmaceutical);
- 80% of the cost of hospital treatment (based upon the agreed 'hospital day price'). In general, the patient must pay 20% of all hospital cost up to 30 days in-patient treatment. Thereafter all payments are waived;
- 65% of the cost of tests and general care.

In certain cases the reimbursement of the insurance funds is 100%. This is the case with a course of very extensive treatment or when the patient cannot afford the costs. For dental services, reimbursement remains low; household contributions reach 59% of expenditure.
The trend in recent years has been towards 100% coverage by the insurance fund of the cost of treatment. In 1982, 73,1% of reimbursements carried out under the 'Régime Général' were met in total by the insurance fund compared with 55.2% in 1970 (First, 1985).

Complete population coverage for health care cost has increased administrative control over health care delivery. A set of agreements (**'conventions'**) has succesfully set the rule for dealings of physicians, patients and the funds. The basic principle underlying these successive agreements was to give physicians in private practice certain privileges in exchange for giving up freedom to set their own fee. According to the conventions, the participant physicians in private practice receive compensation on a fee-for-service basis, directly after the service rendered. The fees are established for each procedure

by agreement between administrators of the Health Insurance Funds and representatives of physicians.
In 1982, 98,2% of the physicians in private practice, accepted the convention. Within the 'convention' over 12% of the physicians are allowed to bill additional charges, because they are considered to be so excellent and outstanding, either by way of qualification or general talent. In contrast to their colleague's, who totally subscribe the convention, this group cannot benefit from certain tax privileges (Jaury, 1983).

Patients, as in Belgium, are free to choose their doctor, either **specialist or general practitioner,** and doctors are free to refuse patients. In theory patients can 'shop around' and see as many doctors as they wish, even for one episode of illness. Medical specialists can be consulted without any referral by the GP.

In january 1982 there were about 120.000 practicing physicians in France. About one-third of them are working from their own premises, another one-third have a mixed practice being part-time employed by a hospital; the final group is made up of purely salaried doctors, either in hospitals or in other types of institutions. 62% of the physicians in private practice are general practitioners, 38% specialists (1980). The three main specialties are surgery, radiology and gynaecology. The vast majority of ambulatory care in France (90%) is provided by private practitioners, GP's or specialists. They also deliver nearly half the care to patients in hospitals (Sandier, 1983). So one may say that private practice plays a central role in the French health care system. General practitioners performed about 6500 procedures in 1979, medical specialists about 4600. The ratio of home visits to office visits to surgery, x-rays and specialized procedures differ considerably: for general practitioners this ratio is 35:56:9 and for specialists 2:34:64 (Sandier, 1983).
Compared to the Netherlands, medical specialists in France are less dependent on the hospital. In this respect they resemble their Belgian colleagues. They often practice in private surgeries and in independent clinics not connected to a hospital.

The French system is characterized by a fairly high percentage of **private hospitals** and clinic beds. The French private hospitals are divided into non-profit and profit-making institutions. The first are run by religious orders, insurance funds, research funds

etc. Profit-making institutions are either clinics providing predominantly surgical and maternity facilities, or specialized medium/long stay care institutions. The private hospitals can choose voluntarily to form part of the public hospital service. In that case certain duties, as 24-hour accessibility, are required. Hospitals which prefer to stay outside the public hospital sector may still conclude a partial contract of association with the public service covering such fields as joint training of staff, pooling of equipment etc. The total number of private hospitals in 1982 was 2420; 34% was non-profit making with an average size of 91 beds; 66% was profit-making, with an average size of 66 beds (First, 1985). The total bed capacity of general hospitals in France rose 8,12% between 1972 and 1979. In 1981 there were a total of 888 public general hospitals, with a bed-capacity of 435.898, of which 306.050 (70%) in the hospital sector, and 129.848 (30%) in annexes and attached hospices.

The majority of these non-medical beds are directed on the provision of geriatric facilities. In addition, in 1980, there were a total of 3223 hospices for the aged and nursing homes hospitals (First, 1985).

Each **public general hospital** in France is classified into one of the following four categories (1982);

a. Hôpitaux Locaux. These must at least contain a medical or an maternity ward (the majority of the facilities in these hospitals are given over to simple long stay treatment). These rural hospitals are staffed on a part-time basis by local GP's, who are responsible for the daily management and care of the patients. Urban GP's are allowed but not encouraged to visit their patients in hospital and to discuss the treatment with the appropriate specialist, (29 establishments).
b. Hôpitaux. These must at least contain general medical and surgical services, maternity and radiology wards, a pediatric section, a biological laboratory, and dental care and out-patients facilities, (181 establishments).
c. Centres Hôspitaliers. These must contain all the facilities described above, as well as oto-rhino-laryngological, ophthalmological and stomatological wards, a pediatric ward and facilities for medium and long-term treatment for the chronically ill, convalescents and those requiring rehabilitation care, (319 establishments).

d. Centres Hospitaliers Régionaux. These are distinguistable from the Centres Hospitaliers in the number of specialized wards available, (359 establishments; First, 1985).

The differing scope of these establishments is shown by their average size (resp. 151, 375, 828, 3114 beds; First 1985).

In public hospitals the 'hospital day price' is a comprehensive tariff, calculated on the basis of an anticipated activity. It is different from one institution to another. The doctors are usually salaried, and their income is totally independent from their activity. In private clinics the 'hospital-day-price' is the same in all institutions in a given regional area. It takes into account only the encillary services of the clinic. The doctors are paid separately on a fee-for-service basis.
So the fee-schedule governs the specialist and the GP in his office practice and home visits, in private clinics and in the private services of public hospitals.

The French **fee-schedule** ('nomenclature générale des actes professionels') complies with medical confidentiality but classifies medical procedures by so-called 'key-letters', with a coefficient to indicate the relative importance of each procedure. So the physician mentions on the claim the code for the type of procedure performed, in stead of its actual name. Specialists are able to charge higher fees than general practitioners. Table 2.6 shows the convention tariffs for 1980.

Table 2.6.: 'Convention' tariffs (annual average)1

	Office visits										
					Additional charge				radio-	rheuma-	delive-
Years	GP's	Specialists	GP's	Specialists	night	sunday	'K'	normal	logists	tologists	ries
1970	15,86	27,04	21,87	34,74	30,00	18,00	4,98	3,35	4,10	3,85	271,60
1980	43,00	64,00	59,00	77,00	85,00	65,00	8,95	5,55	7,15	6,55	650,00

1 The price of an appendicietomy ('K50') would be in 1980: 8,95 x 50 = 447,50 ff souce. Sandier, 1983 table 9.

In order to make physicians more sensitive to the financial consequences of their activities, the Health Insurance Funds send physicians on a regular basis a list of their procedures and the amount that was billed for the services prescribed. These 'profiles' might encourage the physicians to 'control' their own method of practicing.

2.4. Consequences of differences

There are differences between the three health care systems; the major differences exist between the Netherlands on the one hand and Belgium and France on the other hand. Some of the differences do fit well into the model for explaining regional variations in hospital admission rates.
France has a large supply of hospital beds; so we expect a substantial correlation between the bed supply and hospital admission rates.
Of the three countries studied Belgium has by far the highest rates for doctors-(general practitioners and specialists) density. The North of France has lower rates compared to the rest of France as well as to Belgium and the Netherlands.
Death rates vary considerably within the countries; some parts of the North of France showing the worst figures for the whole region, while in other parts death rates are only moderately high.
In general terms differences come down to the following elements:

The Netherlands	versus	Belgium/France
indirect access to specialists		direct access
specialists tied to hospitals		many specialists in ambulatory practice
low death rates		higher rates, especially in the Walloon part of Belgium and the French mining districts
few alcohol related diseases		very high rates (France), high rates (Belgium)
practically no copayment rates for publicly insured persons		copayment rates (with higher reimbursement for low income groups in Belgium)
low density of g.p.'s		very high (Belgium) and high density (France)
sick funds cannot own hospital facilities		sick funds can own hospitals
considerable amount of home deliveries		mostly clinical deliveries

differences between:

Belgium	versus	France
very high providers density		moderately providers density
sharp reduction of copayment for low income groups		reduction only for the very poor
only non-profit hospitals (as in Holland)		profit and non-profit hospitals

For our study the most important differences are: direct access of specialistic care in Belgium and France combined with independent, ambulatory practices of specialists (in the Netherlands directly tied to hospitals). In addition exemption from copayment for medical services in France is rare. Here the influence of income factors could be found (in contrast to Belgium and the Netherlands).
The very high doctor's density in Belgium (contrary to France and the Netherlands) may influence the inclination to keep patients in ambulatory care.

For the rest differences between France and Belgium vary gradually; the most important 'system differences' can be found between the Dutch and the other two regions.

3. THE CHOICE OF UNIT OF ANALYSIS, THE SOURCES OF THE DATA AND THE OPERATIONALIZATION AND FREQUENCY DISTRIBUTION OF THE VARIABLES

3.1. The region (unit of analysis)

The choice of the regions as unit of analysis largely depends on the kind of information one wishes to use. Not all statistical information is gathered on every geographical level. If one intends to use different types of statistical information (e.g. socio-economic or demographic information), besides hospital admissions, a more general type of region is more suitable than a specific one (e.g. hospital regions). In our study on regional variation in hospital admissions, both general as specific types of statistical information will be used. In this respect, regions of a general type are most suitable.

The Dutch Central Bureau of Statistics offers two interesting geographical divisions; a 80-fold division and a 43-fold division. The 80-fold division is based upon functional interactions with respect to residence, work, social and health facilities and social relationships. This type of region has by definition an urbanized core and surroundings of more or less urbanized countryside. For analytical purposes this type of division is most interesting because it consists of municipalities (the lowest independent administrative unit). A major objection to this division, however, is that it does not necessarily follow the administrative boundaries of the twelve Dutch provinces, in case a city attracts commuters from other provinces. Not all statistical information we require is therefore available on this geographical level.
We chose the 43-fold division, which follows the provincial boundaries and is therefore less empirical. This type of unit is called the COROP-region.
One COROP-region (the Southern IJsselmeerpolders, COROP-region no. 40) requires some additional remarks. In our earlier research this region has been left out of the analysis because of the extremely deviant demographical composition (a very young population) and a complete absence of medical specialists and hospitals (the first hospital was opened in September 1981). The population was then added to COROP-region no. 10 (Zwolle and environs). In the present

study the COROP-region no. 40 is analysed seperately. We therefore have 43 regions at our disposal for the Netherlands in 1982.

For Belgium the choice was not hard to make. The data we had at our disposal are published for arrondissements. The regional level oscillates between the municipalities and the provinces. In Belgium there are a total of 43 arrondissements, which are fairly comparable with the Dutch COROP-regions.

With respect to Northern France some methodological adaptations are needed to create regions comparable with the Dutch and Belgium units of analysis.

Northern France is defined as made up of four regions:
1. Nord-Pas-de-Calais;
2. Lorraine;
3. Picardie;
4. Champagne-Ardennes.

These regions are divided into 51 arrondissements with 8.5 million of inhabitants and form a natural geographic extension of Belgium and the Netherlands. The Parisien region is left out of account because its (deviating) extremely urbanized character.

The French data were obtained from three sources:
1. General data (e.g. death/birth rates) are available per community, arrondissement, departement or region (source INSEE, Institute National de la Statistique et des Etudes Economiques).
2. Health data (e.g. admission rates, number of beds etc.) are collected by the Ministry of Health or by the DRASS or DDASS (Direction Regionale (resp. Départementale) des Affaires Sanitaires et Sociales) per "secteur sanitaire" (health district). The 51 arrondissements which make up Northern France (i.e. the four administrative regions of interest) do not exactly match the (44) secteurs sanitaires. Some secteurs are considarably larger, others smaller than the more or less corresponding arrondissements, as is illustrated in figure 3.0 for the region Nord-Pas-de-Calais.
3. Medical demographic data are provided by the CNAMTS (Caisse Nationale d'Assurance-Maladie des Travailleurs Salaries) per

Figure 3.0.: Division of Nord-pas-de-Calais in arrondissements and secteurs sanitaires

Legend: _____ : Delimitation of the secteurs sanitaires (see appendix);
-------- : Delimitation of the arrondissements

geographic region as defined by the CPAM (Caisses Primaires d'Assurance-Maladie). These regions in turn differ geographically from the ones mentioned in 1. and 2.

As the health data are most important, it is decided to use the secteurs sanitaires division of Northern France. The general and medical demographic data need therefore to be transformed by adequate (des)aggregation in order to apply to the new units of analysis.

3.2. The dependent variable

In this section we will describe the operationalization and the sources of the dependent variable: the number of hospital admissions. We will also show the frequency distribution and the geographic differences.

3.2.1. Hospital admissions

The Netherlands:

The Dutch figures refer to the number of admissions to general, teaching (academic) and special hospitals among the inhabitants of a specific municipality, related to the number of inhabitants as of January 1st 1983.

From the Ministry of Public Health, Welfare and Culture we obtained data about the municipality of residence of admitted patients. Admissions in psychiatric institutions were excluded. On the basis of these data we calculated the total number of admissions for each of the 43 COROP-regions. The number of inhabitants per municipality have also been aggregated for the 43 COROP-regions.

Belgium:

For Belgium the number of admissions to all hospitals per arrondissement are published by the Ministry of Public Health (Ministerie van Volksgezondheid, 1985). Included are, however, admissions in mental hospitals, as is not the case in Dutch admission data. Corrections were made on basis of psychiatric admission rates on provincial level, published by the same Ministry. The number of psychiatric admissions were assigned to each arrondissement in proportion to the number of inhabitants.

France:
For France we obtained data from the CRESGE (Centre de Recherches Economiques Socioloques et de Gestion). These data contain the number of admissions per "secteur sanitaire" to general public and private hospitals. Within each hospital a distinction can be made between the so-called short, medium and long stay beds. A stay becomes medium or long according to the number of days in the short-stay service. For reasons of comparability we only took the admissions to short (Surgery, Medicine and Gynaecology) stay beds. Long stay admissions are excluded because they mainly refer to geriatric patients. The number of admissions is related to the number of inhabitants per "secteur sanitaire" as of January 1st 1983. These data are also obtained from the CRESGE.
Comparing French with Dutch and Belgian data one must keep in mind that in France, a patient can be transferred within a single illness period to another type of bed. This accounts for another (new) admission.

Figure 3.1 shows the distribution of the hospital admission rates for all three countries. The distribution is displayed geographically on map 3.1.

The highest rate in Belgium is found in the provinces Hainaut and the lowest one in districts St. Niklaas and Dendermonde. The Lorraine region in Northern France shows the highest rate whereas the districts Ardennes-Sud, Romilly-Sezanne and Lille show relatively low admission rates. The Dutch admission rates are in general much lower than the Belgian and French rates. Relatively high rates are found in the districts Haarlem, Het Gooi, Zeeuwsch-Vlaanderen, Amsterdam and 's-Hertogenbosch.

3.3. The independent variables

The variables, used to explain variations in the hospital admission rate can be divided into two categories. On the one hand there are a number of variables that have the same kind of influence on hospital admissions in all three countries. These variables make up the general part of the postulated model that explains variations in the hospital admission rate. The specific part of the model consist either of variables that can be measured

Map 3.1.: Geographical distribution of hospital admission rates in the Netherlands, Belgium and Northern France, 1982 (admissions/1000 inhabitants).

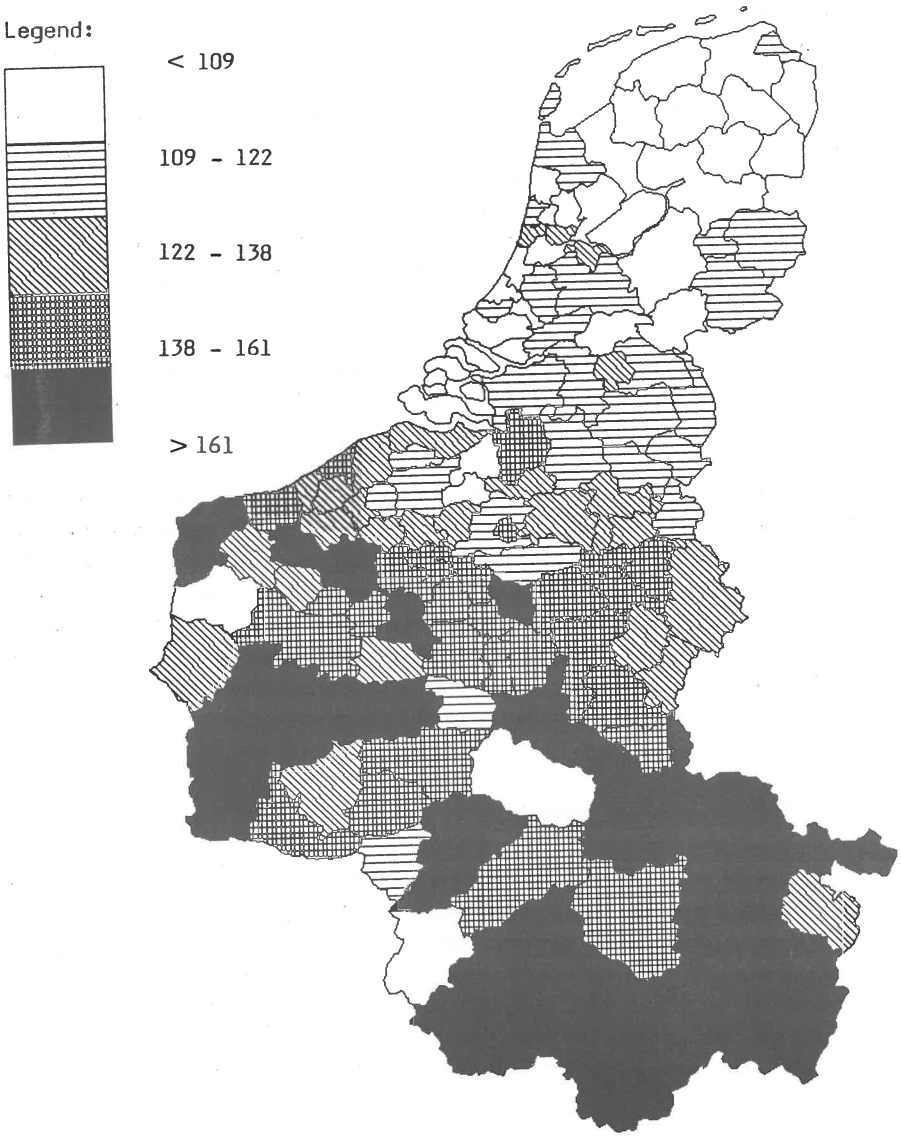
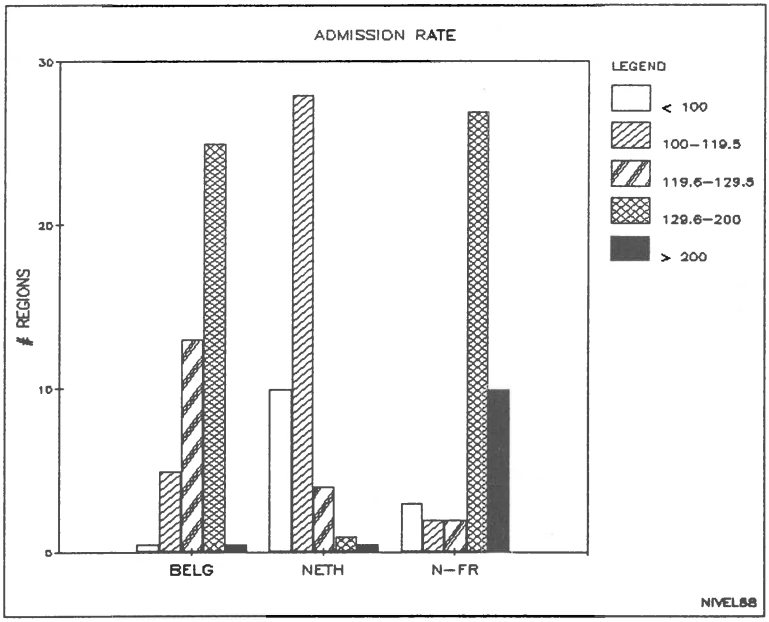


Figure 3.1.: Hospital admission rates (0/00) for 130 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France	Total
Mean	137.08	107.48	174.22	139.86
Sd	19.46	11.19	59.59	45.85

in all three systems, but are expected to influence the hospital admission rates differentially, or variables that only exist in one of the three health care systems. We will first describe the variables that can be classified under the general part of the model.

3.3.1. General model: variables representing the demand for health care

We chose the following variables as indicators of the demand for health care:

a. age-adjusted death rates;
b. the age/sex distribution of the population;
c. the distribution of income as an indicator of social class;
d. the degree of urbanization.

3.3.1.1. Age-adjusted death rates

Provided that differences in the age distribution between populations have been eliminated, death rates can be taken as good indicators of the health status of a population. As the age-sex distributions in all three countries differ considerably, we constructed a standard population, by averaging the proportional division of age/sex categories in all three countries. The next step was to relate the age/sex specific mortality rates to the standard population, leading to a standard mortality figure.
On request, we received from the Dutch Central Bureau of Statistics (CBS) and the Belgian National Institute of Statistics (NIS), the age/sex specific mortality rates per district. For France, the same data were provided by the CRESGE.
The frequency distributions and map are shown below.

The districts with the highest death rates in the Netherlands are found in the Capital, parts of the Northern provinces, the Veluwe and in South Limburg.
For Belgium the industrial areas around Liège, Charleroi and Mons show the highest rates, but death rates in the "rural" Ardennes are not much lower.
Although the variation in Belgium is almost twice the variation in the Netherlands, according to this indicator, Belgium is much less 'healthy' than their northern neighbours.

Map 3.2.: The age/sex adjusted death rates in the Netherlands, Belgium and Northern France, 1982 (death/1000 inhabitants).

