

Does Competition Increase Economic Efficiency in Swedish County Councils?

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Abstract: The Swedish health care system is to a large extent publicly managed by 21 local county councils. During recent years there has been a movement where local county councils have opted to allow more of the production to be performed by alternative producers (i.e. private firms, cooperatives etc.). The purpose of this paper is thus to study if local county councils who has a large proportion of health care performed by alternative producers are more economically efficient than other county councils. The results indicate that county councils with more alternative caregivers are supplying their services more efficiently.

Keywords: Economic efficiency in health care, Data Envelopment Analysis, Tobit regression

JEL-Codes: I11, I12, H40

1. Introduction

The Swedish health care system is to a large extent publicly managed with most health care facilities owned and operated by 21 local, independent and politically governed county councils. During recent years there has, however, been a movement where the local county councils have opted to allow more of the production to be performed in production facilities owned by others (i.e. private firms, cooperatives etc.) than the local county council. Also, studies from other sectors in the economy have shown that public providers subject to competition are more efficient than public providers with a local monopoly (e.g. Millward and Parker, 1983; Sandström and Bergström, 2005).

There are some previous studies of performance in the Swedish health care sector. Färe et al. (1995) and Färe et al. (1996) estimated Malmquist productivity indices for Swedish hospitals, and found that productivity had declined during the period 1980 to 1991. Jonsson (1994) compares productivity measures in a county council who implemented a purchaser/provider split to fourteen county councils who did not implement such a system. The results indicated that productivity had increased more in the county council where the purchaser/provider split. Finally, Gerdtham et al (1999) had the same main purpose as Jonsson (1994), but use empirical methods closely related to this paper, of measuring technical efficiency. In their paper, Gerdtham et al (1999) uses the approach of Borden (1988) and Bedard and Wen (1990) in their studies of how different reimbursement systems affected efficiency in US health care systems. The analysis is performed in two steps; first, economic efficiency is estimated using data envelopment analysis (DEA), and second, the resulting efficiency scores are used as the dependent variable in regression models trying to explain the efficiency score of different production facilities or different county councils. The results from Gerdtham et al. (1999) are mixed, but when pooling the data the results show that the introduction of purchaser/provider splits increased economic efficiency in Swedish county councils. It should also be noted that Gertham et al. (1999) includes the share of private physician visits in out-patient special care in their estimations. The results indicated that the share of private physician visits did not affect economic efficiency in the county councils, while having a non-socialist local government, the proportions of elderly persons and the number of hospital beds all had a positive impact on economic efficiency. However, during the last decade there has been an increase in the amount of health care provided by others than the local county councils, which

makes it important to revisit the question of how other producers affects economic efficiency in Swedish local county councils.

The purpose of this paper is thus to study if local county councils who has a large proportion of health care performed by alternative producers are more economically efficient than other county councils. The analysis will be performed using the two step approach adopted by Borden (1988), Bedard and Wen (1990) and Gerdtham et al (1999).

There are at least four ways that a larger proportion of health care performed by alternative producers could increase economic efficiency in local county councils. First, for profit maximizing alternative producers of health care the financial rewards of efficiency is more directly connected to the employee and/or the owner of the alternative production plant, making the personal incentives to create an efficient production plant greater.

Second, almost all health care supplied by alternative producers in Sweden is produced in relatively small scale production units. Then, if there are diseconomies of scale in production of health care, this could make county councils using a relatively large amount of such small scale care more efficient. Third, there is an ongoing debate about so called X-inefficiency (i.e. that production units with low exposure to competition do not minimize costs) in the public sector. If this is the case, a relatively larger share of alternative producers of health care may lead to increased efficiency, due to increased competition in health care production. Finally, if alternative producers use a higher level of specialisation than the local county councils do, this could lead to such units being more efficient. If, for example, alternative caregivers use more administrative personnel than in the county councils own health care facilities, this could result in higher efficiency if this makes it possible for physicians and nurses to focus on working with patients.

This paper contributes to the literature in the following way; first, the large increase in the amount of health care performed by others than the local county councils warrants that the question of how this affects efficiency in the Swedish health care system should be revisited. Second, increased data availability allows us to control for more confounding factors than previous studies, making potential missing variable bias less likely.

