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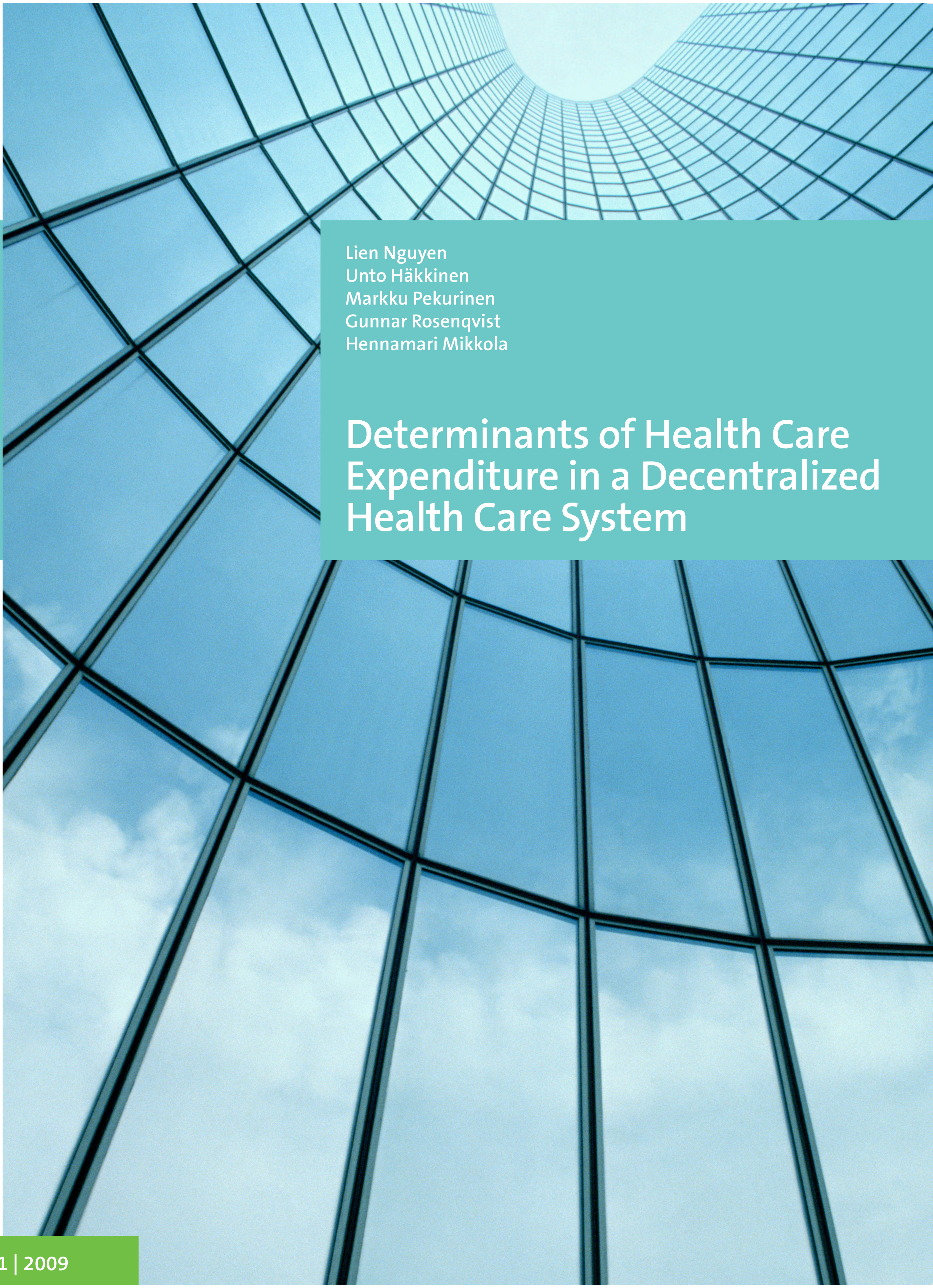

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Determinants of Health Care Expenditure in a Decentralized Health Care System

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Abstract

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This paper casts a different light on the relationship between income and the municipal tax rate, while investigating the determinants of per capita total health expenditure in Finland. Two 2-way fixed-effects models are estimated applying a simple two-stage estimation procedure to municipality-level panel data (N = 415) for the period 1993–2004.

Key determinants of per capita total health expenditure were the proportion of elderly, the rate of disability pensions, the employment-to-population ratio, the municipal tax rate, the state reimbursements of prescription medicines and private dental care, income, and population density. The hospital districts were statistically significantly associated with health expenditure. Both measures of income elasticity were small (0.045 and 0.020), implying that public health care is a major necessity good. The findings suggest that the high use of prescription medicines has resulted from increased population morbidity and that local tax rates have been used as a method of financing local services.

Keywords: Municipal health expenditure, local government, panel data analysis, decentralization, federalism

Contents

Introduction

A considerable number of empirical studies have tried to explain variations in health expenditure using different types of data, models and explanatory variables. Numerous macro-level studies have shown that income is the main non-demographic driver of health expenditure, as seen in the high and positive income elasticity of health expenditure (Getzen, 2000; Committee, 2006; OECD, 2006). Concerns have been expressed over this conclusion. First, the magnitude of income elasticity tends to increase with the level of aggregation, i.e. the higher the level of aggregation, the higher the elasticity (Getzen, 2000; Committee, 2006; OECD, 2006). Further, measured income elasticities are found to be typically small in those studies using regional-level data (Getzen, 2000; Committee, 2006; OECD, 2006). Moreover, they tend to be close to zero or even negative in those studies using individual-level data (Getzen, 2006).

No consensus on the appropriate magnitude of income elasticity of health expenditure has been reached, suggesting that the estimated high measures of income elasticity (above unity) may result from aggregation problems and omitted variable bias and is thus a failure to control for many confounding factors, such as prices or costs, health status, and differences in health care utilization. In addition, one may argue that at the aggregate level, income is closely related to the use of new medical technology and products. For example, in many developed countries and also in Finland, expenditure on pharmaceuticals during the last decade has increased more rapidly than other types of health expenditure or GDP. The main driver for the increase in this expenditure type is thought to be the introduction of new and more expensive medicines. More to the point, it is currently well recognized that health expenditure is determined by a complex series of demand and supply side factors, like population health status, economic growth, new medical techniques and progress, methods of organizing and financing health care, as well as health care resources, in addition to aging or other demographic factors (Häkkinen and Luoma, 1995; Di Matteo and Di Matteo, 1998; Gianonni and Hittris, 2002; Cantarero, 2005; Crivelli *et al.*, 2006).

The Finnish health care system can be considered one of the most decentralized in the world (Häkkinen and Lehto, 2005) seen in the light of a fiscal federalism framework (Oates, 1999). In principle, public goods that are consumed locally should be produced locally. Decentralization is promoted because it is believed to lead to increased welfare as the local authorities are allowed or/and expected to act in accordance with local preferences, local cost structures, and local accountability to community priorities. In Finland, local preferences are assumed to be included in the provision of services through local elections. Moreover, the local authorities can decide levels of their own local tax rates and means to organize services as well as how much they invest in health care. Due to these financial incentives, they are expected to behave in an efficient way in order to contain the costs of services. Further, annually each municipality has to allocate resources not only to health care but also to the other local service sectors, such that all allocated resources must be balanced according to the municipality's existing resources.

At the macro level, compared to many other countries, the Finnish health care system seems to curtail the costs of health care rather well. Per capita health expenditure and the share of GDP in Finland have been relatively lower than the equivalent figures in many developed and Nordic countries (Moilanen *et al.*, 2008). This result is partly attributable to the relatively low wages of health care personnel and partly to the especially effective cost management of the municipalities (Häkkinen, 2009). However, to be able to make appropriate health policy, one needs to understand municipal economic behavior. This in turn calls for identifying the factors involved in municipal choices in dealing with health expenditure in addition to the factors determining health expenditure.