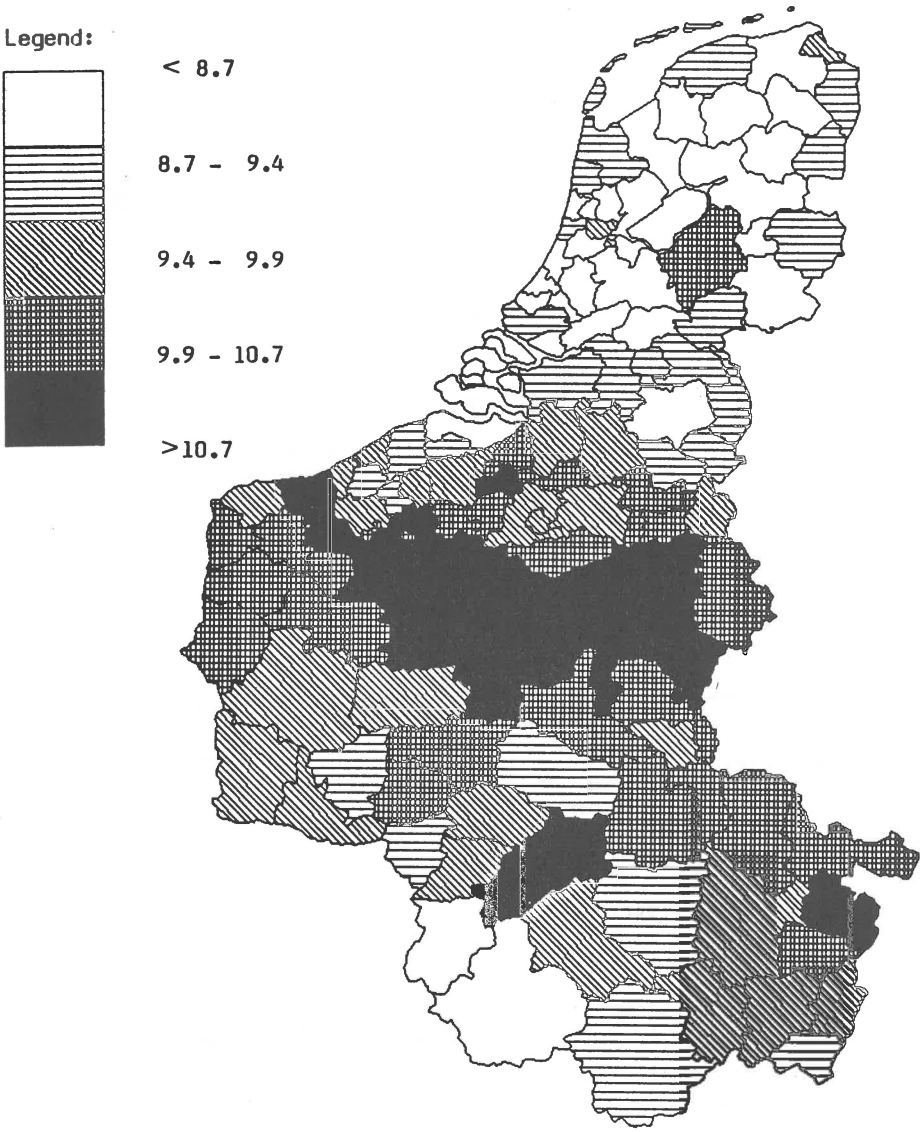
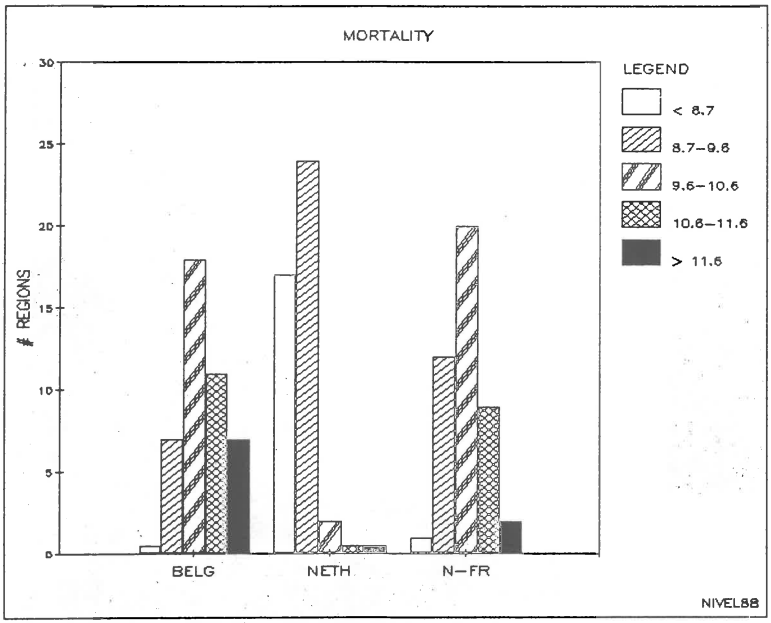


Figure 3.2: Frequency distribution of age/sex-adjusted death rates per 1,000 inhabitants for 130 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France	Total
Mean	10.48	8.68	10.08	9.75
Sd	0.97	0.58	0.78	1.10

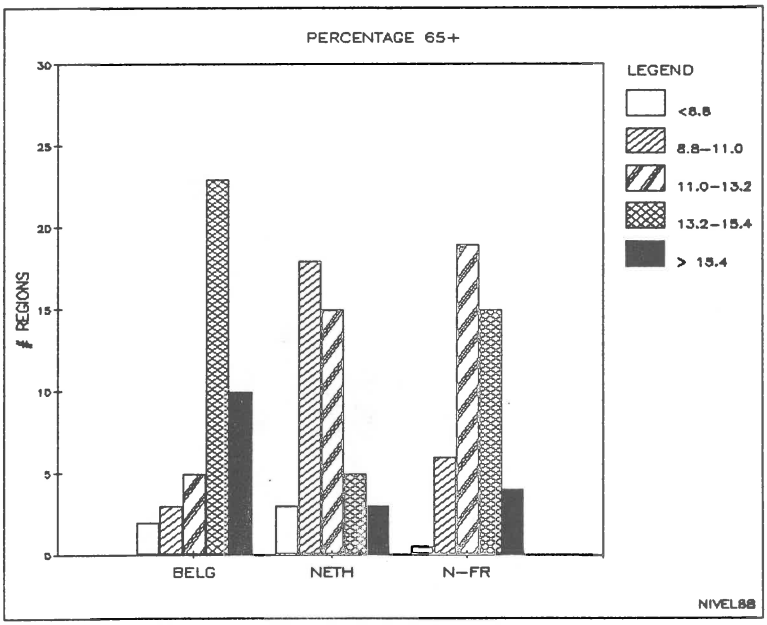
3.3.1.2. Age distribution

a. The proportion of people over 65.

The Dutch Central Bureau of Statistics publishes on a yearly basis distribution tables of population by age/sex category for each municipality. On request we received a datafile per 1-1-83, which could easily be aggregated to a higher level, the COROP-regions. For Belgium statistics per districts were provided by the Belgium

National Institute of Statistics (NIS). The French data we received on request from the CRESGE.
The frequency distributions and the geographical differences are shown in figure 3.3 and map 3.3.

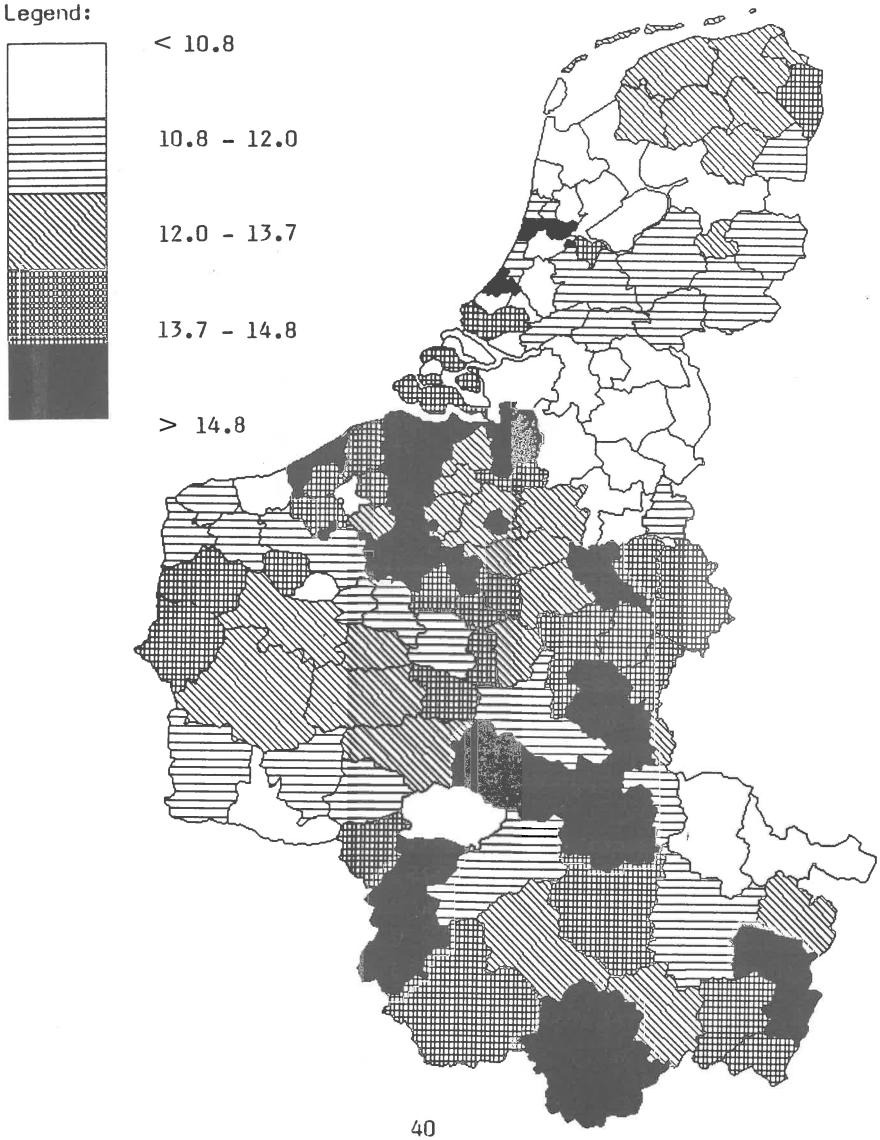
Figure 3.3: Percentage 65 years and older for 130 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France	Total
Mean	13.97	11.48	12.82	12.75
Sd	2.00	2.38	1.97	2.34

The demographical compositions of the three countries differ considerably. The Netherlands have the lowest rates of elderly, followed by Northern France and Belgium.

Map 3.3.: Proportion of elderly (65 years of age and older) in the Netherlands, Belgium and Northern France, 1982 (number of 65+-ers/100 inhabitants).



In Belgium the highest proportion of old-age pensioners is found in the area around Liège (districts of Huy and Waremme) and the province of Hainaut (districts of Tournai, Ath and Mouscron). The Capital has also a relatively old population.
Regions with the highest proportion of elderly in the Netherlands are: Amsterdam, The Hague, the rural areas of the province of Zeeland and the northern provinces as well as the relatively wealthy areas of Het Gooi and Kennemerland. Relatively "old" districts in Northern France are mainly found in the region Champagne-Ardennes (e.g. districts Romilly-Sezanne, 17.21, Ardennes-Sud, 16.72 and Epernay, 15.51).

b. The proportion of 0-4 years old
The sources for this health care demand indicator are the same as described in the former section. The frequency distributions are shown in figure 3.4, the geographical variation in map 3.4.

Only small differences between the countries of interest are found, the Netherlands being somewhat younger. There is however a considerable difference in demographical variation within the countries.
The proportions old and young inhabitants are - as expected - moderately to highly and inversely correlated (Belgium: -.68, the Netherlands: -.63, Northern France: -.53 and Total: -.55), although there are some exceptions like the province of Friesland in the Netherlands where rather high proportions of both age groups live.
The relatively great variation within the Netherlands is partly caused by one specific COROP-region: de Zuidelijke IJsselmeerpolders. This region has an extremely deviant demographical composition; 14.5% 0-4 years old!

Map 3.4.: Proportion of 0-4 years old in the Netherlands, Belgium and Northern France, 1982 (number of 0-4 years old/100 inhabitants).

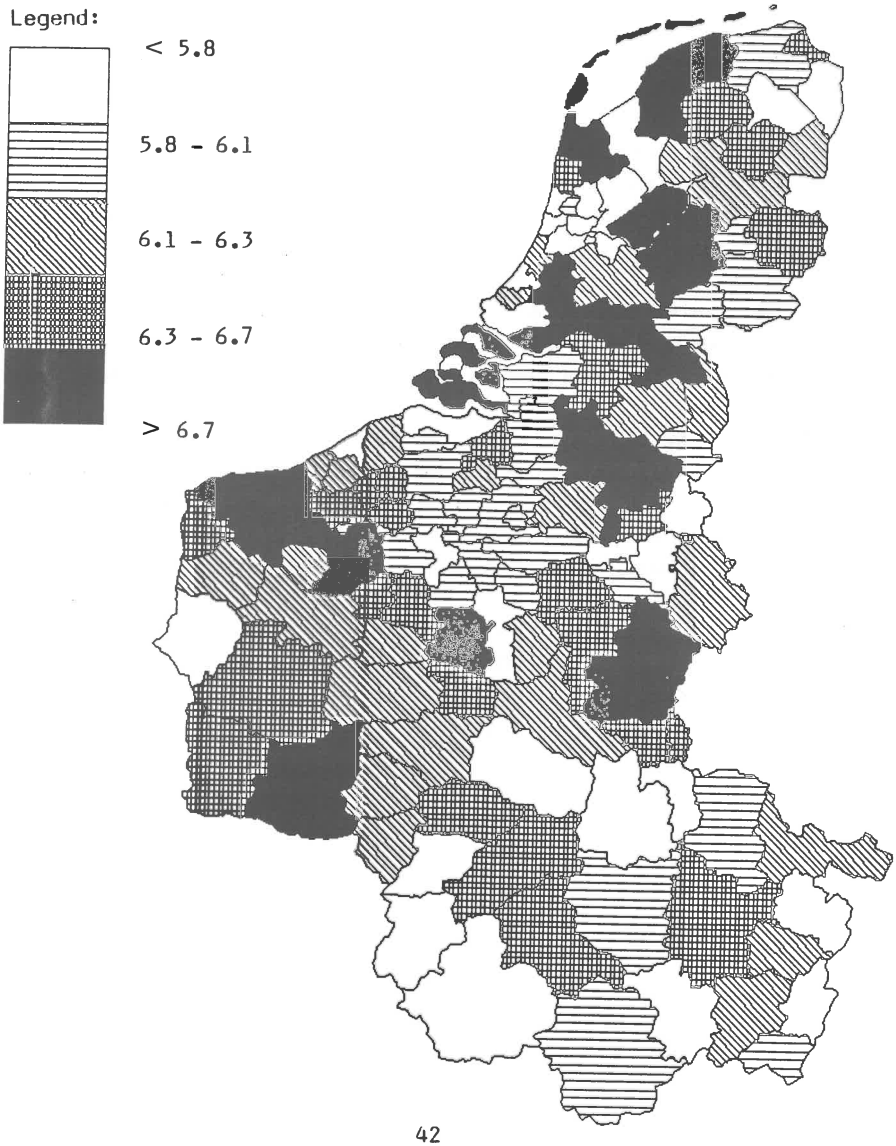
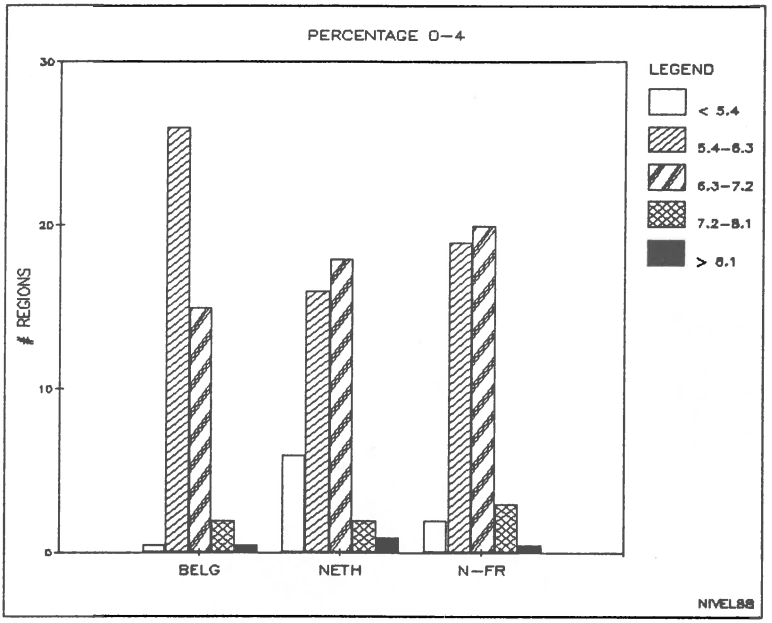


Figure 3.4: Proportion 0-4 years old for 130 districts in Belgium, the Netherlands and Northern France (1982)

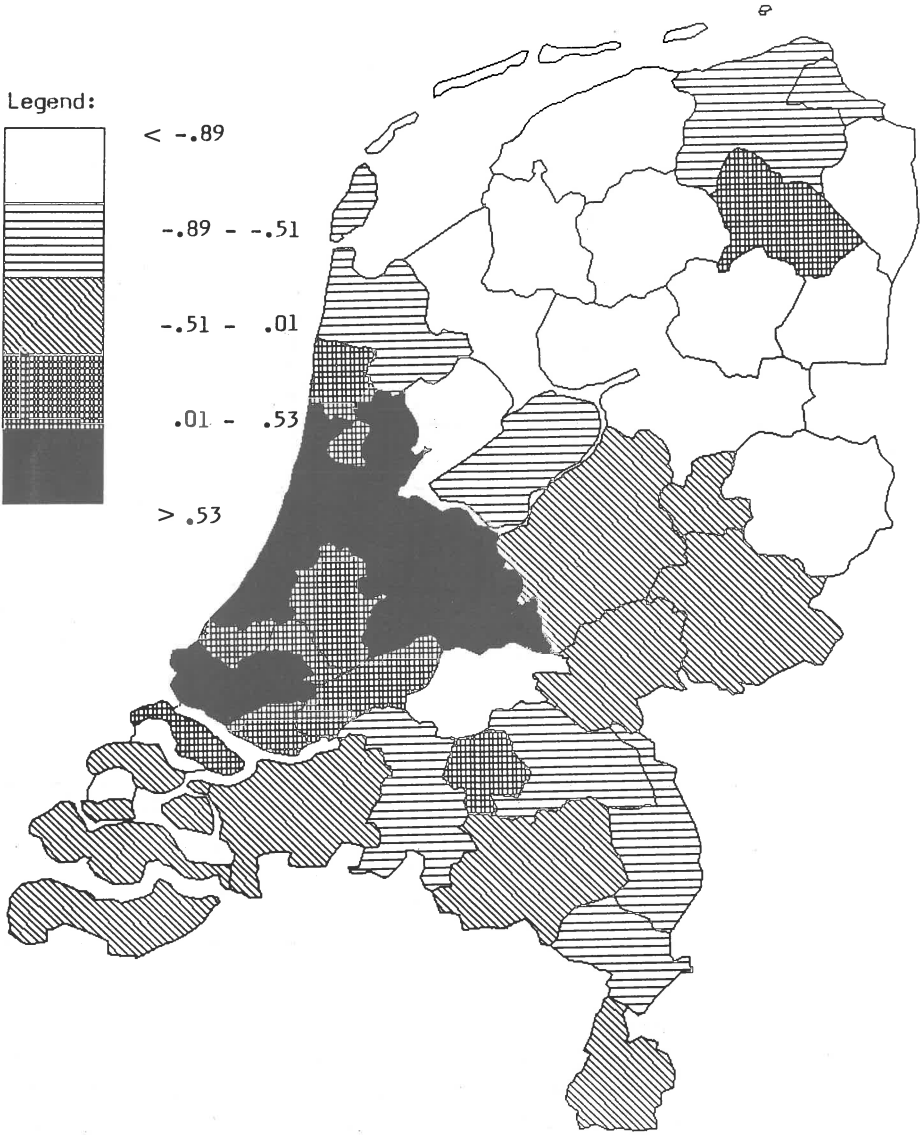


	Belgium	the Netherlands	N.France	Total
Mean	6.25	6.41	6.25	6.30
Sd	0.50	1.42	0.73	0.96

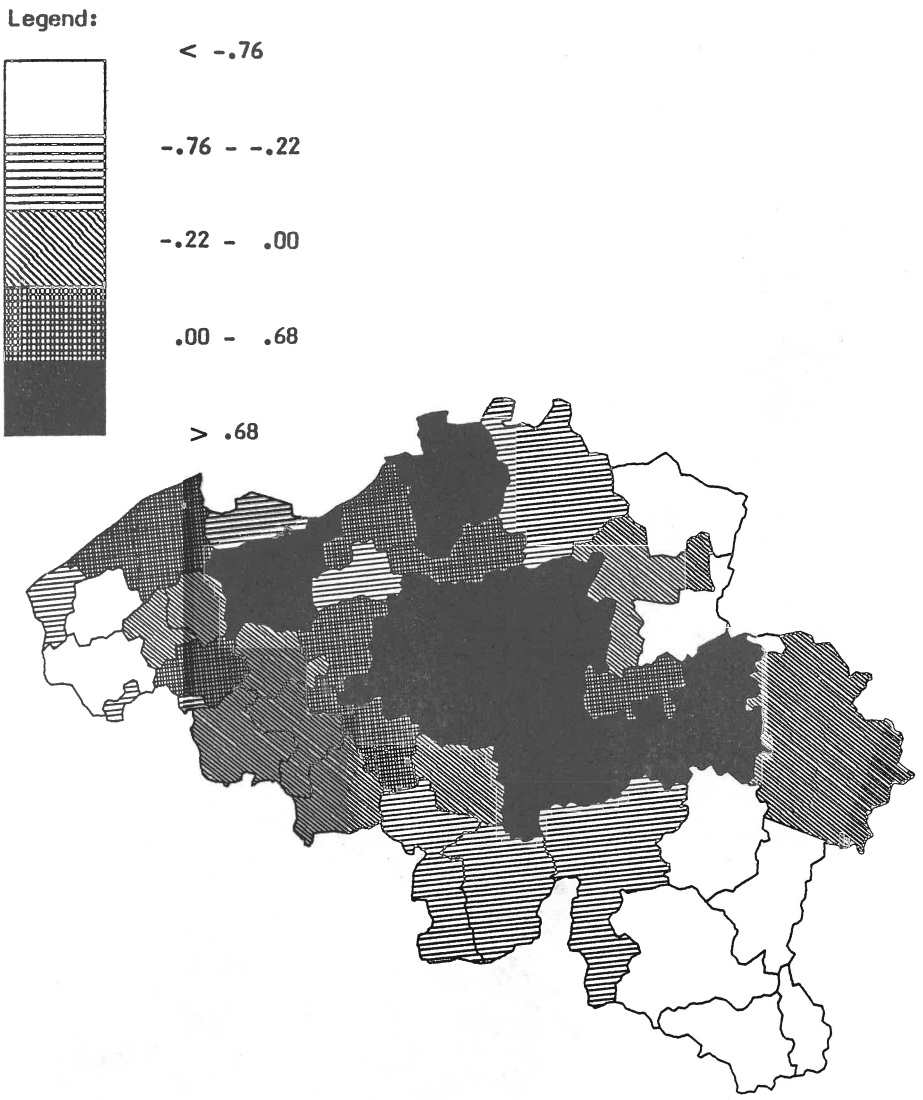
3.3.1.3. The distribution of income

Income is used as a rough indicator for differences in social class composition between the regions. Because these indicators cannot be compared directly, we have constructed a comparable index. Ideally one must look at the price-indices for each country. Because the three countries do not differ essentially in this respect we chose a simple solution. The average income per

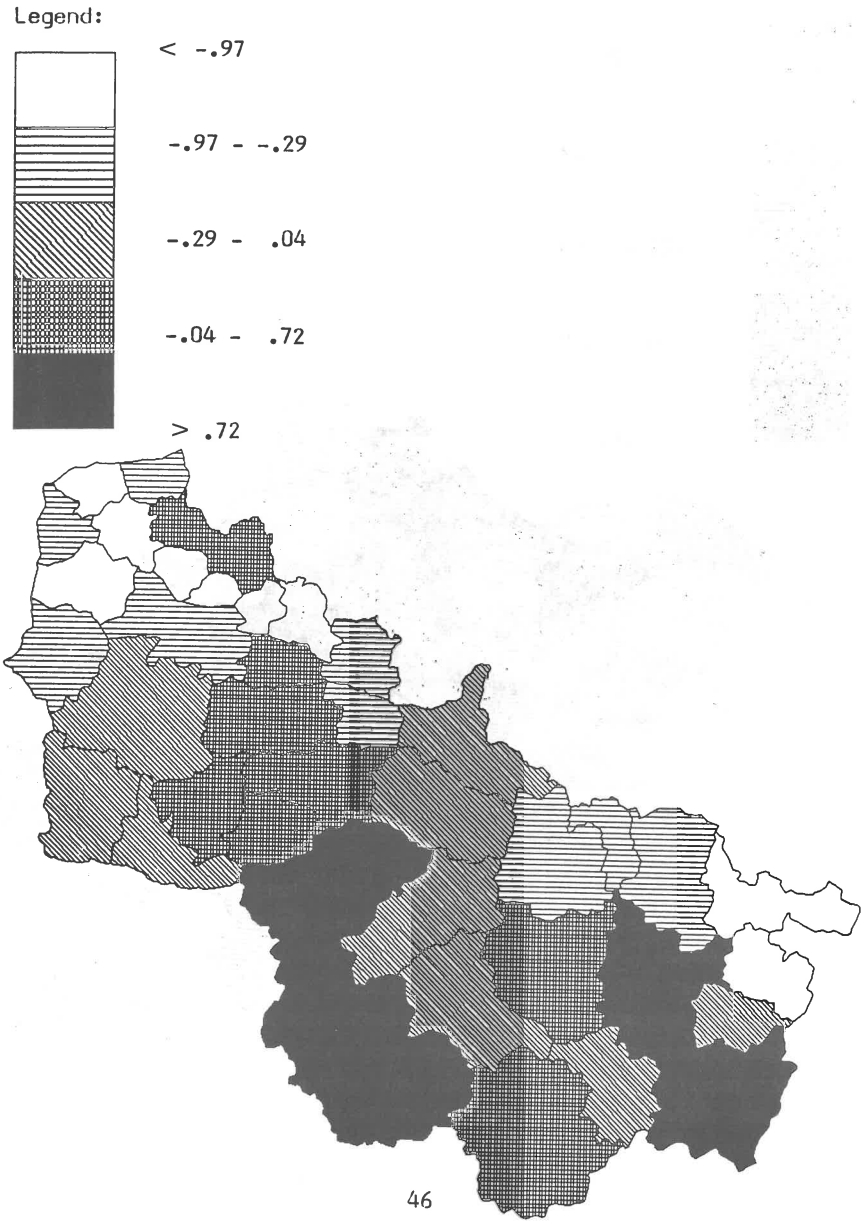
Map 3.5.a: Standardized income in the Netherlands, 1982.



