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PRODUCTIVITY CHANGES IN FINNISH HEALTH CENTRES IN 1988-1995: A MALMQUIST INDEX APPROACH

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Abstract: This paper studies productivity development of Finnish health centres in 1988-95 by applying different specifications of Malmquist index. As input variables we use operating costs or the number of personnel by employee category, and as output variables different kinds of visits, bed days and discharges. Measuring input use by operating costs gives more positive estimates of productivity change than those obtained by measuring inputs by the number of personnel. This suggests that productivity growth can partly be explained by changes towards a more efficient input mix in health centres. The choice of the base year had only a small effect on productivity change estimates. The results show that the productivity decline of health centres which was quite substantial all through the 1970s and 1980s reversed to a rise from 1990 onwards. The turn in productivity development occurred at the same time as the state and municipalities experienced severe financial difficulties due to recession and falling tax revenues.

Key words: Health centres, productivity, Malmquist index

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Tiivistelmä: Tutkimuksen tavoitteena on selvittää terveyskeskusten tuottavuuskehitystä vuosina 1988-95 käyttäen menetelmänä Malmquist indeksiä. Terveyskeskusten panoskäytön mittana on käytetty käyttömenoja tai kolmen henkilöstöryhmän henkilöstömääriä. Avohoidon tuotoksina oli neljä käyntiryhmää ja vuodeosastohoidon tuotoksina kolme hoitopäiväryhmää ja yksi hoitojaksomuuttuja. Tulosten mukaan 1970- ja 1980-luvuilta alkanut terveyskeskusten tuottavuuden lasku päättyi vuonna 1990 ja kääntyi lievään nousuun. Kun panostenkäyttöä mitattiin kustannuksilla, saatiin tuottavuuskehityksestä myönteisempi kuva kuin käytettäessä henkilöstömääriä panosmittareina. Myönteistä tuottavuuskehitystä selittää siten teknisen tehokkuuden ohella parantunut panoskäytön allokatiivinen tehokkuus. Perusvuoden valinnalla ei näyttänyt olevan vaikutusta terveyskeskusten tuottavuuskehitykseen. Tuottavuuden kohoaminen ajoittui samanaikaisesti taloudellisen taantuman aiheuttaman verotulojen alentumisen kanssa.

Asiasanat: Terveyskeskukset, tuottavuus, Malmquist indeksi

Contents

1. Introduction

From 1991 to 1995 real health care expenditure in Finland decreased by 14 per cent. This is in sharp contrast to health expenditure development in the previous decades when health care costs rose continuously and quite rapidly. In the 1980s the average annual real growth rate of health expenditure per capita was over 4 per cent. Many studies on productivity of health centres and hospitals provided evidence that negative productivity development and inefficiency in health care provision may have contributed significantly to rising health expenditure. Significant negative productive trends were found for hospitals and health centres (Luoma and Järviö 1992, Alander *et al.* 1990, Kangasniemi 1995).

Studies using data from the early 1990s found also large efficiency differences among health care institutions producing similar types of services (Luoma *et al.* 1996, Linna and Häkkinen 1996). Economic incentives were found to be significant predictors for health centre inefficiency. The higher the income level of the population was the more inefficiency there tended to be. Another important variable was the subsidy rate related to state grants for the health sector. Until 1993 state subsidies in Finland were paid to municipalities or federations of municipalities as a fixed proportion of health centre expenditure. The rate varied from 29 per cent to 66 per cent in 1991.

The studies, which we have referred to analysed the development in the 1980s or the situation in 1991, which can be considered to result from resource allocation decisions, made in the 1980s. In the 1990s there have occurred two major changes which should provide a kind of test whether our findings based on cross-sectional studies can predict the development of cost efficiency and productivity over time. The first change was the very severe economic recession that hit Finland in 1991. During the following three-year period the real GDP in Finland declined cumulatively by some 12 per cent. Unemployment grew from modest four per cent to almost twenty per cent. Public expenditure rose rapidly as well as public debt.

The second big change was that the old grant system was reformed radically in 1993. In the new system block grants are substituted for open matching grants. The new block grants are based on demographic criteria like age structure and morbidity of the population as well as on some characteristics, which are thought to be cost raising factors for municipal service production. The important change is that the price subsidy for health centre expenditure was abolished. Municipalities have to bear the full marginal costs for health centre inputs.

According to our cross sectional study (Luoma *et al.* 1996), these two changes - the fall in income following recession and state subsidy reform - should have a considerable effect on health centre productivity and cost efficiency. The purpose of this study is to examine to what extent recent productivity development provides evidence of these kinds of impacts. We analyse productivity changes in Finnish health centres in 1988-95 by Malmquist index approach. During recent years this method has become increasingly popular for assessing productivity development of health care providers and public organisations. For a survey of Finnish public sector applications see Hjerppe and Luoma (1997). Linna (1998, 1999) has used Malmquist index approach for analysing productivity of Finnish hospitals. In section 2 we introduce the method of Malmquist index and in section 3 the data used in our analyses. In section 4 we present results of the analyses.

2. Methods

We calculate the productivity change of Finnish health centres by applying the nonparametric Malmquist index approach. The Malmquist productivity index was introduced by Caves *et al.* (1982). The empirical potential of the approach was shown by Färe *et al.* (1994)[1] who demonstrated how the values of distance functions needed in the approach could be computed by applying linear programming techniques used in data envelopment analysis.

