THE JOURNAL OF SOCIAL POLICY STUDIES
ЖУРНАЛ ИССЛЕДОВАНИЙ СОЦИАЛЬНОЙ ПОЛИТИКИ

ARTICLES IN ENGLISH

Edgars Stals, Zhanna Tsaurkubule, Rita Konstante

USEFULNESS OF ADMINISTRATIVE DATA IN ASSESSING THE SERVICE QUALITY AND TECHNICAL EFFICIENCY OF SOCIAL CARE CENTRES

Latvia, like other countries worldwide, faces the challenges of an ageing society, with an increasing proportion of elderly population group and the demand for long-term social care services at local level. The Latvian Social Protection and Labour Market Policy Guidelines for 2021–2027 include actions on the improvement of the quality monitoring and efficiency assessment system of social services. In this article, the authors evaluate the quality of 67 social care centres (SCC) in the period from 2011 to 2017, and technical efficiency (TE) of 64 SCCs in 2017 by using publicly available administrative data of SCCs. The aim of the work is to find out whether administrative data can be used in the evaluation of the quality of care at SCC and TE of SCC. The authors conclude that the analysis of administrative data does not allow one to determine the quality of SCC because administrative data do not contain predictors of the care process. The administrative data of SCC can be used in the evaluation of TE of SCC, where, depending on the applied method, set goals, and objectives, the obtained results can be used to determine the effectiveness of local government SCCs and to improve economic activity. Based on the content of the work, the authors point out the need to

Edgars Stals – PhD ABD (economy), Baltic International Academy, Riga, Latvia. Email: sedgars@inbox.lv

Zhanna Tsaurkubule – Dr. Sci. (Ing), Professor, Vice Rector, Baltic International Academy, Riga, Latvia. Email: zcaurkubule@inbox.lv

Rita Konstante – Dr.med., lecturer, University of Latvia Faculty of Medicine, Riga, Latvia. Email: rita.konstante@gmail.com

introduce unified quality indicators (QI) of the care process at SCCs of Latvia. This would ensure opportunities for control of the quality of care at SCCs, transparency of the care process, and quality assessment. In addition, QI can be used as a component in evaluating the efficiency of SCCs. The authors acknowledge that further research related to the assessment of SCC quality and efficiency in Latvia is needed.

Keywords: efficiency, Latvia, service quality, social care centres, quality indicators

DOI: 10.17323/727-0634-2022-20-4-645-658

Introduction

The trend of demographic ageing is a global challenge for national socio-economic systems, the effects of which are already being experienced today (Maestas et al. 2016; Henriksen, Cooley 2017; Harper 2018; Yoshino et al. 2019). As a result of the surge in the number of elderly people, the demand for both formal and informal social care has increased significantly (Rajevska 2018; Spasova et al. 2018; Mironova 2020). Spasova et al. (2018) point out that the problem of an ageing population is a common long-term challenge for the European Union, where the age dependency ratio, as well as public expenditures on long-term social care, are rapidly increasing. Several areas of social policy that must be enshrined in legal terms are in the competence of municipal authorities. In connection with the ageing of the population and the growing demand for social care services, not only the issue of the capacity of long-term social care provision in the country, but also the issue of related costs has become more topical (Rajevska 2018). In Latvia, the responsibility for the provision of SCC services is divided between the central government and local governments, where the latter are responsible for providing long-term social care and social rehabilitation for the elderly (Parliament of Latvia 2002). Taking the differences in economic capacities of Latvian local governments into account, the provision of social care depends on the limited financial resources that affect the availability of local SCC services, economic processes of SCC, and service provision (Parliament of Latvia 2019).

At present, various shortcomings related to the care process and rehabilitation have been identified at Latvia's SCCs, which are characteristic for both the local and state SCCs. Many care provision issues are related to the lack of QI at SCCs (Health Inspectorate 2020). Namely, the recording, registration, and electronic documentation of the number of residents' falls, bedsores, hospitalisations, vaccinations, strokes, etc. is not performed at the SCCs. Cases of dehydration, weight loss, depression, etc. are also not recorded, which is largely due not only to the lack of such practices, but also to the low level of competence of care workers and nurses in recognising early acute symptoms (Health Inspectorate 2020).