Map 3.5.b.: Standardized income in Belgium, 1982.



Map 3.5.c.: Standardized income in Northern France, 1982



region is standardized to a normal distribution. The standardized deviation from the mean is considered as an indicator of socio-economic differences between the regions (Z-scores).

The sources for the three countries were:
- the Netherlands: the Central Bureau of Statistics (Centraal Bureau voor de Statistiek, 1986)
- Belgium: the National Institute of Statistics (Nationaal Instituut voor de Statistiek, 1984)
- France: the CRESGE (Centre de Recherches Economiques Sociologiques et de Gestion, personal communication.)

The geographical quintile distributions are shown in maps 3.5.a (the Netherlands), 3.5.b (Belgium) and 3.5.c (Northern France), as the standardized incomes are computed for each country separately. Low income areas in the Netherlands are mainly found in the northern provinces. The province of Luxembourg shows the lowest rates in Belgium, as the Nord-Pas-de-Calais region in Northern France.

3.3.1.4 Urbanization

Regions of a nodal type (the unit of analysis in our study) have, by definition, an urbanized core and surroundings of more or less suburbanized countryside. So a characterization according to the degree of urbanization is not easy.
As an indicator/proxy for urbanization we therefore chose the population density of the region (number of inhabitants per km^2).
The sources were:
- The Netherlands: Central Bureau of Statistics (Centraal Bureau voor de Statistiek, 1983);
- Belgium: National Institute of Statistics (Nationaal Instituut voor de Statistiek, 1983)
- France: CRESGE, (Centre de Recherches Economiques Sociologiques et de Gestion, personal communication)

The frequency distribution is shown in figure 3.6 and the geographical variation in map 3.6.

Map 3.6.: Population density in the Netherlands, Belgium and Northern France, 1982 (number of inhabitants per km^2).

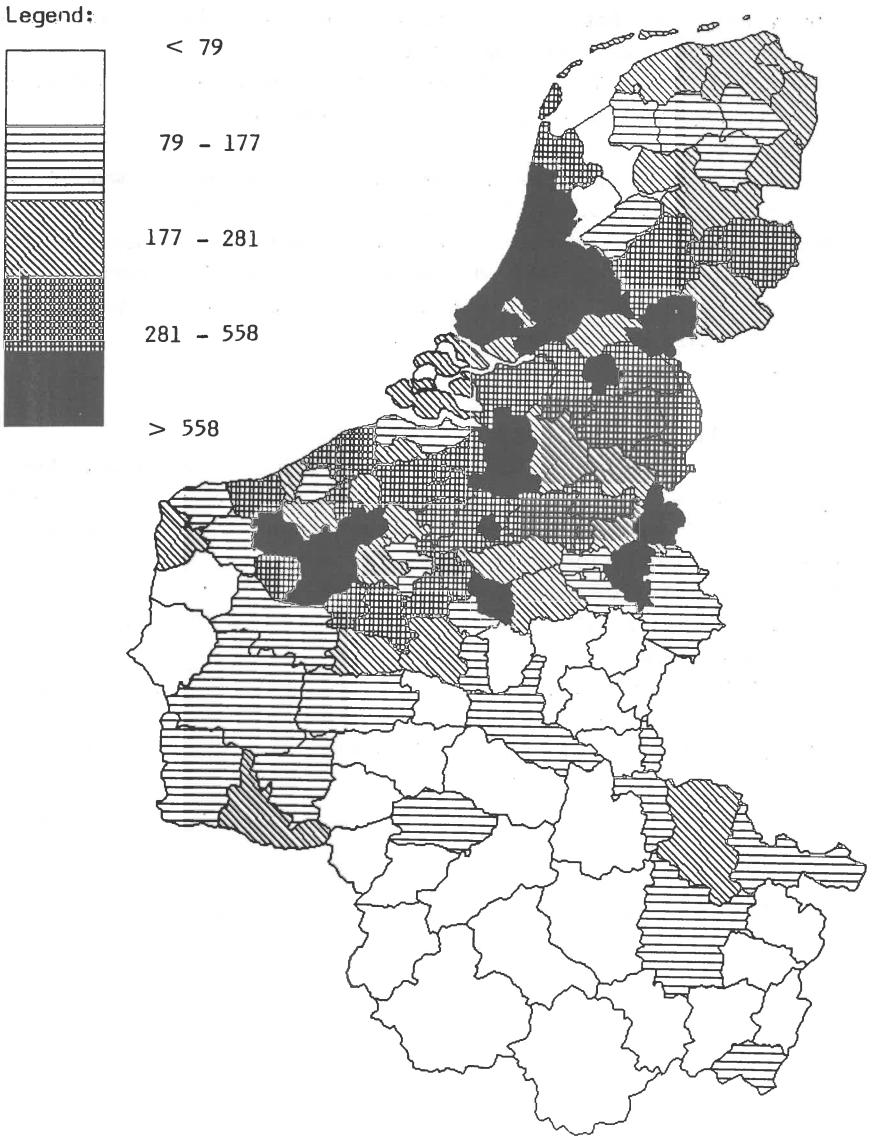
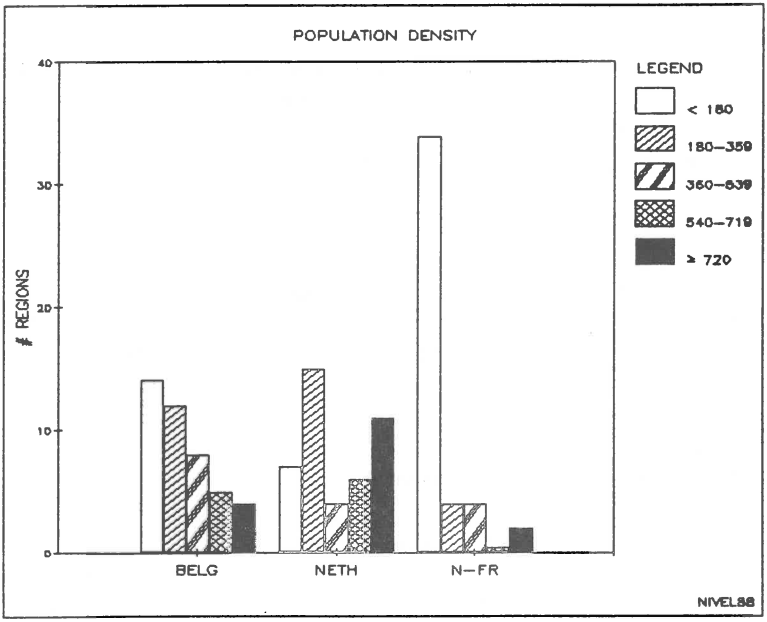


Figure 3.6: Population density (inhabitants per km^2) in 130 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France	Total
Mean	463.35	679.51	163.80	433.46
Sd	910.11	806.41	205.00	735.32

The average population density in Holland is four times as high as in Northern France (680 versus 164 inh/km^2), whereas Belgium is three times as densely populated as the Northern part of France.
In the Netherlands population seems to be bimodally distributed. A rather large part, Randstad (Townbelt) is, compared to the rest of the country (with exception of the South of Limburg) very densely populated.
In Belgium the districts with the most dense populations are the metropolitan areas of Brussels (6110 inh/km^2), Antwerp, Liège

and Charleroi.The rural areas of the provinces Luxembourg and Namen have the lowest population density.
The rural areas of the Ardennes in Northern France are populated most sparsely, whereas the highest population density in Northern France can be found in Nord-Pas-de-Calais, especially in the districts Lille and Lens.

3.3.2. General model: variables representing the supply side

The variables representing the supply side of the health care system are:

a. the number of hospital beds;
b. the size of hospitals, indicated by the average number of hospital beds per hospital;
c. the mean stay per admission;
d. the number of long stay or geriatric beds.

The density of physicians is not categorized under the general model, because the position and remuneration system of physicians differ in the three countries.

3.3.2.1. Hospital beds

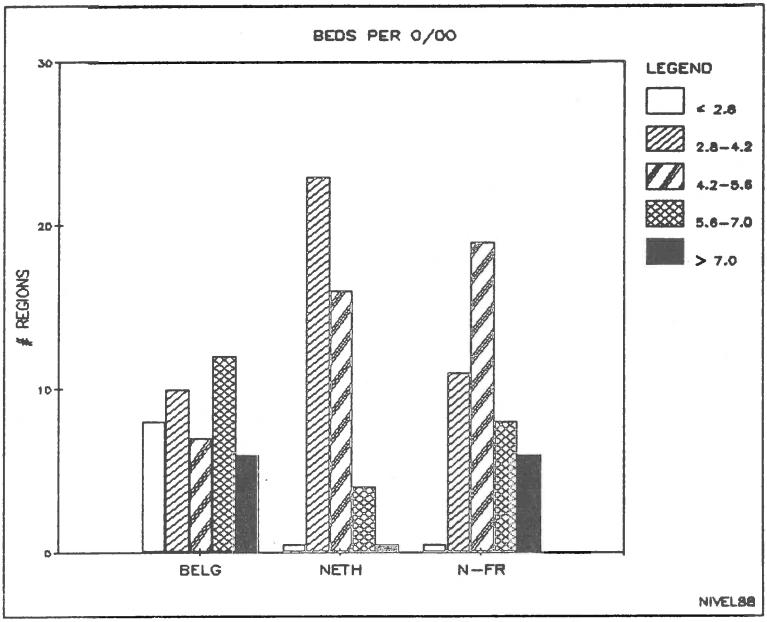
The number of hospital beds has been taken as an indicator of the supply side because most studies on hospital admission rates show a moderate to strong relation between these variables.
For the Netherlands we considered the number of acute medical and surgical beds in general and teaching hospitals per 1-1-1982.
These data are published annually by the National Hospital Institute (Nationaal Ziekenhuis Instituut, 1982). On the basis of data from the Ministry of Public Health, Welfare and Culture, the number of beds is corrected with respect to the origin of patients, according to the following procedure: on the basis of the orientation of all COROP-regions to COROP-regions with hospitals we created a hypothetical hospital district for each "hospital COROP". We then assigned the number of hospital beds per 1,000 inhabitants of the hypothetical hospital districts to the COROP-regions, incorporated in the hypothetical district.

For Belgium the number of beds in acute hospitals (hôpitaux aigu) is taken into account. These data are published annually by the Ministry of Public Health (Ministerie van Volksgezondheid, 1985). The correction for origin of patients, is not possible because no information on origin was available. The number of beds is published per hospital, so we had to aggregate all hospital beds

per district.

The distributions are shown in figure 3.7 and map 3.7.

Figure 3.7.: The number of acute medical and surgical beds per 1,000 pop. for 128 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium[1]	the Netherlands	N.France	Total
Mean	5.04	4.30	5.35	4.90
Sd	1.93	0.78	1.47	1.52

1 Two districts ('Diksmuide' and 'Philippeville') have no hospital beds and are excluded from this analysis.

Hospital beds in Northern France include the number of acute medical and surgical beds ("court séjour") in both public and

private (general) hospitals. These data are received on request from the Centre de Recherches Economiques Sociologiques et de Gestion (CRESGE) and are aggregated per health region ("secteur sanitaire").

In Holland the highest rates are found in "het Gooi" and the "Vechtstreek", "Achterhoek", "Amsterdam" and in "de Zuidelijke IJsselmeerpolders" (in the so-called new-land, the first hospital opened its doors medio 1981).
The highest rates in Belgium are found in the province of West Flanders (districts "Brugge", "Roeselaere") and the districts "Soignies" and "Brussels".
The districts in Northern France with high rates are: "Nancy-Pompey-Toul", "Calais" and "Reims".
As is illustrated on map 3.7 hospital beds are more evenly distributed in the Netherlands than in Belgium and Northern France.

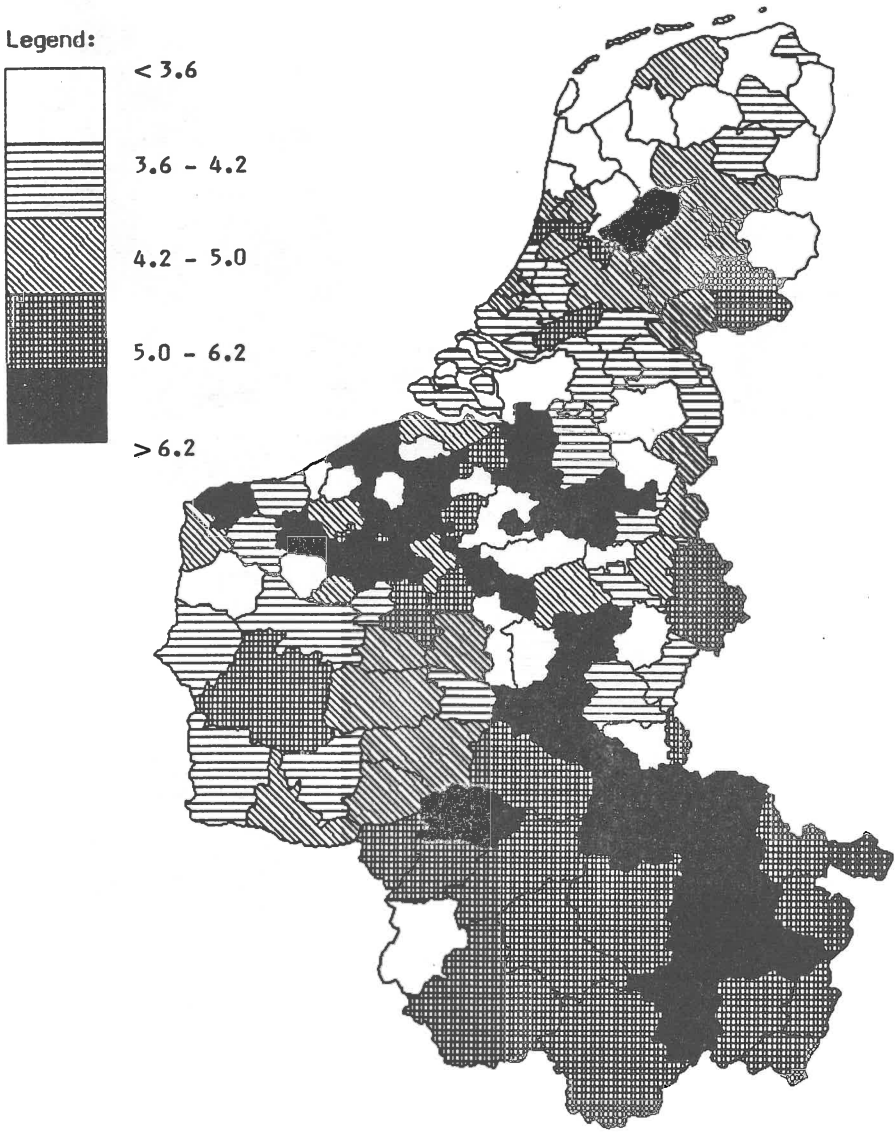
3.3.2.2. The size of hospitals

Hospital-scale influences the average length of stay per hospital as has been shown by Van Montfort (1980).
The average number of hospital beds per hospital for each district is considered to be an index for hospital size.
For the Netherlands only the acute medical and surgical beds in general and teaching hospitals were included in the calculation (Source: Nationaal Ziekenhuis Instituut, 1982).
For Belgium too only beds in acute hospitals are taken into account (Source: Ministerie van Volksgezondheid, 1985).
Hospital size in Northern France relates not only to acute but to all hospital beds. This has to be taken into account when French data are compared to Belgian and Dutch data. Information is provided by the CRESGE.

Figure 3.8 and map 3.8 show the distributions.

The largest hospitals can be found in the Netherlands, not only in the most densely populated regions. Variation of size in this country is considerable.
The smallest hospitals are found in Northern France, but this can be partly caused by the fact that all hospitals are taken into account (not just acute hospitals).

Map 3.7.: Number of acute medical and surgical hospital beds per 1000 inhabitants in the Netherlands, Belgium and Northern France, 1982).



Map 3.8.: Average number of beds per hospital in the Netherlands, Belgium and Northern France, 1982.

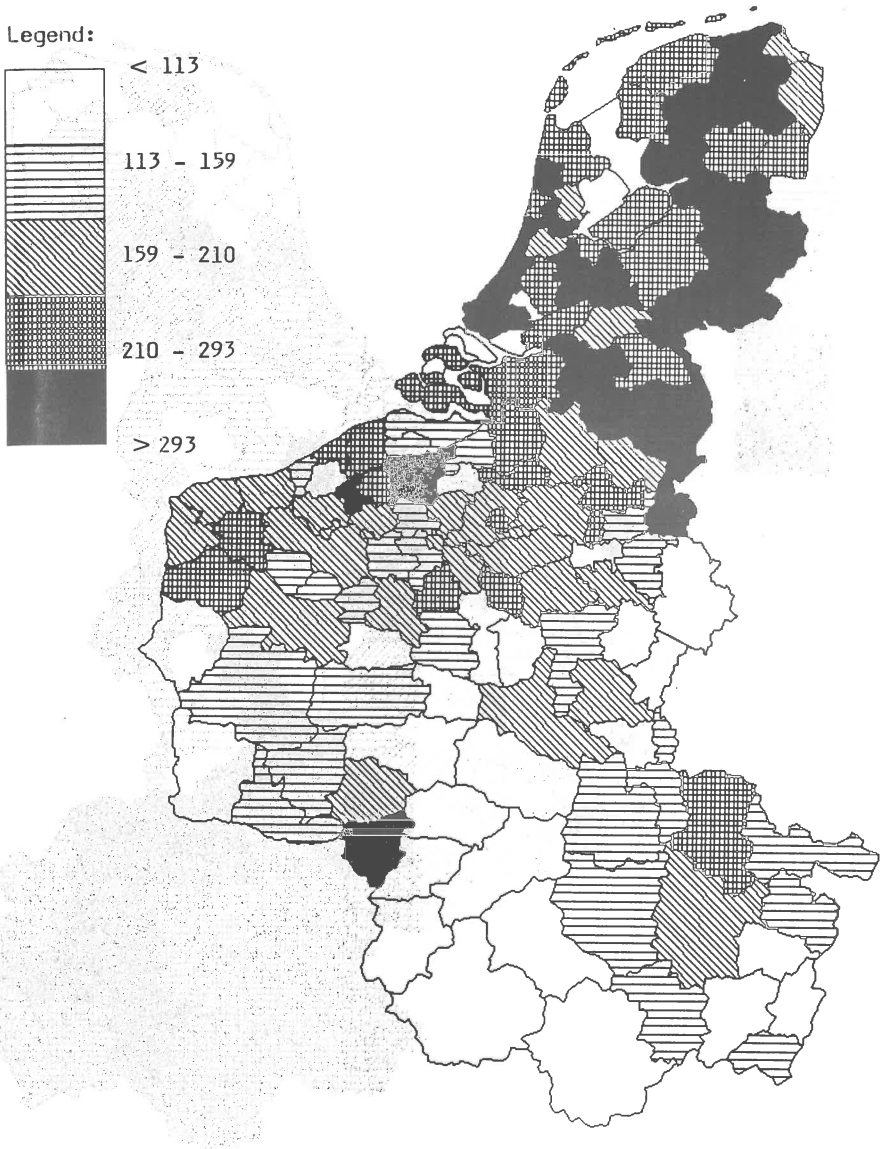
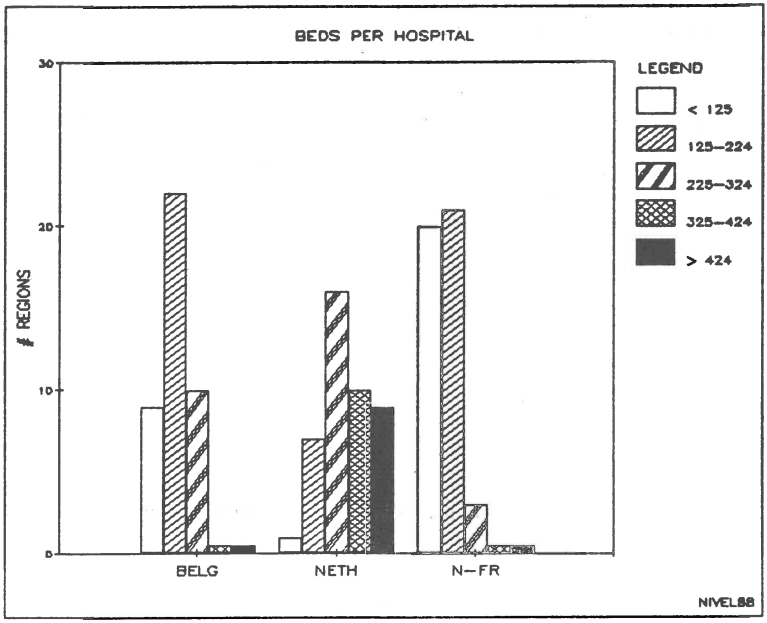


Figure 3.8: The average number of hospital beds for 128 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium[1]	the Netherlands	N.-France	Total
Mean	173.42	329.60	136.42	213.17
Sd	62.56	136.22	59.37	125.31

1 Two districts have no hospitals ("Diksmuide and Philippeville).

3.3.2.3. The mean stay per admission

The Netherlands:

Information on the numer of hospital days is available per hospital, not per municipality or COROP-region (Nationaal Ziekenhuis Instituut, 1982).

The mean stay per admission is estimated by grouping all hospitals per COROP-region, aggregating the number of bed days of general and teaching hospitals and dividing the total number of bed days by the number of admissions.
The number of admissions is composed of the total number of inhabitants of the region admitted to any hospital (in- or outside the COROP-region) whereas the number of hospital days is composed of the total number of days produced by the hospitals in that particular region. So the number of hospital days and the number of admissions do not apply to the same population. This procedure seems, however, appropriate, because no systematic error is expected.

Belgium:
From the Belgian Ministery of Public Health we received on request the mean stay per admission for each arrondissement in acute hospitals in 1982.

France:
As for the hospital admission rates information on the mean stay per admission per health region is provided by the CRESGE (Centre de Recherches Economiques Sociologiques et de Gestion). As mentioned before we restrict ourselves to the mean stay in short-term beds ("court séjour").

Figure 3.9 and map 3.9 show the distributions.

The highest rates in the Netherlands are found in the districts of Amsterdam, Rotterdam, Het Gooi, 's-Gravenhage and Zeeuws-Vlaanderen; the lowest ones in Delfzijl e.o. and in the "Zuidelijke IJsselmeerpolders". In Belgium relatively low rates are found in the province of Luxembourg (districts Marché-en-Famenne, Neufchateau and Virton). The highest rates in Northern France are found in the districts Ardennes-Sud and Romilly-Sezanne.

Map 3.9.: Mean stay per hospital admission in the Netherlands, Belgium and Northern France in 1984 (days per admission).

