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ARILD AAKVIK AND TOR HELGE HOLMÅS

THE RELATIONSHIP BETWEEN ECONOMIC CONDITIONS, ACCESS TO PRIMARY HEALTH CARE, AND HEALTH OUTCOMES

Department of Economics

UNIVERSITY OF BERGEN

The Relationship Between Economic Conditions, Access to Health Care, and Health Outcomes

Arild Aakvik[1]
Department of Economics, University of Bergen

Tor Helge Holmås
Department of Economics, University of Bergen and Programme for Health Economics in Bergen (HEB)

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[1]Corresponding author: Arild Aakvik, Department of Economics, University of Bergen, Fosswinckelsg. 6, N-5007 Bergen, Norway. E-mail: arild.aakvik@econ.uib.no. The data are gathered from Statistics Norway. The data can be obtained from the authors after publication, except for specific mortality rates which is not publicly available.

ABSTRACT

This paper analyses the impact of access to health care and economic conditions on health outcomes. Fixed-effects models are estimated using municipality data from 1996 to 2001. Health is proxied by total mortality rates divided into three different causes of death. Access to health care is proxied by number of physicians, and other medical personnel. Unemployment, which has been an important determinant of mortality in many studies, is found to have no effect on health outcomes in our data. We also find an insignificant effect of per capital number of GPs on mortality. However, the number of vacant positions (unmet demand) in municipalities increases mortality rates significantly. In a policy simulation, we find that mortality rates can be reduced on average by 0.8 per cent by eliminating all (around 500) vacant GP positions.

JEL Numbers: I12, J63

Keywords: general practitioners, mortality rates, municipalities, fixed-effect models, mortality, morbidity

1. INTRODUCTION

Many studies have analyzed the relationship between economic resources and health outcomes, focusing mostly on the effect of economic conditions such as the unemployment rate or an aggregate measures of income/spending on mortality (see for instance Forbes and McGregor (1984), Gravelle (1984), Hitiris and Posnett (1992), Grubaugh and Santerre (1994), Joyce and Mocan (1997), Ruhm (2000, 2003), Cutler et al. (2002)). Other studies have focused on mortality rates at hospitals. Mortality rates are explained by resource use at the hospital, policy changes in the reimbursement rates, managed care, and of technological change (see Cutler (1995), Geweke et al. (2003), Kessler and McClellan (2000), and McClellan and Noguchi (1998)).

This paper analyses the relationship between the number of GPs (physician-population ratio) and health outcomes, which is proxied by total mortality divided into 3 different causes of death.[1] Mortality rates change over time and vary substantially across municipalities. In the regression models we control for variables such as geographical location (dummy variables), socioeconomic status (age, education), morbidity (number of disabled persons), economic conditions at the municipality level (unemployment rate), and health care utilization (number of persons receiving home care, patient days in hospitals).

Fixed-effects (FE) models are estimated using longitudinal data for the six year time period from 1996-2001. The unit of observation is municipality, of which there are 435 in Norway. The fixed-effect model reduces potentially serious bias present in most time-series or cross-sectional analysis, resulting from the inability to control for unobserved factors important for health outcomes and correlated with economic

[1] Mortality is only one measure of health status. Morbidity and other subjective indicators of well-being are also likely to be affected be economic factors. We use mortality rates since this measure of health is easily quantifiable and precisely measured over time. An alternative to mortality would be to use expected average length of life. The correlation between mortality rates and life expectancy is very high. Auster et al. (1969) find a correlation coefficient between mortality rates and life expectancy of 0.96 using US state level data.

conditions both over time and across municipalities. The model controls for time-invariant factors by exploiting variation over time within each municipality.

This study provides new evidence on the relationship between number of general practitioners (GPs) per capita and mortality rates. Several studies have found a significant and negative effect of number of GPs in municipalities on mortality, see for instance Auster et al. (1969), Robst and Graham (1997), Robst (2001). The two latter studies find that more physicians reduce mortality rates mainly in rural areas, while the effect is small in urban areas. We do not find any significant relationship between per capita number of physicians and mortality rates in our study when we in addition to the physician-population ratio condition on the number of vacant positions for GPs. However, we do find a significant relationship between vacant positions for physicians, which is a proxy for unmet demand, and mortality. This relationship is especially strong for deaths due to diseases in the circulatory system, and is found both for urban and rural areas. In a policy simulation, we find that eliminating all vacant GP positions (around 500), mortality rates can be reduced on average by 0.8 per cent. The unemployment rate in municipalities is not found to influence mortality. However, increased spending on the health and social sector at the municipality level affects mortality rates significantly. We also find substantial geographical variation in mortality rates and a clear age effect.

The paper is structured in the following way. Section 2 describes the institutional settings relevant for our study. In Section 3, the data used in the analysis is presented, along with some descriptive statistics. Section 4 includes a discussion of the econometric model used in analyzing the relationship between mortality and access to health care. Section 5 presents the empirical results of the regression analysis. Some concluding remarks are made in the final section.

2. INSTITUTIONAL SETTINGS

Our empirical analysis focuses on physicians in the primary health care sector (GPs), and in this part of the paper we offer some institutional details about this service, especially on primary physician services. In Norway, the responsibility for health services is rooted in the public sector.[2] The public health system is under the jurisdiction of the Ministry of Health and Social Affairs, which is responsible for devising and monitoring national health policy. Responsibility for provision of services is decentralized to the municipal and regional (county) administrative level.[3]

The counties provide the more specialized medical services, including both general and psychiatric institutions as well as other specialised medical services, such as laboratory, radiographic and ambulance services. Primary health care, including both preventive and curative treatment, is in the hands of the municipalities. The municipalities are required by law to offer services for disease prevention and health promotion, diagnosis and treatment of illness, rehabilitation, and long-term care. There are no defined minimum standards with regard to the level or quality of the health services.