In this paper, we apply a two-stage estimation procedure to municipality-level panel data for the period 1993–2004 to investigate the determinants of per capita total municipal health expenditure in Finland. Our analysis adds new aspects to the existing empirical research. First, it offers an opportunity to look closer at the complex relationship between income and health expenditure. Income is characterized as having not only a direct effect on health expenditure but also another effect via the local tax rate for financing local health care. One can assume that in a typically small and rather homogenous country, health technology has diffused quite simultaneously and equally in all parts of the country, owing to which the income effect can be measured more precisely. Second, as each local government authority annually decides simultaneously upon both the levels of all public expenditures and the level of the local tax rate, our analysis is partly based on behavioral modeling of local public expenditure determination. Third, there have been several local experiments in Finland in containing health expenditure over the last decade. Thus, this study also allows us to analyze their impact on the municipal total health expenditure.

The Finnish health care system

In terms of institutional structure, financing and goals, the Finnish health care system resembles those of other Nordic countries and the UK. The system covers the whole population with services being mainly produced by the public (municipal) sector and financed through general taxation. Each municipality is, either alone or in federation with others, responsible for providing basic services, such as health and dental care, nursing homes and other social services for the elderly, child day care, social assistance, and basic education. Municipally provided health care covers primary care (mostly produced in health centers) and specialized hospital care, which are financed by municipal taxes, state grants, and user charges. The private health care sector complements the municipal sector, playing an essential role particularly in both dental and occupational health care. National Health Insurance (NHI) subsidizes the use of certain private health services, such as outpatient prescribed medicines, examinations and treatments performed by doctors, dental care, and transportation expenses (see Appendix A).

In terms of specialized care provision, twenty hospital districts that own the hospitals (i.e. university, central, and regional hospitals) produce most of the specialized outpatient and inpatient care services. Each municipality has to be affiliated to one of these hospital districts. The two parties mutually consent prospectively to a framework contract concerning prices and quantities of services needed in the coming year. The hospitals typically apply standard bed-day, case-based (e.g. DRG-based) and mixed pricing (combined fee-for-service and bed-day pricing). Some municipalities are also able to produce by themselves certain specialized care services and provide long-term care services in their own health centers. According to the current legislation, both the NHI and patients are financing outpatient and private health care prescription medicines, whereas the municipalities pay for other medicines (those used in the public hospitals and nursing homes).

Municipalities vary greatly in the size of population for which they are responsible. The smallest town Velkua has a population of 233 inhabitants (as of 2004), whereas more than half a million people inhabit the capital Helsinki. Half of the 415 municipalities have a population not greater than 5000, with only 15 municipalities having more than 50 000 (as of 2004). Cost-sharing is generally higher for privately provided services than for the corresponding municipally provided services. For example, user charges account for roughly 35% of the total cost of medicines prescribed outside hospitals, whereas they only contribute 10% to the total cost of services provided by the health centers and 5% of the total cost of specialized hospital care services. However, when patients use long-term care in a health center ward or a municipal nursing home, the charge for lodgings will be up to 80% of the individual's disposable income. In 2006, the state, municipalities, NHI, and households respectively contributed 21%, 39%, 17%, and 20% to the financing of the total health care expenditure. Private health insurance roughly accounted for 2% of that overall financing. Privately produced health care represented 20% of the total value of health care production. Occupational health care was offered to about 84% of all the employees in Finland in 2004 (Vuorenkoski, 2008).

Theoretical and practical background

One special case of the broader question of modeling how lower levels of government decide a whole variety of policies is the behavioral modeling of local public expenditure determination (Wildasin, 1986). Using the preferences and budget constraints of a single agent, the median voter model has often been applied to local public expenditure on public services (Wildasin, 1986; Rubinfeld, 1987) and more recently to the effects of intergenerational social benefits and municipality sizes on public spending (Strömberg, 2006; Breunig and Rocaboy, 2008).

Previous empirical models of health expenditure determinants at the macro level fall into two broad approaches. In the context of a demand model framework, the major driving forces behind the growth in health expenditures are found to be per capita income, aging of the population, population's size and age- or/and gender-specific utilization of health care (see e.g. Gerdtham and Jönsson, 2000; Getzen, 2000). Alternatively, emphasizing the supply side of health expenditures and the institutional factors of health systems, other studies have shown that the main determinants of health spending are the relative price of health care, public provision and financing, supply of health care personnel and resources, as well as national income and age structure. A mixed approach focuses on local health expenditures in the long-term in a characteristically decentralized health system. Local health expenditure is first considered as an outcome resulting from both supply- and demand-side factors and their interactions, but is also considerably influenced by new technologies and medical progress as well as by structural or/and organizational factors, including some features of public choice (democracy) (Di Matteo and Di Matteo, 1998; Gianonni and Hittris, 2002; Cantarero, 2005; Crivelli *et al.*, 2006; Cantarero and Lago-Peñas, 2009).

Irrespective of the approach or data used, the main constraint on health expenditure is thought to be determined by income, while health expenditure levels are determined by the relative price or price proxy of health care. However, no consensus has been reached on whether health care is a normal or luxury good; this is in no small part due to the numerous statistical methods applied and the various types of data used, as well as the absence of a reasonably convincing theoretical model (Gerdtham and Jönsson, 2000; Di Matteo and Di Matteo, 1998; Getzen, 2006; Cantarero and Lago-Peñas, 2009). As discussed, the impacts of income and price of health care on health expenditures at the macro level are complicated by many confounding factors, from which an aggregation fallacy in the estimation of the income elasticity of health expenditure arises. Nevertheless, efforts to examine the determinants of local health expenditure using a panel data model approach have identified several central factors, such as per capita income, the proportion of population aged 65 or over, urbanization, unemployment, mortality, population density, and physician density (Cantarero, 2005; Cantarero and Lago-Peñas, 2009; Crivelli *et al.*, 2006; Järviö and Luoma, 1999).

The key assumptions of the median voter model (single-peaked preferences, true preference-based voting, and a one-dimensional public good) are seen to be quite restrictive. As such, the model cannot be used to explain municipal health expenditures in Finland (Häkkinen and Luoma, 1995; Moisio, 2002; Häkkinen, 2009). Indeed, local politics in Finland is built on a multi-party system, while the budget decisions made by the municipal councils are typically multi-dimensional. In addition, many health centers are run by federations of municipalities, where the decision-making of a single municipality can be diminished. Furthermore, the hospital districts make use of their own definitions and methods for calculating service prices in their operational activities, which the affiliated municipalities generally have to accept (Mikkola, 2002).

The present study is based on a slight variation of behavioral modeling of local public expenditure determination (Wildasin, 1986), focusing on the demand side factors of health care and expenditure and the health system-related characteristics as a way of explaining variation in municipal total health spending. As a result of the decentralization, the organization and production of municipal health care can be seen as an efficient process where local authorities are able to take into account municipality-specific preferences and needs while containing service costs and balancing resource allocation across local service sectors (Oates, 1999). If health care is a policy priority of local government, then the delegation of fiscal responsibility to local authorities is expected to increase local health expenditure and thus total local expenditure.