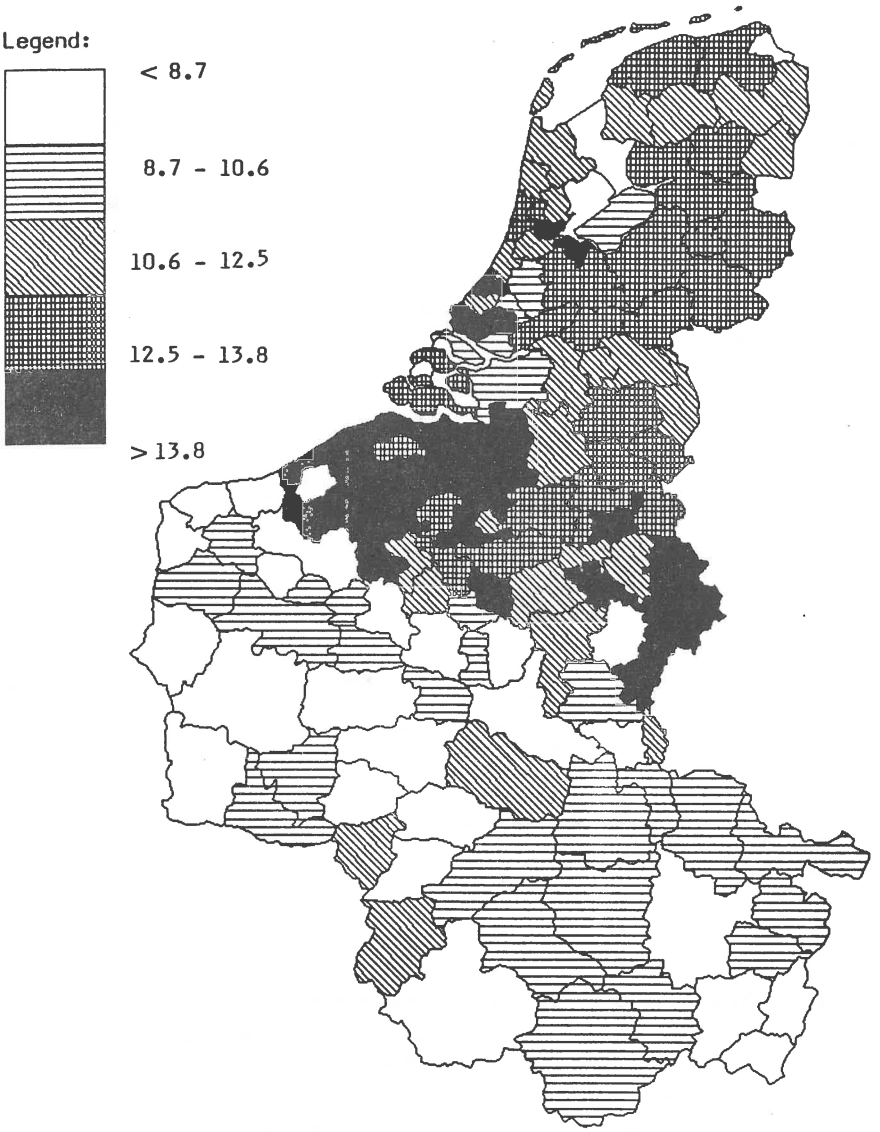
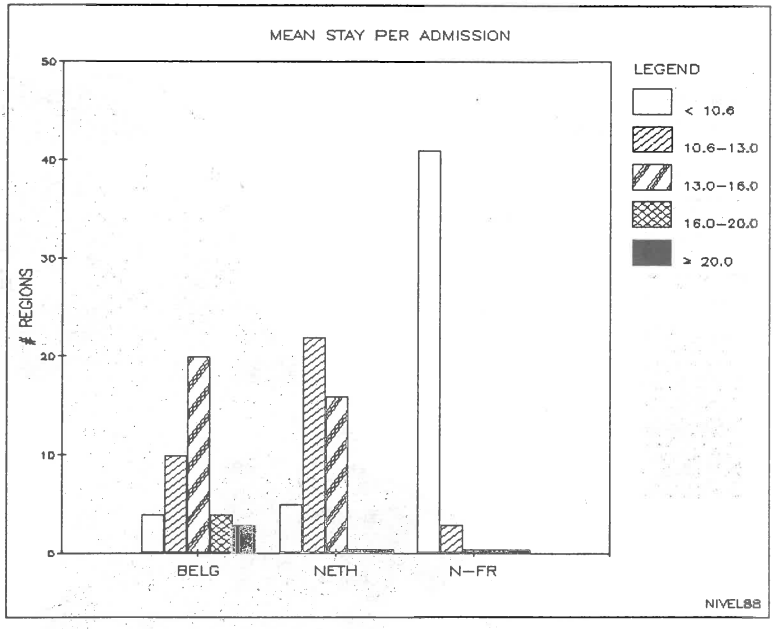


Figure 3.9.: Mean stay per admission for 128 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium**	the Netherlands	N.-France*	Total
Mean	14.38	12.51	8.77	11.82
Sd	3.98	1.48	1.16	3.41

* short-stay admissions

** Two districts -Diksmuide and Philippeville- have no hospital beds.

3.3.2.4. Provisions for the old age pensioners

The hospital admission rate is directly influenced by (inter alia) the alternative treatment facilities such as nursing homes for the elderly and ambulatory care clinics.

Data on the number of beds in nursing homes and the number of long

term hospital beds are used as an indicator for alternatives to hospital care.

The sources for the three countries were:

The Netherlands:
The number of available beds in nursing homes (somatic and psychiatric) is published annually by the National Hospital Institute (Nederlands Ziekenhuis Instituut, 1982) per institution in 1982. These data are aggregated to COROP level.

Belgium:
The number of beds in geriatric institutions is published annually by the Ministry of Public Health (Ministerie van Volksgezondheid, 1985) per institution. The data reflect 1982 and are aggregated to the level of arrondissements.

Northern France:
On request, the CRESGE provided us with data on the number of so-called "long stay beds" and the number of "nursing beds", in general (public and private) hospitals. This information is available only on the level of the "secteur sanitaire". There are, however, a number of geriatric facilities outside general hospitals ("maisons de retraite privées", "hospices et maisons de retraite public autonomes", "logements-foyers"). Data on the number of beds in this type of institutions are only available at a regional level and are not taken into account.

Figure 3.10 and map 3.10 show the frequency distribution of the geriatric beds per 1,000 inhabitants of 65 years and older. For Northern France, only the geriatric beds as part of general hospitals are shown.
The differences between Belgium and the other two countries are striking. The Northern French rates are almost at the same level as Dutch rates, the more so when the underestimation of the French rates is taken into account.
Relatively high rates in Belgium are found in the districts Bastogne, Soignies, Diksmuide and Charleroi.
In the Netherlands the districts Delfzijl, Leiden, South-East Northern Brabant and 's-Hertogenbosch show high rates, whereas fairly high rates in Northern France are found in the districts Calais, Neufchateau-Vittel, Montreuil/Mer and Ardennes-Sud.

Map 3.10.: Number of geriatric beds per 1000 population of 65 years and older in the Netherlands, Belgium and Northern France in 1982.

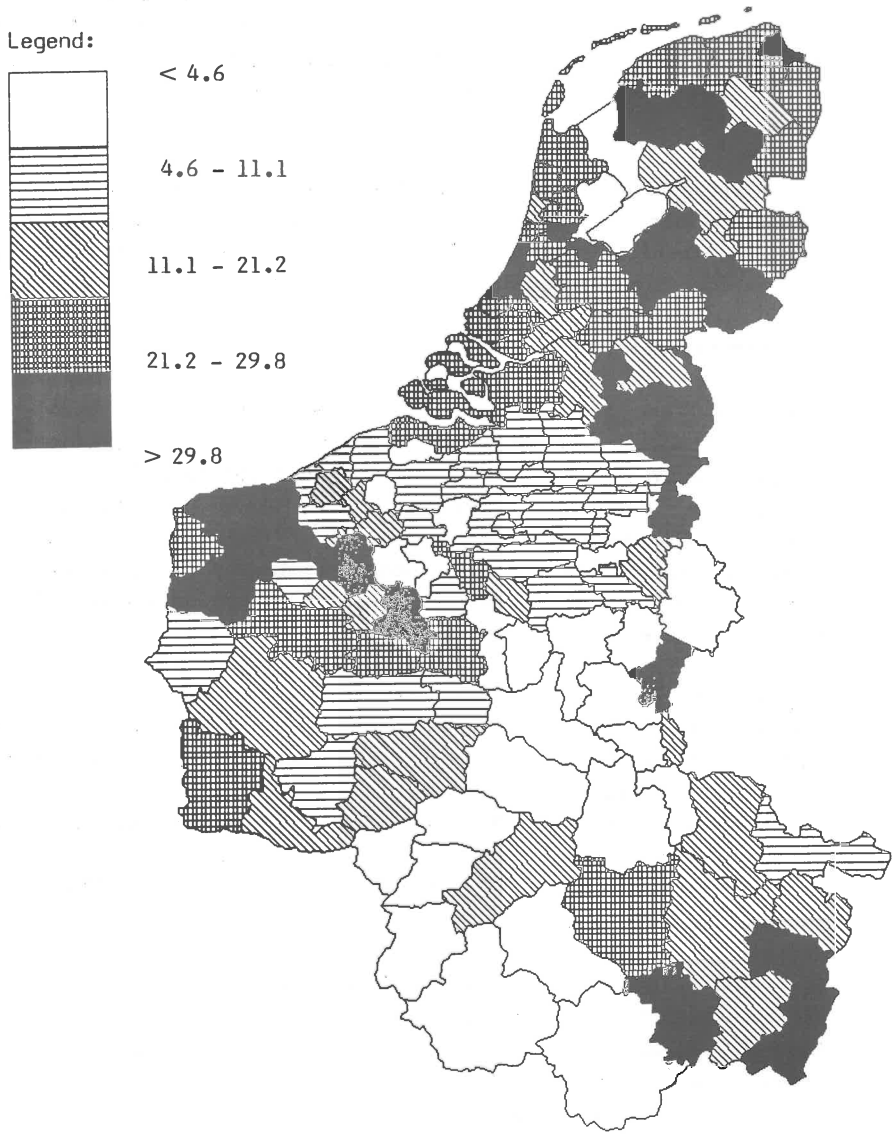
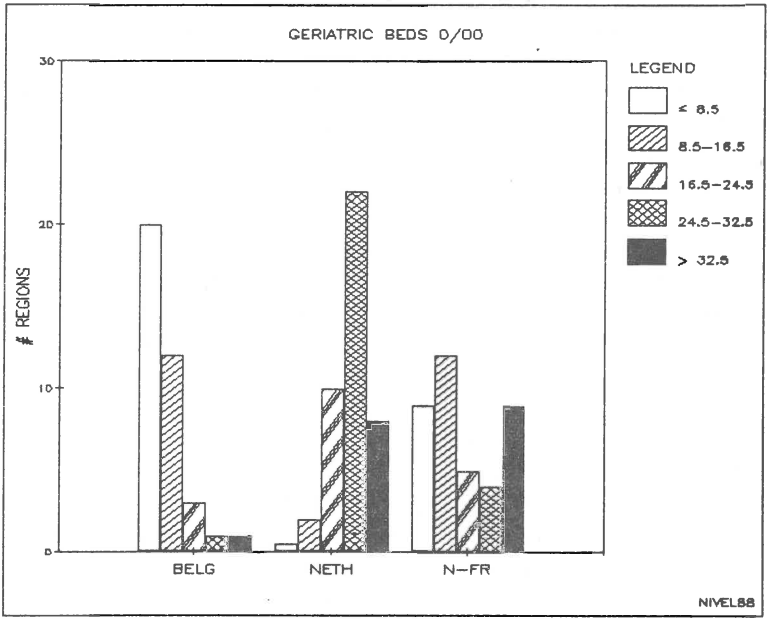


Figure 3.10: The number of geriatric beds per 1,000 population of 65 years and older for 118 districts in the Netherlands, Belgium and Northern France (1982).



	Belgium	the Netherlands	N.France	Total*
Mean	10.20	27.39	22.30	20.32
Sd	10.01	6.44	18.59	14.47

* 12 districts have no geriatric beds (Belgium: 6, the Netherlands: 1, N.-France: 5).

3.3.3. Specific model: system related variables

Some of the independent variables are intrinsically related to the legal and financial regulations that come between suppliers and consumers of health care. Therefore they cannot be compared.

Examples of this type are:

- Variables related to the **insurance system** (privately and publicly insured patients in the Dutch system, self employed and salaried participants of the Belgian and French health insurance system).
- **Ownership of hospitals.** In all three countries both publicly and privately owned hospitals coexist. Hospitals owned by insurance organisations only exist in Belgium and France.
- **Cultural differences.** Cultural differences that do have a clear effect on hospital admission rates are the customs regarding delivery. Unlike the Dutch situation, in France and Belgium deliveries at home are rare.

Whereas the variables described in the previous section (3.3.2) have the same kind of influence on hospital admissions in all three countries, the variables mentioned here either exert an influence dependent on the nature of the system or are unique for a particular health care system.

In this section we will show the frequency distribution of the following variables:

a. the density of physicians in different categories: specialists (all specialists and the so-called popular specialists) and general practitioners;
b. the relative number of publicly insured patients (the Netherlands);
c. the relative number of persons insured according to the "régime générale" in Belgium (salaried persons);
d. the relative number of widows, orphans, disabled and old age pensioners for both "régimes" (the so-called WIGW's, Belgium);
e. the relative number of unemployed persons (France);
f. the percentage of health insurance fund owned hospital beds (Belgium and France);
g. the number of births per 1,000 population (all countries).

3.3.3.1. The number of physicians

3.3.3.1.1. Medical specialists

There are at least two important differences between specialists in the Netherlands on the one hand and Belgium and Northern France on the other.
One is that in the Netherlands all medical specialists are second

line providers, only to be consulted after referral by a general practitioner, whereas their Belgian and French amices are directly accessable.
Another difference relates to the fact that some Belgian and French specialists (like paediatricians, gynaecologists or internists) perform activities that are in the Netherlands only performed by general practitioners.

The following sources for obtaining the data were used:

The Netherlands:
On request the Dutch National Hospital Institute provided us with a list of physicians classsified under the different specialities (in full-time equivalents).
The data are aggregated to the level of the COROP-region.

Belgium:
The number of medical specialists was copied directly from Leroy (Leroy, 1987, tables 86-88; number in full-time equivalents).

Northern France:
The CRESGE provided us with a list of physicians classsified under the different specialists per health region ("secteur sanitaire").

In figure 3.11 and 3.12 show the number of inhabitants per specialist and per so-called "popular specialist" (internists, paediatricians and gynaecologists) respectively. The distributions are shown in map 3.11 and 3.12.

Map 3.11.: Number of inhabitants per medical specialist in the Netherlands, Belgium and Northern France, 1982.

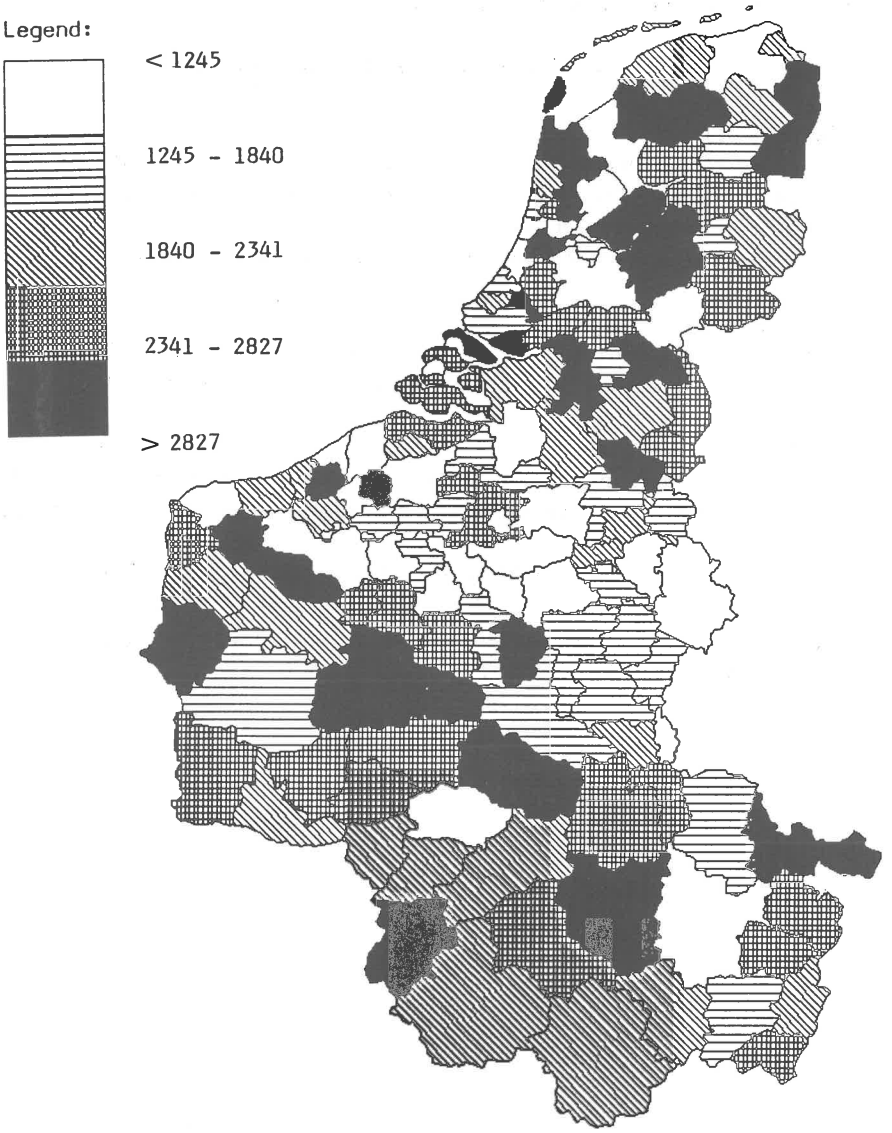
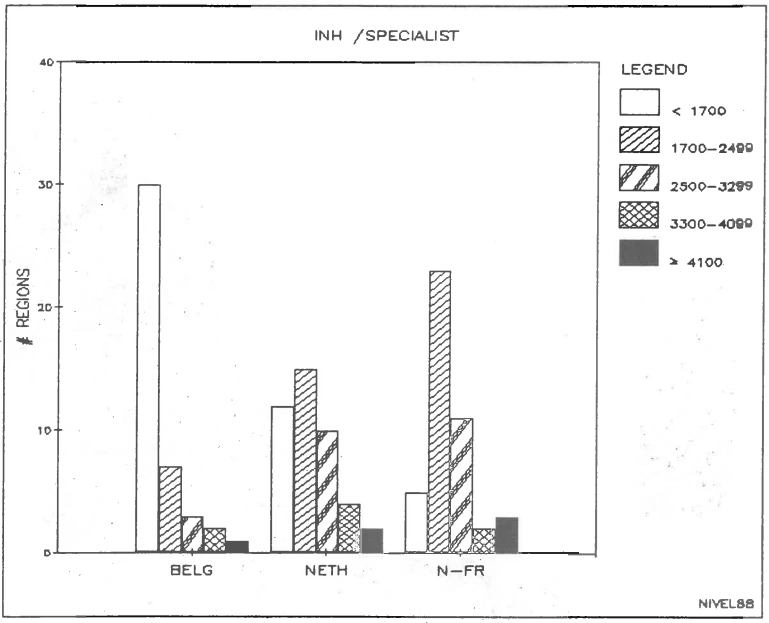


Figure 3.11.: Number of inhabitants per medical specialist for 130 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France	Total
Mean	1678.98	2357.54	2988.23	2346.55
Sd	1014.34	1183.03	3711.41	2381.43

Map 3.12.: Number of inhabitants per popular specialist (internists, paediatricians and gynaecologists) in the Netherlands, Belgium and Northern France, 1982.

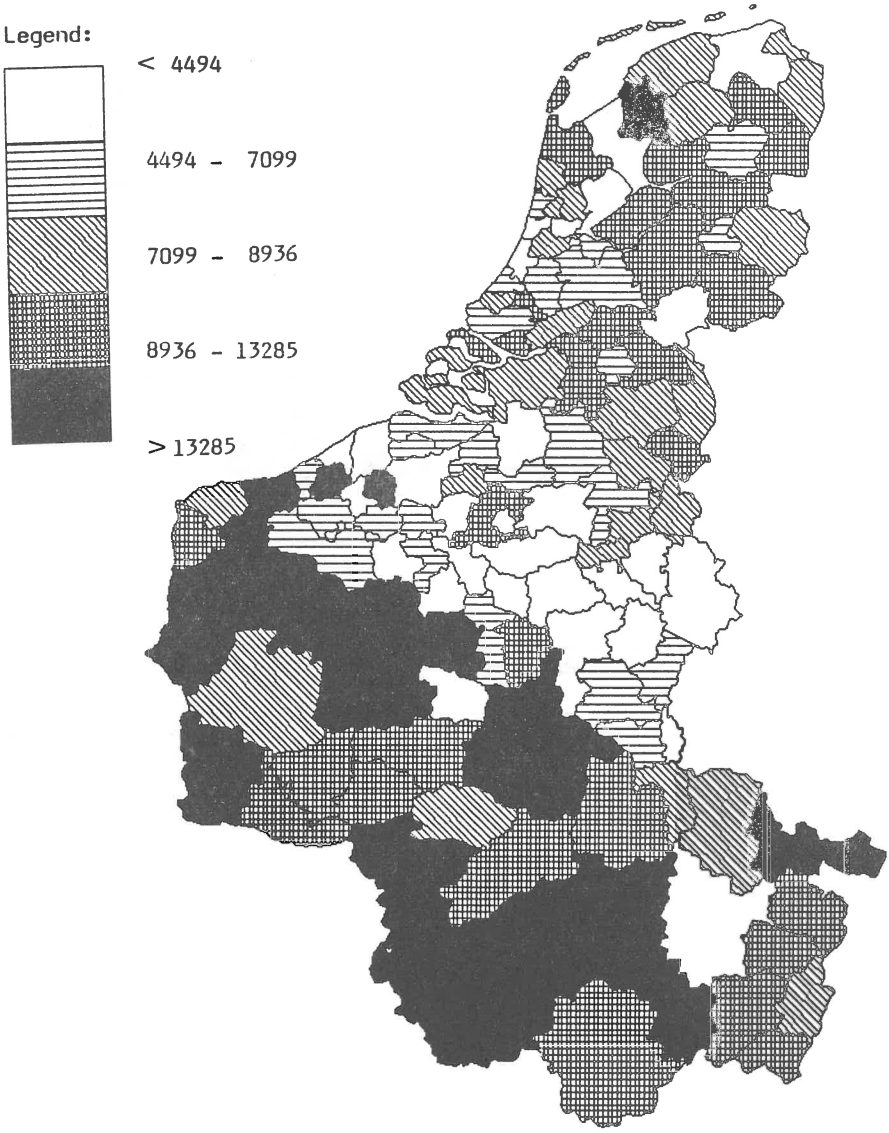
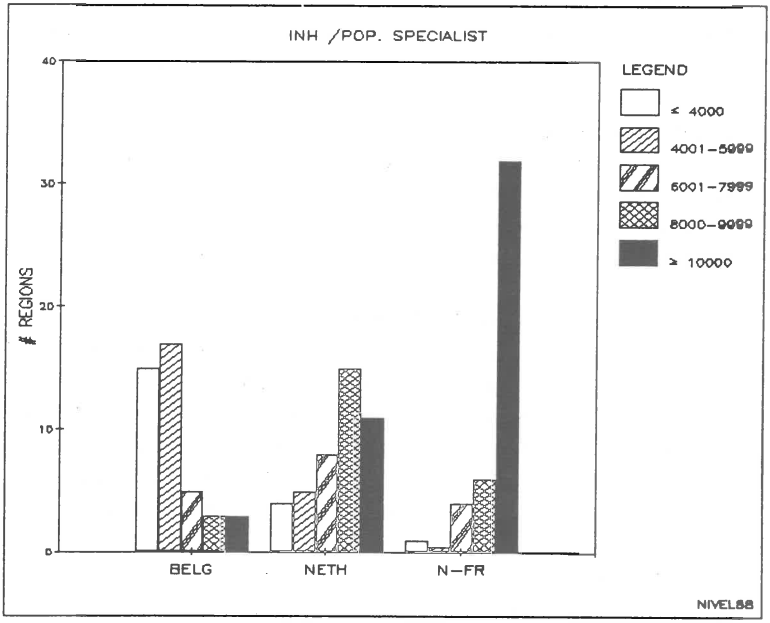


Figure 3.12.: Number of inhabitants per popular specialist (internists, paediatricians and gynaecologists) for 129 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France*	Total
Mean	5967.74	8090.77	14532.46	9530.33
Sd	5039.93	2900.35	8747.88	7040.62

* No popular specialists in Vervins

All specialists

The density variation in Northern France is larger than in the Netherlands and Belgium. The areas with the highest density of medical specialists (the smallest number of inhabitants per specialist) are to be found in Belgium (e.g. Brussels, 374).
The density of specialists in Belgium is relatively low in the

provinces West and East Flanders and in the districts of Maaseik and Philippeville.
In Holland the areas around university hospitals show the highest density of medical specialists. The districts South-West Friesland and Rijnmond (with the exception of the city of Rotterdam) are populated least densely by medical specialists.
In Northern France the districts Lille and Calais in the region Nord-Pas-de-Calais and Nancy-Pompey-Toul in the region Lorraine are populated most densely by medical specialists.

Popular specialists
The pattern is similar to that in the former section, although the density variation within each country is greater. Belgium is populated most densely by popular specialists, followed by the Netherlands and at great distance by Northern-France.

3.3.3.1.2. General practitioners
In this section we are faced with a serious problem of definition. The word 'general practitioner' in the Netherlands has another meaning than in France. In the latter country, general physicians, commmitted to hospices and other institutions are also encompassed under the label of general practitioners who are working from their own premises. The sources for the three countries were:

The Netherlands:
The Dutch Institute of Primary Health Care (NIVEL), records of professionals in primary care.

Belgium:
Data are directly taken from Leroy, (Leroy, 1987 table 83) and are available per arrondissement.

Northern France:
The CRESGE provided us with a list of general practitioners (GP) (salaried and liberal) per health region ("secteur sanitaire").