This paper is organized as follows; in the next section the data and methods used in this study are presented. Section 3 reports the results from the estimations of economic efficiency and the regression analysis used to explain the efficiency scores. Finally, in section 4 the results, potential caveats, and directions for future research are discussed.

2. Material and Methods

As mentioned above, our analysis resembles that of Gerdtham et al (1999), Borden (1988) and Bedard and Wen (1990). The analysis is performed in two steps; first, economic efficiency is estimated using data envelopment analysis (DEA), and second, the efficiency scores are used as the dependent variable in regression models trying to explain the efficiency score of different production facilities or different county councils. In the field of productivity analysis, productivity change is decomposed into technological development and technical efficiency change. Therefore, given the available production technology, increasing technical efficiency will be interpreted as increasing productivity in this paper. As in Gerdtham et al. (1999), this paper will focus on technical efficiency, and from now on we use the term economic efficiency as synonymous to technical efficiency. It should, however, be noted that this means that we assume allocative efficiency, i.e., that prices are set efficiently on all relevant markets (see Coelli, 1998, p.162). The method of analysis will be discussed in detail below.

First, the economic efficiency in Swedish local county councils for the years 2001 to 2004 is estimated. In order to do this, one must first chose if one should use an input- or output oriented approach. An output oriented approach means that the aim of the study is to investigate by how much output can be increased using a fix amount of inputs and technology. An input oriented approach studies by how much inputs can be decreased using the available production technology for a given level of output. The choice of approach should be based on which side of the economic problem (inputs- or outputs) the decision makers in the local county councils have more control over. Since Swedish local county councils are bound by law to treat the sick, and the spread of disease in the community is largely out of the hand of decision makers, we have adopted an input based approach. It is thus assumed that decision makers in the local county councils can choose the input mix used in the production of health care in the county council.

Production data concerning inputs and outputs in health care production for the Swedish local county councils have been collected from the official records published by the Swedish Association of Local Authorities and Regions. Data have been collected annually for the years 2001 until 2004, and all data expressed in monetary terms have been discounted using the producer price index. Due to missing data, two local county councils (Uppsala and Gotland) had to be excluded, leaving 19 local county councils to be studied. Also, in order to increase the degrees of freedom in the Tobit regression models, the data have been pooled creating a dataset consisting of 76 observations.

In this paper it is assumed that health care is produced using three types of inputs; labour (L), capital (K), and health care from other sources (I). Labour is measured as total labour cost in the different municipalities in million Swedish kronor (SEK) and capital is measured as the total reported capital stock including buildings, machines and other inventories in million SEK. If we were to only include the amount of labour and capital in each local county council in the empirical analysis this amounts to making the implicit assumption that all health care is provided by the local county councils. However, some local county councils buy part of their health care from private firms or other county councils. In order to account for this, the amount of health care bought from other sources (private firms, cooperatives etc. or other county councils) is also included in the estimations of economic efficiency.

Turning to the measurement of output, the conceptual output of interest for the researcher is the change in the population health status due to health care production in the local county council. This is difficult to measure, and as most previous studies we are forced to use a number of intermediate output measures instead. In this paper output will be measured by the number of physician visits (PVISIT) in thousands in the local county council, the number of visits to district nurses in thousands (NVISIT), the number of short-term hospital beds available (BEDS), and the amount of health care sold to other producers of health care (SALES) in million SEK. Descriptive statistics for these inputs and outputs are presented in Table 1.

Table 1 about here.

In order to estimate the economic efficiency scores of the local county councils, the following linear programming problem is solved;

$$\min_{TE_i^{VRS}, \lambda} TE_i^{VRS} \quad i = 1, \dots, 76 \quad (1)$$

subject to

$$-y_{im} + \sum_{m=1}^4 y_{im} \lambda_i \geq 0 \quad (2)$$

$$TE_i^{VRS} x_{ik} - \sum_{k=1}^3 x_{ik} \lambda_i \geq 0 \quad (3)$$

$$\sum_{i=1}^{76} \lambda_i = 1 \quad (4)$$

$$\lambda_i \geq 0 \quad (5)$$

where y_{im} represents m ($=1, \dots, 4$) outputs for i ($=1, \dots, 76$) observations, or decision making units (DMUs), x_{ik} represents k ($=1, \dots, 3$) inputs for i ($=1, \dots, 76$) observations, or DMUs, λ_i is a nonnegative intensity variable over observations, and TE_i^{VRS} is the specific efficiency score to be estimated for each of the 76 observations.