Studying the impact of income on total municipal health expenditure involves the inspection of income disparities at the municipality level. Since income is thought to determine the optimal amount of health spending for a society or jurisdiction, it has a direct effect on the financing of health services and thus on health spending. There are no restrictions upon the local tax instrument for the municipalities. If the local authorities do not want to overspend and rely on debt, they can impose higher levels of their proportional local tax rates. A higher local tax rate results naturally in higher local income tax revenues. This suggests that another effect on local health expenditure of income is transferred via the interaction between income and the local tax rate. Hence, an increase in health expenditure related to the provision of public health care has to be offset against the amount of income tax revenue raised by the method of financing. Theoretically, a lump-sum grant shifts the local budget to the right, generating an income effect on the consumption of local health care and thus on local health expenditure (Wildasin, 1986). However, in practice when the local authorities attempt to contain public expenditures and enhance competition as well, no assurance can be given that they spend the allocated grant, non-earmarked as well as earmarked, on the provision of a certain public good (Tuomala, 1997; Häkkinen, 2009).

Education has been found to have a large and considerable impact on health and consumption of health care at the individual and national level (Grossman, 1972, 2000) and is expected to affect and change health expenditure via the relationship between health status and health care consumed. It has been argued that after the 1990s, the main driver of health spending is not price but volume of health care (Lopez-Casasnovas *et al.*, 2005). In addition, the graying and aging process has brought about a relatively higher number of certain treatments or increased intensity of services and treatment episodes, which may play an important role in explaining variation in health spending (Getzen, 2006; Häkkinen and Lehto, 2005). Moreover, it has been argued that increased expenditure on prescription medicines in Finland arises from technological developments and the applicability of new pharmaceuticals, as well as from larger patient groups and the aging of population (Vuorenkoski, 2008).

Local governments seem to have experienced large variations in health needs and revenues. Decentralization of expenditure responsibility and competences has led to wide differences between the municipalities in terms of per capita health care expenditures (Hujanen *et al.*, 2006). This is likely attributed to variations in health needs, clinical practice, and the delivery of health care between both the municipalities and the hospital districts. In addition, the very small municipalities have experienced increasing difficulties with securing enough skilled health care professionals to provide services. Furthermore, they have also faced growing financial difficulties as the economic risks of hospital care expenditures are relatively higher for them than for the bigger municipalities (Vuorenkoski, 2008).

Data and variable specifications

We make use of previously gathered municipality-level panel data (N = 415) for the period 1993–2004 (T = 12) (Hujanen *et al.*, 2006). Additional municipal information was collected from the registers of Statistics Finland and the Social Insurance Institution. To take into account differences in costs and wages, we deflated the NHI reimbursement of prescribed medicines using cost indices of medicines (2004 = 100), disposable income using employees' wage-level indices (2004 = 100), while all other monetary variables were deflated to 2004 prices using the municipal health care price indices.

The dependent variable is the per capita total municipal expenditure on health care services including primary, specialized and elderly care (hereafter *THCE*). This expenditure measure is defined explicitly in Appendix A. THCE is postulated to be dependent upon municipality-specific demographic, socioeconomic and organizational or/and structural factors describing the Finnish health care system. Table 1 presents definitions and summary statistics of the selected variables and theoretical directions of the effects that the explanatory variables have on the dependent variable.

The demographic factors are considered to be associated with the need and demand for health care. It is observed that treatment costs are high for children under school age, and health care costs increase rapidly for those older than 65. However, we include the shares of age- and gender-specific populations in the model as regressors so as to standardize the effects of age and gender on THCE and thus we do not specify their *a priori* expectations on THCE. Municipalities that differ by population size and level of urbanization are assumed to exhibit differences in the costs of producing services. Larger population is assumed to lower the cost of producing public services as a result of economic scales, an expectation also found in club theory (Rubinfeld, 1987). Municipalities' acreages supposedly take into account the impact of distance and remote municipalities on the use of health care, but they are constant over time by nature. Hence, population density (a proxy for the urbanization level of each municipality, popden) can be assumed to display the effect of the size of population on THCE.

Our income variable (inc) is constructed as the average after-tax income per household member (a weight of 1 for adults and ½ for children). Privately produced health services account for about 2.9% of the total annual national health expenditure (Moilanen *et al.*, 2008). Unfortunately, we have no municipality-level cost information on occupational health services used in the private sector. Therefore, to control for the use of private health services on the part of those who are employed, we include the employment-to-population ratio (employ) in the model. As the use of private health care hypothetically reduces the need and demand for public health care, the direction of the effect of 'employ' on THCE is thought to be negative. Because higher educated people supposedly have good health status and thus need less health care than lower educated people, a greater ratio of higher educated inhabitants to the municipal population (eduhigh) is expected to reduce THCE. However, since education is normally highly correlated with income and health knowledge, a higher municipal education rate hypothetically augments THCE. Health status and morbidity variables appear to be the most important predictors of individual health care utilization (Hulka and Wheat, 1985). The age and gender standardized rate of disability pensions (disabi), which assesses the overall state of health and need for health care, is expected to be positively related to THCE. We do not include the mortality variable in the model because mortality is closely connected to the elderly populations, which the shares of population older than 64 already capture.

TABLE 1. Variable definitions and descriptive statistics of the municipality-specific variables

Variable	Definition	*A priori* expec-tation	Mean (Overall)	Standard deviation		
				Overall	Between groups	Within groups
Dependent variable						
	Total municipal health care expenditure per capita (€1000) (including primary, elderly and specialized care)		1.317	0.235	0.192	0.137
Independent variables						
Demographic variables						
a06pm	Share of males aged 0–6 of population		0.041	0.009	0.008	0.004
a717pm	Share of males aged 7–17 of population		0.076	0.011	0.011	0.004
a1840pm	Share of males aged 18–40 of population		0.139	0.017	0.013	0.011
a4164pm	Share of males aged 41–64 of population		0.172	0.018	0.014	0.010
a6574pm	Share of males aged 65–74 of population		0.046	0.012	0.011	0.004
a7584pm	Share of males aged 75–84 of population		0.022	0.008	0.007	0.004
a85pm	Share of males aged 85 or over of population		0.005	0.002	0.002	0.001
a06pf	Share of females aged 0–6 of population		0.039	0.009	0.008	0.004
a717pf	Share of females aged 7–17 of population		0.072	0.011	0.010	0.004
a1840pf	Share of females aged 18–40 of population		0.124	0.021	0.018	0.010
a4164pf	Share of females aged 41–64 of population		0.157	0.015	0.012	0.009
a6574pf	Share of females aged 65–74 of population		0.054	0.012	0.012	0.004
a7584pf	Share of females aged 75–84 of population		0.039	0.012	0.011	0.004
a85pf	Share of females aged 85 or over of population		0.013	0.005	0.004	0.002
popden	Population density ($/10^4$)	–	0.005	0.020	0.020	0.001
Socioeconomic variables						
inc	Disposable income per capita (€1000)	+	9.716	2.058	1.280	1.612
employ	Ratio of the employed to population aged ≥ 18	–	0.488	0.070	0.063	0.029
eduhigh	Share of high educated people of population aged ≥ 18	–/+	0.139	0.068	0.048	0.049
disabi[#]	Age and gender standardized index of disability pensions of population aged 16–54	+	1.166	0.354	0.346	0.074
tax	Municipal tax unit rate	–/+	0.181	0.007	0.006	0.004
Structural and organizational variables						
rexado	NHI reimbursement for private physician services and examinations per capita (€1000)	–	0.020	0.007	0.006	0.002
reden	NHI reimbursement for private dental care per capita (€1000)	–	0.007	0.005	0.004	0.003
remedi	NHI reimbursement for prescribed medicines per capita (€1000)	–/+	0.192	0.039	0.031	0.024
subsidy	Total state grants allocated to the munucipality per capita (€1000)	+	1.427	0.599	0.484	0.353
hoscom	= 1 if a health center hospital was merged with a hospital owned by some hospital district during the year when merging occurred or later	–	0.013	0.113	0.092	0.065
specare	Share of specialized (inpatient) care of total health expenditure	+	0.472	0.069	0.060	0.034
Cumulative year dummy variables						
y9394	= 1 if 1994 ≤ year ≤ 2004					
y9495	= 1 if 1995 ≤ year ≤ 2004					
y9596	= 1 if 1996 ≤ year ≤ 2004					
y9697	= 1 if 1997 ≤ year ≤ 2004					
y9798	= 1 if 1998 ≤ year ≤ 2004					
y9899	= 1 if 1999 ≤ year ≤ 2004					
y9900	= 1 if 2000 ≤ year ≤ 2004					
y0001	= 1 if 2001 ≤ year ≤ 2004					
y0102	= 1 if year 2002 or 2003 or 2004					
y0203	= 1 if year 2003 or 2004					
y0304	= 1 if year 2004					
Hospital districts as effects coding variables						
Hd20	= –1 if the hospital district of Helsinki and Uusimaa					
Hd_j	= 1 if the hospital district j (j = 1, 2, …, 19), 0 for the hospital district s ≠ j					

NHI = National Health Insurance. [#] Whole country = 1.000.