The basic idea of the Malmquist productivity index is to measure total factor productivity change**.** As generally in productivity measurement, an index of output is divided by an index of inputs. The key question for productivity indices is the determination of weights. The advantage of Malmquist index is that price information or cost share information is not needed for weighting in this approach. This is an invaluable property for public sector applications since for public services reliable price information is often missing.

An important advantage of applying Malmquist index to panel data is that one can decompose productivity change into two components: efficiency change (catching-up effect) and technical change (shift of the efficiency frontier). This kind of information is useful since productivity improving policy measures depend on the pattern of productivity change. The appropriate policy responses will be different for productivity slowdown due to the catching-up being modest, and when the slowdown is due to the lack of change of the frontier technology (Grosskopf 1993).

Malmquist index is constructed from distance functions, allowing explicit calculation and isolation of changes in inefficiency. Färe *et al.* (1994) calculated distance functions directly in the ”goods” space by means of linear programming. Their calculations exploit the fact that the output distance functions used to construct the Malmquist index are reciprocal to Farrell (1957) output-oriented technical-efficiency measures. They therefore bear a close relationship to the standard output-oriented DEA-model. This link to efficiency allows to decompose productivity changes into changes in efficiency and changes in the best-practice frontier (technical change) (Färe et. al 1994, p.254).
The input distance function can be defined as follows:

$$D_i^t = Sup\{\delta \mid \delta > 0, x/\delta \in S^t(y)\} \qquad (1)$$

where $S^t = \{(x^t,y^t): x^t$ can produce $y^t\}$ is the set of output and input vectors given the technology available in period t. For any input quantity vector *x*, $x/D_i^t(x,y)$ is the smallest input vector on the ray from the origin through *x* that is able to produce *y*. In other words $D_i^t(x,y)$ is the maximum value by which the input vector can be divided and still produce the given output vector y. Taking t as the base period, implying that the technology of period t is used as a reference, the input oriented Malmquist index can be defined as

$$M_I^{t,t+1}(y^t,x^t,y^{t+1},x^{t+1}) = \left[\frac{D_I^t(y^{t+1},x^{t+1})}{D_I^t(y^t,x^t)}\right] \tag{2}$$

In a similar fashion the period t+1 technology could be used as a reference point. Färe et al. (1994) have suggested that Malmquist indices should be calculated as the geometric mean of the indices obtained by using two adjacent periods t and t+1 as the reference or the base. According to them productivity change between periods t and t+1 should be calculated according to the formula:

$$M_I^{t,t+1}(y^t,x^t,y^{t+1},x^{t+1}) = \left[\frac{D_I^t(y^{t+1},x^{t+1})\cdot D_I^{t+1}(y^{t+1},x^{t+1})}{D_I^t(y^t,x^t)\cdot D_I^{t+1}(y^t,x^t)}\right]^{\frac{1}{2}} \tag{3}$$

With panel data covering more than two periods it is, of course possible to use as the base period any of the periods for which data is available. In productivity calculations it is common to use the first period as the base period (Førsund 1993).

The first distance function measures the maximum equiproportianate reduction in inputs still allowing to produce (x^{t+1},y^{t+1}) with the previous period technology. Similarly, the second mixed-period function measures the maximum proportional reduction in inputs still leaving (x^t,y^t) feasible. In both of these mixed-period cases, the value of the distance function may be less than unity. The value of the mixed-period distance functions exceeds or is equal to unity if and only if the observations being assessed are ”feasible”, i.e., are members of technology in the other period.

Equation (3) can be rewritten as

$$M_I^{t,t+1}(y^t,x^t,y^{t+1},x^{t+1}) = \frac{D^{t+1}(x^{t+1},y^{t+1})}{D^t(x^t,y^t)}\left[\frac{D^t(x^{t+1},y^{t+1})D^t(x^t,y^t)}{D^{t+1}(x^{t+1},y^{t+1})D^{t+1}(x^t,y^t)}\right]^{1/2} \tag{4}$$

Computation of Malmquist indices can be carried out by applying linear programming techniques for determining the type of efficiency measures introduced by Farrell (1957). Since Farrell efficiency measures are reciprocals of distance functions the Malmquist productivity index between two periods 1 and 2 with technology base i can be written using Farrell efficiency measures (E) (Berg, Førsund and Jansen 1992, Førsund 1993):

$$M_i(1,2) = MC \text{ x } MF_i\,(1,2) = \frac{E_{22}}{E_{11}} \cdot \frac{E_{i2} / E_{22}}{E_{i1} / E_{11}} \qquad (5)$$

where $E_{ij,}$ i=1,2, j=1,2 is the efficiency score of units in period *i* compared to the efficiency frontier in period *j*.

The efficiency change, i.e. catching-up effect (MC) is the relative change in efficiency between the periods and it shows the direction of change in the input-saving potential, as measured by relative distance to ”own” frontiers. The technical change, the frontier shift effect $MF_{i,}$ measures the relative distance between two technologies in terms of relative efficiency for the same observation measured against two different frontiers (Førsund 1993).