Despite the fact that the directions of action of the Cabinet of Ministers (2021) guidelines include the improvement of the quality monitoring and efficiency evaluation system of social services, the efficiency and quality of the SCCs of Latvia have not been studied to date. This fact impedes making objective assessments regarding both the impact of changes in the efficiency of SCC economic activity on the quality of SCC care and the improvement of the quality monitoring and efficiency evaluation system as such.

In this work, the authors performed an analysis of SCCs administrative data using correlation and multivariate linear regression methods based on Schnelle et al. (2004); Kjøs, Havig (2015); Carey et al. (2018); Shapiro, Tate (1995); Berlowitz et al. (2010); Goodwin et al. (2017); Antwi, Bowblis (2018) and Iezzoni (1997). In the assessment of SAC efficiency, administrative data of SAC are analyzed using non-parametric DEA (Data Envelopment Analysis) and parametric SFA (Stochastic Frontier Analysis) based on Tran et al. (2019); Katharakis et al. (2013); Medeiros, Schwierz (2015); Jacobs (2001); Procházková (2011); Theodoridis, Anwar (2011) and Dejan et al. (2019).

Use of administrative data in the assessment of the quality of SCCs

Administrative data have been used to assess SCCs by such researchers as Shapiro, Tate (1995), Berlowitz et al. (2010), Goodwin et al. (2017) etc. A study conducted by Antwi, Bowblis (2018) identified an association between the turnover of nursing personnel at SCCs, level of care quality, and resident mortality. It is noted that the decrease in the number of nurses at SCCs leads to a lower quality of care, for instance regarding bedsores, and suggests that other quality indicators are also negatively affected. As a result, the mortality trend at SCCs increases. In addition to administrative data, the study uses QI, i.e., the number of bedsores. Administrative data offer practical advantages in terms of quality assessment, cover public reports on the activities of service providers, and are publicly available. At the same time, it should be noted that the clinical content of administrative data is limited. As described by Iezzoni (1997), administrative data can be used as a screening tool to identify quality issues in service delivery that need to be studied in depth.

Considering the lack of objective assessment of quality at Latvia's SCCs, the authors used publicly available administrative data of SCCs with the aim of finding out whether these data can be used for the assessment of the quality of SCCs.

Administrative data of SCCs is the only data source in Latvia, which includes information on the economic activities of SCCs and is publicly available (Ministry of Welfare 2021). The statistical information on 67 SCCs for the period from 2011 to 2017 were selected for the analysis. This period of time was selected on the basis of the low variability of the SCCs during the respective period. In the administrative data, SCCs are characterised by using 36 separately registered indicators (predictors). Four predictors, which were best suited for the purpose of analysis, were selected for the study, namely average life expectancy of SCC residents, actual revenue of SCCs, total number of full-time work loads (shifts) of SCC employees per SCC resident, and the number of SCC residents. It is important to note that administrative data only include structural and outcome predictors of SCCs without process predictors (Donabedian 1988). The average life expectancy of SCC residents was selected as an indicator of quality based on the research of Holtzman, Lurie (1996) and Antwi, Bowblis (2018) regarding the impact of SCC quality on the life expectancy of residents at SCCs. Similarly, the total number of full-time workloads of SCC employees per SCC resident and the number of SCC residents were selected based on a study of Antwi, Bowblis (2018). The actual revenues of SCC were selected based on the research of Hicks et al. (2004), Carey et al. (2018), and Weech-Maldonado et al. (2019).

Pearson correlation analysis and multifactor linear regression were applied to the predictors in order to find the relationship between them and to predict their impact on the quality indicator – average life expectancy.