The municipality's financial capacity is gauged by the municipal tax rate (tax). As argued, to meet all local demand for services and to cope with increased expenditure (and thus budget deficit), the municipalities can only impose a higher level of their proportional tax rates. This implies a positive association between the local tax rate and THCE. On the other hand, as publicly provided services often do not have market prices, we could consider the municipal tax rate as one kind of price variable for municipally provided health care: the higher the price, the lower the demand for health services and thus the level of health expenditure, other things being the same. Hence, the *a priori* direction of the effect on THCE of 'tax' is undecided.

Because the use of private care presumably reduces the need and use of public care (substitution effects) and as NHI reimbursements are paid to patients, we expect all the NHI reimbursements ('remedi' for prescribed medicines, 'reden' for private dental care, and 'rexado' for both private physician services and examinations) to be negatively related to THCE. However, there exists a cost-shifting problem among the parties due to ambiguities at the interface of institutional and outpatient care entailed by the dual-channel financed health care system (Huttunen, 2008). Further, evidence from many previous international studies shows a positive relationship between health expenditure and prescription drugs. Hence, our expectation of the direction of the effect of 'remedi' on THCE is not *a priori* clear. Mergers between hospitals and health centers with hospital wards from the same hospital districts are expected to increase hospitals' operational scale and thus lessen THCE, owing to the exhibition of economics of scale in the provision of health care. During 1993–2004, this kind of hospital merger occurred in 12 municipalities. This activity is one of several local reforms carried out to improve the collaboration between primary and secondary health care and to improve efficiency and contain health care expenditure (Vuorenkoski, 2008). Since the Finnish health care system has relied heavily on inpatient care practices, we attempted to use the share of inpatient care of THCE as an indicator of allocative inefficiency. If THCE significantly increases with a higher share of inpatient care, health resources are considered to be inefficiently allocated, as an outpatient-oriented service mix would be relatively cheaper. However, we dropped the variable from the final estimated model.

Statistical methods

The econometric model

Panel data allows us to control and test for municipality and time-invariant effects and to conduct appropriate estimations in the presence of those invariant effects (Baltagi, 1995; Greene, 2000). A general model specified to y_{it}, the THCE of an inhabitant living in municipality i = 1, 2, …, N measured in year t = 1, 2, …, T, is of the form

$$(1) \qquad y_{it} = \alpha + x_{it}\beta + \varepsilon_{it} + \mu_i + \nu_t$$

where α is a common intercept and βs are the regression coefficients (for all the municipalities). Vector x_{it} denotes the time-varying explanatory variables, ε_{it} is the error term, and μ_i and ν_t are the municipality-specific term and the time-specific term respectively. The two-way fixed effects (FE) model (1) assumes that μ_i and ν_t are fixed constants for each municipality and each time period respectively. In this panel data estimation, the appropriate model appears to be an OLS model including both the municipality-specific and time-specific dummy variables. As such, the unknown time and municipality effects on the dependent variable can be displayed as changes in the intercept. The error term $\varepsilon_{it} \sim iid\ (0, \sigma^2)$ represents a time-varying idiosyncratic random error term, accounting for unknown time and municipality effects not included in the regression.

Alternatively, a two-way random effects (RE) model can be specified as

$$(2) \qquad y_{it} = \alpha + x_{it}\beta + \mu_i + \nu_t + \eta_{it}$$

where $\varepsilon_{it} = \mu_i + \nu_t + \eta_{it}$ is now the stochastic part of the model, $\mu_i \sim iid\ (0, \sigma^2_\mu)$, $\nu_t \sim iid\ (0, \sigma^2_\nu)$, and $\eta_{it} \sim iid\ (0, \sigma^2_\eta)$. This is also called an error components model, which can be estimated using generalized least squares (GLS).

Estimation strategy

We used F- and *t*-tests to check the statistical significance of the independent variables in a preliminary analysis and the F-tests to find out time and municipality effects on the dependent variable (Table 2). To choose between FE and RE models, we used Hausman tests (Hausman, 1978). The Hausman test results showed that there were differences in the coefficients estimated by the efficient RE estimator and the consistent FE estimator (Table 2). Therefore, the exogeneity of the regressors with respect to the time-invariant error term was rejected, leading us to consider the two-way FE model. The FE model is viewed as a reasonable approach since the full set of municipalities is included in the model and differences in THCE between the municipalities can be viewed as parametric shifts of the regression function (Greene, 2000). The application of the FE model is also supported because the within-variation of many of the explanatory variables is relatively high, suggesting a low statistical efficiency of the RE model (see Table 1).

Many empirical studies on the determinants of local government expenditure and health care expenditure have specified a double logarithmic function (e.g. Gerdtham and Jönsson, 2000). Nevertheless, with the attempt to further explore the role of income and local tax rate

TABLE 2. Tests of municipality and time effects of the linear model

Model	R^2 total	Root MSE	Test statistic	*p*-value	Decision
Pooled OLS	0.6989	0.1295			
Pooled OLS and municipality dummies	0.8841	0.0840	F(414, 4540) = 17.53	0.000	Municipality dummies jointly significant
Pooled OLS and time dummies	0.7212	0.1248	F(11, 4943) = 36.00	0.000	Time dummies jointly significant
Pooled OLS and both munipality and time dummies	0.8976	0.0790	F(426, 4529) = 20.62	0.000	Both municipality and time dummies jointly significant
Fixed effects vs. random effects			Hausman $\chi^2(25)$ = 244.89	0.000	1-way fixed effects model
Fixed effects including time effects			F(11, 4529) = 54.07	0.000	2-way fixed effects model (since time dummies jointly significant)

on THCE and so as to more easily interpret the estimated results,[1] we decided to apply a linear model in the primary analyses.[2] As discussed, income is characterized as having two kinds of effect on THCE: a direct (income) effect and another effect via the local proportional tax rate. This connection between the local tax rate and income is specified as an interaction between 'tax' and 'inc', considered as a proxy for local income tax revenues, which appears as a regressor in our second two-way FE model. In the final models, we obtained robust (heteroschedasticity-adjusted) standard errors using the Huber-White sandwich estimator.

Since considerable variations in clinical practice and the delivery of health care between the hospital districts can influence THCE, time-invariant regressors, such as the hospital districts, are also of interest in the modeling. When the covariates are time-invariant or rarely change over time, they are highly or perfectly correlated with the unit-level effect and thus they are not precisely estimated by the traditional FE model (Wooldridge, 2005). To obtain estimates from each of our two-way FE panel data models, we carry out a simple two-stage estimation that is adapted from the panel data study of Kerkhofs and Lindeboom (1997). In the first stage, the least squares estimation method drops all the hospital districts as they are constant over time. Hence, the individual (municipality) effect estimates also contain the effects of the time-invariant hospital districts. Therefore, in the second stage, we compute the individual fixed effects, which are actually the residuals from the first stage estimation. Then, these computed individual fixed effects are regressed on the constant exogenous hospital districts. This gives the coefficients of the hospital districts that were excluded in the first stage. Moreover, the residuals obtained from the second stage estimations are the estimates of individual fixed effects.