The catching-up component of efficiency change shows whether producer *i* is moving closer or farther away from the best practice. The value of the component is greater than, equal to or less than unity according to whether relative performance of producer *i* is improving, unchanging or declining. The component of frontier shift shows whether the best practice relative to which producer *i* is compared is improving, stagnant or deteriorating. The value of frontier shift component is greater, equal to or less than unity according to whether technical change is positive, zero or negative, on average, at the two observations (Grifell-Tatje and Lovell, 1996).

The two approaches of adjacent periods and a fixed base period generate the same values for the catching-up index, but if annual frontiers intersect they can generate different values for the technical change component, and thus also for the Malmquist productivity index itself (Grifell-Tatje and Lovell, 1996).

We compute several different Malmquist indices for years 1988-1995 using alternative specification of inputs. Malmquist indices applying a fixed base year as well as indices which are geometric averages of adjacent year are calculated. We carry out the calculations with the constant returns to scale assumption and in the input saving direction.

3. Data and variables

We have calculated Malmquist input-oriented productivity indices for Finnish health centres for the time period 1988-1995 using data which has been compiled from several sets of statistics, studies and registers. Cost and output information was derived mainly from the KETI[2] and SOTKA registers, the hospital discharge register and the financial statistics of health centres. The observation unit was a public health centre providing primary health care services to residents within a specific area. Our analysis was based on two subsets of 193 and 159 health centres, which were led by a general practitioner and provided both inpatient and outpatient care. Specialist led health centres and the health centres without inpatient ward were excluded. By excluding them we tried to form a reasonably homogeneous set of health centres. We excluded from our data also those health centres for which information on inputs or outputs was missing for one or more years.

In our first analysis we used as the only input variable health centre operating costs at constant prices (in 1995 prices). Main differences in input prices between health centres were eliminated by adjusting cost figures by removing cost-of-living bonuses and bonus for service in remote areas. Operating costs included personnel costs, material costs, costs of purchased services, rents and other costs. On average the share of personnel costs varied from 66 % to 72 % of the operating costs in 1988-95.

The operating costs of health centres increased rapidly in the first three years and were at their highest level in 1991 (8.2 million FIM). Since 1991, following the economic recession, the costs decreased nearly as rapidly as they had earlier increased. The real operating costs of health centres were in 1995 approximately at the same level as in 1988.

As an alternative choice of input variables we used the number of full time equivalents (FTE) by personnel category. Part time employees were transformed into FTEs by utilising monthly wage figures. The data on personnel was based on the yearly inquiry by Statistics Finland and it includes information on the number and wages of health centre personnel during two weeks in October. Health centre employees were divided into three personnel categories: 1) physicians and dentists, 2) nursing personnel and 3) other personnel. These analyses were restricted to 159 health centres for which the number of FTEs could be reliably estimated for each year from 1988 to 1995. There were 34 health centres in ”the operating cost-input group”, for which data on the number of personnel was missing or considered unreliable.

The development of the number of total personnel was similar to that of operating costs in 1988-95. The number of the personnel reached its peak in 1991. Thereafter it decreased so that in 1995 it was at the same level as in 1988. Over the whole period the number of physicians grew by 6 per cent and the number of nurses grew by 11 per cent but the number of other personnel reduced by 19 per cent.

The relative salaries of doctors, nursing personnel and other personnel did not change significantly during the study period. The average annual increase was 1.8 per cent for doctors' salaries, 1.7 per cent for nurses and 1.2 per cent for other personnel in 1988-95.

In calculating Malmquist index we utilised different kinds of visits as measures for outpatient care. The four outpatient output categories were: visits to physician, dental visits, visits to other health care personnel and visits of supervised domiciliary care (home nursing). The data of inpatient care consisted both discharges and bed days. The volume of acute short term care was measured by the number of discharges. Bed days were used as the output measure for long term chronic care and for patients whose stay in health centre ward was terminated by death as well as for patients who stayed in health centre wards because of social difficulties. All inpatient care that lasted at least 29 days was considered as long term care. Bed days were divided according to the age of patient (0-64, 65-74 and over 75 years).

In general output volumes of health centres did not change much during the period 1988-95 (Table 1). In outpatient care the most notable changes were the 16 per cent increase in visits to other personnel from 1993 to 1995 and 14 per cent decrease in the number of home nursing visits (domiciliary care) from 1991 to 1995. In inpatient care the number of bed days grew slightly up to the year 1991 and decreased slowly thereafter. The most significant change was the growth of acute short term care. The number of admissions increased each year. In 1995 the number of admissions was 45 per cent larger than in 1988 whereas the number of outpatient care visits and the number of bed days were roughly the same in 1988 and 1995.

Table 1. Outputs of 193 health centres in 1988-95

	1988	1989	1990	1991	1992	1993	1994	1995
Visits to physicians	7354370	7143553	7093137	7329673	7491943	7354423	7139940	7567007
Visits to other personnel	6721548	6790257	6258548	6660214	6687692	6469432	7294489	7500188
Dentist visits	3861668	3818727	3834890	3963008	4011381	3836445	3811183	3694024
Dom. care	2320996	2388295	2420671	2458074	2454163	2267289	2203233	2077450
Bed days I (0-64 years)	406720	413142	415912	422796	419605	405088	383581	408177
Bed days II (65-74 years)	650752	661028	665459	676474	671367	648140	613729	653084
Bed days III (75+ years)	3009727	3057253	3077747	3128692	3105074	2997649	2838498	3020513
Discharges	93924	94427	94399	100477	110557	124896	129840	135875

4. Results

The productivity development of health centres was studied by Malmquist index using both either operating costs or the number of FTEs in three personnel groups as input variables. We also present the productivity development using Malmquist index of the average unit and the arithmetic mean of Malmquist indices. The average unit is a composite unite which is formed by adding up the inputs and outputs of all health centres. Thus it is a weighted average of all health centres and has an average input and output structure.