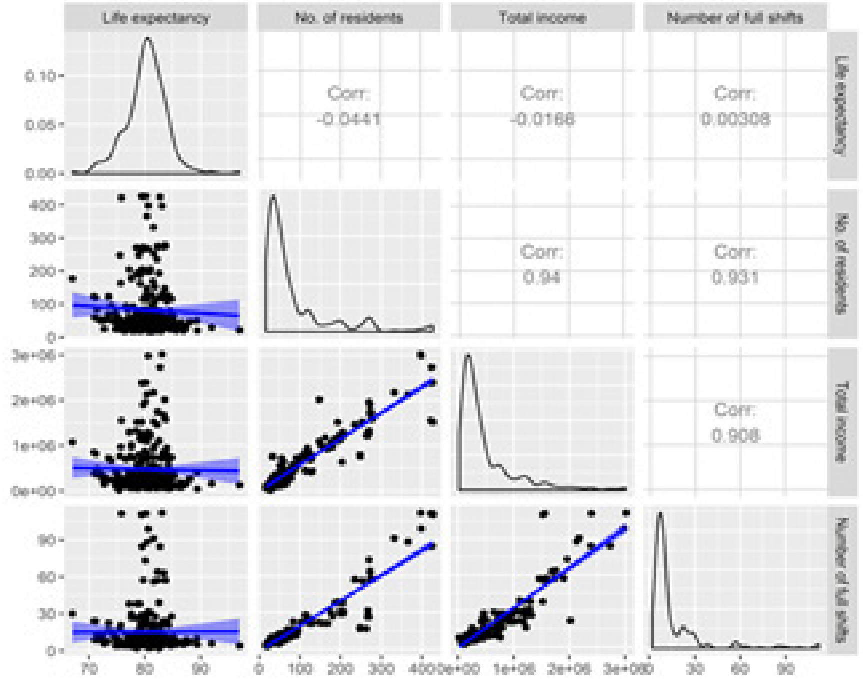

Figure 1. Correlation matrix

The results of correlation analysis demonstrated a close association between the actual revenue of SCCs and the total number of full-time workloads of SCC employees per SCC resident, actual revenues of SCCs and the number of SCC residents, as well as the total number of full-time work loads of SCC employees per SCC resident and the number of SCC residents. However, the relationship between the average life expectancy of SCC residents and other predictors was insignificant.

Thus, if the multiple factor linear regression model is:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + \epsilon_i, \ i = 1, 2, \ldots n,$$

where p – number of predictors and n – number of observations, then the developed model is:

$$LE_a = \beta_0 + \beta_1 CL_{nr} + \beta_2 R_a + \beta_3 WL_{ft}$$

The authors used the least squares method to find the indicators where: LE_a – average life expectancy of SCC residents; CL_{nr} – number of SCC residents; R_a -actual revenue of SCCs; WL_{ft} – total number of full-time workloads of SCC employees.

After three-step regression, where the predictors with the highest p value were deleted, the regression results pointed to a low statistical reliability of the model and the model was not significant. After the first manipulation $p > 0.05$ (0.156), but R^2 (0.018). After the second manipulation model, the value of R^2 did not increase, $p > 0.05$ (0.095), but R^2 (0.017). After the third manipulation, where $p > 0.05$ (0.459) but R^2 (0.002), the model also did not acquire statistical significance and was not able to predict.

The results of the analysis show that over a 7-year period, revenues of 67 SCCs, changes in resident and staff workloads, without the involvement of QI data (for instance, bedsores, falls, re-hospitalisations) do not reflect the impact on the average life expectancy of SCC residents as a quality criterion. Thus, it can be concluded that it is not possible to assess the quality of SCC care by using only the administrative data of SCCs for the analysis due to the lack of QI.

Use of administrative data in the assessment of the efficiency of SCCs

Tran et al. (2019) point to two dominant methods used in the performance of efficiency evaluation – parametric SFA and non-parametric DEA. In some works, the triangulation of these methods is used to find out the differences between the obtained results or to choose the most suitable existing data processing method (Katharakis et al. 2013; Medeiros, Schwierz 2015; Jacobs 2001; Procházková 2011; Theodoridis, Anwar 2011; Dejan et al. 2019).

Several works, such as López-Espín et al. (2014), Aparicio (2016), Ghaeli (2017), Emrouznejad et al. (2014) indicate that DEA may be applied to any area or object and is considered to be one of the methods that analyses and researches the correlation between investment resources and obtained results. Determination of efficient objects is performed by comparing each of these values with the values of all other objects. Similarly, SFA is also widely used for the evaluation of object efficiency (Rezaei et al. 2016; Lan et al. 2010).

The use of DEA and SFA allows one to identify the determinants of inefficiency (Wang, Tao 2010; Theodoridis, Anwar 2011). However, the strong influence of the choice of method on the obtained TE value must be taken into consideration and, consequently, also on further management decisions. Therefore, the research method should be evaluated depending on the objective (Dejan et al. 2019; Önder et al. 2013; Katharakis et al. 2013).