The second part of the empirical approach uses the estimated efficiency scores, \hat{TE}_i^{VRS} , as the dependent variable in a regression analysis. This approach has been used in previous studies of hospital efficiency (Kooreman, 1994; Ferrier and Valdmanis, 1996) and county council efficiency (Gerdtham et al., 1999). The economic efficiency scores from the first part of the empirical work is bounded between zero and one, meaning that the dependent variable in the regression model is censored, and that ordinary least squares regression produces biased estimates (see e.g. Maddala, 2001, p. 334). In order to address this problem, the following Tobit regression model (Tobin, 1958) is estimated;

$$\begin{aligned} \hat{TE}_{it}^{VRS} = & \alpha + \beta_1 * \text{ALTER}_{it} + \beta_2 * \text{FSTATUS}_{it} + \beta_3 * \text{REGION}_{it} \quad (6) \\ & + \beta_4 * \text{QUALITY}_{it} + \beta_5 * \text{POPDENS}_{it} + \beta_6 * \text{OLD}_{it} \\ & + \beta_7 * \text{CIRCULATORY}_{it} + \beta_8 * \text{NERVOUS SYSTEM}_{it} \\ & + \beta_9 * \text{PSYCHIATRIC}_{it} + \beta_{10} * \text{NON-SOCIALIST}_{it} \\ & + \beta_{11} * \text{TREND}_{it} + \varepsilon_{it} \end{aligned}$$

where \hat{TE}_{it}^{VRS} is the estimated efficiency score over each observation, i.e., for county council i ($=1, \dots, 19$) in year t ($=2001, \dots, 2004$). The first four independent variables all represent features of the local county council. ALTER is our main variable of interest, and it is defined as the number of physician visits at facilities run by others than the local county council divided by the total number of physician visits in the local county council. Previous studies have shown that competition from private providers has increased efficiency in other sectors in the economy (see e.g. Millward and Parker, 1983; Sandström and Bergström, 2005). In addition, even if competition does not increase efficiency in the local county councils, an increase in the amount of health care being performed by alternative producers could have a positive effect on efficiency. This would, for example, be the case if these production units owned and operated by alternative producers of health care are more effective than the production units operated by the local county councils. As such, our hypothesis is that a large share of health service being produced by others than the local county council will have a positive impact on efficiency.

FSTATUS represents the surplus or deficit for the local county council in millions of SEK and our hypothesis is that a high surplus in the local county council will have a negative impact on efficiency. This has been found in previous studies, see e.g. Gerdtham et al (1999), and their explanation of the result is that deficits force local county councils to become more efficient. REGION is a dummy variable equal to one if the local county council in question has a region hospital. Region hospitals are large hospitals that in many cases are also responsible for educating physicians and other health care personnel, as well as doing medical research. As these activities do not produce the types of outputs included in this study, we expect that having a regional hospital will have a negative impact on efficiency. Finally, QUALITY is our measure of the quality of care given in the different local county councils, and it is measured as the 28-day mortality rates among treated stroke patients in the different county councils.

The two following variables, POPDENS and OLD, have been included to control for differences in demographics between county councils. POPDENS measures the population density (inhabitants per square kilometre) in the local county council. One might expect that more densely populated county councils will be more effective. Such county councils should, for example, use fewer resources in transports of patients, and these resources could then be

used to produce other forms of health care output. OLD is the proportion of the population above 75 years of age, and our hypothesis is that an older population will require more health care being produced. As such, the proportion of old inhabitants in a local county council will affect the amount of resources in health care production and, thus, the efficiency of the county council.