1 According to the data, some municipalities had 'negative' grants and no population aged 85 or over in some years. The negative grants originated from the revenue sharing system, and those municipalities that experienced the negative grants were generally the wealthiest and biggest ones.

2 By using the Box-Cox method, a natural logarithmic functional form for the dependent variable was supported. In addition, Davidson and Mackinnon's PE-test (Davidson and MacKinnon, 1981) provided support to a log-linear two-way FE model where positive continuous independent variables were log-transformed and the rest were untransformed. The coefficient of the share of inpatient care (specare) obtained from this estimated model was negative but statistically insignificant (heteroskedasticity-adjusted $t = -0.20$) and thus 'specare' was dropped. For this model, the Breush-Pagan test carried out suggested the presence of heteroschedasticity ($\chi^2(1) = 34.61$, $p = 0.000$).

Results

Both the two-way FE models roughly explained 90% of the variation in the THCE with 70% of the within-variation in the outcome explained by changes in the explanatory variables exclusive to the municipality-specific effects (Table 3). Both the within R^2 and total R^2 values were slightly higher for Model 2, which took into consideration the local income tax revenue (taxinc). With the exception of the three regressors ‘inc’, ‘tax’ and ‘taxinc’, all the estimation results from both models that were statistically significant in the Model 1 remained so.

For both genders, the proportions of populations aged 85 or over were positively related to THCE. This positive relationship has been found in many earlier empirical studies. As compared to the category of the proportion of boys under seven, the proportion of females aged 65–74 (a6574pf) and that of girls under seven (a06pf) were negatively associated with THCE. In addition, some age and gender groups younger than 65 years (a717pm, a1840pf) and the population density (popden) were negatively related to THCE.

The rate of disability pensions (disabi) and the employment-to-population ratio (employ) were positively associated with THCE. A lower reimbursement of private dental care (reden) and a higher reimbursement of prescribed medicines (remedi) were related to a higher THCE. The total state grants (subsidy) were insignificantly positively related to THCE. The coefficients of the variables ‘rexado’ (reimbursement of private physician services and examinations) and ‘hoscom’ (combination of hospitals) carried the expected negative signs, but they were not statistically significant.

The positive coefficient of ‘inc’ was insignificant in Model 1, while it was highly statistically significant in Model 2. Moreover, the direction of the statistically significant effect of ‘tax’ altered from negative (Model 1) to positive (Model 2). Further, the local income tax revenue (taxinc) was negatively related to THCE (Model 2). Having used the estimation results from Model 2 to compute the total effect of ‘inc’ and the total effect of ‘tax’,[3] the former was 0.0027 (std. err. = $3.453/10^3$) and the latter was –1.4651 (std. err. = 0.4553).[4] As such, the magnitude of the total effect of ‘inc’ was smaller and the magnitude of the total effect of ‘tax’ was, in absolute values, higher than the magnitudes of the corresponding coefficients obtained from Model 1. Computed at the overall means, the income elasticity for Model 1 was 0.0449, whereas the income elasticity for Model 2 was 0.0200. Thus, both measured income elasticities were not only less than unity but were also very modest (vrt. Häkkinen and Luoma, 1995; Järviö and Luoma, 1999; Gerdtham and Jönsson, 2000), suggesting that THCE is indeed more of a major necessity than a luxury good. In both models, the coefficients of the total state grants (subsidy)—positive though statistically insignificant—were larger than the coefficients of income. Hence, the hypothesis of the ‘flypaper effect’ often tested in many empirical studies on regional expenditure (Wildasin, 1986) was supported in this study.[5]

3 The predicted outcome from Model 2 can be simply written as $\hat{y} = \hat{b}_1 x_1 + \hat{b}_2 x_2 + \hat{b}_3 x_1 x_2 + others$ where x_1 = ‘tax’, x_2 = ‘inc’, and $x_1 x_2$ = ‘taxinc’. The total effect of ‘tax’ is $(\partial \hat{y} / \partial x_1) = \hat{b}_1 + \hat{b}_3 x_2$, of which the variance is $\operatorname{var}(\hat{b}_1 + \hat{b}_3 x_2) = \operatorname{var}(\hat{b}_1) + x_2^2 \operatorname{var}(\hat{b}_3) + 2x_2 \operatorname{cov}(\hat{b}_1, \hat{b}_3)$. The total effect of ‘inc’ is $(\partial \hat{y} / \partial x_2) = \hat{b}_2 + \hat{b}_3 x_1$, of which the variance is $\operatorname{var}(\hat{b}_2 + \hat{b}_3 x_1) = \operatorname{var}(\hat{b}_2) + x_1^2 \operatorname{var}(\hat{b}_3) + 2x_1 \operatorname{cov}(\hat{b}_2, \hat{b}_3)$.

4 Since the model is linear, those total effects can be computed using either the overall means of the variables or by computing them to each observation and then taking the averages of the individual total effects. Both computations give the same figures. The variances of both the total effects were computed at the overall means of the three independent variables.

5 However, in this study, ‘subsidy’ is not the state grant allocated for providing health services but the sum of all the state grants allocated for providing all local sector services.

TABLE 3. First stage estimates from the two-way fixed effects models: factors associated with the per capita total municipal health care expenditure in 1993–2004

Variable	Model 1			Model 2		
	Coefficient	*t*-value		Coefficient	*t*-value	
Constant	1.9836	3.55	***	1.1101	1.83	
y9394	-0.0523	-8.00	***	-0.0533	-8.19	***
y9495	0.0162	2.62	**	0.0179	2.92	**
y9596	0.0370	5.16	***	0.0382	5.33	***
y9697	0.0352	5.21	***	0.0363	5.42	***
y9798	0.0008	0.07		0.0051	0.45	
y9899	-0.0125	-2.32	*	-0.0109	-2.07	*
y9900	-0.0096	-1.80		-0.0078	-1.49	
y0001	0.0404	6.58	***	0.0431	7.21	***
y0102	0.0159	2.61	**	0.0197	3.24	***
y0203	0.0731	10.44	***	0.0769	11.23	***
y0304	0.0407	5.82	***	0.0448	6.56	***
a717pm	-2.0254	-3.22	***	-2.0553	-3.26	***
a1840pm	-0.2720	-0.40		-0.1033	-0.15	
a4164pm	-0.7125	-0.96		-0.7106	-0.96	
a6574pm	0.9111	0.97		0.8987	0.96	
a7584pm	2.5111	2.14	*	2.4962	2.12	*
a85pm	5.3977	3.12	**	5.3172	3.10	**
a06pf	-2.6716	-2.99	**	-2.7174	-3.04	**
a717pf	-0.1935	-0.26		-0.1607	-0.22	
a1840pf	-1.8089	-2.17	*	-1.7051	-2.04	*
a4164pf	-1.0218	-1.42		-0.8169	-1.13	
a6574pf	-2.9740	-3.69	***	-2.8982	-3.57	***
a7584pf	0.1697	0.21		0.2575	0.32	
a85pf	7.2094	6.00	***	7.2891	6.07	***
popden	-2.4033	-1.97	*	-3.8443	-3.31	***
disabi	0.0708	3.46	***	0.0716	3.53	***
employ	0.1385	1.96	*	0.1697	2.40	*
eduhigh	0.0329	0.27		-0.0195	-0.16	
inc	0.0061	1.42		0.0891	4.97	***
tax	-1.3846	-3.02	**	3.1700	2.73	**
rexadoc	-0.0927	-0.13		-0.1034	-0.15	
reden	-2.6668	-3.58	***	-2.7272	-3.68	***
remedi	0.5555	4.75	***	0.5407	4.65	***
subsidy	0.0105	1.04		0.0103	1.03	
hoscom	-0.0072	-0.63		-0.0077	-0.66	
taxinc				-0.4771	-4.53	***
Model	F(35, 4530) = 288.24			F(36, 4529) = 285.09		
σ_u		0.1363			0.1451	
σ_e		0.0790			0.0788	
Rho		0.7483			0.7720	
Corr(u_i, Xb)		0.0698			-0.0736	
Within R^2		0.6974			0.6988	
Between R^2		0.4996			0.4325	
Overall R^2		0.5651			0.5213	
Root MSE		0.0756			0.0755	
Total $R^{2\#}$		0.8975			0.8980	
Root MSE #		0.0790			0.0789	
Number of observations		415			415	
Number of periods		12			12	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
\# When the effects of the municipality dummies were present.