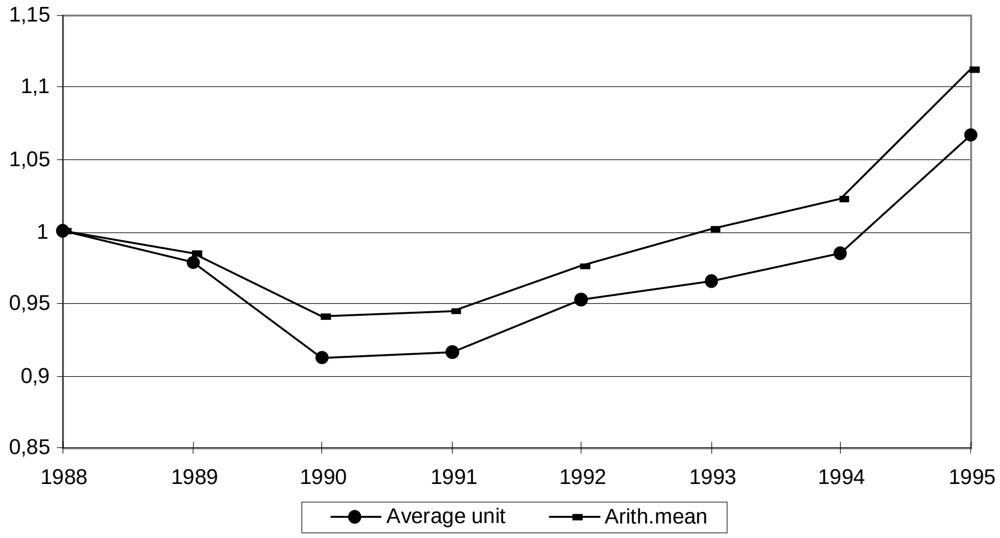
4.1 Operating costs as the input variable

The productivity development for the average health centre and for the arithmetic mean of Malmquist indices are presented in the Fig.1. Measured with both indicators, the Malmquist index shows declining productivity during the first two years.

Since 1990 productivity improved each year measured by both indicators. From 1994 to 1995 productivity growth was especially rapid. In the end of the period, the productivity of the average unit was about eight per cent higher than in 1988. When the average unit was used in measurement, the respective productivity growth was about five per cents smaller than measure based on the arithmetic mean of Malmquist indices. Using cost weighted mean of Malmquist indices, there was no difference comparing to the arithmetic mean of Malmquist indices. This implies that small health centres tended to have a somewhat better productivity development than large ones.

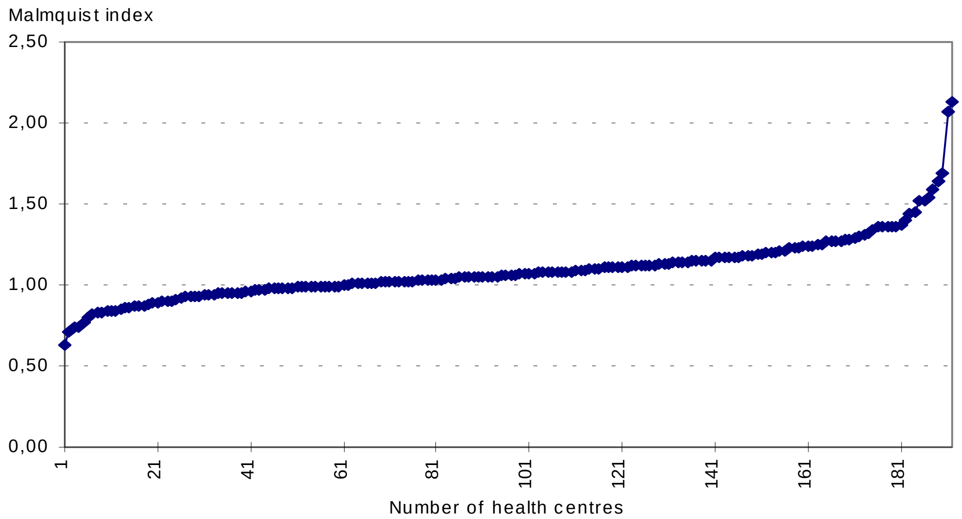
Overall, the pattern of productivity development is consistent with our hypotheses that state grant reform and the recession experienced in the early 1990s should have a positive effect on health centre productivity development.

Figure 1. The productivity change of the average unit and the average of Malmquist indices in 1988-95, base year=1988; operating costs as the input variable



There was a wide variation in productivity development across health centres (Fig. 2). Two thirds of health centres increased their productivity. For 28 per cent of them productivity growth was less than 10 per cent and in one fifth of health centres productivity growth was more than 20 per cent. There were two outliers, in which productivity increased more than 100 per cent.