Publicly available statistics of the Ministry of Welfare of the Republic of Latvia on social services and social assistance at the end of 2017 are used for data selection (Ministry of Welfare 2021). Within the framework of TE analysis, the SCC is viewed as a Decision-Making Unit (DMU). In this study, seven predictors were selected as input/output of models: number of healthcare professionals (in workloads); carers, nannies, and social educators (in workloads); other DMU employees (in workloads); total number of employees (in workloads); number of bed days at the end of 2017; total expenditure (EUR); and remuneration costs (EUR).

Table 1

Input/output of DEA models

	Model 1	***Model 2***	***Model 3***
Input	Number of healthcare professionals (per shift)	Number of healthcare professionals (per shift)	Total number of employees (per shift)
	Caregivers, nurses and social educators (by shift)	Caregivers, nurses and social educators (by shift)	
	Other employees of the DMU (by shift)	Other employees of the DMU (by shift)	
		Total expenses, EUR	
Output	Number of bed-days at the end of 2017	Number of bed-days at the end of 2017	Remuneration costs

The predictor 'other DMU employees (in workloads)' includes DMU social work specialists (in workloads), rehabilitation specialists (in workloads), administrative personnel (in workloads), and other DMU employees without a specific classification of job description (in workloads). The predictors of administrative staff (in workloads) and other DMU staff without a specific classification of job description (in workloads) were combined because they have functions unrelated to the provision of direct care. Meanwhile, social work specialists (in workloads) and rehabilitation specialists (in workloads) were added to 'other DMU employees' (in workloads) based on the relatively low share of workloads within this predictor in relation to health care professionals and caregivers, nurses, and social educators, i.e., 304,4 workloads against 4,915 workloads within the overall DMU selection, respectively. By using the seven selected predictors, three separate models were constructed that characterize the TE of a DMU.

Out of the 67 SCCs included in the quality assessment, three SCCs were removed due to incomplete data. Therefore, a total of 64 SCCs were included in the efficiency assessment.

DEA uses the definition of input-oriented constant returns to scale (CRS) ratio by CCR (*Charnes, Cooper and Rhodes*), which means that a proportional increase in input results in a proportional increase in output (Toloo, Nalchigar 2009). CCR generalizes the definition of a single input/output ratio to multiple inputs/outputs (Banker et al. 1984).

It is necessary to solve the following linear programming equation to identify the Most Efficient (ME) DMU in an input-oriented CRS:

$$E$$

$$Ex_i^0 \geq \sum_{k=1}^{K} \lambda^k x_i^k, i = 1, \dots, m$$

$$y_i^0 \leq \sum_{k=1}^{K} \lambda^k y_j^k, j = 1, \dots, n$$

$$\lambda \epsilon R_+^K$$

m – number of input variables
n – number of output variables
K – total number of DMUs
λ – efficiency ratio (ER)
x^0 and y^0 – ME DMU input/output variables
x^k and y^k – DMU input/output variables (Bogetoft, Otto 2011).

When using SFA, the assumption is made that the efficiency evaluation function of the ME DMU is unknown. According to Procházková (2011) and Hossain et al. (2012), the SFA model is defined as follows:

$$y_i = f(x_i; \beta) + \epsilon_i$$

$$\epsilon_i = v_i - u_i$$

where $i \in N$;
N=(1,…,n)
y_i – assessment of efficiency;

x_i – vector of input values for the ith DMU;

β – vector of predictors to be evaluated;

v_i – independent random variable, $v_i \sim N(0,\sigma_v^2)$;

u_i evaluation of inefficiency (negative value), does not depend on and $u_i \sim N^+(0,\sigma_u^2)$

By using the R software, the TE of 64 DMUs are evaluated in accordance with DEA and SFA methods.

Table 2 demonstrates 15 coefficients of efficiency (CEs) out of 64 according to SFA, and the CEs calculated according to DEA are aligned by SFA results. It can be seen that SFA does not assign CE value 1, while overall values assigned to DMUs by SFA are higher. This can be explained by the specific nature of SFA, where SFA CE are determined on the basis of the stochastic limits of the object's operational capacities, where the efficiency of the object is determined by the probability that a specific object can become even more efficient (Hossain et al. 2012). In order to check the objectivity of the results obtained by both methods, a comparison of CEs obtained by means of SFA and DEA methods is performed using Pearson correlation analysis, while Box Plot analysis is used to determine the most suitable method for evaluating the efficiency of SCCs.As can be seen, the CEs of the methods are positively correlated in terms of p values that are lower than 0.05. The coefficients of determination differ slightly between the models and point to a closer spread of the CEs of the 3rd model around the correlation line.