The distribution is shown in figure 3.13 and map 3.13.

Map 3.13.: Number of inhabitants per general practitioner in the Netherlands, Belgium and Northern France, 1982

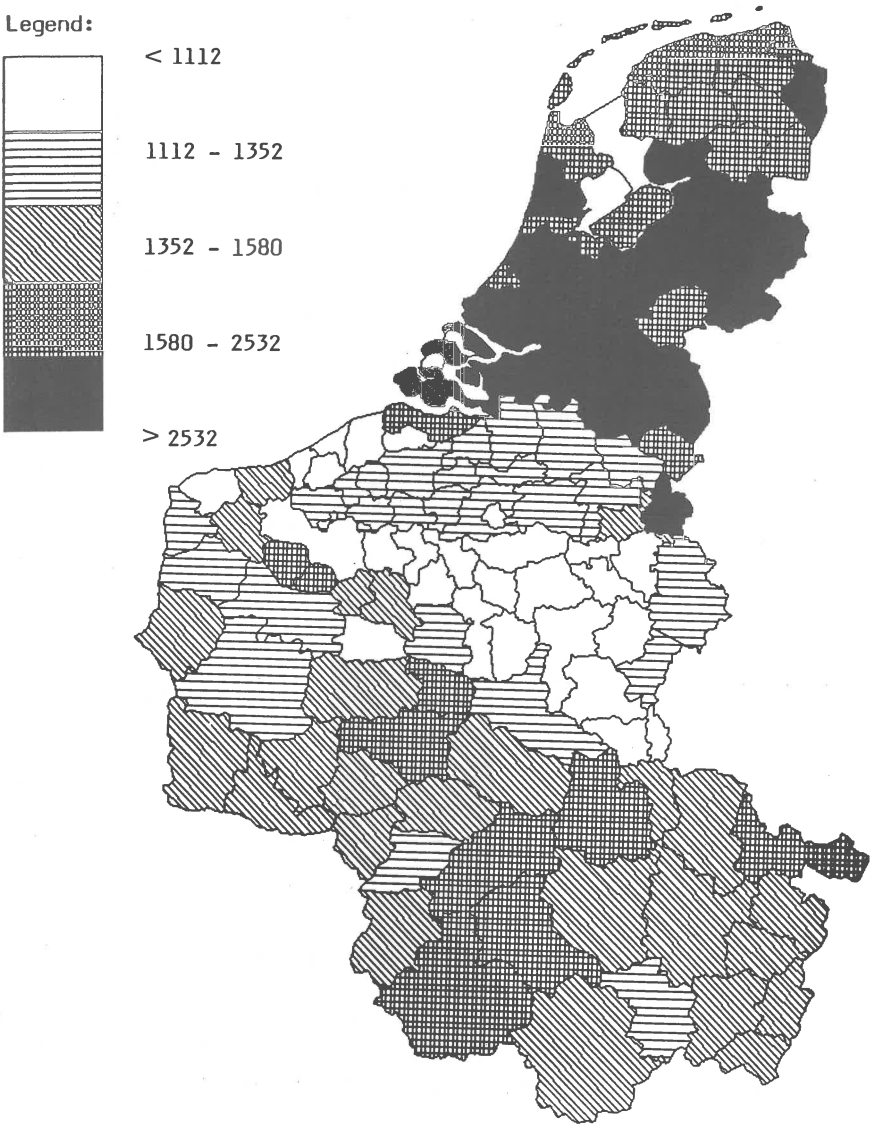
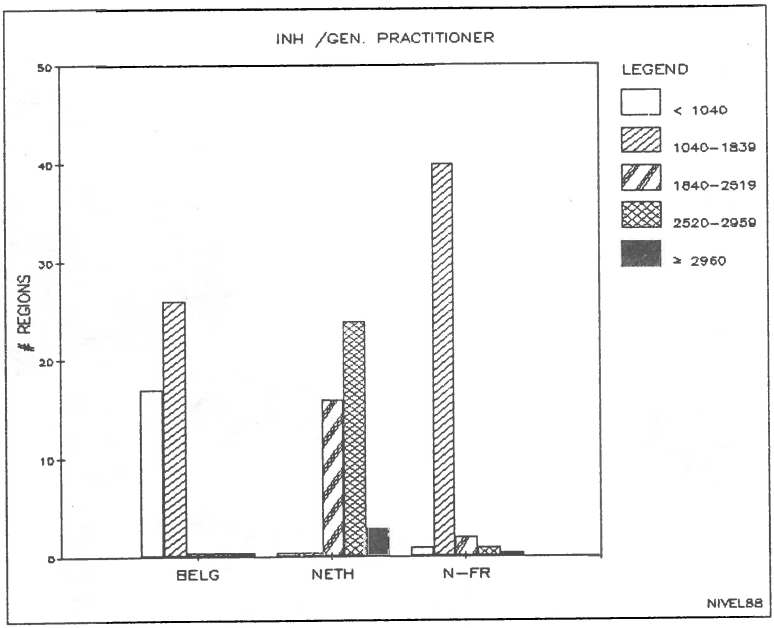


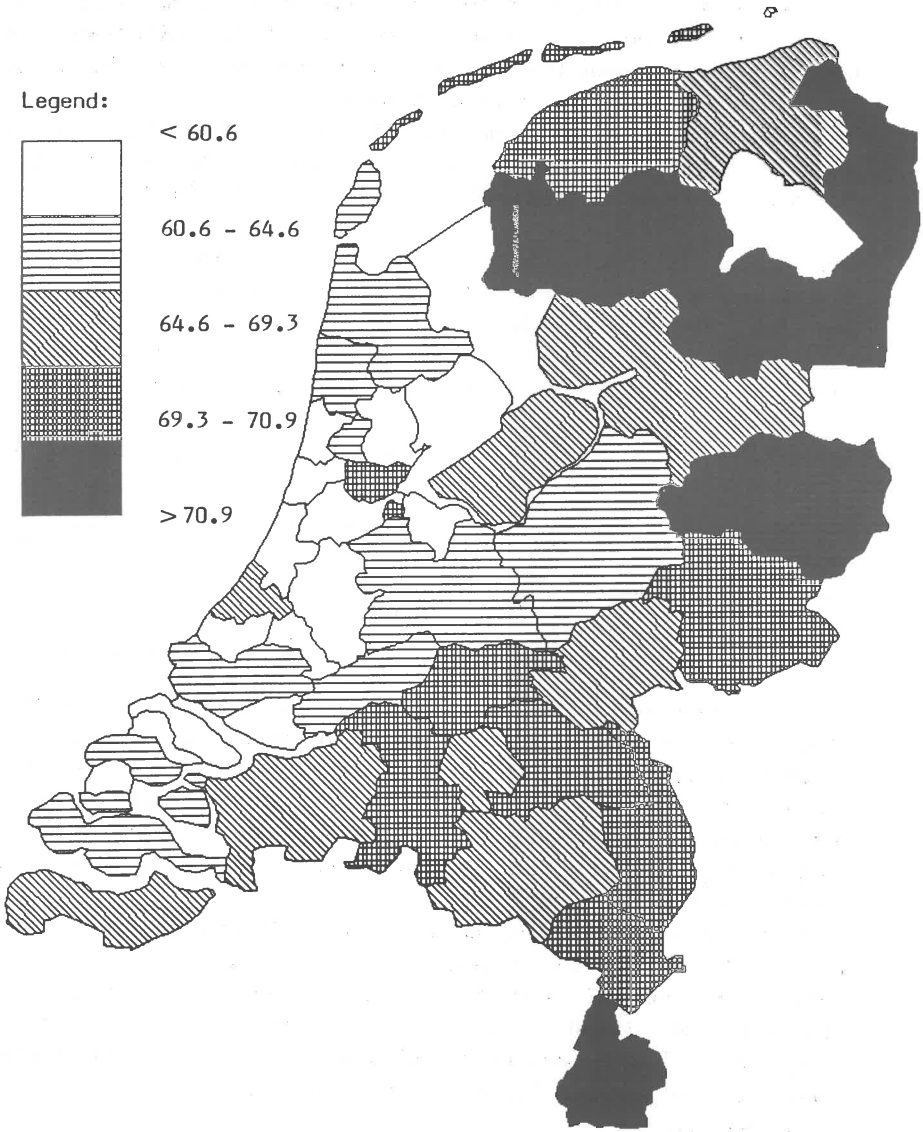
Figure 3.13.: Number of inhabitants per general practitioner for 130 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France	Total
Mean	1086.23	2607.19	1462.55	1716.69
Sd	172.72	223.53	301.87	689.35

As with the number of medical specialists, Belgium is populated most densely by general practitioners.
In Belgium the density of GP's is relatively high (small number of inhabitants per GP) in the provinces of Luxembourg and Liège. Lower density in Holland is predominantly found in the southern and eastern parts of the country. In Northern France the districts Boulay-Forbach, Epinal and Vervins show the lowest density rates.

Map 3.14.: Proportion of publicly insured persons in the Netherlands (1982). Number per 100 inhabitants.



3.3.3.2. Insurance Variables

The first variable discussed in this paragraph is the proportion of publicly insured persons in the Netherlands. The higher consumption rates for publicly insured persons are supposedly due to the relative barrier of the free insurance system (almost no co-payment for publicly insured persons) or to differences in health status between these in wealth differing groups (publicly insured versus privately insured patients).
The distribution of the proportion of publicly insured persons is shown in table 3.14 and map 3.14. The data are derived from the "Landelijk Informatie Systeem Ziekenfondsen" (LISZ, 1982).

The highest rates of publicly insured persons are found in the districts East-Groningen and the South-East of Drenthe. Het Gooi and the Vechtstreek, Delft, the Westland and the region surrounding Amsterdam (except the capital itself) are the districts with the highest proportion of privately insured persons.

Table 3.14.: The proportion of publicly insured persons in 43 Dutch districts (1982)

60%	60-64%	65-69%	70-74%	74%	Mean	Sd
4	14	10	13	2	66.61	5.05

The same kind of argument about the influence of the insurance system on the health care consumption goes for Belgium. The co-payment system (the so-called "ticket modérateur") does not apply to the "non-active" part of the population (widows, orphans, handicapped and old age pensioners below a certain income level) whereas the "active" (i.e. employed) part has to contribute to received medical service.
Another distinction in the Belgian public insurance system exist between the so-called "régime générale" (which applies to all salaried persons and their dependents as to some other groups like students and domestic servants) and the so-called "régime indépendent" (which applies to self-employed persons). The latter group is only insured for heavy risk like hospital admission and in-patient-care.
As in the case of the publicly insured persons in Holland, the general idea is that the absence of direct co-payment induces the

consumption of health services.
The proportion of "non-actives" and population liable to the "régime indépendent" are derived from Leroy (Leroy, 1987, tables 1-18).

The frequency distributions are shown in table 3.15 and 3.16 and in map 3.15 and 3.16.

The highest rates of "non-actives" are found in the province of Henegouwen, whereas the districts Brugge and Bastogne show the highest rates of persons liable to the "régime indépendent".

Table 3.15.: The proportion of "non-actives" (widows, orphans, handicapped and old age pensioners) in 43 districts in Belgium (1982)

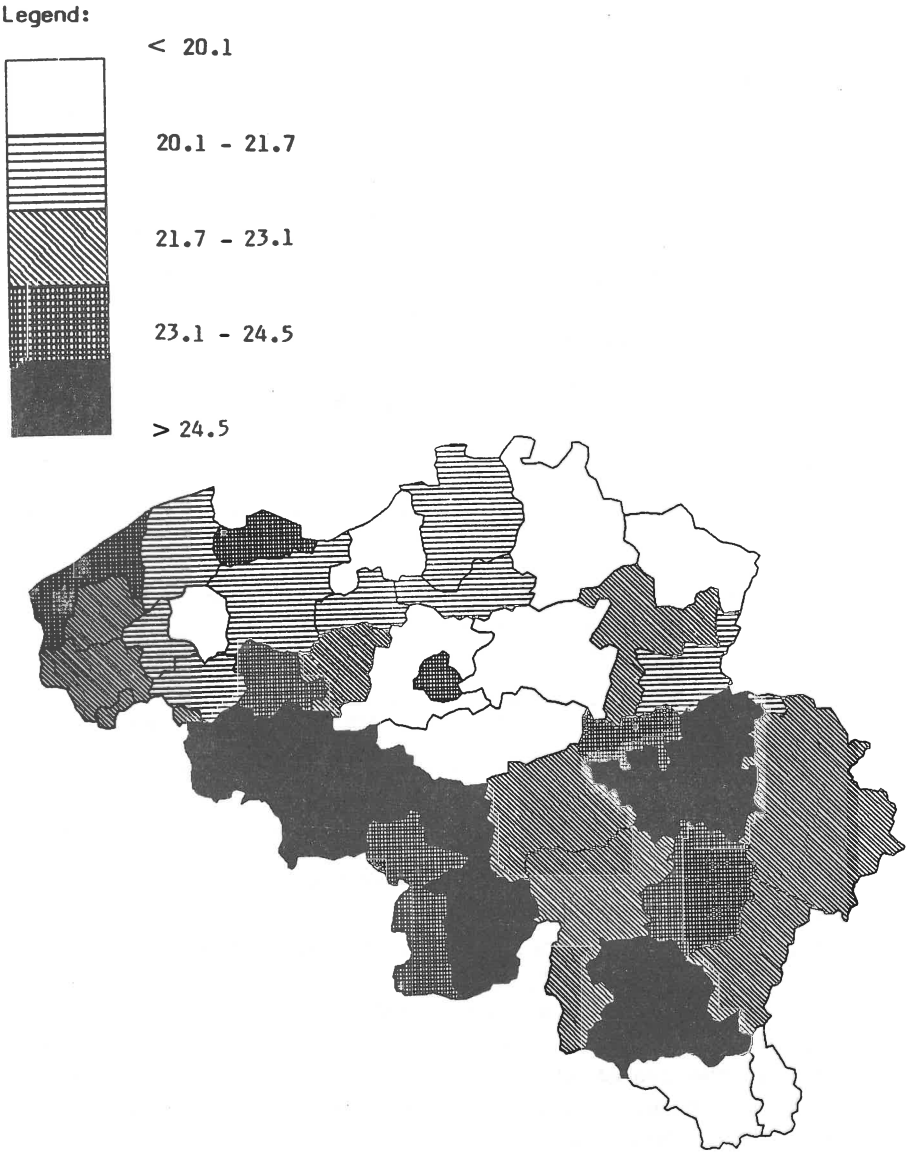
20%	20-22%	23-25%	26-30%	30%	Mean	Sd
8	16	13	5	1	22.67	3.16

Table 3.16.: The proportion of the population liable to the "régime indépendent" for 43 districts in Belgium (1982)

10%	10-15%	16-21%	22-27%	27%	Mean	Sd
3	21	10	7	2	16.67	5.74

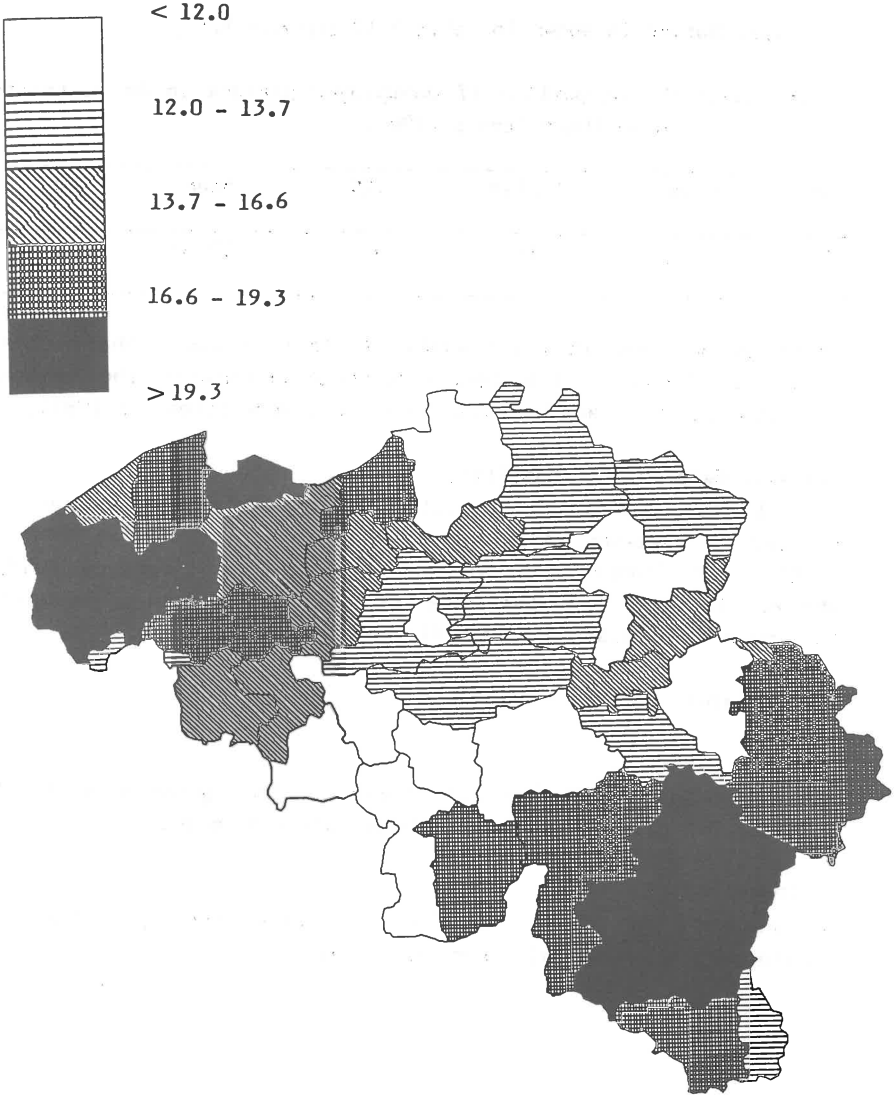
In France, the very poor, who receive the "Aide Médicale Gratuite" or "Aide Médicale Générale", which is paid by the General Councils of the French Departments, are exempted from co-payment. These are funds of "Aide Sociale", quite different from the Social Security System. The CRESGE has made an estimation of the proportion of population in Northern France that is exempted from charges through the system of co-payment. Their valuation is about 10%. There are, however, no data available on a regional level.
The CRESGE has provided data (on a regional level) on the proportion of unemployed persons as a percentage of the active population. This may give a global impression of the proportion of

Map 3.15.: Proportion of "non-actives" (widows, orphans, handicapped and old age pensioners) in Belgium, 1982 (number per 100 inhabitants).



Map 3.16.: Proportion of population liable to the "régime indépendent" in Belgium, 1982 (number per 100 inhabitants).

Legend:



the population that (theoretically) might benefit from the social aid program. One must keep in mind that this variable can also be regarded as an indicator of the socio-economic position, which in turn influences the health status.

The distribution is shown in table 3.17 and map 3.17.

Table 3.17.: The proportion of unemployed persons in 44 districts in Northern France (1982)

8%	8-9%	10-11%	12%	Mean	Sd
8	15	16	5	10.02	1.78

There is a clear division within Northern France. The highest rates are found in the region Nord-Pas-de-Calais; the regions Champagne-Ardennes and Lorraine show the lowest rates (in 1982).

3.3.3.3. Ownership of hospitals

In all three countries publicly and privately owned hospitals coexist. A striking difference between the countries is that in Belgium and France hospitals can be owned by insurance funds, whereas this is not the case in the Netherlands. This might influence the admission rate differentially.

Sources are:

Belgium:
Ministry of Public Health (Ministerie van Volksgezondheid, 1985). Data per 1-1-82. Only acute care hospitals are enclosed.

Northern France:
On request the CRESGE provided us with data per "secteur sanitaire". All hospitals beds are included.

Map 3.17.: Proportion unemployed in Northern France, 1982 (number per 100 inhabitants).

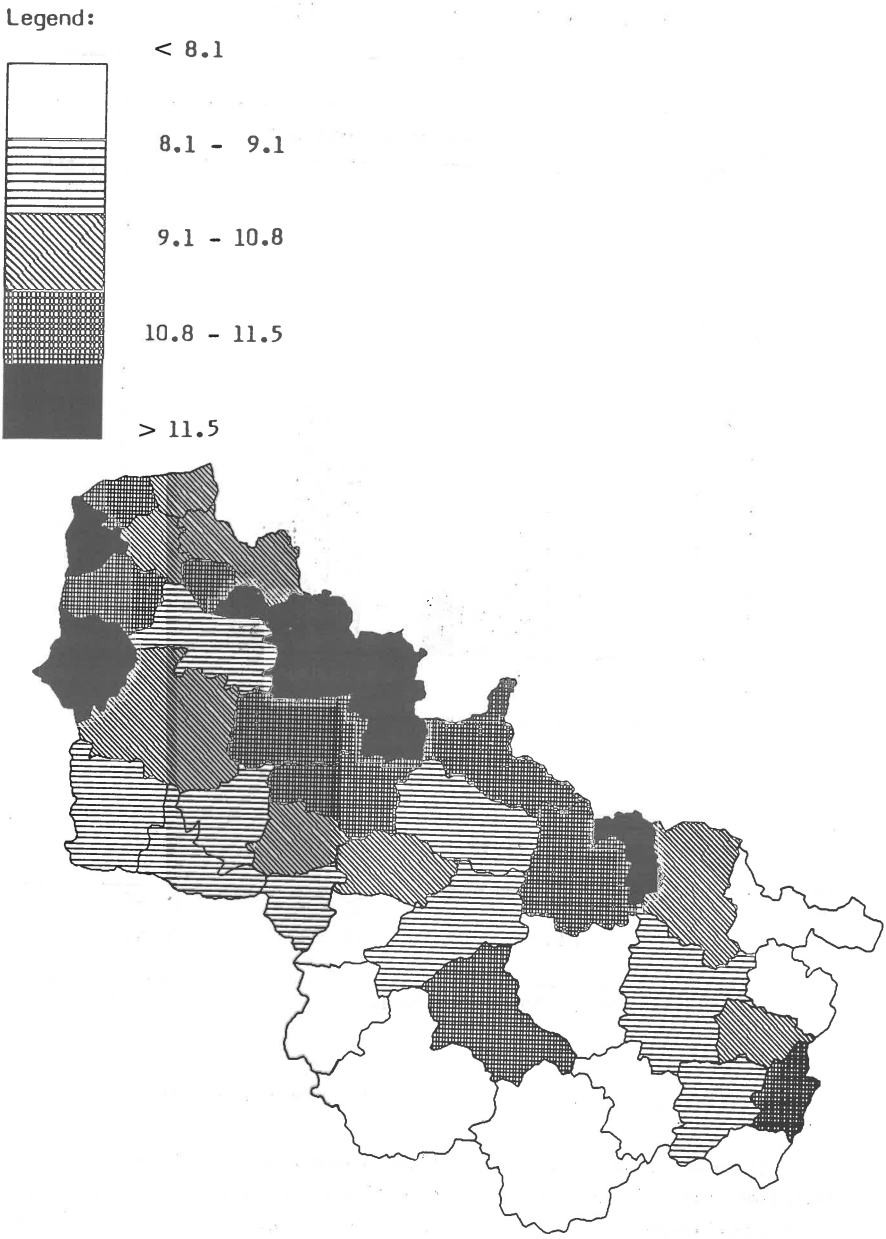
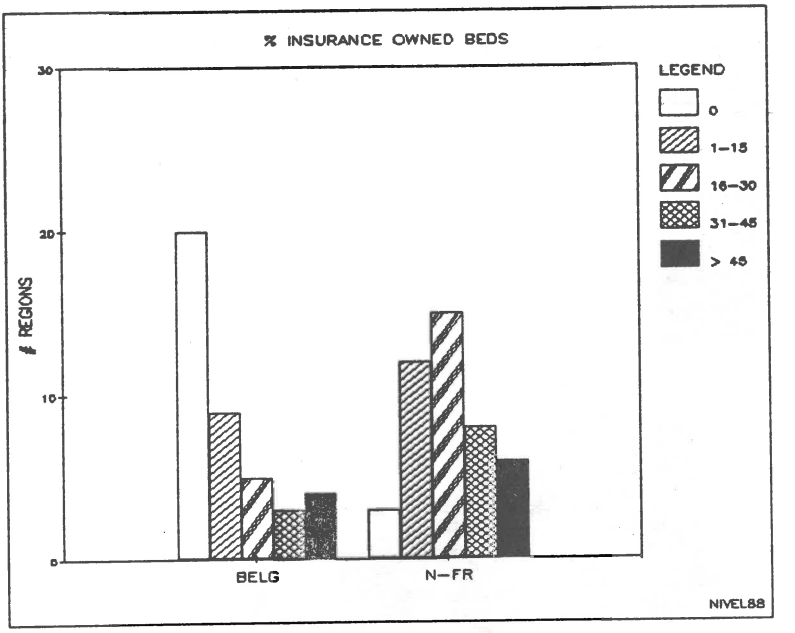