Figure 2. The distribution of Malmquist productivity index 1988-95 (193 units)



The use of operating costs as an input variable in analysing productivity of health centres is not without problems. Input price differences between health centres cause some ambiguity how to interpret obtained productivity estimates.

Statistics on the distribution of productivity changes of the average health centre are presented in table 2. About two-thirds of health centres improved their productivity during the period 1988-1995, in about two-fifths of them productivity increased quite considerable, by more than ten per cent. In the lowest quartile of health centres productivity fell at least by two per cent. In the third quartile of health centres, productivity increased by 17 per cent from 1988 to 1995. In the best quartile of health centres, the productivity has risen from three per cent to 15 per cent from 1988 to 1995. In the same time also in the weakest health centres the productivity fall has diminished from eight per cent to null.

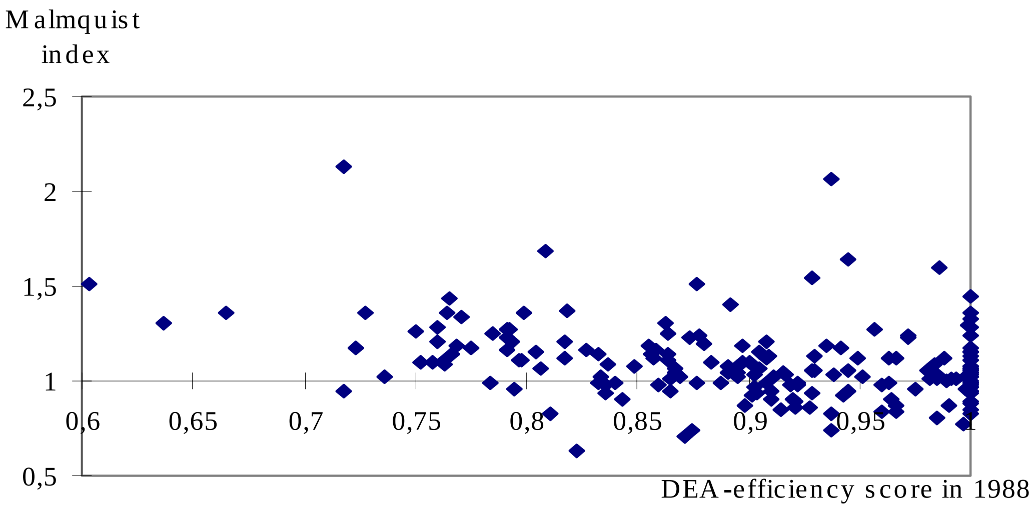
Table 2. Distribution of Malmquist productivity indices 1988-1995 (193 units)

	Q1	Median	Q3	Mi > 1
1988-1989	0.94	0.98	1.03	71
1989-1990	0.92	0.96	0.99	40
1990-1991	0.97	1.00	1.04	98
1991-1992	0.99	1.02	1.07	134
1992-1993	0.95	1.02	1.07	104
1993-1994	0.95	1.01	1.09	107
1994-1995	1.00	1.07	1.15	141
1988-1995	0.98	1.06	1.17	131

Q1 = The first quartile
Q3 = The third quartile

A natural hypothesis would be that those health centres which were inefficient at the beginning of the period would show a better productivity development than health centres which were efficient. However, as Fig. 3 illustrates, there does not seem to be any association between inefficiency in the beginning of the period and productivity change over time.

Figure 3. Malmquist index 1988-95 according to DEA-efficiency scores in 1988



Another surprising feature of the development of relative efficiency scores was that the variation of efficiency scores became larger towards the end of the period. In the beginning of the period one fifth of health centres were classified as efficient but in the end of the period the share of the efficient health centres was under ten per cent. In the last three years the median of DEA-efficiency scores fell over ten per cents (Table 3).

Table 3. The distribution of DEA-efficiency scores in 1988-95

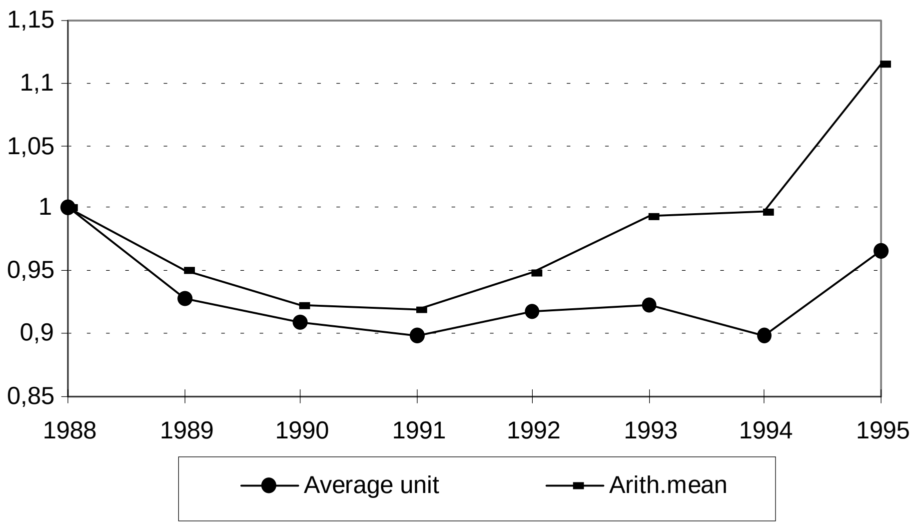
	E88	E89	E90	E91	E92	E93	E94	E95
mean	0.90	0.89	0.89	0.88	0.89	0.84	0.83	0.78
Md	0.91	0.89	0.88	0.90	0.90	0.83	0.82	0.77
s	0.09	0.09	0.09	0.09	0.09	0.10	0.11	0.12
E=1	39	36	30	30	31	17	16	14
min	0.60	0.70	0.66	0.64	0.63	0.59	0.55	0.49

The number of the efficient health centres has declined after 1993 and there were only four health centres which were efficient in both 1988 and 1995. Also the group of least efficient health centres changed. Out of the 32 health centres, which had an efficiency score below 0.8 in 1988, only 20 belonged to respective groups in 1995.