The primary health care sector is financed through grants from the municipality, retrospective reimbursement by the National Insurance Scheme (NIS) for services supplied and out-of-pocket payments by the patients. The main responsibilities for the Norwegian primary health care sector can be grouped as follow. First, the municipalities have the responsibility of promotion of health and prevention of illness and injuries, which includes organizing and running school health services, health centres, and child health care by health visitors, midwives and physicians. Second, the municipalities have the responsibility of diagnosing, treatment and rehabilitation, which includes general medical treatment, physiotherapy and nursing. Third, the municipalities have the responsibility of nursing and care in and outside institutions, which includes running nursing homes, home nursing and several other activities.

Two groups of physicians provide primary health services: physicians employed by the municipality and self-employed physicians who have a contract with the municipality. Both employed physicians and contract physicians work separately from hospital services and provide the first contact between the patients and the health services. Salaried physicians typically work at health centres, often in group practice

[2] For a more thorough description of the Norwegian health sector, see van der Noord et al. (1998).
[3] The national authorities have retained some delivery mandates as well, including the control of several national councils, research institutions, the National Hospital of Norway (Rikshospitalet), the National Cancer Hospital (Radiumhospitalet) and a few other highly specialised hospitals.

with other physicians. They are on a fixed salary, and their working hours are mainly determined by a contract between the physician and the municipality. The contract usually stipulates normal working hours and designates the physicians' tasks. The number of directly employed physicians has decreased from 1073 in 1995 to 647 in 2001. Contract physicians, on the other hand, have had an increase from 2001 in 1995 to 3008 in 2001. They have a contract with the municipality to cover some of their expenses (about 30 per cent of contract physicians' gross income). Additionally, they obtain income from patient fees and from a fixed fee reimbursement scheme. Contract physicians can, to a large extent, make their own decision about the number of hours worked.[4]

In Norway, the municipalities have a legal obligation to employ physicians to carry out certain administrative, emergency and clinical functions. Beyond this, no legislations regarding minimum requirements for physician-patient ratios exist. However, in order to secure a geographically balanced distribution of doctors, a commission with members from the central government and the Norwegian Medical Association (NMA) regulate the establishment of new positions for both GPs and hospital specialists. This means that the municipalities need approval from this committee in order to establish new positions for physicians. The average amount municipalities have to pay for each GPs is around NOK 700 per inhabitant (euro 80 per inhabitant). Expenses vary a lot, from around NOK 500 (euro 60) per inhabitant for the largest municipalities to around NOK 2300 (euro 270) per inhabitant for the smallest municipalities. For details about see Kjevik (2004).

3. DATA AND DESCRIPTIVE STATISICS

We use data from 435 municipalities for the 1996-2001 time period. Data are gather from Statistics Norway and are publicly available except for specific mortality rates. The health outcomes are total mortality rates, and deaths due to three specific causes: 1) malignant neoplasm (cancer); 2) diseases in the circulatory system (cerebrovascular disease, ischaemic heart disease, and other heart diseases); 3) diseases in the

[4] The total number of general practitioners per 1000 capita is 1.0 in Norway. The number of GPs per 1000 capita varies in different countries: France (1.6), Germany (1.1), Italy (0.9), Sweden (0.5), UK (0.6), US (0.8).

respiratory system (pneumonia, bronchitis, emphysema, asthma, etc); 4) other causes (accidents, suicide, diseases in the digestive system, mental disorders, etc). Table 1 shows how the different categories are classified according to the ICD-10 system, and explains the variables used in the empirical analyses. The data will be available from the authors after publications, except for specific mortality rates which is not publicly available.

Looking at the number of physicians engaged in primary health care, we first notice that there has been an increase in the number of physician from 0.99 physicians per 1000 inhabitant in 1996 (around 3500 GPs) to 1.10 physicians per inhabitant in 2001 (around 4100 GPs). See Table 2 for details. The majority of these physicians are engaged in diagnosing, treatment and rehabilitation (3375 man-labour years in 2001). In 1996 and 2001, the corresponding figures for physicians working in the school health services/child health care and nursing homes/other institutions were 231 and 249, respectively.

The number of GPs per inhabitant varies significantly across municipalities. Contrary to most OECD countries, Norway has a relatively high per 1000 capita supply of GPs in rural compared to urban areas. As can be seen from Table 2, number of physicians per 1000 inhabitants are higher in rural areas compared with more urban municipalities. This is partly due to the legal obligation for even the smallest municipalities to employ a GP. Also, the administrative and emergency part of the primary health care requires more physicians per inhabitant in small than in large municipalities. The number of physicians per 1000 inhabitants was 1.32 in rural areas in 2001, up from 1.17 in 1996. These municipalities have on average around 3000 inhabitants. In urban municipalities, with an average population of around 14.000 inhabitants, the number of physicians per 1000 inhabitants was around 0.92 in 2001 and 0.83 in 1995. See Table 2 for details.