TABLE 4. Second stage estimates: regression of the time-invariant hospital districts for the per capita total municipal health care expenditure in 1993–2004

Code	Variable Hospital disctrict	Model 1 Coefficient	 *t*-value		Model 2 Coefficient	 *t*-value	
	Constant	0.0060	3.38	***	0.0051	2.74	**
Hd1	Varsinais-Suomi	-0.0685	-12.54	***	-0.0685	-12.27	***
Hd2	Satakunta	-0.0329	-8.01	***	-0.0368	-8.76	***
Hd3	Kanta-Häme	-0.0339	-6.24	***	-0.0315	-5.53	***
Hd4	Pirkanmaa	-0.0302	-4.97	***	-0.0291	-4.77	***
Hd5	Päijät-Häme	-0.1498	-21.45	***	-0.1463	-17.85	***
Hd6	Kymenlaakso	-0.0845	-12.08	***	-0.0747	-8.81	***
Hd7	Etelä-Karjala	-0.1190	-18.92	***	-0.1191	-18.03	***
Hd8	Etelä-Savo	0.0666	8.04	***	0.0664	7.39	***
Hd9	Itä-Savo	0.0525	8.51	***	0.0481	7.88	***
Hd10	Pohjois-Karjala	-0.0110	-2.11	*	-0.0158	-3.11	**
Hd11	Pohjois-Savo	0.0430	11.18	***	0.0376	9.99	***
Hd12	Keski-Suomi	0.0231	4.49	***	0.0217	4.02	***
Hd13	Etelä-Pohjanmaa	-0.0249	-4.17	***	-0.0300	-5.09	***
Hd14	Vaasa	0.0788	11.29	***	0.0799	10.85	***
Hd15	Keski-Pohjanmaa	-0.0939	-11.30	***	-0.1010	-12.16	***
Hd16	Pohjois-Pohjanmaa	0.0122	2.34	*	0.0092	1.78	
Hd17	Kainuu	0.0475	3.33	***	0.0389	2.72	**
Hd18	Länsi-Pohja	0.0568	3.98	***	0.0608	4.24	***
Hd19	Lappi	0.2458	23.51	***	0.2351	22.93	***
Hd20	Helsinki and Uusimaa	0.0224	2.52	*	0.0552	4.59	***
Model		F(19, 4960) = 120.47			F(19, 4960) = 106.59		
R^2			0.2875			0.2517	
Root MSE			0.1151			0.1256	
Number of observations			4980			4980	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Since the year dummy variables were defined cumulatively, each year variable displayed a change in the THCE as compared to the previous year's outcome (Table 3). For example, the expected THCE for the year 1994 decreased approximately €52 (Model 1). During the 2000s, general technological developments and the growth of the economy have likely contributed to the increase in THCE. With the hospital districts constructed as effects coding variables and given THCE measured in €1000, a coefficient of 0.2458 for the hospital district of Lappi (Hd19) meant that the expected expenditure for that hospital district was about €246 higher than the grand mean of the expected expenditures for all the hospital districts (Table 4, Model 1). The individual effects of the municipality-specific dummies are presented in Figures B1–B2 in Appendix B. Both estimated models provided almost the same individual effects (correlation of 0.984). The individual effect of the capital Helsinki was found to be highest.

Discussion and conclusion

Both measures of the income elasticity of THCE in this study were rather small. This result supports the view that the measured income elasticity of health expenditure above unity found in many earlier international macro-level studies may be overestimated due to omitted variable bias and/or aggregation-related problems. Our estimated income elasticities probably reflected differences in the need-based use of health services rather than the ability to pay being a determinant of THCE. The finding is quite similar to and going in the same direction as that found in many other studies (e.g. Häkkinen *et al.*, 2008). Setting the public sector on its own, the use of public health care is equally distributed. Income-related inequality in the total use of health care in a mixed health care system is generally generated by the use of private health care. On the other hand, the resulting significant positive coefficient of the employment-to-population ratio went against our expectation. Nevertheless, this positive association could be explained by the fact that the employed population's earned incomes have boosted the municipalities' financial condition and opportunities to invest in health care, which in turn leads to higher THCE.

Although the use of age- and gender-specific populations was meant to standardize their effects on THCE, it is also of interest to note that the *t*-value and magnitude of the positive coefficient of 'a85pf' are higher than the equivalent figures of the coefficient of 'a85pm' (Table 3). This result may indicate that the aging effect on THCE of the oldest female population is more concentrated than the corresponding effect of the male counterparts. For the males, the aging effect seems to have commenced a little earlier but intensified more slowly. The former impact is expressed by the statistically significant coefficient of 'a7584pm', while the latter impact by the sum of the coefficients of 'a7584pm' and 'a85pm' being almost equal to the coefficient of 'a85pf'.

Among the explanatory financial factors affecting THCE, the highest negative coefficient found is that of private dental care. This bears out the fact that private dental care has been used substantially due to insufficient availability of public dental care, and in particular to the age-based restrictions on public care before the dental care reform of 2002 (Vuorenkoski, 2008). On the other hand, the highest positive coefficient found is that of the NHI reimbursement of prescribed medicines, suggesting that the use of prescribed medicines has the most important impact on increases in THCE. This finding undermines the assumption of a reduced care need, where pharmaceuticals would substitute for other health services, thus lowering the use of health care and bringing down health expenditures. It also corroborates the observation that the responsibility for the costs of prescription medicines has been passed around between the parties (the municipalities, the NHI and the patients), ending up most often in the hands of the NHI (Huttunen, 2008). However, since no large regional differences in the use of prescribed medicines in the country have appeared and both the measures of income elasticity in this study were very small, the result suggests that the use of health services from which local health expenditures were derived is not a sufficiently good measure. Therefore, the use of prescription medicines probably reflects population morbidity, especially the regional or municipal differences in morbidity, as sick people need prescription medicines in addition to health services.

We have assumed that the year dummy variables capture the unknown time effects such as technological development and general economic growth. Nevertheless, one might still argue that an increase in THCE has partly been a result of an increase in medicine expenditure due to the development, promotion and use of newer and advanced medical care products, as reflected by the large positive coefficient of the reimbursed medicines (remedi). However, there is also evidence that at the aggregate level, technological improvement in pharmaceutical products does not increase the health expenditure but indeed decreases it (Abdülkadir and Köksal, 2009). This gives support to our argument that at the municipality level, the rising trend in health spending connected to the use of prescription medicines is attributable to higher population morbidity and the increased number of patients to be treated. On the other hand, the growth in health expenditures on older people is also thought to be attributable to the connection between wealth and longevity. Future senior citizens are expected to have higher income and better general health than their present-day counterparts. If owing to the effect of higher income, the share of the elderly population with good health steadily increases and therefore the likelihood that they need to move to institutional care diminishes, then aging and the costs of institutional care generated by it may have a lesser impact on THCE in the future.