4.2 FTEs in three personnel groups as inputs

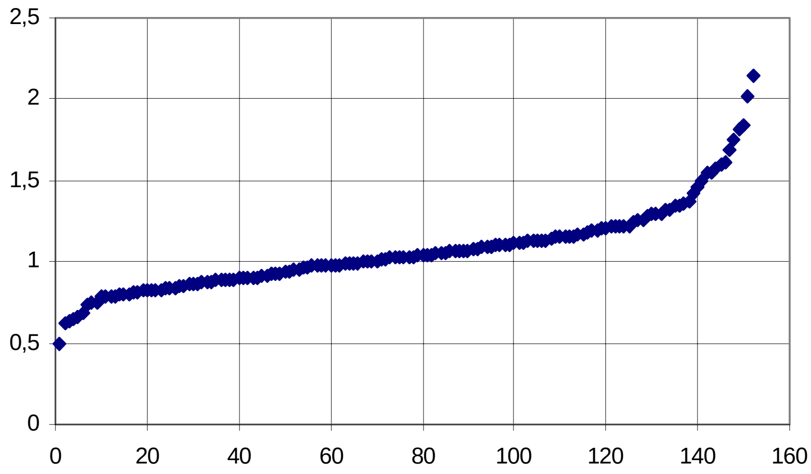
When FTEs by personnel category were used as input variables, and the average unit is used for assessing productivity, changes in productivity are quite small. Productivity declines considerably from 1988 to 1989 but thereafter it remains almost constant until 1994. From 1994 to 1995 productivity improves significantly but is still 3.5 per cent lower than in 1988. Arithmetic mean of Malmquist indices shows a significantly better productivity development reflecting the better productivity development of small health centres (Fig.4). The arithmetic mean of Malmquist indices is 12 per cent higher in 1995 than in 1988.

Figure 4. The productivity change of the average unit and the average of Malmquist indices in 1988-95, base year=1988; FTEs by personnel category as input variables



Over a half of health centres had increasing productivity development in 1988-95 (57 %), but there were great differences in productivity development between health centres (Fig. 5). There were two outliers, whose Malmquist index value was over two.

Figure 5: The distribution of Malmquist productivity index Mi8895 (159 units)



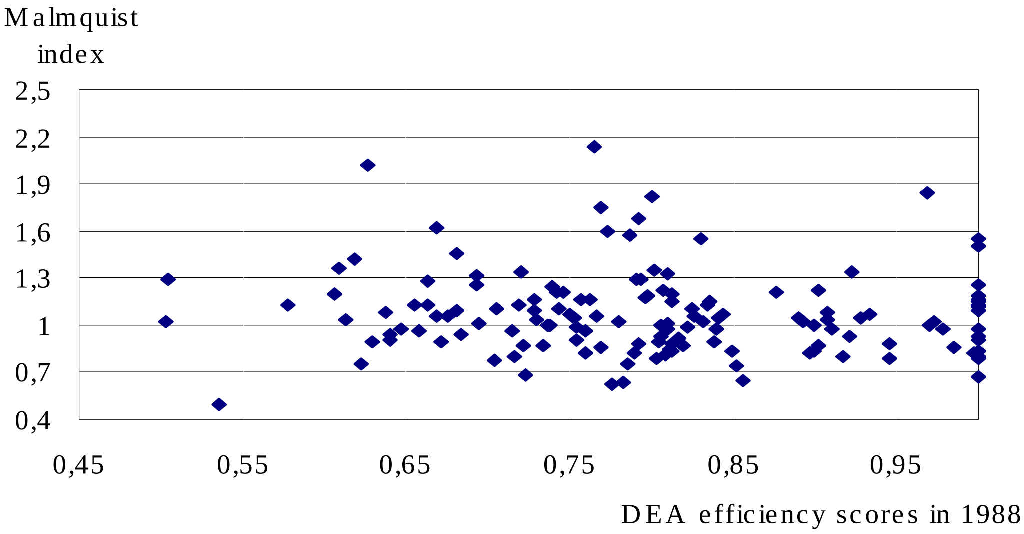
The number of health centres with positive productivity development increased each year in 1988-95 (table 4). From 1988 to 1980 and from 1989 to 1990 almost three quarters of health centres had declining productivity development. Over the whole period 1988-95, 43 per cent of health centres had declining productivity development (Malmquist index <1).