Furthermore, three variables, CIRCULATORY, NERVOUS SYSTEM and PSYCHIATRIC, have been included to control for differences in case mix between county councils. These variables are measured using the Nordic Diagnosis Related Group (NDRG) system. The original DRG system was invented at Yale University during the 1960ties, and the system was developed in order to measure case mix in hospitals and/or local county councils in a practical manor.

NON-SOCIALIST is a dummy variable equalling one if the local county council has a non-socialist government. Previous studies (Gerdtham et al, 1999) have shown that non-socialist county councils have higher economic efficiency than other county councils, and we thus expect that a non-socialist local government will have a positive impact on efficiency. TREND is a time trend included to capture possible time trends in efficiency.

Finally, an inspection of the efficiency scores also showed that one county council, Norrbotten, was a clear outlier when it comes to efficiency scores. As such, in addition to the model presented above, a model including an indicator variable equalling one if the observation was related to the county council of Norrbotten, DNORRBOTTEN, was also estimated. Descriptive statistics for the variables used in the empirical analysis are presented in Table 2, and the results from the estimations of the two different Tobit models are presented in Section 3 below.

Table 2 about here.

3. Results

Turning to the results from the estimation of the Tobit regression model, parameter estimates and standard errors are presented in Table 3. Note that the parameter estimate relating to the indicator variable for Norrbotten is negative and statistically significant at the 5 percent level.

As such, the following presentation of the results will focus on the second model where the outlier effect of Norrbotten has been controlled for.

Table 3 about here.

The results show that the parameter estimates for the local county council features ALTER, REGION and QUALITY are all positive and statistically significant at the 5 percent level. Note, however, that QUALITY is measured as the 28-day mortality rate after suffering a stroke in the different county councils. As such, a positive parameter estimate indicates that there is a positive correlation between efficiency and mortality.

Turning to the demographic and case mix variables, the parameter estimate for POPDENS is negative and statistically significant at the 5 percent level, while the estimate for OLD is negative and statistically significant at the 10 percent level. The results also show a negative and statistically significant correlation between efficiency and the amount of patients under psychiatric care.

Finally, the TREND variable and the indicator variable relating to non-socialist county councils, NON-SOCIALIST, are both negative and statistically significant at the 5 percent level.

4. Discussion

As mentioned in the introduction, there are at least four ways that a larger proportion of health care performed by alternative producers could increase economic efficiency in local county councils, financial rewards, diseconomies of scale, X-inefficiency and specialisation. As such, the purpose of this paper has been to study if local county councils who has a large proportion of health care performed by alternative producers are more economically efficient than other county councils. Following Borden (1988), Bedard and Wen (1990) and Gerdtham et al (1999), the analysis in this paper was performed in two steps. First, economic efficiency was estimated using data envelopment analysis (DEA) and, second, the efficiency scores were used as the dependent variable in regression models trying to explain economic efficiency of different production facilities or different county councils.

The results show that the parameter estimate for the proportion of health care being performed by alternative producers of health care was positive and statistically significant at the 5 percent level, indicating that a larger proportion of health care performed by alternative producers increases economic efficiency in Swedish local county councils. The data at hand does not, however, allow us to discriminate between the four possible motivations for this result discussed above.

The findings in this paper coincide with the results presented by Millward and Parker (1983) and Sandström and Bergström (2005), which have shown that competition from other providers has increased efficiency in other sectors than healthcare in the economy. The finding that local county councils with a larger proportion of health care being produced by alternative producers are more efficient could, however, also be the result of production units owned and operated by alternative producers of health care being more efficient than the production units operated by the local county councils.

Contrary to Gerdtham et al (1999) the results also indicate that after controlling for the proportion of health care being produced by others than the county council, the indicator variable relating to non-socialist county councils is both negative and statistically significant at the 5 percent level. A possible explanation for this result could be that non-socialist county councils chose to buy a larger part of their health care from alternative health care producers instead of investing in order to increase efficiency at their own county council facilities. This also turns out to be the case in our data, where the non-socialist county councils have on average 33 percent of the physician visits (divided by the number of physicians in the county council) at production units owned and operated by alternative health care producers, while the corresponding number for socialist county councils is 19 percent.