Figure 3.18.: The distribution of the proportion of health insurance funds owned beds in 85 districts in Belgium and Northern France (1982)



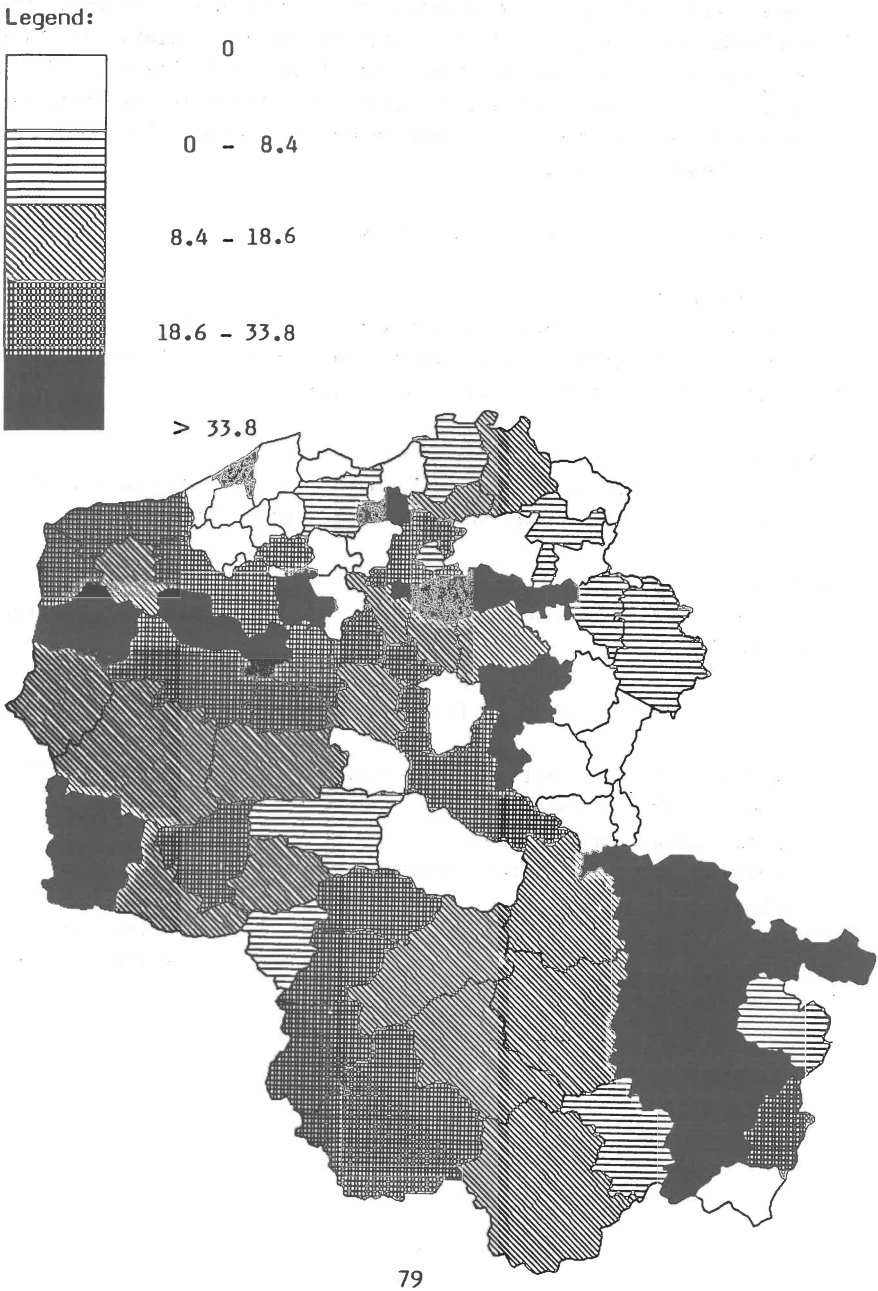
	Belgium*	N.France	Total
Mean	13.37	25.49	19.65
Sd	21.59	18.80	20.97

* In two districts, hospital beds are lacking (Diksmuide and Philippeville).

The distribution is shown in figure 3.18 and map 3.18.

The highest proportion of health insurance funds owned beds in Belgium are found in the districts Waremme and Dinant. In Northern-France the districts Briey and Boulay-Forbach show relatively high rates.

Map 3.18.: Proportion of beds owned by health insurance funds in Belgium and Northern France, 1982 (number of fund owned beds per 100 hospital beds).



3.3.3.4. The number of births

Differences in costums regarding the place of delivery problably influence hospital admission rates.
As mentioned before, a characteristic difference between the Netherlands and the two other countries is the relatively high percentage of deliveries at home (34.5% in 1983: Boerma, 1983). Different habits with respect to delivery influence the hospital admission rates. We therefore considered the number of births as a system related variable.

The sources for the three countries were:

The Netherlands:
The Dutch Central Bureau of Statistics (CBS, 1983): number of 0-year olds per 1,000 inhabitants per municipality. These data are aggregated to the level of the COROP-region.

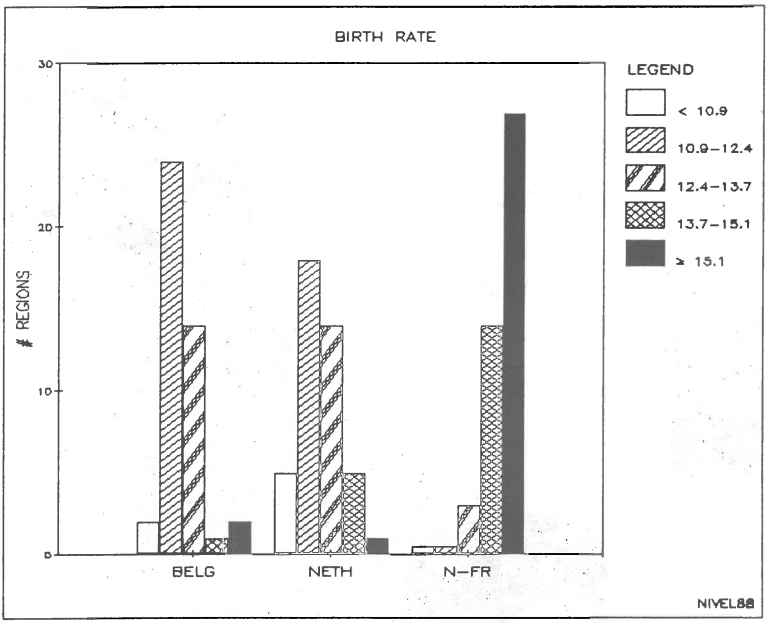
Belgium:
On request the Belgium National Institute of Statistics (NIS) provided us with the number of 0-year olds per district.

France:
The CRESGE provided us with the number of 0-year olds per "secteur sanitaire".

The distribution is shown in figure 3.19 and map 3.19.

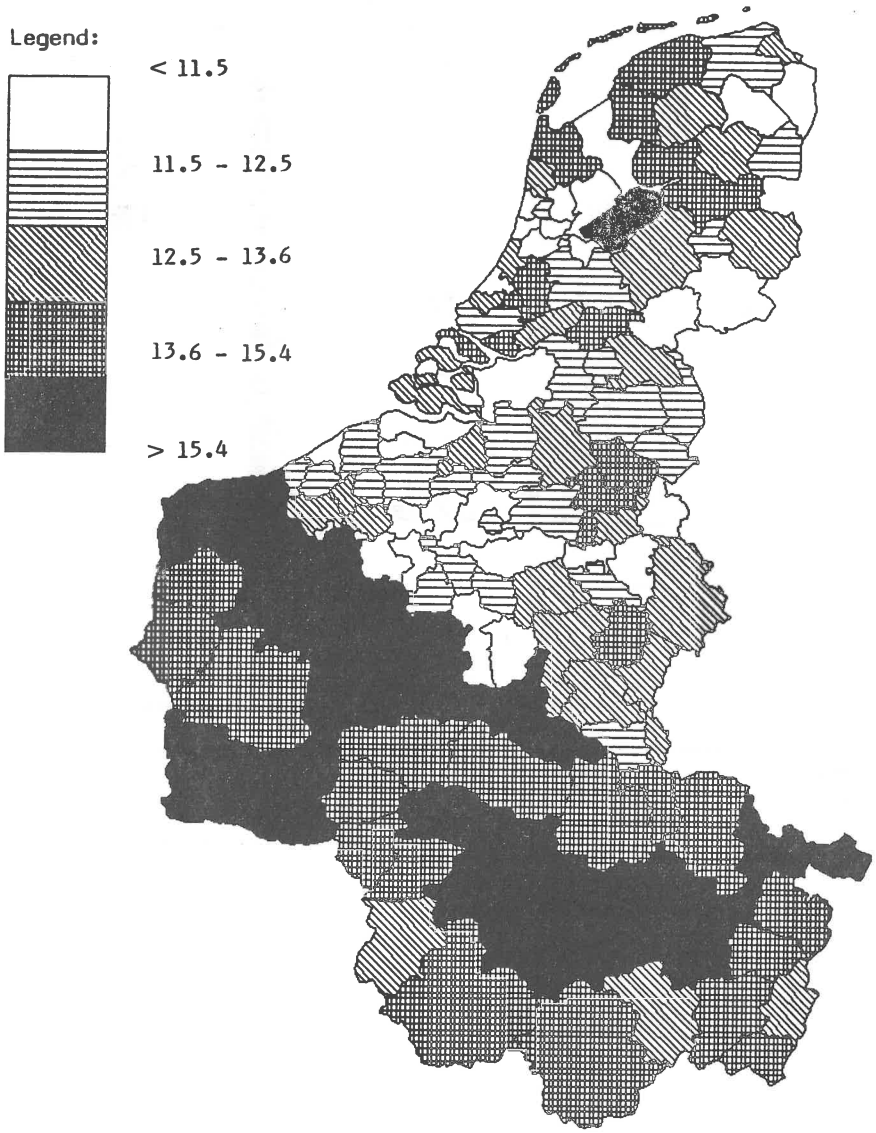
The highest rate in Holland is found in the district Zuidelijke IJsselmeerpolders, whereas the lowest rates are found in the districts IJmond and Haarlem.
In Belgium the districts Maaseik and Marché-en-Famenne show relatively high rates.
Northern France shows in general higher birth rates than the Netherlands and Belgium, especially in the region Nord-Pas-de-Calais.

Figure 3.19.: Number of births per 1,000 inhabitants in 130 districts in the Netherlands, Belgium and Northern France (1982)



	Belgium	the Netherlands	N.France	Total
Mean	12.22	12.40	15.71	13.46
Sd	1.07	1.74	1.42	2.15

Map 3.19.: Birth rate in the Netherlands, Belgium and Northern France, 1982 (number of births per 1000 inhabitants).



4. ANALYSIS OF REGIONAL VARIATIONS

4.1. General model

4.1.1. Comparative analysis on 1982 data

In order to explain regional variation in hospital admissions we started with a model, containing eight independent variables:

1. proportion elderly (age of 65 and over);
2. mortality (age adjusted);
3. number of hospital beds per thousand inhabitants (0/00);
4. standardized income;
5. hospital stay;
6. population density;
7. average hospital size;
8. number of long stay beds per thousand inhabitants (0/00).

The results of a regression analysis of the (8 variables) hypothesized model on admission rates are presented in table 4.1.

In this model, however, no general variable can be found: no variable is able to contribute significantly to the explanation of admission rates in all three countries. In this set-up only hospital stay is a common factor in Belgium and Northern France. and number of beds 0/00 in the Netherlands and Northern France. The common factors in Belgium and the Netherlands are mortality and hospital size (with an opposite effect; the same goes for - marginally significant - the proportion elderly).

The admissions in Northern France can be explained almost totally by two variables: the mean stay per admission and the number of beds 0/00 (Adjusted R^2= .90): The shorter the stay and the more beds available, the more admissions take place; a striking result.

Both stay and income in Belgium are negatively interrelated with admissions: the more admissions take place, the shorter stay and the lower income. Hospital admissions in Belgium are also significantly influenced by the proportion of elderly, hospital size, mortality and population density. All these variables show a positive correlation. So, the older the population, the higher mortality and population density (c.q. the more urbanized), and the larger the hospitals, the more patients are admitted. This extensive model explains almost 50% of the regional variation in Belgian admissions.

Table 4.1.: General model; Regression* on number of hospital admissions 0/00 in 1982. B-coefficients (T-statistic). Inclusion of hospital size and long stay beds

Variables	the Netherlands	Belgium	N.France
- Proportion 65+	-.89	2.30	-.89
	(-1.66)	(2.71)	(-.60)
- Mean stay	.63	-.96	-27.15
	(.77)	(-1.96)	(-12.89)
- Income	1.28	-4.08	-1.24
	(.99)	(-2.34)	(-.41)
- Mortality	4.53	9.29	.49
	(2.72)	(4.89)	(.11)
- Pop.density	.001	.002	-.006
	(.58)	(1.99)	(.54)
- Beds 0/00	4.54	.10	31.25
	(3.53)	(.09)	(19.99)
- Hospital size	-.02	.11	.001
	(-3.02)	(2.87)	(.01)
- Long stay beds	.07	.46	-.14
	(.51)	(1.79)	(-.95)
- Constant	55.18	-3.69	253.0
	(3.51)	(-.17)	(4.86)
- Adjusted R^2	.25	.49	.90

* _____ : $p < .05$
_ _ _ _ _ : $.05 < p < .10$

In the Netherlands the model accounts for 25% of admissional variation. Mortality contributes significantly as does hospital size, albeit contrary to Belgium: in the Netherlands smaller hospital size induces more admissions. Also the number of beds play an important role as in Northern France, though to a lesser degree.

So the extensive model seems to perform best in Northern France with 90% explained regional variation in admissions. Admissions there seem to be linked up with only mean stay and number of beds. In Belgium 50% of the admissional variation can be accounted

for by no less than six contributing factors. Insufficient performance is found in the Netherlands (25% explained variance) with three significantly contributing variables.
No variable is 'general', in that no variable is important to the three countries, though four variables exert their significant influence in two countries: hospital size, mortality, number of beds 0/00 and mean stay.
The contribution of long stay beds is disappointing. It seems therefore worthwhile to repeat the analysis without this variable. The results are presented in table 4.2.

Table 4.2.: General model, Regression* on number of hospital admissions 0/00 in 1982. B-coefficients (T-statistic). Inclusion of hospital size. Exclusion of long stay beds.

Variables	the Netherlands	Belgium	N.France
- Proportion 65+	_-.91_	2.17	-1.17
	(-1.70)	(2.53)	(-.81)
- Mean stay	.69	_-.90_	-26.93
	(.85)	(-1.83)	(-12.85)
- Income	1.44	-3.87	-1.21
	(1.15)	(-2.19)	(-.40)
- Mortality	4.83	10.38	.06
	(3.11)	(5.70)	(.01)
- Pop. density	.001	_.002_	.000
	(.56)	(1.98)	(.47)
- Beds 0/00	4.46	.66	31.37
	(3.51)	(.61)	(20.12)
- Hospital size	-.02	.11	-.02
	(-3.00)	(2.82)	(-.39)
- Constant	54.20	-13.19	259.27
	(3.49)	(-.60)	(4.99)
- Adjusted R^2	.25	.48	.90

* _____ : $p < .05$
_ _ _ : $.05 < p < .10$

In Northern France nothing has changed: still 90% is explained by the same variables mean stay and number of beds 0/00. In Belgium the importance of mean stay and population density is diminished by the exclusion of number of long stay beds. As important can be considered the proportions 65+-ers, mortality and hospital size (all positively) and income (negatively). Still about 50% of admissional variation can be explained.
No change has taken place in the Netherlands. Again 25% variation in admission rates is explained by the same factors: mortality and number of beds (positively) and hospital size (negatively; again contrary to Belgium).

The part that hospital size plays in this configuration needs further investigation. This variable contributes significantly to the explanation of hospital admissions in the Netherlands and Belgium, though in opposite direction. Simultaneously the number of beds is effective in the Netherlands, but not in Belgium.

The correlation between bed supply, admission rate and hospital size in the Netherlands, Belgium and Northern France in 1982 is show in table 4.3.

Table 4.3 Correlation* between bed supply, admission rate and hospital size in the Netherlands, Belgium, and Northern France in 1982.

	The Netherlands		Belgium		Northern France	
	bed sup.	adm.	bed sup.	adm.	bed sup.	adm.
adm. rate	.43	-	.40	-	.84	-
hosp. size	-.14	-.21	.63	.21	.30	.17

* ____: $p < .05$
_ _ : $.05 < p < .10$

Admission rate and bed supply correlate significantly in all three countries. Also the relation between hospital size and admission rate is the same in the countries of interest: they are not (or only marginally) correlated. Hospital size is however differently related to bed supply in Belgium on the one hand and the Netherlands and Northern France on the other: there is a very strong relationship between hospital size and number of beds in Belgium, contrary to the other countries. This get might blurr the relation between bed supply and admission rate in Belgium, as is indicated before.
Therefore the number of beds 0/00 is submitted to a closer examination in table 4.4., which presents regressions of the proportion 65+ers, income, population density, hospital size and mortality on the number of beds 0/00, cq. bed supply.

Table 4.4 Determinants* of regional variation of hospital bed supply in the Netherlands, Belgium and Northern France in 1982. Generalized least squares regression method B-coefficients (T-statistics)

	The Netherlands		Belgium		Northern France	
prop. 65^+	-.02	(-.66)	.20	(2.43)	-.30	(-3.30)
income	.18	(2.06)	-.52	(-2.93)	.79	(4.30)
pop. dens	.0003	(2.48)	.0003	(2.61)	-.0005	(-.83)
hosp.size	-.002	(3.38)	.02	(7.50)	.008	(2.80)
mortality	-.09	(-.79)	.18	(1.06)	-.20	(.66)
Constant	5.61	(5.67)	-3.17	(-1.58)	10.18	(3.10)
R^2 adj.	.27		.49		.40	

As table 4.4. indicates, hospital size is an important determinant of bed supply in Belgium, in that regions with larger hospitals supply more beds. This is not the case in the Netherlands. Altough hospital size appears to contribute significantly to the explanation of variation of the number of bed 0/00, the parameter is ten times smaller (and negative). Also in Northern France hospital size is a minor determinant compared to the Belgian case.

Though more interesting remarks on 4.4 can be made (eg. the relation between income and bed supply), the point here is, that hospital size seems to be a disturbance of the general model and has to be considered as a specific variable. It is therefore worthwile to perform the regression analyses without hospital size as a determinant of admission rate. The results are presented in table 4.5

Table 4.5.: General model, regression* on number of hospital admissions 0/00 in 1982. B-coefficients (T-statistic). Exclusion of long stay beds and hospital size.

Variables	the Netherlands	Belgium	N.France
- Proportion 65+	-.59	1.72	-.99
	(-1.10)	(1.88)	(-.73)
- Mean stay	.09	-.25	-27.12
	(.11)	(-.47)	(-13.37)
- Income	1.60	-2.54	-1.14
	(1.24)	(-1.29)	(-.38)
- Mortality	4.56	9.69	.04
	(2.86)	(5.15)	(.01)
- Pop.density	-.00	.003	.004
	(-.30)	(2.04)	(.41)
- Beds 0/00	5.76	2.89	31.22
	(4.68)	(3.21)	(20.82)
- Constant	48.75	-1.27	257.28
	(3.07)	(-.06)	(5.01)
- Adjusted R^2	.21	.43	.91

* _____ : $p < .05$
_ _ _ : $.05 < p < .10$

With reference to Belgium the influence of proportion elderly, income and mean stay is diminished. A significant contribution to explanation of admission rate is established by mortality, number of beds 0/00 and population density, to a lesser extent by the proportion of 65+-ers. The contributing factors explain 44% of the regional variation in admissions.

The contribution of the proportion 65+-ers is also diminished in Holland. Significantly contributing are mortality and the number of beds, but only 21% of the admissional variance is explained.

No changes take place in Northern France.

Obviously the number of hospital beds 0/00 is a general supply variable in this configuration. But what about mortality? Can this indicator of health status be considered as a general variable? Indeed mortality is positively related to hospital admissions in the Netherlands and Belgium, but is not important in Northern France (see table 4.5). There is reason to look more closely to the interdependency of mortality, income, number of beds and hospital admissions, as shown in table 4.6.

Table 4.6: Partial correlations between mortality rate, admission rate and number of beds 0/00 in 1982 (zero order correlation between brackets)

Partial between	Corrected for	the Netherlands	Belgium	Northern France
Mort/Adm.	Income	.19(.17)	.43(.43)	.04(-.21)
Mort/Adm.	Beds	.22(.17)	.51(.43)	.02(-.21)
Mort/Beds	Income	-.04(-.06)	-.08(-.08)	-.02(-.26)
Mort/Adm.	Beds (income)	.22(.17)	.51(.43)	.10(-.21)
Beds/Adm.	Income	.37(.42)	.42(.42)	.81(.84)

Northern France differs from Belgium and the Netherlands with respect to:

- correlation between mortality and admissions: (not significant) negative correlation, whereas positive correlation is found in Belgium and the Netherlands (-.21 vs .19 (NL) and .43 (B))
- correlation between mortality and beds: in France significant negative correlation, no correlation in other countries (-.26 vs -.04 (NL) and -.08 (B))
- correlation between mortality and income: significant negative correlation in Northern France (-.59 vs -.06 (NL) and -.08 (B))
- correlation between income and admissions: significant positive correlation in Northern France (.40 vs .23 (NL) and -.02 (B)).

These findings seem to indicate that both income and number of beds distort the relation between mortality and beds. In

table 4.6 are presented some interesting partial correlations. The correlation between mortality and admissions changes from from -.21 to +.10, when the influence of both income and beds are eliminated. This is more in line with results in the other countries, though the correlation is still small.

Also the partial correlation of mortality and number of beds 0/00, corrected for income in Northern France is more similar to findings in Belgium and the Netherlands.

So the hypothesis that both income and number of beds 0/00 distort the relation between mortality and admission is, to some extent, confirmed.

Another way to look at the determinants of mortality is shown in table 4.7. In this table mortality is explained by the proportion elderly (65 years and older), income and population density in 1982.

Table 4.7 Determinants* of regional variation in age-adjusted death rates in the Netherlands, Belgium and the north of France in 1982. Generalized least squares regression method. B coefficients (T-statistics)

	The Netherlands		Belgium		N-France	
Prop.65+	.01	(.60)	.14	(2.96)	.006	(.22)
Income	-.30	(-4.73)	-.14	(-1.51)	-.38	(-7.38)
Pop.density	.0003	(4.47)	-.0001	(-2.40)	.002	(9.58)
Constant	8.41	(32.43)	8.62	(13.53)	9.72	(26.19)
Adjusted R^2	.16		.10		.69	

* _____: $p < .05$
_ _ _ _: $0.05 < p < .10$

Table 4.7 indicates that Northern France and the Netherlands are similar in that both income and population density are important determinants of mortality: higher mortality rate is found in poorer and more densely populated areas, though those two determinants explain only 16% of the mortality variance in the Netherlands, but no less than 70% in Northern France. A different picture exists in Belgium; income is not related to mortality and population density is negatively related (contrary to Northern France and the Netherlands). In Belgium mortality is higher in more sparsely populated areas with older population. Only 10% of variance in mortality is explained.
Whatever the reason of these differences, the point here is that mortality rate does not deviate that much as a determinant of admissions compared to the other countries, as suggested by table 4.5. Mortality is therefore treated as a general demand variable.

All this does not explain why income in Northern France is strongly related to mortality, number of beds and admissions. Is it simply because more beds are available in richer regions? Or do lower class people live in relatively unhealthy regions? This question needs further clarification.

Summary and conclusions

Only two variables in the reduced general model explain 91% of the variation in French admission rates: the number of hospital beds and mean stay per admission. Less available beds and shorter mean stay induce more hospital admissions.
In Belgium especially important are mortality, population density and the number of beds. They explain 44% of the variance.
The general model is somewhat disappointing in the Netherlands: only 21% of admissional variance is explained, mainly by mortality and number of beds 0/00.
Some comment is useful at this point.
The cost of healthcare is determined, among others, but to a considerable extent by the number of admissions to the second, specialistic echelon. As is obvious from table 4.5 in France the admissions are solely determined by number of beds and mean stay, not by mortality or other health indices. It is not amazing then

to find cost of health care in France to be one of the highest in Europe, and growing fastest, though the validity of Northern-French data to France as a whole is not clear yet. The contribution to the explaining potency of the general model by the number of beds 0/00 is also considerable in the Netherlands and Belgium, though in the Netherlands more so than in Belgium. This is reflected in health care cost as presented in table 4.8.