Table 4. Distribution of Malmquist productivity indices, 1988-1995 (159 units)

	Q1	Median	Q3	Mi > 1
1988-1989	0.87	0.93	1.00	38
1989-1990	0.91	0.97	1.01	54
1990-1991	0.94	0.99	1.06	71
1991-1992	0.96	1.01	1.07	84
1992-1993	0.97	1.02	1.09	93
1993-1994	0.94	1.01	1.07	79
1994-1995	1.00	1.08	1.20	115
1988-1995	0.89	1.03	1.17	86

When FTEs by personnel category were used as input variables, there is no clear relationship between inefficiency at the beginning of the period and productivity change over time (Fig.6). The share of the productivity increasing health centres is, however, somewhat larger among the most inefficient health centres (DEA-efficiency score lower than 0.7 in 1988) than among the rest of the health centres (DEA-score over 0.7 in 1988).

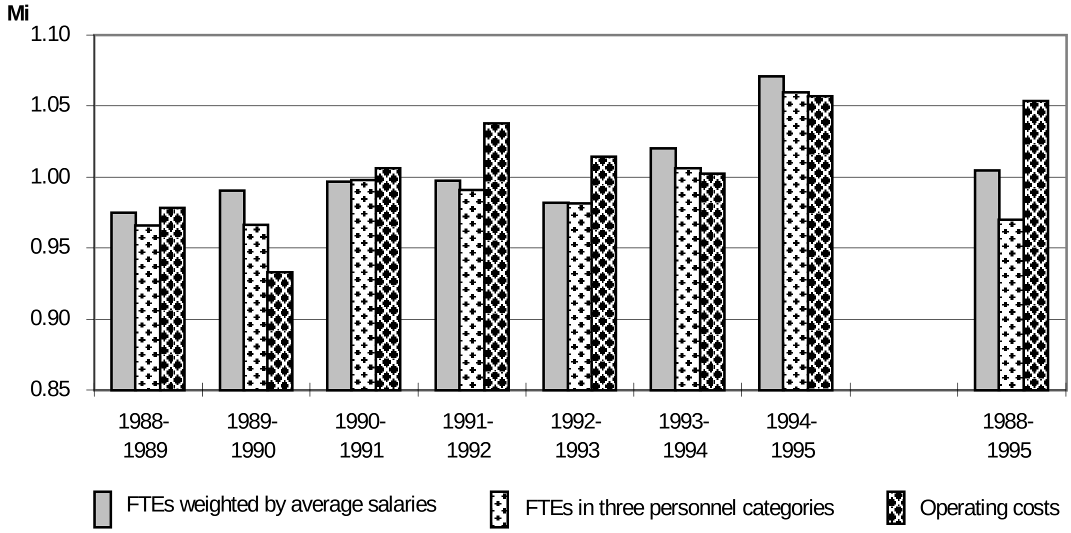
Figure 6. Malmquist index Mi8895 according to DEA-efficiency scores in 1988



4.3 Geometric means of Malmquist indices using adjacent years as reference technologies

The figure 7 shows productivity changes which have been calculated by the method suggested by Färe et al (1994) and has been applied in productivity study on Finnish hospitals by Linna (1998). They define the input-oriented Malmquist index for two adjacent years by calculating a geometric mean of two Malmquist indices. One of these is calculated in relation to the production frontier for the first year and the other in relation to the production frontier in the second year. Three different specifications for input variables have been used. In one of them the only input variable is FTEs weighted by the average salaries of three personnel categories: doctors and dentists, nursing personnel, other personnel. In another specification the numbers of FTEs in these three personnel categories are used as input variables. In the third specification operating costs at constant prices is used as the input variable.

Figure 7. Productivity changes for the average health centre with different input specifications.

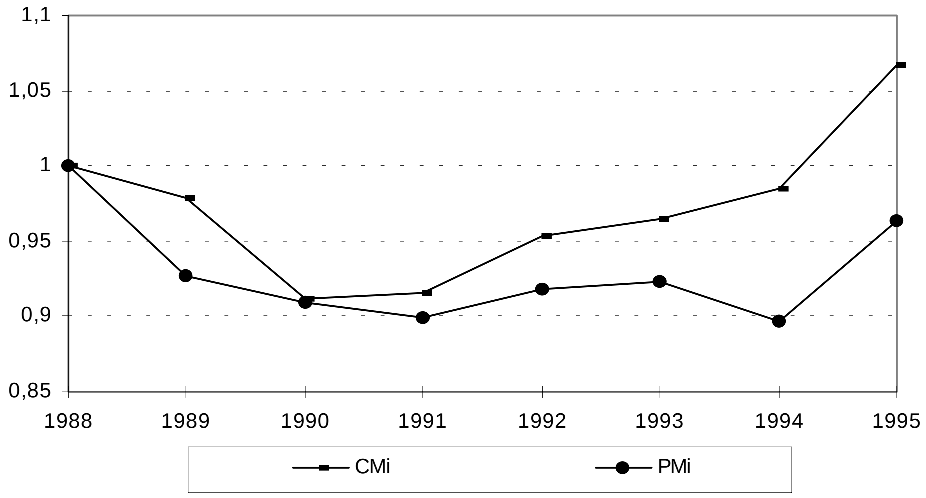


Overall the productivity change results presented in table are quite similar to those obtained by having the first year technology as the fixed base. Productivity falls during the beginning of the period and increases from the 1993 onwards. Specification which uses operating costs as the input variable produces more positive productivity development than the specifications which use the number of personnel as input variables.