Most GPs prefer to work in the larger cities. Thus, many municipalities in rural areas have difficulties attracting GPs to work for them. The number of vacant positions per 1000 inhabitants in rural areas was around 0.17 in 1996. The number of vacant positions was reduced to 0.13 in rural areas in 2001. See Table 2 for details. This means that the number of vacant positions in rural areas decreased from around 12 per cent of all GP positions in 1996 to 9 per cent in 2001.

In urban areas, the number of vacant position per 1000 inhabitants was only around 0.05, which means that around 6 per cent on all GP positions at the municipality level are vacant at a given point in time. The positions in urban areas are usually filled rather quickly. Physicians in rural areas face weaker earnings potentials compared to GPs in urban areas, who have the possibility of increased earnings from fees for service. The turnover rate for medical doctors also tends to be higher in smaller compared to larger municipalities (see Grytten el at. (1994)).

Despite such different conditions facing rural and urban areas, patients uniformly complain about long waiting times and a lack of personal contact with doctors, as reflected in short consultations and long waiting times before the consultation takes place (see Johnsen and Holtedahl (1997)). Variations in the activities of GPs vary between municipalities. See Kjevik (2004) for an analysis of variations in tasks and activities in Norway, and Boerma (2003) for an analysis of variations in tasks of GPs within and between different European countries.

We see from Table 2 that total mortality rates are higher in rural areas compared to urban areas. This is the case for all causes of death, but is especially the case for diseases in the circulatory system. Total mortality and most specific mortality rates have declined over time, although the changes over the 6 year period we are analyzing are very small (see Table 3 for details). Mortality rates also vary substantially across municipalities. The 10 percentile mortality rate was 7 in 2001, while the 90 percentile mortality rate was around 16.

A preliminary indication of the relationship between the per capita number of GPs and the three specific causes of mortality is depicted in Figure 1. We find an inverse relationship between the per capita number of GPs and diseases in the circulatory system (cerebrovascular disease, ischaemic heart disease). However, we do not find the same correlation between changes in the number of per capita GPs and deaths due to malignant neoplasm (cancer) and diseases in the respiratory system (pneumonia, bronchitis, emphysema, asthma) over the time period from 1986 to 2001. The latter group shows a fairly large variation over time. The number of causes due to malignant neoplasm is relatively constant over time.

Some of the differences in mortality between urban and rural areas can be explained by age. From Table 2 we see that the population in rural areas are slightly older compared to persons living in urban municipalities. Except for the per capita number of physicians and vacant positions, which is higher in urban areas, the other background variables do not show a large difference when comparing the two different types of municipalities.

From Table 3 we see that the population is clearly aging even for the short time period from 1996 to 2001. In 1996, 4.8 per cent of the population was above the age of 80. In 2001, this number had increased to 5.2 per cent. Persons older than 67 who receives care through home nursing have increased from 8 per cent to 9 per cent, while the proportion of individuals in institutions has gone slightly down.

4. ECONOMETRIC ISSUES

We use panel data for the 1996-2001 time period. We use each municipality in Norway as the unit of analysis. Using municipality data usually has the disadvantage that the number of control variables in regression models are few compared to individual data (see for instance Ruhm (2000)). However, in our case we have a number of background variables such as geographical location (dummy variables in the fixed-effect model), socioeconomic status (age categories, education), morbidity (number of disabled persons), economic conditions at the municipality level (unemployment rate, etc), and health care utilization (number of persons receiving home care, number and duration of hospital stays, etc).

Mortality rates change over time and vary substantially across municipalities. The same is true for most of the variables we have collected. Thus, the data lend itself well to analyse how different factors affect mortality and duration of life in a fixed-effect framework. Using the subscripts j and t to index the municipality and year, the basic regression equation is

(1) $H_{jt} = \alpha_t + E_{jt}\beta_1 + X_{jt}\beta_2 + M_{jt}\beta_3 + U_{jt}\beta_4 + S_j + e_{jt}$,

where H_{jt} is the mortality rate varying over time and between municipalities, E_{jt} is the proxies for economic conditions, X_{jt} is a vector of socioeconomic and demographic variables, M_{jt} is a vector of morbidity variables, U_{jt} is a vector of health care utilization, and e_{jt} the error term. The fixed-effects S_j controls for time-invariant municipality characteristics. α_t accounts for nationwide time effects, β_1 is a vector that captures the impact of within-municipality deviations in economic conditions, β_2 captures the effect of background variables, β_3 captures the effect of morbidity variables, and β_4 captures the effect of health care utilization variables on morbidity. Observations are weighted by municipality size. The fixed-effect model has been used in several studies of explaining variation in different dimensions of health (see for instance Ruhm (2000)).

In the econometric set-up we are using, it is assumed that the change in health care utilization and change in access to health care has an immediate effect on health outcomes. The effect of medical services and other factors at the municipality level prior to our observation period are assumed to be constant over time, and thus are differentiated out in the fixed effect model.

The use of mortality rates rather than other aspects of health have several advantages. First, they represent objective indicators of health. Second, they are easily available in most countries at the municipality level. Third, they have been used in different types of research in the health sector. Thus, different studies within and between countries can be compared. However, mortality data is an imperfect measure of health status since such data are not able to capture the effects of illnesses or medical interventions. The use of mortality data separated into causes of death will partly overcome this issue.

The effect of per capita number of GPs on morbidity is captured by both including morbidity data and other regressors and through the fixed-effect model, where the effect of all unobserved time-invariant variables are cancelled by differencing since we look at relative changes rather then absolute levels. We believe that the potential simultaneity problem between mortality and number of GPs, where the relationship between the number of GPs and mortality can misinterpreted by the fact that areas where mortality is high attracts many GPs, is small. The allocation of GPs is mainly based on factors such as the size of the municipality and age distribution of the population. Such factors are exogenous in our model, and we proceed with the fixed-effect model rather than a two-stage least square regression. The fixed-effect estimates exploit within-municipality variations in background variables and have the potential of improving the results based on descriptive statistics.