The estimated negative association of the municipal tax rate and THCE points toward the fact that the tax burden is relatively lower in the big and populated municipalities than in the small and remote ones. Hence, the former can provide their inhabitants with more services from a relatively lower tax burden than average. As the municipal tax rate can be manipulated to correct the imbalance between municipal revenues and expenses, the tax rate variable might be endogenous. Unfortunately, since the function of the local tax rate is not known and good instruments for the tax rate variable are not available with the present data, we have not been able to model THCE within, for example, a two-stage least-squares regression. However, by using the interaction between the local tax rate and income, we have shown that the local tax rate could be made use of as a method of financing to improve the municipalities' budget and revenue base and thus to deal with increased health expenditure. Moreover, our application of a two-stage estimation procedure has retrieved the estimates of the time-invariant hospital districts that the traditional FE model removed from its estimation. Nevertheless, we have not been able to explain the variation in THCE that is likely to be accounted for by numerous lasting upper-level structural factors and/or organizational solutions and choices (e.g. which hospital district a municipality belongs to and what methods and cost structures each hospital district has applied in practice) and thus is outside the scope of our study.

To conclude, the differences in municipal total health expenditure are mainly explained by the shares of the elderly, the employment-to-population ratio, the rate of disability pensions, the municipal tax rate, the NHI reimbursements of prescription medicines and private dental care, income, and population density. Both measures of income elasticity were very small, implying that public health care is a major necessity good. Higher use of prescription medicines has likely resulted from increased morbidity, and local tax rates seemed to be have been used as a device to finance local services due to disparate municipal financial capacities. The findings confirm to the importance of investing in health policy actions and measures that promote health and prevent diseases as well as maintain work and daily activities. To achieve long-term efficiency effects with health care decentralization, more attention should be paid to the state grant system or financial incentives and possibilities for reinforcing the municipalities' revenue base and financial capacity to secure the funding and provision of public health care.

Acknowledgments

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References

Abdülkadir C, Köksal B. 2009. The effect of newer drugs on health spending: do they really increase the costs?. *Health Economics*. DOI: 10.1002/hec.1494.

Baltagi BH. 1995. *Econometric Analysis of Panel Data*. John Wiley & Sons: Chichester.

Breunig R, Rocaboy Y. 2008. Per-capita public expenditures and population size: a non-parametric analysis using French data. *Public choice* **136**: 429–445.

Cantarero D. 2005. Decentralization and health care expenditure: The Spanish case. *Applied Economic Letters* **12**: 963–966.

Cantarero D, Lago-Peñas S. 2009. The determinants of health care expenditure: a reexamination. *Applied Economic Letters* **16**.

Economic Policy Committee and the European Commission. 2006. The impact of ageing on public expenditure: projections for the EU25 Member States on pensions, health care, long-term care, education and unemployment transfers (2004–2050). *European Economy. Special Report no 1/2006.*

Crivelli L, Filippinia M, Mosca I. 2006. Federalism and regional health care expenditures: an empirical analysis for the Swiss cantons. *Health Economics* **15**: 535–541.

Davidson R, MacKinnon JG. 1981. Several tests for model specification in the presence of alternative hypotheses. *Econometrica* **49**: 781–793.

Di Matteo L, Di Matteo R. 1998. Evidence on the determinants of Canadian provincial government health expenditure 1965–1991. *Journal of Health Economics* **17**: 211–228.

Gerdtham U-G, Jönsson B. 2000. International comparisons of health expenditure: theory, data and econometric analysis. In *Handbook of Health Economics*, Vol. 1, Culyer AJ, Newhouse JP (eds). Elsevier: Amsterdam; 11–53.

Gerdtham U-G, Sogaard J, Andersson F, Jonsson B. 1992. An Econometric Analysis of Health Care Expenditure: A Cross-Section Study of the OECD Countries. *Journal of Health Economics* **11**: 63–84.

Getzen TE. 2000. Health care is an individual necessity and a national luxury: applying multilevel decision models to the analysis of health care. *Journal of Health Economics* **19**: 259–270.

Getzen TE. 2006. Aggregation and the Measurement of Health Care Costs. *Health Services Research* **41**: 1938–1954.

Gianonni M, Hittris T. 2002. The regional impact of health care expenditure: The case of Italy. *Applied Economics* **34**: 1829–1836.

Greene WH. 2000. *Econometric Analysis*. Prentice-Hall International Inc.: Upper Saddle River.

Grossman M. 1972. On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy* **80**: 223-255.

Grossman M. 2000. The human capital model. In *Handbook of Health Economics*, Vol. 1, Culyer AJ, Newhouse JP (eds). Elsevier: Amsterdam; 347–408.

Hausman JA. 1978. Specification tests in economics. *Econometrica* **46**: 1251–1271.

Hujanen T, Pekurinen M, Häkkinen U. 2006. Terveyden- ja vanhustenhuollon alueellinen tarve ja menot 1993–2004. *Työpapereita 11/2006*. Stakes: Helsinki.

Hulka BS, Wheat JR. 1985. Patterns of utilization. The patient perspective. *Medical Care* **23**: 438–460.

Huttunen J. 2008. Lääkkeiden kaksikanavarahoitus (Two-channel financing of medicines). In *Lääkkeet ja Terveys 2008 (Medicines and health 2008)*, Saarinen A, Tamminen N (eds). Lääketietokeskus Oy: Helsinki; 83–87.

Häkkinen U. 2009. Finland. In *Cost Containment and Efficiency in National Health Systems: A Global Comparison*, Rapoport J, Jacobs P (eds). WILEY-VCH Verlag GmbH & Co. KGaA: Weinheim; 63–96.

Häkkinen U, Lehto J. 2005. Reform, Change, and Continuity in Finnish Health Care. *Journal of Health Politics, Policy and Law* **30**: 79–96.

Häkkinen U, Luoma K. 1995. Determinants of expenditure variation in health care and care of the elderly among Finnish municipalities. *Health Economics* **4**: 199–211.

Häkkinen U, Martikainen P, Noro A, Nihtilä E, Peltola M. 2008. Aging, health expenditure, proximity to death, and income in Finland. *Health Economics, Policy and Law* **3**: 165–195.

Järviö M-L, Luoma K. 1999. Kuntien terveydenhuoltomenojen kehitys 1990–96 ja menokehitystä selittävät tekijät (Municipal health care expenditure 1990–96 and factors associated with health care expenditure). *VATT-Discussion papers 199*. Government Institute for Economic Research: Helsinki.

Kerkhofs M, Lindeboom M. 1997. Age related health dynamics and changes in labour market status. *Health Economics* **6**: 407–423.

Lopez-Casasnovas G, Costa-Font J, Planas I. 2005. Diversity and regional inequalities in the Spanish 'system of health care services'. *Health Economics* **14**: S221–S235.

Mikkola H. 2002. Empirical studies on Finnish hospital pricing methods. *Acta Universitatis Oeconomicae Helsingiensis* A-203. Helsinki School of Economics: Helsinki.

Moilanen J, Knape N, Häkkinen U, Hujanen T, Matveinen P. 2008. Terveydenhuollon menot ja rahoitus 1995–2005. *Raportteja 16/2008*. Stakes: Helsinki.

Moisio A. 2002. Essays on Finnish municipal finance and intergovernmental grants. Goverment Institute for Economic Research: Helsinki.

Moore WJ, Newman RJ, Fheili M. 1992. Measuring the relationship between income and NHEs. *Health Care Financing Review* **14**: 133–144.