The median of DEA ranges from 0.59 to 0.67, while Q_0 and Q_4 values in the 1st model range from 0.36 to 0.93 respectively, but in the 2nd model from 0.36 to 1. This represents a relatively optimal distribution of CE assignment. In the 1st model, DEA provides 3 ME DMUs as characteristic, in the 2nd model – 10 ME DMUs, and in the 3rd model – 1 ME DMU. Although in the 1st DEA model the outlier values are identified with coefficients 0.95 and 1, the closest following value to them is 0.93, which characterised Q4. The interquartile range (IQR) is acceptable, where in the 2nd DEA model it amounts to 0.34 in comparison with 0.09 in accordance with the SFA method. The median of SFA varies from 0.79 to 0.86 depending on the model, while the amplitude of Q_0 and Q_4 values ranges from 0.59 to 0.91. In the 1st model – up to 0.76 and in the 3rd model – 0.96, which points to a high allocation of CE to the SCC sample. The SFA method does not assign ME DMU with CE value 1. It is noteworthy that the 2nd model in SFA, in contrast to the DEA, exhibits outliers. In SFA, a low IQR of 0.09–0.1 characterises a narrow distribution of CE assignment.

DEA results had a trend to demonstrate the highest CE, with a wider variability of the range of obtained results, which allows the revision of values with a minimal coverage of the CE by the SAC method. Such results are suitable for inclusion in other data analysis methods subordinate to TE evaluation (CE dynamics, sensitivity analysis) and provide an opportunity for more convenient data interpretation and transparency of results. The CEs obtained by SFA are characterised by a narrow IQR, non-assignment of CE value 1, and a high placement of the median of the results, which points to an approximation of the CE close to the maximum value. Unlike DEA, the results of SFA are levelled, but can be used for further data processing depending on the objective of the study.

Table 2

CE comparison

Model 1	SFA	0,92	0,89	0,89	0,88	0,88	0,88	0,88	0,88	0,88	0,87	…	0,52
	DEA	1	0,93	0,72	1	0,91	0,83	0,73	0,96	0,74	0,96	…	0,46
Model 2	SFA	0,91	0,91	0,91	0,91	0,9	0,9	0,9	0,9	0,89	0,89	…	0,69
	DEA	1	1	1	1	1	1	0,91	0,47	1	0,95	…	0,46
Model 3	SFA	0,97	0,94	0,94	0,93	0,92	0,92	0,92	0,91	0,91	0,91	…	0,41
	DEA	1	0,79	0,77	0,75	0,69	0,71	0,69	0,69	0,67	0,67	…	0,23

Table 3

Correlation of results

Methods	Models	PCC	r-squared	p-value	slope coefficient
SFA – DEA	1	0,709	0,412	1,07E-08	0,373
	2	0,589	0,297	3,20E-06	0,149
	3	0,994	0,834	7,09E-26	0,741

Box plot

Methods/models	Q_0	Q4	Median	Outliers	IQR
DEA 1	0,36	0,93	0,6	0,95; 1	0,16
SFA 1	0,59	0,91	0,79	0,52; 0,56	0,1
DEA 2	0,36	0,1	0,67	-	0,34
SFA 2	0,72	0,91	0,84	0,69; 0,7	0,06
DEA 3	0,43	0,79	0,59	0,22; 0,79; 1	0,09
SFA 3	0,76	0,96	0,86	0,41; 0,69; 0,7; 0,72	0,06

Conclusion

We conclude that inclusion of administrative data in DEA and SFA methods enables the use of these tools both for the assessment of the level of SCC efficiency and the budget planning of SCC. The method enables the identification of input/output predictors that cause inefficiency or affect efficiency, which provides the opportunity to appropriately adjust the economic activity of SCC and increase efficiency, for instance by reducing certain costs and making amendments to personnel workloads. However, the administrative data must be comprehensive, qualitative, and objective, which would provide the opportunity to cover as extensive a selection of researched objects as possible.