5. EMPIRICAL RESULTS

We use the fixed-effects model of the form stated in equation (1), where the dependent variable is the death rate per 1000 persons. Time dummies are included in all regressions.

We run separate regression along the urban/rural dimension and for four different causes of death. Table 4 shows the result for the fixed-effect model in terms of total mortality rates for all municipalities, and results from regression along the urban/rural dimension. The results from the regressions where we discriminate between different causes of death are given in Table 5.

It is not surprising to find that age is an important variable explaining mortality rates at the municipality level. A larger proportion of persons above the age of 80 years significantly increases the mortality rate. This effect is found for all causes of mortality, and also in both urban and rural municipalities. A high proportion of individuals in the age group between 67 and 79 increase mortality in rural municipalities (but not so in urban areas); see Table 4. We also find a significant relationship between the number of persons in this age group and mortality due to diseases in the respiratory system, but not so for the other causes of death.

We find a significantly effect of schooling on health given that we control for other background variables. Many studies find a significant link between schooling and health status (see for instance Auster el al. (1969), Grossman (1972), Kemna (1987)). Fuchs (1998) also point to the striking negative correlation between number of years of schooling and mortality, in particular for the US. In our study we find a negative relationship between schooling and mortality rates. We use the proportion of persons with education at the high school level or higher as the explanatory variable. The effect of education on mortality is small in terms of absolute value, in particular for urban municipalities. An increase of around 100 persons in the highest educational group are predicted to reduce the number of dead by one. The effect of education is twice as large in rural municipalities compared to urban areas; see Table 4. However, we do not find the same clear effect of education when we divide mortality into different causes of death. From Table 5 we see that this effect is significant only for mortality due to diseases in the respiratory system and for the other group. See also Bosma et al. (1999), Deaton and Paxson (1999) for a discussion of the effect of education on mortality rates.[5]

In our study, we find an insignificant relationship between unemployment and mortality. Ruhm (2000) analyze the relationship between unemployment and total and age specific mortality rates, using US state level data for the 1972-1991 period. He finds that total mortality exhibits a procyclical variation. A one percentage point increase in the state unemployment rate decreases the predicted death rate by around 0.5 percent, or around 0.46 deaths per 1000 inhabitants. The procyclical variation in health point to a potentially role for cyclical fluctuations in the time costs of medical care or healthy lifestyles and raise the possibility that employment itself sometimes has adverse effects of health. However, expected life span in Norway at birth is 82 years for females and 77 years for male. Infant mortality is among the lowest in the world. Less than 200 children below the age of 1 die each year, out of a total population of 4.5 million and around 56,000 births. The average pension age is 61. Thus, most people who die are pensioners. Given that we condition on resources used

[5] We also included income as an explanatory variable in addition education. Income turned out to have a positive effect on mortality rates, and in some regression an insignificant effect. Auster et al. (1969) also find a positive effect of income on mortality, and at the same time a negative effect of education. Due to the strong trend in income changes over time and the high correlation between education and income, we have dropped the income variable from the final regressions. Deaton and Paxton (1999) find that neither trends in income or income inequality provide plausible explanation for the mortality decline observed in UK and US. Fuchs (1998) point out that income is important up to a given minimum level. The correlation between income and mortality above the minimum level is small both within and across industrialized countries.

in the health sector, we would not expect to find a significant relationship between mortality and unemployment in our data.[6]

We do not find a significant effect of the per capita number of physicians and mortality rates in any of our regression in Table 4 and 5, when we in addition condition on the per capita number of vacant positions for physicians. Robst and Graham (1997) examine the relationship between access to medical care and health status. They use a subjective reported measure of health status at the individual level ranging from 1 to 5. They find a significant relationship between the number of physicians on the health status of individuals in rural areas. However, they do not find the same relationship in urban areas.[7] The physician-population ratio is in most countries much lower in the rural areas compared to urban districts (see Fuchs (1998)). However, in Norway the physician-population ratio are higher in rural than urban areas. This fact probably explains the insignificant relationship between number of GPs and mortality rate when condition on the per capita number of vacant positions.[8]

One important variable explaining mortality rates in our analysis is the per capita number of vacant position at the municipalities. Municipalities in rural areas usually have a problem attracting GPs to their district. The effect of vacant positions is large and highly significant in all regression in Table 4 and 5, except for the regression where we focus on mortality rates due to malignant neoplasm and diseases in the respiratory system. More vacant positions in the municipality increase mortality rates significantly for the other causes of death. Number of vacant position can be a proxy for unmet demand for health care. The effect of this variable is particularly high for

[6] Cutler et al. (2002) use time series data from Mexico to analyze the relationship between mortality and economic crises. They find that mortality rates have increased with economic crises, among the elderly and possibly among the very young. They discuss the reason to expect an inverse relationship between mortality and economic crises. 1) Economic downturns reduce income which reduces resources for consumption and investment of goods that improve or maintain good health. 2) Economic downturns reduce public spending of health, which may affect groups particularly dependent on the public health system. 3) Crises and economic conditions affect the informal care that families can provide for children and the aged.