Oates WE. 1999. An Essay on Fiscal Federalism. *Journal of Economic Literature* **XXXVII**: 1120–1149.

OECD. 2006. Projecting OECD health and long-term expenditures: what are the main drivers? OECD: Paris.

Rubinfeld DL. 1987. The Economics of Local Public Sector. In *Handbook of Public Economics*, Vol. II, Auerbach AJ, Felstein M (eds). Elsevier Science Publishers BV: Amsterdam; 571–645.

Strömberg D. 2006. Demography, voting, and public expenditures: theory and evidence from Swedish municipalities. http://www-2.iies.su.se/~stromber/Demography.pdf [26 March 2009].

Tuomala M. 1997. *Julkistalous (Public Economics)*. Tammer-Paino Oy: Tampere.

Wildasin DE. 1986. *Urban Public Finance*. Harwood Academic Publishers GmbH: Chur.

Wooldridge JM. 2005. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press.

Vuorenkoski L. 2008. *Finland: Health System Review*. The European Observatory on Health Care Systems: Copenhagen.

Zweifel P, Felder S, Meier M. 1999. Ageing of population and health care expenditure: a red herring? *Health Economics* **8**: 485–496.

Appendix A. The total health care expenditure measure used in the study

<table>
<tr><th colspan="2">Health care (I)</th><th colspan="2">Elderly care (II)</th></tr>
<tr><td>Municipal services
• Primary health care
• Specialized hospital care</td><td>Private services
• Medicines prescribed by doctors
• Doctors' services
• Examinations and treatments
• Dental services

These are included in the National Health Insurance scheme</td><td>Municipal services
• Home help (e.g. home and support services, day care centers, care allowances)
• Sheltered housing
• Residential homes</td><td>Private services
• Housing
• Care allowances

These are supported by the National Health Insurance</td></tr>
<tr><td colspan="4">Total health care = Health care and elderly care = (I) + (II)</td></tr>
</table>

Appendix B. The estimates of the individual municipality effects from both the two-way fixed effects models based on a two-stage estimation procedure

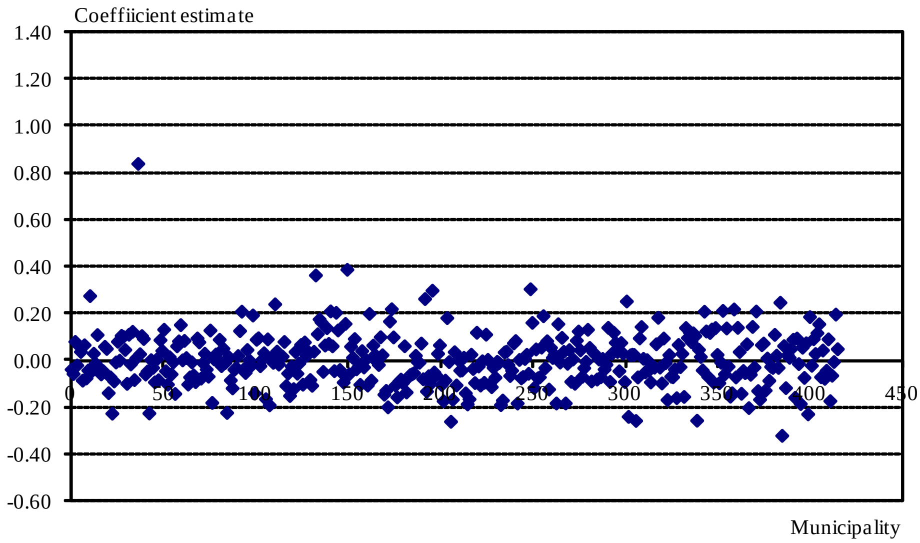

FIGURE B1. The individual effects of the municipality dummies obtained from Model 1.

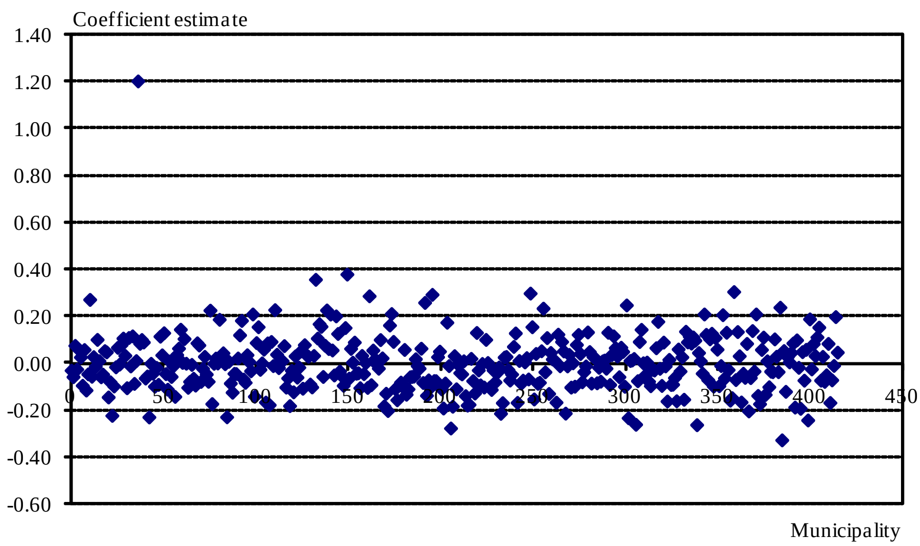

FIGURE B2. The individual effects of the municipality dummies obtained from Model 2.

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Petri Huhtanen, Päivi Hokka, Pia Mäkelä. Juomatapatutkimus 2008: aineistokuvaus
Avauksia 16/2009

Johanna Hiitola Erilaisin eväin huostassapidon jälkeen. Selvitys Tampereella, Hämeenlinnassa, Porissa ja Tampereen seutukunnassa vuonna 2007 lakkautetuista huostassapidoista
Avauksia 15/2009

Jouko Karjalainen, Olli Viljanen Arki kuntoon – lainrikkojien tuen tarve
Avauksia 14/2009

Simo Kokko, Eija Peltonen, Virpi Honkanen (toim.) Perusterveydenhuollon kehittämisen suuntaviivoja. Raportti perusterveydenhuollon vahvistamistoimien suunnittelutyöstä
Avauksia 13/2009

Pekka Ruotsalainen (toim.). Sosiaali- ja terveydenhuollon tietojenkäsittelyn tutkimuspäivät. Tutkimuspaperit 2009
Avauksia 12/2009

Eila Laukkanen, Teija Kemppi, Jari Kylmä, Arja Airaksinen, Antti Henttonen, Kaisa Haatainen. SIHTI-interventio. Nuoren ongelmien ja elämäntilanteen kokonaisvaltainen arviointi perustason ja erikoissairaanhoidon yhteistyönä
Avauksia 11/2009

Hennamari Mikkola, Satu Kapiainen, Timo Seppälä, Mikko Peltola, Ulla Tuominen, Markku Pekurinen, Unto Häkkinen. Tutkimus terveydenhuollon maksukattojen yhdistämisestä
Avauksia 10/2009

Pasi Moisio. Vähimmäisturva ja köyhyysraja Suomessa
Avauksia 9/2009

Kerttu Perttilä, Pia Hakamäki, Timo Hujanen, Timo Ståhl (toim.). Terveyden edistämisen taloudellinen arviointi kunnissa
Avauksia 8/2009

Päivi Nurmi-Koikkalainen. Vättlämätön apu elämisen mahdollistajana
Avauksia 7/2009

Marjaana Seppänen, Reija Heinola, Sirpa Andersson. Hyvinvointia ja terveyttä edistävää toimintaa käytännössä
Avauksia 6/2009