The cost of health care is also high in the Netherlands, in spite of the fact that hospital admissions are not merely, to the same extent determined by supply variables. Heesters and Kesenne (1985), comparing the Dutch and Belgian healthcare systems, state that in the Netherlands both cost per head and cost per bed (in the intramural sector) are higher than in Belgium and point to a more extensive intramural sector in the Netherlands. E.g. nursing homes are not available in Belgium. This might explain differences in cost between Northern France, the Netherlands and Belgium.

Apart from that Heesters and Kesenne estimate the cost of the Belgium healthcare system higher than the OECD (7.5% versus 6.1% GDP) and the cost of the Dutch healthcare somewhat lower (8.3% versus 8.6% GDP).

Table 4.8.: Total health expenditure in proportion Gross Domestic product (Source: OECD, 1987)

Year	the Netherlands	Belgium	France
1960	3.9	3.4	4.3
1965	4.4	3.9	5.3
1970	6.0	4.0	6.1
1975	7.7	5.4	7.6
1980	8.2	6.1	8.5
1982	8.6	6.1	9.3

The number of beds per thousand inhabitants is the only variable important for all involved countries. Mortality is especially important in Belgium and to a lesser extent (though significantly) in the Netherlands. So, with respect to Belgium and the Netherlands hospital admission rate is determined by supply as well as demand variables. Though not important to the model, it is

showed that mortality is also influential in Northern France, similar to the other countries, be it not to the same extent. It is argued that also mortality can be considered as a general variable.
Population density is only important to Belgium, although most probably it does not act directly on admission rate but by mediation of proportion of elderly (correlation .53) and number of beds 0/00 (correlation .42).

As stated before, the general model variables explain up to 90% of the French and 43% of Belgian admissional variation, but only 20% in the Netherlands. In other words, a lot of variance in Dutch admission rates remains to be explained. Which (specific) factors are useful will be explored in due course.

4.1.2. Longitudinal analysis: general model in 1974, 1979 and 1982.

The data in paragraph 4.1.1 refer to the year 1982, in which Northern France entered the scene.
Also data referring to 1974 and 1979, are available for Belgium and the Netherlands. It is interesting and important to know to what extent the general model holds in previous periods and whether the contribution of specific variables changes.

In table 4.9 the results of the longitudinal analysis on Dutch data are presented, in table 4.10 those on Belgian data. The general model consist of the same contributing variables as presented in table 4.5: the version without long stay beds and hospital size.

Table 4.9.:
Longitudinal analysis. Regression* of general model variables and admissions 0/00 in 1974, 1979 and 1982 in the Netherlands. B-coefficients.

Variables	1974	1979	1982
Proportion 65+	.10	-.70	-.59
Mean stay	-2.16	-1.43	.09
Income	-.89	.07	1.60
Mortality	5.76	1.39	4.56
Pop.density	-.000	.002	-.000
Beds 0/00	12.32	8.69	5.76
Adjusted R^2	.49	.33	.21

* _____ : $p < .05$
_ _ _ : $.05 < p < .10$

As is obvious from table 4.9 the completeness, c.q. the quality of performance of the model in the Netherlands seems to diminish, explaining 49% (in 1974) to 21% (in 1982) of variance in admission rates.
The number of beds 0/00 stays an important, significantly contributing factor although the influence seems to weaken in due course. The same goes for mean stay: This variable was contributing significantly in 1974, but not in subsequent periods. Mortality is important, in 1974 and 1982, with an unexplainable decline in 1979. The population density was only manifest in 1974 but not in later years.

The policy of the Dutch government to diminish admission rates by reducing the number of hospital beds has not been very succesful. The necessity of gilling beds however is directly and indirectly diminished and this might be the reasson that admission rates become more and more independent of number of beds.

The general model is more consistent in Belgium (see table 4.10). Between 45% and 55% of the variance in admission rates is explained. Mortality, population density and the number of beds stay (significantly) important, although the influence of the latter seems to weaken. Income and the proportion elderly people, though manifest in 1974, contribute less in subsequent years.

Table 4.10: Longitudinal analysis. Regression* of general model variables on admissions 0/00 in 1974, 1979 and 1982 in Belgium. B-coefficients.

Variables	1974	1979	1982
Proportion 65+	-2.03	-.85	1.72
Mean stay	.07	-.43	-.25
Income	-4.44	-2.21	-2.54
Mortality	5.51	13.61	9.69
Pop.density	.003	.008	.003
Beds 0/00	5.14	3.19	2.89
Adjusted R^2	.43	.50	.43

* _____ : $p < .05$
_ _ _ _ : $.05 < p < .10$

4.1.3. Discrimination of regions by general model variables: another approach

The question whether a general model is able to explain variation in admission rates for each of the countries separately, and whether the contributing model variables differ in importance to the explanation was discussed in paragraph 4.1.1. and 4.1.2.

In this paragraph the question is raised whether the involved variables (admission rate, mean stay, proportion 65+, number of beds, population density, mortality and income) are able to differentiate regions. In other words can regions correctly be classified with respect to nationality by means of the indicated variables.
The purpose of this excercise is not to investigate the nature of admissions, but

1. to get an impression of the potential discriminability of the involved variables.
2. to study the nature of transition in nationality. In other words differ border regions from other regions with respect to all or some model variables or is intranational variation smaller than international variation.?

   This is done by means of discriminant analyses. Results will be reported elsewhere in more detail (Van der Zee et al, 1989).

Discriminant analysis computes one or more discriminant functions. These are weighted linear combinations of variables in order to maximize discriminability of the regions.
A score on the discriminant function is computed for each region: the discriminant score. According to this value regions are classified.
The discriminant analysis is performed stepwise, that is, according to a criterium, first the most important explaining variable is entered in the discriminant functions. After this the second important one and so on. After each step the regions are classified on the basis of up to than available information.

The successively entered variables in table 4.11 are presented in descending order of importance together with the proportion correctly classified regions per country and the averaged proportion.

Table 4.11: Proportion correctly classified regions (per country and per step) in a stepwise discriminant analysis

Order	Variable	T. Netherlands	Belgium	N.France	Average
1	Mortality	90.7	48.8	52.3	63.9
2	Mean stay	93.0	76.7	84.1	84.6
3	Admissions 0/00	95.3	76.7	81.8	84.6
4	Proportion 65+	90.7	76.7	79.5	82.3
5	Pop.density	95.3	72.1	79.5	82.3
6	Beds 0/00	95.3	76.7	79.5	83.9
7	Income	93.0	76.7	86.4	85.4

Table 4.11 points out that the variables constituting the general model are capable of discriminating regions with respect to their nationality, and accurately so (85% is correctly classified). Especially mean stay and mortality, entered in step one and two, contribute highly to this result. After step two the proportion correctly classified regions does not change any more.

Two significant discriminant functions can be created. Mortality and number of beds 0/00 correlate highly with function 1 (.68 and .50 respectively) and mean stay and proportion elderly with function 2 (.78 and .34 respectively).

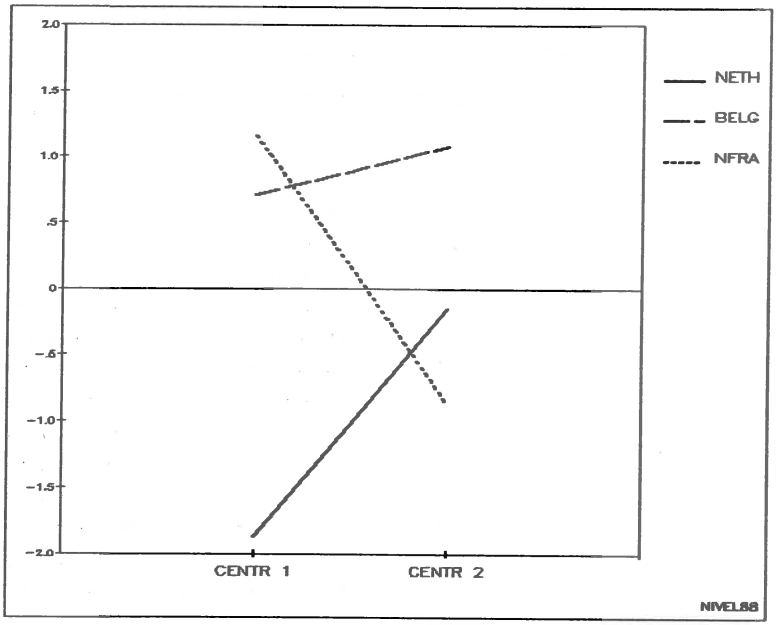
As mentioned earlier each region has a score on each discriminant function. The average scores of the regions, constituting a country, are called groupcentroïds, which are presented in table 4.12 and graphically in figure 4.1

Northern France and the Netherlands appear to be more or less similar with respect to discriminantfunction 2 (i.e. mean stay and proportion elderly), whereas France resembles Belgium with respect to the first discriminant function (i.e. mortality and number of beds 0/00).

Table 4.12: Groupcentroïds as a result of discriminant analysis on 7 variables

	Function 1	Function 2
the Netherlands	- .188	- .16
Belgium	.70	1.07
Northern France	1.15	- .89

Figure 4.1.: Graphical presentation of table 4.12



As mentioned before, 85.4% of the regions is correctly classified, so 14.6% is not. The misclassified regions and their nationality can be found in table 4.13.

Table 4.13: Incorrectly classified regions

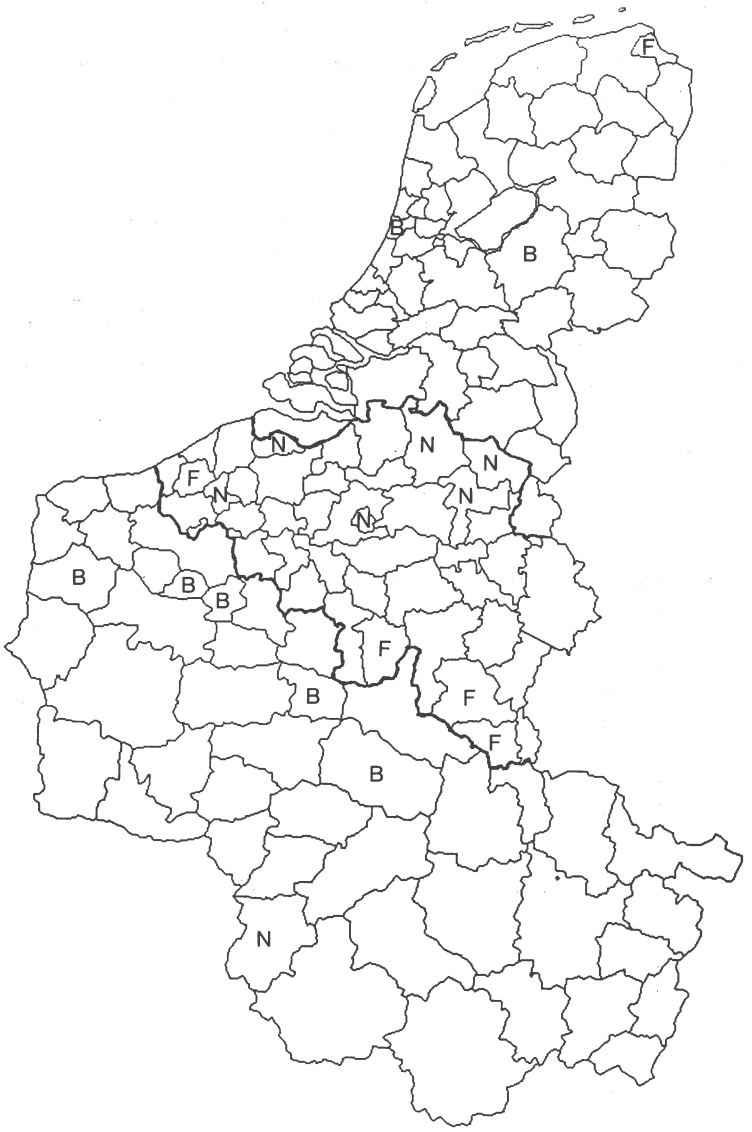
	Region number	Name	Classification
The Netherlands	2	Delfzijl	Northern France
	13	Veluwe	Belgium
	21	Haarlem	Belgium
Belgium	3	Turnhout	the Netherlands
	4	Brussels Cap.	the Netherlands
	9	Diksmuide	Northern France
	13	Roeselaere	the Netherlands
	18	Eeklo	the Netherlands
	33	Hasselt	the Netherlands
	34	Maaseik	the Netherlands
	39	Neufchateau	Northern France
	40	Virton	Northern France
	43	Philippeville	Northern France
Northern France	2	Ardennes-Sud	Belgium
	3	Romilly-Sézanne	The Netherlands
	27	Lens	Belgium
	28	Douai	Belgium
	33	Montreuil/Mer	Belgium
	38	Vervins	Belgium

The regions are presented geographically in map 4.2.

Altogether 19 regions are incorrectly classified. Most of them are situated in the borderland of Northern France/Belgium or Belgium/the Netherlands. Apparently there is a very clear national fundamental prevailing theme in the data, which gradually changes from one country to the other in borderland. These regions are classified back and forth to the other nationality.

The reason of classification of some regions (e.g. Delfzijl to Northern France) will remain unsolved. Perhaps the classification of Brussels Capital and Romilly-Sézanne to the Netherlands can be

Map 4.2.: Incorrectly classified regions in the Netherlands, Belgium and Northern France. Full model is used (see table 4.13 and text for explanation).



explained by the degree of urbanization.

In the remainder of this paragraph results will be presented of a discriminant analysis on two variables: mortality and mean stay. As mentioned before, already 84.6% of the regions is correctly classified on the basis of only these two variables. In table 4.14 groupcentroïds are presented and in table 4.15 the incorrectly classified regions. Figure 4.3 shows table 4.14 graphically and map 4.4 presents the regions and their classification geographically.

Table 4.14.: Groupcentroïds as a result of discriminant analysis on the variables mortality and mean stay

	Function 1	Function 2
the Netherlands	-1.32	.28
Belgium	1.00	.68
Northern France	.32	- .94

Figure 4.3.: Graphical presentation of table 4.14.

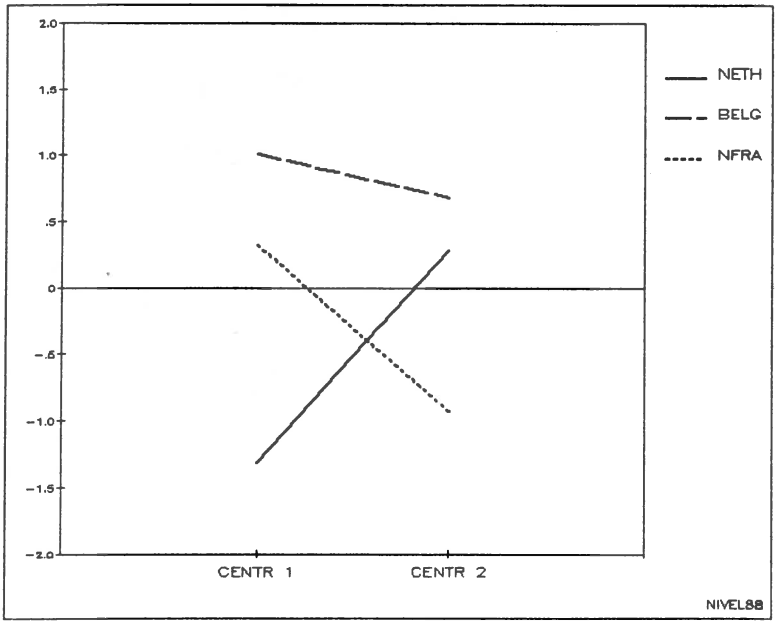


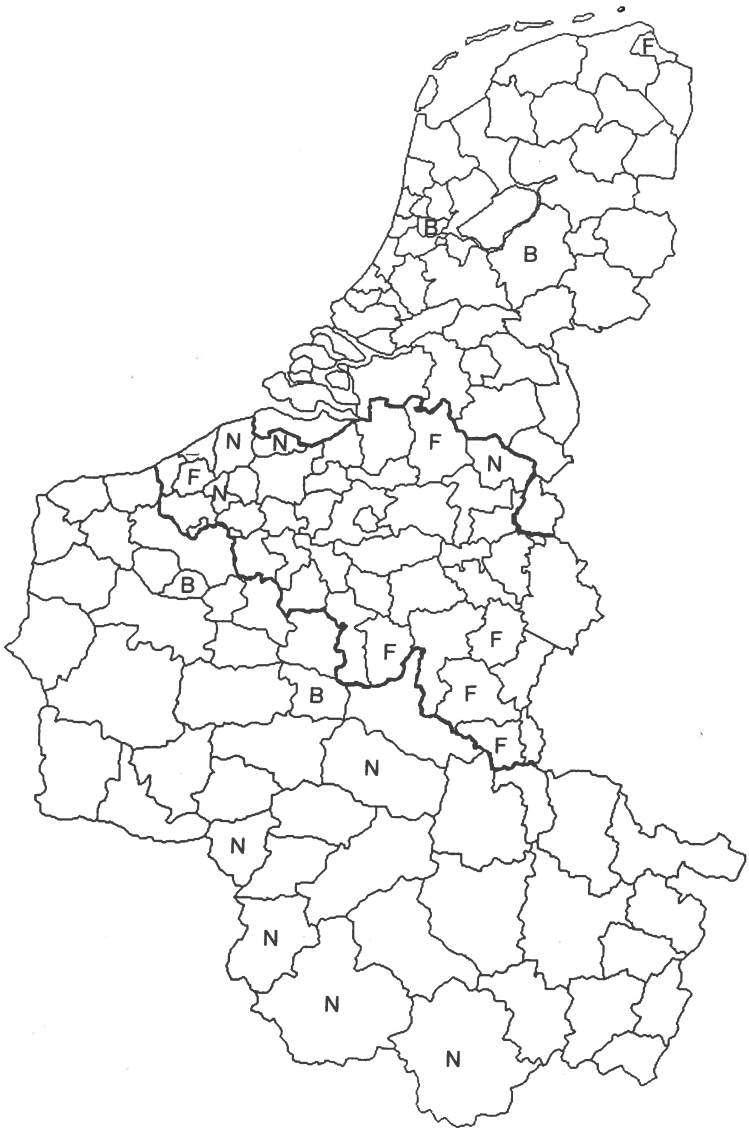
Table 4.15.: Incorrectly classified regions: analysis on mortality and mean stay

	Region number	Name	Classification
the Netherlands	2	Delfzijl	Northern France
	13	Veluwe	Belgium
	41	Amsterdam City	Belgium
Belgium	3	Turnhout	Northern France
	8	Brugge	Netherlands
	9	Diksmuide	Northern France
	13	Roeselaere	the Netherlands
	18	Eeklo	the Netherlands
	34	Maaseik	the Netherlands
	38	Marché-en-Fam.	Northern France
	39	Neufchateau	Northern France
	40	Virton	Northern France
	43	Philippeville	Northern France
Northern France	2	Ardennes-Sud	the Netherlands
	3	Romilly-Sézanne	the Netherlands
	4	Troye-Bar s.Aube	the Netherlands
	8	Chaumont-Langres	the Netherlands
	27	Lens	Belgium
	38	Vervins	Belgium
	44	Chateau-Thierry	the Netherlands

As is obvious from figure 4.3 Northern France resembles Belgium with respect to function 1 (mortality) similar to previous excercise, but this time Belgium and the Netherlands are similar with respect to function 2 (mean stay).

Twenty regions are not correctly classified. Again, mutual attribution takes place in the borderland. Fourteen of these regions were also incorrectly classified in the former analysis. Perhaps the degree of urbanization is the reason of incorrect classification of the French regions Romilly-Sézanne, Chateau-Thierry, Troye-Bar sur Aube and Chaumont-Langres.

Map 4.4.: Incorrectly classified regions in the Netherlands, Belgium and Northern France. Only mortality and mean stay are included in the model (see table 4.15 and text for explanation).



4.1.4. Summary/conclusions

The first part of this chapter is build on results of previous studies. The general model is taken as a starting point for studying c.q. explaining the admission rate. The factor long stay beds appears to have no explanatory power, whereas inclusion of hospital size distorts interpretation. Both variables are subsequently eliminated.

By means of discriminant analyses it is shown that on the basis of involved variables (i.e. number of beds 0/00, admission rate, income, mortality, proportion 65+, population density and mean stay) regions can be correctly classified with respect to their nationalities. This is taken as evidence for the importance of the variables. (It appears to be possible on basis of only mortality and mean stay to classify the regions correctly). The effect of the model variables seems to be country-specific with a gradual change in border regions.

With respect to longitudinal comparison of the general model over subsequent periods (1974, 1979, 1982; only data available of the Netherlands and Belgium) it is remarkable that the explaining power of the general model has diminished from 49% via 33% to 21% explained variance of admission rates in the Netherlands. A more consistent pattern is seen in Belgium: over 40% of admissional variance is explained, with an upward peak of 50% in 1979.
In both countries mortality and number of beds remained important, whereas the effect of income and the proportion of 65+-ers in Belgium and of mean stay in the Netherlands diminished. Population density appears to have influence on admission rate only in Belgium.

The admission rate in Northern France is almost completely explained by number of beds 0/00 and mean stay (90%) in 1982. It has been mentioned that this points to an extremely expensive health care system.

In Belgium mortality, number of beds 0/00 and population density explain 43%, whereas in the Netherlands, disappointingly, 21% of admissional variance is explained by mortality and number of beds.

4.2. Specific variables

The effect of specific variables on admission rates will be described in three ways:

1. by presenting seperate effects of the specific variables, similar to or comparable with previous studies (Groenewegen and van der Zee, 1985; van der Zee and Groenewegen, 1985);
2. by performing a four-step regression analysis, in which four groups of variables are tested subsequently;
3. by adopting a heuristic approach to the problem of explaining variation in admission rates. Now a stepwise regression is performed with potential inclusion of all (normalized) variables.

4.2.1. Separate effects of specific variables

In this paragraph are presented the effects of some specific variables on the residuals of admission rates, containing variation that is not explained by mortality and number of beds.

For each country the regression on residual admission rate is computed of:

1. ratio general practitioners / specialists;
2. ratio general practitioners + popular specialists / other specialists;
3. inhabitants / general practitioner;
4. inhabitants / popular specialist;
5. inhabitants / specialist;
6. hospital size (now considered to be specific);
7. proportion of 65+-ers (now considered to be specific).

In addition is regressed:

1. proportion publicly insured (the Netherlands);
2. proportion liable to the "régime independent";
3. proportion non-actives (Belgium);
4. proportion non-employed (France);
5. proportion beds owned by insurance funds (Belgium and France).

For general information on these variables we refer to chapter 3.

Each regression also contains, similar to previous studies, the variable birth rate. Birth rate is expected to have a differential

effect on admission rates, because in Belgium and France all births induce full admission, whereas most births in the Netherlands do not.

In tables 4.17, 4.18 and 4.19 are presented the B-coefficients of the involved variables, T-statistic and the adjusted R^2 for each country.

The regressions of mortality and number of beds 0/00 are shown in table 4.16. The influence of these variables differ enormously with respect to nationality.

Table 4.16.: Regression* of mortality and number of beds 0/00 on admission rates per nationality. B-coefficient (T-statistic), 1982

	the Netherlands	Belgium	N.France
- Mortality	3.85	10.27	.11
	(2.70)	(5.82)	(.02)
- Nb. of beds 0/00	6.03	4.27	31.13
	(5.91)	(5.42)	(14.09)
- Constant	48.02	7.18	13.67
	(3.54)	(.38)	(.27)
- Adjusted R^2	.21	.37	.70

* _____ : $p < .05$
_ _ _ : $.05 < p < .10$

Birth rate contributes significantly to explaining residual admission rates only in the Netherlands, and is negatively correlated with admissions. The explaining power is small. Although in France and Belgium, contrary to the Netherlands, births count for a full admission (all births take place in hospitals) there appears to be no significant coherention between birth rate and residual admission rate in those two countries. Perhaps birth rate has to be considered more as a general health indicator, to the extent that more births, i.e. a younger population induce less admissions. This relation is only obvious in the Netherlands. Another explanation is that birth rate acts

Table 4.17.: Regression* of specific variables on residual admission rates. Residuals contain variation not accounted for by mortality and number of beds 0/00. Presented are B-coefficients (T-statistics): the Netherlands, 1982.