[7] When running separate regressions for urban and rural areas, and not controlling for vacant positions, we find the same results as Robst and Graham (1997). The effect of number of physicians in rural areas is -0.909 (0.344), while the same effect in urban areas is only –0.169 (0.326), where the number in parenthesis indicates standard error.

[8] Robst (2000) focus on the importance of including the availability of health care in the early stage of a persons life in explaining mortality rates. They find a significant effect of physician availability during childhood on mortality rates later in life.

mortality rates due to diseases in the circulatory system (for instance heart attacks). If we extrapolate the results, we find that by eliminating all vacant GP positions (around 500) mortality rates can be reduced on average by 0.8 per cent. Filling one vacant position decreases the predicted number of deaths by approximately one person.

We also find that the proportion of the population above the age of 67 who receives home nursing significantly reduces mortality rates, although the estimated effect is relatively small. 100 extra persons in home nursing is predicted to decrease the total number of deaths by one person. See table 4 for details. Being looked after by professional health care personnel increases the likelihood of early detection of medical problems. The effect of this variable is stronger in rural areas than in urban areas. The effect of this variable is strong for all causes of death, except for malignant neoplasm as a cause of death.

6. CONCLUDING REMARKS

This study shows a weak relationship between total mortality rates and per capita number of GPs once we take into account the per capita number of vacant positions for GPs at the municipality level, where per capita number of vacant position is an indicator of unmet demand for medical treatment. The lack of a significant relationship between these two variables is robust to different specifications of the model.

Our results question several previous results in the literature. First, we find no relationship between the level of unemployment once we control for the level of spending on health and social policy. Second, although we find a negatively relationship between the number of GPs and mortality when we do not control for per capita number of vacant positions, as is found in many other studies in the literature, this effect disappears once we control for per capita number of vacant GP positions. Third, the effect of education on mortality rates is less clear cut in modern societies. Increased income and education may be important for mortality rates for very low levels of education. However, in well developed welfare states with a relatively high level of income and education to begin with, the relationship between these variables and mortality rates is often close to zero. We find that educational attainment has an effect on mortality rates due to diseases of the respiratory system (which might be due to an over-representation of smokers in lower education groups), but not so for diseases due to malignant neoplasm or diseases in the circulatory system.

Our study cannot be used to answer the question of what is the optimal number of physicians. However, we focus on the marginal effect of GPs at the municipality level from the current level of per capital number of physicians. Given that we measure the effect of additional GPs on mortality rates it is difficult to judge the effect and benefits of GPs, and compare them with costs, since the effect on mortality is not usually translated into money equivalents. What is one extra year of life worth for one person and can this be compared with societies costs of an extra GP? An alternative research strategy would measure cost per quality adjusted life years (QALY). This measure combines both saved life years and quality of life, and can be used to compare the cost-effectiveness of different interventions. However, we do not have measures of quality of life at the municipality level for the period we are using in the econometric analyses.

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Table 1. Variable description.

Variables	Definition
Physicians	Number of physicians working in the municipal health care services, per 1000 inhabitant
Vacant phys.	Number of vacant physicians in the municipal health care services, per 1000 inhabitant
Mortality	Total municipal mortality rate (total number of deaths per 1000 inhabitant)
Mortality I	Municipal mortality rate due to diseases of the circulatory system (I00 - I99 in ICD-10) (deaths per 1000 inhabitant)
Mortality C	Municipal mortality rate due to malignant neoplasm (C00 – D48 in ICD-10) (deaths per 1000 inhabitant)
Mortality J	Municipal mortality rate due to diseases of the respiratory system (J00 - J99 in ICD-10) (deaths per 1000 inhabitant)
Mortality O	Municipal mortality rate due to other causes (deaths per 1000 inhabitants)
Age67-79	Number of persons between 67 and 79 years old per 1000 inhabitant
Age80+	Number of persons older than 80 per 1000 inhabitant
Population	Number of inhabitants in the municipality
Disability	Number of disable persons, i.e. persons receiving a disability pension, per 1000 inhabitant
Unemployment	Unemployed persons per 1000 inhabitant
High education	Number of persons with education at the high school level or higher per 1000 inhabitant
Total man year	Total man-year (not physicians and physiotherapists) in the municipal health care services, per 1000 inhabitant
Total vacancies	Total vacancies (not physicians and physiotherapists) in the municipal health care services, per 1000 inhabitant
Home nursing > 67	Number of persons older than 67 who receives home nursing per 1000 inhabitant
Institutionalised > 67	Number of persons older than 67 staying at an institution (mainly old age homes and nursing homes) per 1000 inhabitant
Hospitalisation < 67	Number of hospital stays (24 hours or longer) in the municipalities for individuals younger than 67, per 1000 inhabitant
Hospitalisation > 67	Number of hospital stays (24 hours or longer) in the municipality for individuals older than 67, per 1000 inhabitant
Length of stay < 67	Total length of hospital stays in the municipality for individuals younger than 67, per 1000 inhabitant
Length of stay > 67	Total length of hospital stays in the municipality for individuals older than 67, per 1000 inhabitant
Hospitalisation due to cardiovascular diseases	Number of hospital stays (24 hours or longer) due to cardiovascular diseases in the municipality for individuals older than 50, per 1000 inhabitant
Emergency stays	Number of hospital stays for emergency in the municipality, per 1000 inhabitant

Table 2. Descriptive statistics by type of region. Standard error in parenthesis.