4.4 The impact of input variable choice on productivity development

Using FTEs as input variables gives a somewhat less positive picture of productivity development than the use of operating costs as the input variable (Fig.8). Partly this may be due to the fact that some of the health centres had to be omitted from analyses using FTEs as input variables because of missing data. But there also more substantial reasons for the discrepancy of the results. Health centres have been able to reduce considerably the use of non-personnel resources. There is also evidence which suggests that the input mix of health centres has become more efficient. The share of physician input has grown and the share of maintenance, catering and administrative personnel input has decreased. As Coelli and Rao (1999) have argued the effect of this kind of improved allocative efficiency will not necessarily be reflected in the Malmquist index value.

Figure 8. The productivity change of the average unit in 1988-95, base year=1988



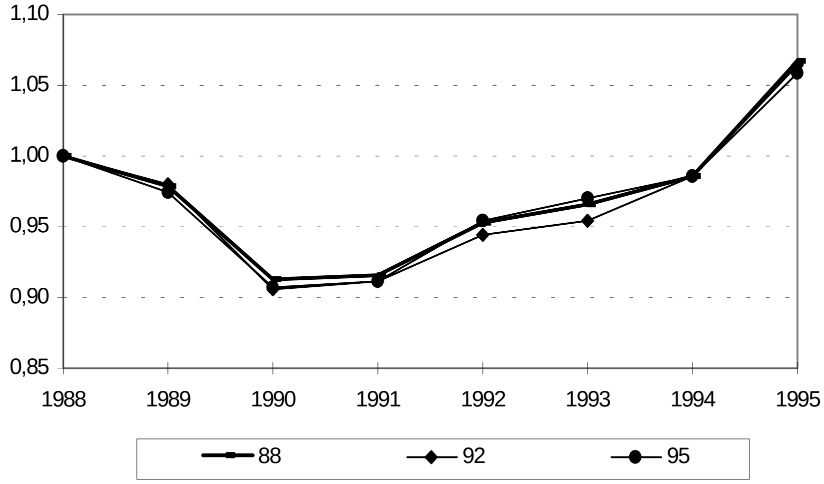
PMi = personnel groups as the input variable
CMi = operating costs as the input variable

4.5 The sensitivity of the results to the choice of the base year

The base year is usually chosen to be either the first year or the last year of the period. Berg et. al (1992) noticed that technical change and productivity index numbers strongly depended on the reference technology: The change of the base year from the first to the last gave reverse results about productivity development in their application.

In our data, the change of the base year had only a very small effect on the estimates of productivity development. Therefore the results are essentially the same whether one applies the approach based on the geometric mean of adjacent years, as suggested by Färe et al. (1994), or uses the fixed base year, as in Førsund (1993). The Figure 9 illustrates the change of productivity of the average health centre with operating costs as the input variable in 1988-95 (productivity in 1988=1) using years 1988, 1992 and 1995 as alternative base years.

Figure 9. Malmquist index productivity change in 1988-95 (1988=1) in different base years (1988, 1992, 1995)



The main direction of the productivity development of Finnish health centres was surprisingly similar in the case of different base years. Only from 1990 to 1994 there were small differences in productivity development depending on the choice of the base year.

5. Discussion

We have applied Malmquist index approach to estimate the productivity development of Finnish health centres in 1988-95. In our application we had eight output variables; four of them measured outpatient care and four inpatient care. As input variables we used either operating costs at constant prices or the number of FTEs in three personnel groups.

The results show that from 1990 onwards the productivity of health centres started to rise. Earlier studies have indicated that productivity of health centres had declined quite significantly during the 1970s and 1980s. The turn in productivity development occurred at the same time as the state and municipalities experienced severe financial difficulties due to severe recession and falling tax revenues in Finland. The reform of the state grant system in 1993 may have also contributed to improved productivity development. Under the new block grant system financial incentives of municipal decision makers to control health centre costs are much stronger than in the earlier matching grant system.

In order to test how robust the productivity estimates are we calculated several different specifications of Malmquist indices. Overall pattern of change in productivity was similar irrespective of the specification used. However, the use of operating costs at constant prices resulted in a more positive assessment of productivity development than the use of FTEs by personnel category. Partly this is may be due to the fact that health centres made substantial savings in the use of purchased services following the recession. Another explanation is that when several input variables are used the Malmquist index does not fully capture the productivity improvement that is caused by an improved allocative efficiency in the use of inputs.

Balk and Althin (1996) have illustrated with data from Swedish pharmacies that Malmquist productivity index numbers can be very sensitive to the choice of the base year. Fortunately in our application the choice of the base year has no significant impact on the productivity results.

A more detailed examination showed that the variation in productivity development among health centres is great and their efficiency differences have grown. During 1988-95 two thirds of health centres have improved their productivity, a half of health centres have improved the productivity more than six per cent and one quarter more than 17 per cent. A somewhat surprising finding was that there seems to be no association between the efficiency scores of health centres in 1988 and their productivity development in 1988-95.

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[1] This paper was originally distributed in 1989 as a working paper.
[2] KETI is a large data file kept the Ministry of Social Affairs and Health. Itt contains cost and output information based on annual reports of health centres. These data extend to year 1992. For later years the data was derived from the SOTKA register which is a large data set covering a.o. cost, output and utilization information by municipality. It is kept by STAKES.