There is a possibility that the inclusion of a quality component in the efficiency assessment would provide more objective results of analysis if the quality indicators in relation to the other predictors included in the efficiency assessment model are logical and mutually comparable. In this context, Tran et al. (2019) refer to 39 studies they have analysed, where 31 studies included different non-standardised quality measures providing mixed results regarding the effect of quality on efficiency. This means that quality indicators must be standardised and uniform across all SCCs. Considering the fact that the administrative data of SCCs do not include predictors related to the care process, it is necessary to include QI of SCCs in the assessment of efficiency, which must be developed in accordance with the examples of foreign good practices (Nakrem 2009). The lack of QIs at Latvia's municipal SCCs prevents an objective assessment of the internal level of service and care quality and performance of case data-based quality control and monitoring, as well as the objective formulation of the self-assessment of the SCC care process. Due to the lack of uniform QIs, the comparison of institutions with each other is also impossible. Wiener (2003) believes that QIs of SCCs are necessary for both government regulatory monitoring, as well as service providers, since they help in identifying problems in the process of care provision. At this point, further research in the area of social care that deals with aspects of the quality and efficiency of the services of SCCs is needed. This could possibly ensure further development of the sector and high quality of service provision, as well as service availability.

Based on the content of this work and the analysis, it can be concluded that the administrative data of SCCs are not suitable for the assessment of SCC quality, which, in the context of the current lack of QI at the SCCs of Latvia, does not allow for performing the assessment of SCC quality. SCC administrative data can be used in SCC TE estimation using DEA and SFA methods.

References

Antwi Y., Bowblis J. (2018) The Impact of Nurse Turnover on Quality of Care and Mortality in Nursing Homes: Evidence from the Great Recession. *American Journal of Health Economics*, 4 (2): 131–163.

Aparicio J. (2016) A Survey on Measuring Efficiency Through The Determination of the Least Distance in Data Envelopment Analysis. *Journal of Centrum Cathedra*, 9 (2): 143–167.

Banker R., Natarajan R. (2008) Evaluating Contextual Variables Affecting Productivity Using Data Envelopment Analysis. *Operations Research*, 56 (1): 48–58.

Berlowitz D., Hickey E., Saliba D. (2010) Can Administrative Data Identify Active Diagnoses for Long-Term Care Resident Assessment? *Journal of Rehabilitation Research & Development*, 47 (8): 719–724.

Bogetoft P., Otto L. (2011) *Benchmarking with DEA, SFA, and R*. New York: Springer.

Cabinet of Ministers of the Republic of Latvia (2021) *Par Sociālās aizsardzības un darba tirgus politikas pamatnostādnēm 2021.–2027 gadam* [On Social Protection and Labour Market Policy Guidelines for 2021–2027]. Available at: https://likumi.lv/ta/id/325828-par-socialas-aizsardzibas-un-darba-tirgus-politikas-pamatnostadnem-2021–2027-gadam (accessed 6 April 2022).

Carey K., Zhao S., Snow A., Hartmann C. (2018) The Relationship between Nursing Home Quality and Costs: Evidence from the VA. *PloS One*, 13 (9): e0203764.

Dejan R., Nebojsa J., Milorad J., Marko V. (2019) *Assessment of Efficiency Of Military Transport Units Using the DEA and SFA Methods*. Available at: https://www.semanticscholar.org/paper/Assessment-of-efficiency-of-military-transport-the-Dejan-Nebojsa/5a352a9c0c120fc69920898094427609aef4ea97 (accessed 27 March 2021).

Donabedian A. (1988) The Quality of Care. *JAMA*, 260(12): 1743.

Emrouznejad A., Banker R., Miranda Lopes A., Rodrigues de Almeida M. (2014) Data Envelopment Analysis in the Public Sector. *Socio-Economic Planning Sciences*, 48 (1): 2–3.

Ghaeli M. (2017) Measuring The Relative Efficiency of Banks Using DEA Method. *Accounting*, 3 (4): 221–226.

Goodwin J., Li S., Zhou J., Graham J., Karmarkar A., Ottenbacher K. (2017) *Comparison of Methods to Identify Long Term Care Nursing Home Residence With Administrative Data*. Available at: https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913–017–2318–9 (accessed 19 January 2021).

Harper A. (2018) *How to Build a Better Social Care System. New Economics Foundation*. Available at: https://neweconomics.org/2018/06/an-alternative-future-for-social-care-does-exist-and-we-need-to-move-towards-it-with-the-urgency-it-demands (accessed 9 November 2019).