	All municipalities	Urban municipalities	Rural municipalities
Physicians	1.033 (0.364)	0.867 (0.222)	1.221 (0.402)
Vacant phys.	0.103 (0.225)	0.056 (0.149)	0.156 (0.279)
Physicians 1996	0.990 (0.350)	0.833 (0.232)	1.169 (0.375)
Vacant phys. 1996	0.106 (0.225)	0.054 (0.143)	0.166 (0.280)
Physicians 2001	1.104 (0.390)	0.918 (0.195)	1.317 (0.402)
Vacant phys. 2001	0.097 (0.250)	0.064 (0.213)	0.134 (0.282)
Mortality	11.468 (3.482)	10.174 (2.854)	12.942 (3.548)
Mortality I	5.165 (2.098)	4.465 (1.633)	5.962 (2.277)
Mortality C	2.646 (1.106)	2.429 (0.813)	2.893 (1.322)
Mortality J	1.071 (0.779)	0.954 (0.551)	1.203 (0.959)
Mortality O	2.587 (1.243)	2.326 (1.243)	2.884 (1.448)
Age67-79	107.367 (22.944)	98.823 (22.094)	117.905 (19.813)
Age80+	49.929 (15.753)	43.498 (13.423)	57.252 (14.999)
Population	9.091 (17.199)	14.318 (22.196)	3.139 (2.298)
Disability	61.920 (17.688)	60.880 (15.956)	63.105 (19.412)
Unemployment	14.353 (7.406)	13.636 (5.300)	15.170 (9.171)
High education	558.748 (52.645)	575.745 (43.714)	539.395 (55.224)
Total man year	23.536 (8.604)	20.034 (8.135)	27.5210 (7.291)
Total vacancies	1.518 (1.746)	1.166 (1.538)	1.919 (1.878)
Home nursing > 67	86.578 (35.173)	77.318 (27.661)	97.121 (39.581)
Institutionalised > 67	81.382 (30.914)	70.219 (21.183)	94.091 (35.074)
Hospitalisation < 67	122.821 (18.743)	118.081 (14.767)	128.217 (21.180)
Hospitalisation > 67	388.871 (76.907)	382.726 (64.904)	395.867 (88.124)
Length of stay < 67	604.099 (111.639)	586.906 (84.767)	623.674 (133.278)
Length of stay > 67	2884.67 (650.28)	2922.36 (588.75)	2841.75 (711.74)
Hospitalisation due to cardiovascular dis.	57.951 (14.967)	55.141 (11.873)	61.150 (17.306)
Emergency stays	104.587 (19.403)	100.166 (16.397)	109.621 (21.253)
N	2592 obs. (432 municipalities)	1380 obs. (230 municipalities)	1212 obs. (202 municipalities)

Note: The numbers are per 1000 inhabitant except Population, which is in absolute terms.

Table 3. Descriptive statistics, by year.

	1996	1997	1998	1999	2000	2001
Mortality	11.389 (3.453)	11.420 (3.301)	11.532 (3.565)	11.696 (3.434)	11.462 (3.518)	11.310 (3.621)
Mortality I	5.310 (2.066)	5.228 (1.943)	5.311 (2.235)	5.286 (2.116)	5.043 (2.134)	4.812 (2.047)
Mortality C	2.649 (1.049)	2.699 (1.086)	2.526 (1.028)	2.638 (1.097)	2.613 (1.086)	2.750 (1.267)
Mortality J	1.027 (0.722)	0.937 (0.649)	1.069 (0.843)	1.128 (0.773)	1.183 (0.865)	1.080 (0.782)
Mortality O	2.405 (1.174)	2.556 (1.234)	2.627 (1.220)	2.644 (1.293)	2.622 (1.253)	2.667 (1.269)
Age67-79	111.246 (24.117)	109.786 (23.499)	108.595 (23.064)	106.850 (22.638)	105.324 (22.048)	102.399 (21.183)
Age80+	47.782 (15.662)	48.744 (15.683)	49.787 (15.789)	50.632 (15.700)	50.663 (15.662)	51.967 (15.796)
Population	8.969 (16.846)	9.007 (16.973)	9.053 (17.116)	9.110 (17.291)	9.176 (17.467)	9.231 (17.586)
Disability	56.712 (16.205)	58.295 (16.607)	61.022 (17.053)	63.531 (17.474)	65.435 (18.102)	66.526 (18.469)
Unemployment	19.494 (8.941)	15.543 (7.382)	11.918 (5.995)	12.761 (6.388)	13.341 (6.485)	13.062 (6.114)
High education	540.733 (51.546)	547.382 (51.265)	554.638 (50.84)	565.763 (49.941)	569.518 (48.591)	574.454 (55.242)
Total man year	20.100 (8.085)	22.347 (8.285)	23.344 (8.357)	24.421 (8.500)	25.326 (8.684)	25.671 (8.464)
Total vacancies	1.099 (1.394)	1.217 (1.446)	1.679 (1.845)	1.691 (1.712)	1.710 (1.938)	1.712 (1.952)
Physicians	0.990 (0.350)	0.997 (0.346)	1.016 (0.362)	1.029 (0.358)	1.061 (0.367)	1.104 (0.390)
Vacant phys.	0.106 (0.225)	0.093 (0.207)	0.112 (0.225)	0.105 (0.220)	0.104 (0.223)	0.097 (0.250)
Home nursing > 67	79.791 (40.543)	81.634 (33.381)	85.043 (34.486)	89.292 (32.226)	91.523 (32.387)	92.184 (35.579)
Institutionalised > 67	83.875 (31.408)	82.932 (31.949)	81.510 (32.358)	80.288 (31.091)	79.661 (30.079)	80.024 (28.373)
Hospitalisation < 67	119.555 (18.222)	119.811 (18.288)	121.942 (18.078)	124.131 (17.784)	123.314 (17.897)	128.171 (20.756)
Hospitalisation > 67	356.606 (72.171)	369.175 (70.100)	390.367 (72.867)	394.469 (72.120)	399.975 (73.734)	422.632 (82.116)
Length of stay < 67	611.318 (105.77)	609.204 (113.42)	607.074 (109.38)	607.415 (113.64)	595.403 (105.63)	594.177 (120.68)
Length of stay > 67	2788.52 (657.86)	2839.35 (632.08)	2916.68 (664.55)	2886.79 (648.56)	2872.46 (625.34)	3004.22 (655.49)
Hospitalisation due to cardiovascular dis.	55.718 (13.967)	57.218 (14.475)	59.874 (14.549)	58.008 (14.866)	57.223 (15.716)	59.664 (15.798)
Emergency stays	97.239 (17.571)	99.246 (17.078)	105.057 (18.691)	108.065 (19.346)	107.760 (19.606)	110.157 (20.457)
N	432	432	432	432	432	432