The results also show that there is a positive and statistically significant correlation between having a region hospital in the county council and economic efficiency, contrary to our expectations. Note also that there is a positive and significant correlation between our measure of health care quality and economic efficiency. But since our measure of quality is the 28-day mortality rate after suffering a stroke, a positive parameter estimate show that there is a positive correlation between efficiency and mortality, indicating that there has been a price to pay in quality for achieving high economic efficiency in the Swedish county councils.

Turning to the demographic and case mix variables, the parameter estimate for population density is negative and statistically significant at the 5 percent level contrary to our expectations. The parameter estimate relating to the proportion of the population over the age of 75 is, however, negative and statistically significant at the 10 percent level, as expected.

Finally, we would like to suggest some directions for future research. In this paper, we have shown that there is a positive and statistically significant correlation between the proportion of health care being produced by others than the local county councils and economic efficiency. However, the available data did not make it possible to directly determine the causal relationship between the amount of alternative health care and economic efficiency. Instead there are (at least) four different ways that an increase in the amount of health care being produced by others than the local county council could affect economic efficiency. In order to discriminate between the different possible causal pathways, one should collect disaggregated data so that alternative and county council production units could be compared directly in terms of economic efficiency, controlling for as many confounders as possible. If such data could be made available, measuring inputs- and outputs on the individual health centre level, one could also investigate if the salaries of different categories of personnel was equal to the value of their marginal product, or if some categories were being discriminated against. Another improvement would of course be if one could directly measure quality adjusted health outcomes in different county councils, and use these as measures of output instead of indirect measures as the ones used in this paper. We are, however, not aware of any of the above mentioned datasets being available for research in Sweden at present.

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Table 1. Descriptive statistics, outputs and inputs

Variable	Min	Max	Mean	Std. Dev.
Outputs				
PHYSICIAN VISITS	156.41	2613.94	550.47	633.50
NURCE VISITS	237.61	4057.07	1002.52	901.06
BEDS	303.00	3695.00	949.17	886.79
SALES	33.46	898.82	291.22	253.00
Inputs				
LABOUR	601.42	9307.02	2206.53	2164.51
CAPITAL	732.41	10218.19	2682.99	2391.61
OTHER SOURCES	111.09	14913.25	1293.32	2875.82
Efficiency				
VRS	0.73	1.00	0.95	0.07

Table 2. Descriptive statistics, regression variables.

Variable	Min	Max	Mean	Std. Dev.
ALTER	0.02	0.51	0.21	0.14
FSTATUS	-4556.62	762.00	-186.65	656.77
REGION	0.00	1.00	0.32	0.47
QUALITY	20.70	26.50	23.67	1.77
POPDENS	3.00	287.00	44.46	62.00
OLD	7.22	10.68	9.49	0.81
CIRCULATORY	1.52	3.60	2.08	0.44
NERVOUS SYSTEM	1.39	2.77	1.82	0.27
PSYCHIATRIC	1.37	2.84	1.89	0.28
NON-SOCIALIST	0.00	1.00	0.16	0.37
TREND	1.00	4.00	2.50	1.12

Table 3. Estimation results, Tobit regression.

Variable	Model 1		Model 2	
	Estimate	Std. Err.	Estimate	Std. Err.
CONSTANT	0.70	0.22	1.36	0.22 **
ALTER	0.52	0.12 **	0.30	0.11 **
FSTATUS	-1.01E-05	2.58E-05	-1.34E-05	2.11E-05
REGION	0.11	0.03 **	0.05	0.02 **
QUALITY	0.01	5.66E-03 *	0.01	4.63E-03 **
POPDENS	-3.40E-04	3.10E-04	-6.18E-04	2.71E-04 **
OLD	0.02	0.02	-0.05	0.02 **
CIRCULATORY	0.17	0.05 *	0.05	0.04
NERVOUS SYSTEM	-0.14	0.10	0.01	0.09
PSYCHIATRIC	-0.16	0.08 *	-0.14	0.07 **
NON-SOCIALIST	-0.04	0.03	-0.04	0.02 *
TREND	-0.03	0.01 **	-0.03	0.01 **
DNORRBOTTEN	-	-	-0.22	0.05 **

* = significant at the 10 percent level.

** = significant at the 5 percent level.