	1	2	3	4	5	6	7	8
Birth rate	-1.21	.99	-1.14	-1.41	-1.20	-1.68	-1.87	-1.17
	(-1.97)	(-1.63)	(-2.04)	(-2.32)	(-1.94)	(-3.16)	(-3.08)	(-2.22)
1 gen.prac./spec	.42							
	(.19)							
2 gen.prac. + pop./spec.		-.67						
		(-.57)						
3 inh./gen.prac.			-.0003					
			(-.09)					
4 inh./pop.spec.				.0002				
				(.86)				
5 inh./spec.				.0001				
					(.15)			
6 hospital size						-.02		
						(3.49)		
7 prop. 65+							-.81	
							(-2.31)	
8 prop.publicly insured								.29
								(1.84)
Adjusted R^2	.02	.02	.02	.58	.02	.10	.05	.04

* _____: $p<.05$
_ _ _ : $.05 < p < .10$

Table 4.18.: Regression* of specific variables on residual admission rates. Residuals contain variation not accounted for by mortality and number of beds 0/00. Presented are B-coefficients (T-statistics): Belgium, 1982.

	1	2	3	4	5	6	7	8	9	10
Birth rate	-1.66 (-1.02)	-1.32 (-.80)	-.51 (-.31)	-1.76 (-1.08)	-1.30 (-.79)	-1.79 (-1.12)	.85 (.44)	-1.05 (.68)	.43 (.26)	-1.97 (-1.17)
1 gen.prac./spec.	3.50 (-1.22)									
2 gen.prac./spec.		-3.28 (-1.73)								
3 inh./gen.prac.			-.02 (-2.51)							
4 inh./spec.				-.0006 (-.99)						
5 inh./spec.					-.003 (-1.63)					
6 hospital size						.05 (1.80)				
7 prop. 65+							2.05 (2.46)			
8 prop. independent								-1.23 (-3.59)		
9 prop. non-actives									1.76 (3.76)	
10 prop. beds insurance										-.02 (-.15)
Adjusted R^2	.01	.02	.06	.00	.02	.03	.05	.11	.12	.00

* _____ : $p<.05$
_ _ _ : $.05 < p < 10$

Table 4.19.: Regression* of specific variables on residual admission rates. Residuals contain variation not accounted for by mortality and number of beds 0/00. Presented are B-coefficients (T-statistics): Northern France, 1982.

	1	2	3	4	5	6	7	8	9
Birth rate	3.41	2.93	3.87	3.56	3.09	6.43	3.24	3.59	3.98
	(1.42)	(1.20)	(1.56)	(1.49)	(1.27)	(2.52)	(1.13)	(1.44)	(1.64)
1 gen.prac./spec.	-9.33								
	(-1.51)								
2 gen.prac. + pop./spec.		-9.31							
		(-1.81)							
3 inh./gen.prac.			-.0001						
			(-.12)						
4 inh./pop.spec.				-.001					
				(-1.48)					
5 inh./spec.					-.006				
					(-1.56)				
6 hospital size						-.16			
						(-2.41)			
7 Prop. 65+							-1.01		
							(-.45)		
8 prop. unemployed								1.15	
								(.57)	
9 prop. beds insurance									.02
									(.12)
Adjusted R^2	.03	.04	.01	.03	.03	.07	.01	.01	.01

* _____: $p<.05$
_ _ _ : $.05 < p < .10$

only through the intermediary variable mean stay on admission rate implying that a younger population causes shorter hospital stay.

Also important in the Netherlands are hospital size and the proportion elderly, both significantly accounting for 10 resp. 5% of the residual admission rate: the smaller the proportion elderly and hospital size, the more admissions are expected. The proportion publicly insured contribute only marginally.

More influential variables are to be found in Belgium: the proportion non-actives and the proportion insured according to the "régime independent" account for 12 resp. 11% of the residual admission rates. Also important are number of inhabitants/general practitioner (6%) and proportion elderly (5%). Some other variables play a minor part.

With respect to France hospital size contributes significantly (R^2-adjusted = .07). Only in this configuration birth rate is important.

As is illustrated in table 4.16, much variance is left unexplained in the Netherlands (some 80%), followed by Belgium (60%). In general the specific variables do not enhance the explaining power of the model.

4.2.2. Hierarchical four-step regression analysis

This hierarchical four-step regression analysis is applied in order to study in more detail the effect of some (groups of) variables on admissions.

We therefore defined four groups as follows:

I: General variables mortality and number of beds 0/00.

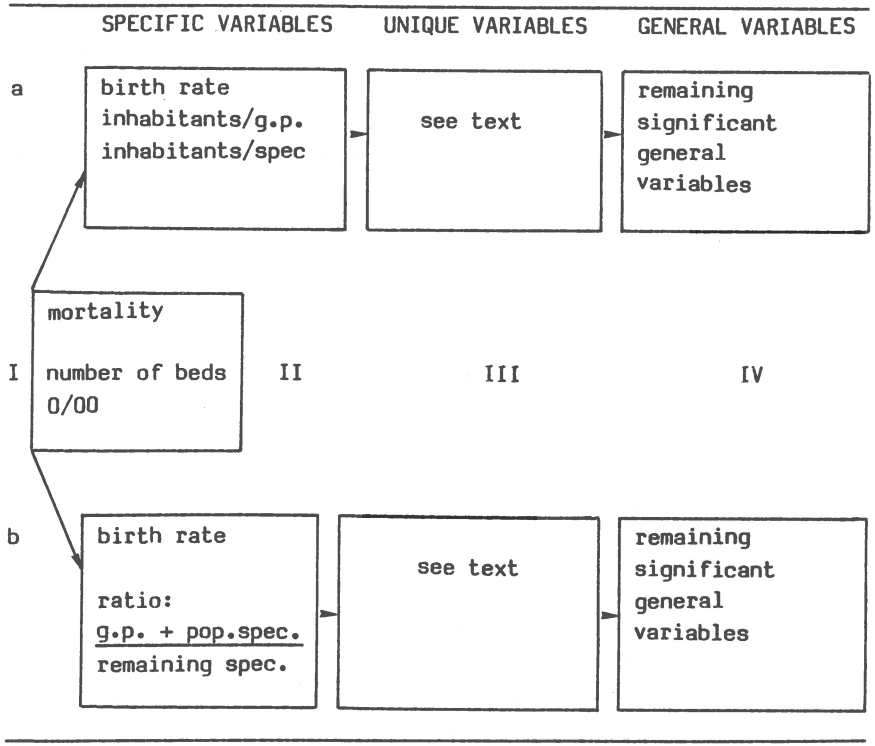
II: Specific variables (present in all countries, but differing with respect to kind and extent of influence)
   a. Birth rate, inhabitants per general practitioner, inhabitants per specialist;
   b. Birth rate, ratio general practitioners + popular specialists / other specialists.

III: Unique variables: unique for each country
- Proportion publicly insured (the Netherlands);
- Proportion insured according to "régime independent" (Belgium);
- Proportion non-actives (Belgium);
- Proportion unemployed (N.France);
- Proportion beds owned by insurers (Belgium and N.France).

IV: Remaining general, significantly contributing variables.

A graphical representation of this analysis is presented in figure 4.5. The results are shown in table 4.16.

Figure 4.5.: Graphical representation of hierarchical four-step regression analysis. See text



With respect to Northern France nothing has changed. The number of beds and mean stay remain most important in explaining admissional variation. In configuration b. the ratio 'general practioners + popular specialists / remaining specialist' appears to be only marginally significant and accounts for 2% of residual variation.

With respect to the Dutch situation are important mortality and the number of beds 0/00, which is a confirmation of earlier mentioned results. After this the residual admissions are somewhat affected by birth rate in fase II.a and subsequently in fase III.a by the proportion publicly insured. In the b.-line the effect of birth-rate is not present.

Table 4.20 : Results of hierarchical four-step regression* on admission rate. Presented are B-coefficients (T-statistics)

Step	Variables	Netherlands	Belgium	N.France
I	- Mortality	3.85 (2.70)	10.27 (5.82)	.11 (.02)
	- Number of beds 0/00	6.03 (5.91)	4.22 (5.42)	31.13 (14.09)
	$-R^2$	.21	.37	.70
IIa	- Birth rate	-1.19 (-1.87)	-.59 (-.35)	3.81 (1.64)
	- Inh/g.p.	-.0004(-.11)	-.03 (-2.64)	.003 (.27)
	- Inh/spec.	.0001 (.16)	.002 (.72)	-.002(-1.27)
	- R^2	.01	.06	.02
IIb	- Birth rate	-.99 (-1.63)	-1.95 (-1.17)	2.99 (1.24)
	- Ratio $\frac{gp + pop}{rem.\ spec}$	-.67 (-.57)	-.71 (-.44)	-8.71 (-1.95)
	- R^2	.02	.00	.05

Table 4.20 : Continued

Step	Variables	Netherlands	Belgium	N.France
IIIa	- Prop. publicly insured	_.28_ (1.80)	-	-
	- Prop. "régime independent"	-	-.86 (-2.38)	-
	- Prop. non-actives	-	.50 (1.07)	-
	- Prop. un-employed	-	-	1.48 (.76)
	- Prop. ins. owned beds	-	-.08 (-.90)	-.03 (-.15)
	- R^2	.02	.07	.00
IIIb	- Prop. publicly insured	_.30_ (1.90)	-	-
	- Prop. "régime independent"	-	-.84 (-2.33)	-
	- Prop. non-actives	-	1.02 (2.21)	-
	- Prop. un-employed	-	-	2.18 (1.14)
	- Prop. ins. owned beds	-	-.04 (-.45)	-.08 (-.40)
	- R^2	.02	.12	.00
IVa	- Pop.density	-	.0006 (.70)	-
	- Prop. 65+	-	-.14 (-.19)	-
	- Mean stay	-	-	-23.31(-12.74)
	- R^2./TOT R^2	-- / .23	.00 / .45	.64 / .89
IVb	- Pop.density	-	.001 (1.51)	-
	- Prop. 65+	-	-.39 (-.32)	-
	- Mean stay	-	-	-24.52(-12.21)
	- R^2 /TOT R^2	-- / .24	.00 / .45	.62 / .89

* _____:p <.05 _ _ _ _: .05 < p <.10

In Belgium the number of inhabitants / general practitioner is important to the admission rate after removal of the effect of mortality and number of beds 0/00 (both important too). In the third fase (a-line) the proportion insured according to the "régime independent", appears to be influential (the higher this proportion, the fewer admissions). When number of inhabitants per general practitioner and specialist are replaced by ratio general practitioners + pop. specialists / specialists (the b-line) then also the proportion of non-actives becomes important.

4.2.3. Summary and preliminary conclusions

With respect to the specific variables the following can be stated:

- In Northern France specific variables do not affect the residual admission rates. Admission rate is almost completely (90%) accounted for by mean stay per admission and number of beds 0/00. The shorter hospital stay and the more beds, the more admissions take place. As mentioned before, the influence of these two variables on admission rate explains the expensive health care of France. Much activities of medical care take place in the expensive second echelon.

- With respect to the Netherlands separate regression analyses reveal the importance of birth rate, hospital size, proportion elderly and, to a lesser extent, the proportion publicly insured. The influence, though marginally, of this latter variable is confirmed in the hierarchical regression analysis, as is that of birth-rate.
  Is the influence of some variables apparent, the importance of this might be questioned, because no more than 23% of the variance is accounted for, versus 45% in Belgium and 90% in Northern France.

- In Belgium are important, according to the seperate analyses, the number of inhabitants / general practitioner, the proportion elderly, the proportion insured according to the "régime independent", proportion non-actives and to a lesser extent hospital size and the ratio general practitioners + popular specialists / remaining specialists.
  The hierarchical analysis again points to the significant effect of the number of inhabitants / general practitioner, the proportion indepently insured and non-actives (in b.-line only).

All these variables however only account for 45% of the admissional variation. Not a poor result, not a good one either.

It is therefore that we conducted a somewhat heuristic analysis as described in the next paragraph.

4.2.4. Heuristic approach. Stepwise regression with potential inclusion of general and specific variables.

In this stepwise regression all normalized variables (proportions, standardisations, number/unit) are allowed to enter the regression if they meet some criterion (F-value). If some variables are highly correlated (say .70) only one of them is included in the analysis to prevent multicollinearity. E.g. the proportions 0-year old and 0-4 years old are excluded in favor of birth rate (correlations with birth rate are higher than .80 in each country).

The included general and specific variables are presented in table 4.21 as are the countries of interest (between brackets).

Table 4.21.: Variables involved in heuristic, stepwise regression analysis on admission rate

1. proportion 65+-ers (N+B+NF)
2. standardized income (N+B+NF)
3. proportion publicly insured (N)
4. inhabitants/general practitioner (N+B+NF)
5. inhabitants/specialist (N+B+NF)
6. number of hospital beds 0/00 (N+B+NF)
7. mean stay/admission (N+B+NF)
8. birth rate (N+B+NF)
9. mortality (N+B+NF)
10. population density (N+B+NF)
11. hospital size (N+B+NF)
12. long stay beds 0/00 65^{+} ers (N+B+NF)
13. proportion non-actives (B)
14. proportion insured "régime independent" (B)
15. proportion beds owned by insurance funds (B+NF)
16. proportion non-employed (NF)

Stepwise regression analysis consists of several steps in which either a variable is selected and entered in the model or a

variable is removed from the model. In each step the variable, that contributes most significantly, according to the criterion (F-value) is selected from the remaining pool. Sometimes the importance of a variable diminishes by the inclusion of another, and is subsequently removed. This process of selection and removal is finished if no variable in the remaining set meets the criterion.

An important disadvantage of this method is that no underlying theory is used to explain relations, as was the case in former sections of this report. The results of this analysis need carefully be studied by taking into account (partial) correlations between contributing and even non-contributing variables.

Thus are selected the most contributing variables for each country in 1982. The results are presented in tables 4.22 (the Netherlands), 4.23 (Belgium) and 4.24 (Northern France).

Table 4.22.: Stepwise regression* on admission rates: The Netherlands, 1982

Step	Variable	B-coefficient	T-Statistic	Adjusted R^2
1	Number of beds 0/00	3.41	3.30	.18
2	Birth rate	-1.54	-2.46	.23
3	Hospital size	-.04	-5.27	.28
4	Prop. publicly ins.	1.10	5.02	.31
5	Inh/specialist	- .003	-3.62	.34
6	Prop. 65^+	-2.04	-4.86	.39
7	Standardized income	4.57	3.36	.43

* _____ : $p < .05$
_ _ _ : $.05 < p < .10$

Table 4.22 reveals a considerable improvement in explaining admission: 45% versus 21% admissional variation accounted for. The number of beds is entered on step 1, indicating the importance of this variable for the Netherlands in 1982. Both proportion of 65^+-ers and birth rate are negatively related to admissions. The question is whether these variables act through the same intermediary (e.g. mean stay) or whether different mechanisms

explain these effects (e.g. are older people more often admitted to nursing homes, c.q. long stay beds?).
On step 4 is included the variable inhabitants/specialist. The negative coefficient simply indicates a positive relation between number of specialists and admissions. Furthermore both income and proportion publicly insured are positively related to admissions. Only employees with lower to medium incomes (up to ± Hfl. 50.000,- a year) are publicly insured. So income and proportion publicly insured are negatively correlated (-.56) and one might expect a counter-productive effect on hospital admissions. This result needs further clarification.

Table 4.23.: Stepwise regression* on admission rates: Belgium, 1982

Step	Variable	B-coefficient	T-statistic	Adjusted R^2
1	Prop. non-actives	2.44	4.45	.57
2	Prop. ins. "rég.ind."	-1.97	-4.91	.61
3	Number of beds 0/00	1.24	1.86	.63
4	Standardized income	-5.65	-3.30	.64
5	Prop. 65+	1.98	2.45	.66

* _____ : $p < .05$
_ _ _ : $.05 < p < .10$

The proportion admissional variance that is accounted for in Belgium by the five variables (see table 4.23) is 66%, whereas general and specific variables in former analyses accounted for only max. 45%. An improvement of more than 20%.
The proportion non-actives and the proportion insured according to the "régime independent" account for over 60% of the Belgian admissional variation: more non-actives and less "independents" induce more hospital admissions. Also the number of hospital beds 0/00, proportion 65+-ers and income play a significant, but minor part. They account for only 5%.
These three variables are also important in the Netherlands, but there are some striking differences. The proportions of older people contribute positively to admissions in Belgium, but negatively in the Netherlands. This might reflect the fact that in Belgium more 65+-ers are admitted to hospitals, whereas part of

them in the Netherlands are admitted to (long stay bed) nursing homes. This kind of institutions is not available in Belgium (see Heesters and Kesenne, 1985).
Furthermore in Belgium income seems to be negatively related to admissions, contrary to the Dutch situation. The number of beds affects admission in the same way but is less important (only marginally significant) in Belgium.

Stepwise regression analysis does not improve results of former analyses with respect to Northern France. About 90% of admissional variation is accounted for by number of beds 0/00 and mean stay. Another significantly contributing variable is the proportion of beds owned by insurance funds, though the explaining power is minimal. So only supply variables seem to be important in Northern France.

Table 4.24.: Stepwise regression* on admission rates: Northern France, 1982

Step	Variable	B-coefficient	T-statistic	Adjusted R^2
1	Number of beds 0/00	30.78	26.34	.70
2	Mean stay	-27.73	-14.55	.91
3	Prop. beds owned by insurance funds	.27	2.41	.91

* _____ : $p < .05$
_ _ _ : $.05 < p < .10$

This excercise seems to be fruitful, because both in the Netherlands and Belgium models with increased explanatory power are found with respect to hospital admissions (in the Netherlands from 21 to 45% , in Belgium from 44 to 66%). No improvement is seen in Northern France.
It needs to be emphasized again, that this approach is heuristic and that no theory is yet available to explain all the results. So, more questions are raised than answered, e.g.

- why does the proportion 65+-ers contribute positively to admissions in Belgium, but negatively in the Netherlands?
- why is income negatively related to admission in Belgium, but positively in the Netherlands?

- are there any health status indicators in Northern France that are related to number of beds 0/00 or mean stay/admission?

Further study is needed to reveal the interdependency of the (newly added) variables that account for more admissional variation than previous models.
The reported results of series of analyses of regional variation in hospital admissions show that the subject is dynamic in several ways: dynamic because of the slowly changing demographical / socioeconomical compositions of societies, dynamic because of (sometimes abruptly) changing health care policy etc.
Therefore regional variation in hospital admission needs to be studied on a permanent basis. It is recommended to extend this research in time and space.

Further research is indicated with respect to:
- Supply variables (e.g. hospital beds, hospital size etc.). In the Netherland, Belgium and Northern France supply factors are not as strictly regulated as in other countries like the United Kindom and several countries outside Central Europe. Extension to these regions allows comparison between differently regulated health care systems.
- Refining health care indicators. Is it possible to refine e.g. mortality, or is health status better indicated by other, more sensitive variables?
- Longitudinal dynamics of general and specific variables. Need models to be redefined, reformed or adapted?
  If so, for what reason?
- Effects of individual use of health care facilities. Conclusion so far are based upon aggregated data (on the level of COROP-regions (the Netherlands), arrondissements (Belgium), or secteurs sanitaires (Northern France).

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Appendix I:- Map of COROP-regions in the Netherlands
- Map of arrondissements in Belgium
- Map of "secteurs sanitaires" in Northern France

The Netherlands

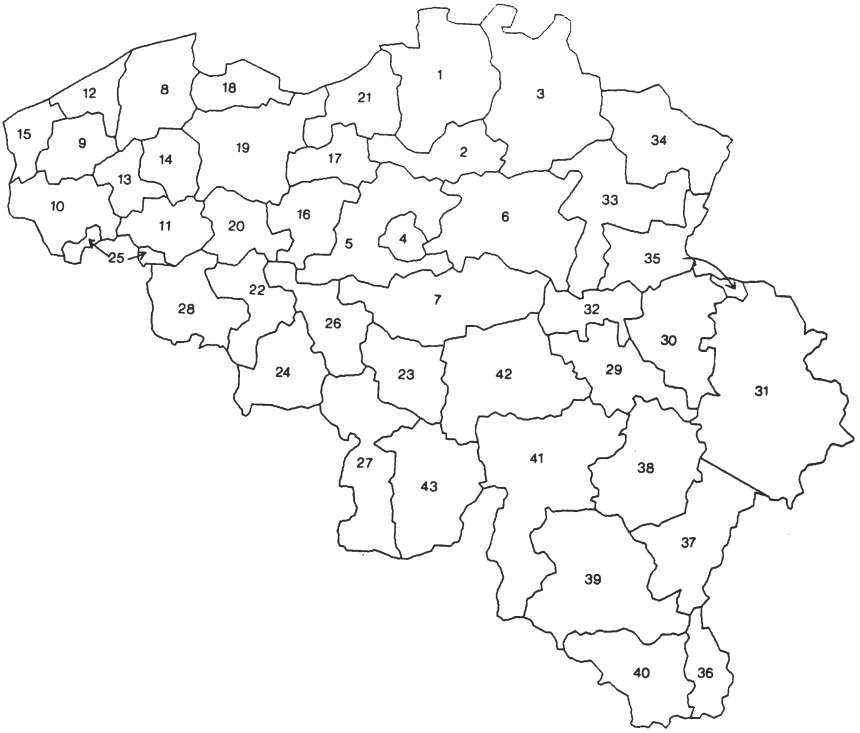
1. Oost-Groningen
2. Delfzijl e.o.
3. Overig Groningen
4. Noord-Friesland
5. Zuidwest-Friesland
6. Zuidoost-Friesland
7. Noord-Drenthe
8. Zuidoost-Drenthe
9. Zuidwest-Drenthe
10. Noord-Overijssel
11. Zuidwest-Overijssel
12. Twente
13. Veluwe
14. Achterhoek
15. Arnhem/Nijmegen
16. Zuidwest-Gelderland
17. Utrecht
18. Kop van Noord-Holland
19. Alkmaar e.o.
20. IJmond
21. Agglomeratie Haarlem
22. Zaanstreek
23. Groot-Amsterdam
24. Het Gooi en de Vechtstreek
25. Agglomeratie Leiden en Bollenstreek
26. Agglomeratie 's-Gravenhage
27. Delft en Westland
28. Oost Zuid-Holland
29. Groot-Rijnmond
30. Zuidoost Zuid-Holland
31. Zeeuwsch-Vlaanderen
32. Overig 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. Zuidelijke IJsselmeerpolders
41. Amsterdam
42. Rijnmond
43. Stadsgewest 's-Hertogenbosch

The Netherlands

Belgium

1. Antwerpen
2. Mechelen
3. Turnhout
4. Brux. Cap-Br. Hoofdstad
5. Halle-Vilvoorde
6. Leuven
7. Nivelles
8. Brugge
9. Diksmuide
10. Ieper
11. Kortrijk
12. Oostende
13. Roeselaere
14. Tielt
15. Veurne
16. Aalst
17. Dendermonde
18. Eeklo
19. Gent
20. Oudenaarde
21. Sint-Niklaas
22. Ath
23. Charleroi
24. Mons
25. Mouscron
26. Soignies
27. Thuin
28. Tournai
29. Huy
30. Liège
31. Verviers
32. Waremme
33. Hasselt
34. Maaseik
35. Tongeren
36. Arlon
37. Bastogne
38. Marché-en-Famenne
39. Neufchateau
40. Virton
41. Dinant
42. Namur
43. Philippeville

Belgium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Northern France

1. Ardennes nord
2. Ardennes sud
3. Romilly-Sezanne
4. Troye-Bar sur Aube
5. Chalons/Marne
6. Epernay
7. Reims
8. Chaumont-Langres
9. Saint-Dizier
10. Verdun/Meuse
11. Briey
12. Metz-Thionville
13. Boulay-Forbach
14. Bar le Duc
15. Nancy-Pompey-Toul
16. Sarrebourg-Dieuze
17. Luneville
18. Neufchateau-Vittel
19. Epinal
20. Saint Dié
21. Remiremont-Gerardmer
22. Dunkerque
23. Calais
24. Boulogne
25. Saint Omer
26. Bethune
27. Lens
28. Douai
29. Valenciènnes
30. Maubeuge
31. Cambrai
32. Arras
33. Montreuil/Mer
34. Metropole
35. Abbeville
36. Amiens
37. Saint Quentin
38. Vervins
39. Beauvais
40. Creil
41. Compiègne-Noyon
42. Laon-Chauny
43. Soissons
44. Chateau-Thierry

Northern France