Table 4. Explaining municipal mortality. Fixed effect models.

	All municipalities	Urban municipalities	Rural municipalities
Age67-79	0.0186* (0.0113)	0.0868*** (0.0150)	-0.0042 (0.0169)
Age80+	0.2394*** (0.0173)	0.2113*** (0.0222)	0.2620*** (0.0264)
Disability	0.0092 (0.0132)	0.0100 (0.0139)	0.0157 (0.0226)
Unemployment	0.0074 (0.0151)	-0.0067 (0.0205)	0.0087 (0.0224)
High education	-0.0122*** (0.0037)	-0.0092*** (0.0033)	-0.0242** (0.0100)
Total man year	0.0095 (0.0187)	0.0192 (0.0235)	0.0180 (0.0293)
Total vacancies	-0.0120 (0.0359)	0.0518 (0.0416)	-0.0526 (0.0571)
Physicians	-0.2944 (0.2577)	0.1675 (0.3503)	-0.5733 (0.3824)
Vacant phys.	0.8559*** (0.2452)	0.8688*** (0.3384)	0.7185** (0.3584)
Home nursing > 67	-0.0114*** (0.0019)	-0.0065*** (0.0024)	-0.0134*** (0.0030)
Institutionalised > 67	-0.0026 (0.0043)	-0.0048 (0.0056)	-0.0019 (0.0065)
Hospitalisation < 67	-0.0163*** (0.0056)	-0.0025 (0.0078)	-0.0204*** (0.0082)
Hospitalisation > 67	0.0026* (0.0015)	0.0016 (0.0019)	0.0029 (0.0023)
Length of stay < 67	0.0029*** (0.0006)	0.0009 (0.0008)	0.0036*** (0.0009)
Length of stay > 67	-0.0001 (0.0001)	0.0002 (0.0002)	-0.0002 (0.0002)
Hospitalisation due to cardiovascular dis.	0.0065 (0.0047)	0.0044 (0.0065)	0.0068 (0.0070)
Emergency stays	0.0185*** (0.0069)	0.0193** (0.0088)	0.0180* (0.0103)
y97	-0.1308 (0.1540)	0.0912 (0.1600)	-0.3795 (0.2802)
y98	-0.2707 (0.1988)	-0.0169 (0.2271)	-0.5881* (0.3553)
y99	0.1452 (0.2218)	0.0241 (0.2391)	-0.2106 (0.4457)
y00	-0.2923 (0.2406)	0.0129 (0.2519)	-0.4018 (0.4944)
y01	-0.6551** (0.2706)	-0.3164 (0.2867)	-0.6963 (0.5542)
cons	2.1889 (2.5216)	-6.2393** (2.6067)	9.7457* (5.7613)

Table 5. Explaining municipal mortality. Fixed effect models.

	Mortality C	Mortality I	Mortality J	Mortality O
Age67-79	-0.0034 (0.0056)	0.0108 (0.0082)	0.0103^{***} (0.0040)	-0.0010 (0.0058)
Age80+	0.0395^{***} (0.0085)	0.1182^{***} (0.0126)	0.0260^{***} (0.0061)	0.0557^{***} (0.0090)
Disability	-0.0036 (0.0065)	-0.0003 (0.0095)	-0.0014 (0.0046)	0.0144^{**} (0.0068)
Unemployment	0.0030 (0.0075)	-0.0039 (0.0110)	0.0081 (0.0053)	0.0002 (0.0079)
High education	-0.0022 (0.0018)	-0.0033 (0.0027)	-0.0022^{*} (0.0013)	-0.0045^{***} (0.0019)
Total man year	0.0076 (0.0092)	-0.0089 (0.0136)	-0.0034 (0.0066)	0.0143 (0.0097)
Total vacancies	-0.0150 (0.0177)	-0.0010 (0.0261)	-0.0006 (0.0126)	0.0047 (0.0187)
Physicians	-0.1854 (0.1271)	0.0603 (0.1870)	-0.0497 (0.0905)	-0.1197 (0.1338)
Vacant physicians	-0.0279 (0.1210)	0.6915^{***} (0.1780)	-0.0678 (0.0862)	0.2601^{**} (0.1273)
Home nursing > 67	-0.0005 (0.0010)	-0.0065^{***} (0.0014)	-0.0027^{***} (0.0007)	-0.0017^{*} (0.0010)
Institutionalised >67	-0.0017 (0.0021)	0.0041 (0.0031)	0.0004 (0.0015)	-0.0054^{**} (0.0022)
Hospitalisation < 67	0.0021 (0.0028)	-0.0149^{***} (0.0041)	-0.0028 (0.0020)	-0.0007 (0.0029)
Hospitalisation > 67	0.0033^{***} (0.0008)	-0.0024^{**} (0.0011)	-0.0009^{*} (0.0005)	0.0026^{***} (0.0008)
Length of stay < 67	0.0012^{***} (0.0003)	0.0010^{**} (0.0004)	0.0003 (0.0002)	0.0003 (0.0003)
Length of stay > 67	-0.0000 (0.0001)	-0.0000 (0.0001)	0.0001 (0.0000)	-0.0001 (0.0001)
Hospitalisation due to cardiovascular dis.	-0.0082^{***} (0.0023)	0.0174^{***} (0.0034)	-0.0008 (0.0017)	-0.0019 (0.0025)
Emergency stays	0.0041 (0.0034)	0.0111^{**} (0.0050)	0.0051^{**} (0.0024)	-0.0019 (0.0035)
y97	-0.0093 (0.0760)	-0.1398 (0.1118)	-0.0371 (0.0541)	0.0555 (0.0800)
y98	-0.2605^{***} (0.0981)	-0.1589 (0.1443)	0.1385^{**} (0.0698)	0.0102 (0.1032)
y99	-0.2097^{*} (0.1095)	-0.1371 (0.1610)	0.2265^{***} (0.0779)	-0.0249 (0.1152)
y00	-0.2356^{**} (0.1188)	-0.2981^{*} (0.1747)	0.3222^{***} (0.0846)	-0.0809 (0.1249)
y01	-0.2075(0.1335)	-0.5673^{***} (0.1964)	0.2504^{***} (0.0951)	-0.1307 (0.1405)
cons	0.6822 (1.2443)	0.5321 (1.8303)	-0.1046 (0.8860)	1.0792 (1.3091)

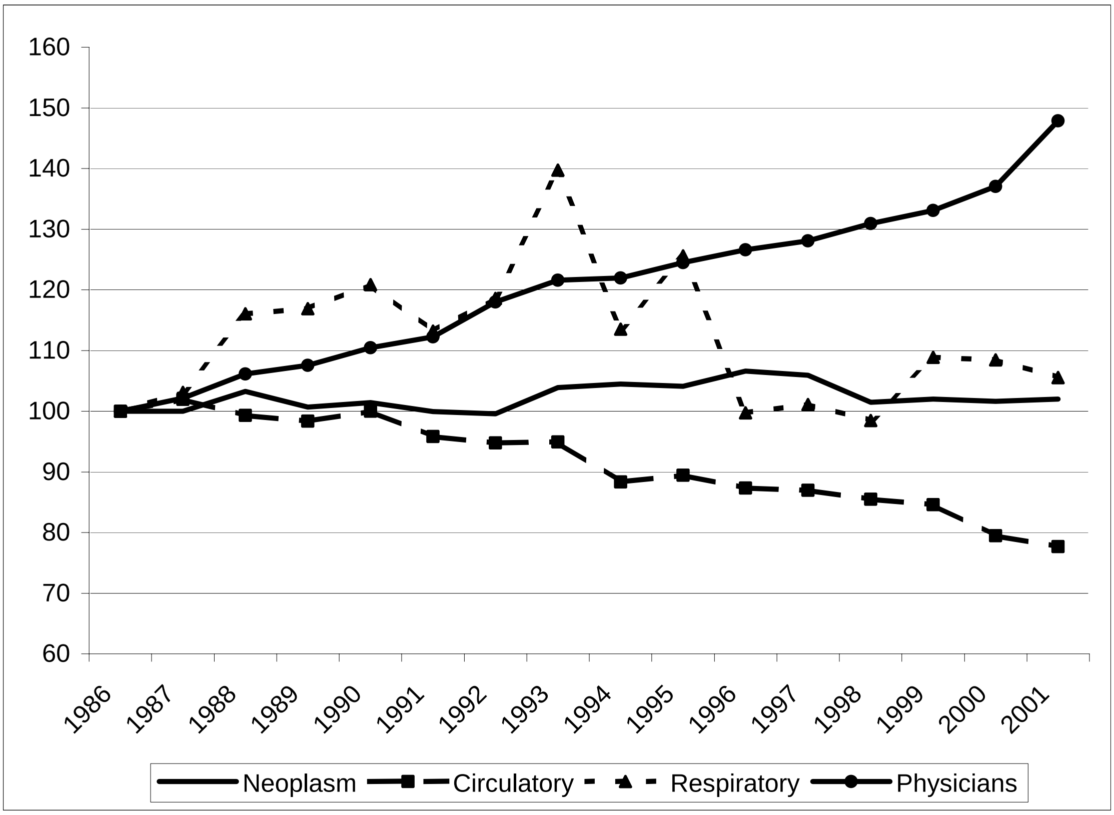

Figure 1. Mortality rates (deaths per 100,000 for the three leading causes of death in Norway) and number of physicians over time. Relative changes from 1986 to 2001.

Department of Economics
University of Bergen
Fosswinckels gate 6
N-5007 Bergen, Norway
Phone: +47 55 58 92 00
Telefax: +47 55 58 92 10
http://www.svf.uib.no/econ