Health Inspectorate Republic of Latvia (2020) *Sociālās aprūpes iestāžu audits/pārbaude 2020* [Audit/Inspection of Social Care Institutions 2020]. Available at: https://www.lps.lv/uploads/docs_module/Soci%C4%81l%C4%81s_apr%C5%ABpes_iest%C4%81%C5%BEu_audits_p%C4%81rbaude_2020,%20Vesel%C4%ABbas_inspekcijas_prezent%C4%81cija.pdf (accessed 24 January 2021).

Henriksen E., Cooley T. (2017) The Demographic Deficit. *SSRN Electronic Journal*, (93): 45–62.

Hicks L., Rantz M., Petroski G., Mukamel D. (2004) Nursing Home Costs and Quality of Care Outcomes. *Nursing Economics*, 22 (4): 178–192.

Holtzman J., Lurie N. (1996) Causes of Increasing Mortality in a Nursing Home Population. *Journal of the American Geriatrics Society*, 44 (3): 258–264.

Hossain M., Kamil A., Baten M., Mustafa A. (2012) Stochastic Frontier Approach and Data Envelopment Analysis to Total Factor Productivity and Efficiency Measurement of Bangladeshi Rice. *Plos ONE*, 7 (10): e46081.

Iezzoni L. (1997) Assessing Quality Using Administrative Data. *Annals of Internal Medicine*, 127 (8_Part_2): 666.

Jacobs R. (2001) Alternative Methods to Examine Hospital Efficiency: Data Envelopment Analysis and Stochastic Frontier Analysis. *Health Care Management Science*, 4 (2): 103–115.

Katharakis G., Katharaki M., Katostaras T. (2013) *An Empirical Comparison of DEA and SFA Method to Measure Hospital Units' Efficiency*. Available at: https://www.semanticscholar.org/paper/An-Empirical-Comparison-of-DEA-and-SFA-Method-to-Katharakis-Katharaki/3c40c91479c8151af146c6d4be4b031efeac13b0 (accessed 22 March 2020).

Kjøs B., Havig A. (2015) An Examination of Quality of Care in Norwegian Nursing Homes – A Change to More Activities? *Scandinavian Journal of Caring Sciences*, 30 (2): 330–339.

Lan Q., Han J., Li M. (2010) Innovation efficiency of Chinese manufacturing industry from 2003 to 2008- Based on SFA method. In: *2010 IEEE 17Th International Conference on Industrial Engineering and Engineering Management*: 524–528.

López-Espín J., Aparicio J., Giménez D., Pastor, J. (2014) Benchmarking and Data Envelopment Analysis. An Approach based on Metaheuristics. *Procedia Computer Science*, (29): 390–399.

Maestas N., Mullen K., Powell D. (2016) *The Effect of Population Aging on Economic Growth, The Labor Force and Productivity* [Ebook]. Available at: https://www.nber.org/papers/w22452.pdf (accessed 16 November 2019).

Medeiros J., Schwierz C. (2015) *Efficiency estimates of health care systems. European Commission Directorate-General for Economic and Financial Affairs.* Available at: https://ec.europa.eu/economy_finance/publications/economic_paper/2015/pdf/ecp549_en.pdf (accessed 23 June 2022).

Ministry of Welfare of the Republic of Latvia (2021) *Gada dati* [Annual Data]. Available at: https://www.lm.gov.lv/lv/gada-dati (accessed 23 March 2021).

Mironova A. (2020) Mezhdunarodnyj opyt organizacii rodstvennogo uhoda za pozhilymi ljud'mi [International Experience in the Organization of Informal Care for the Elderly]. *The Journal of Social Policy Studies*, 19 (3): 465–480.

Nakrem S. (2009) *Kvalitetsindikatorer for pleie og omsorg i sykehjem* [Quality Indicators for Care in Nursing Homes]. Available at: https://rokildeush.files.wordpress.com/2010/05/kvalitetsindikatorer-for-pleie-og-omsorg-i-sykehjem-sigrid-nakrem-19–11–09.pdf (accessed 24 January 2021).

Parliament of the Republic of Latvia (2002) *Sociālo pakalpojumu un sociālās palīdzības likums* [Law on Social Services and Social Assistance]. Available at: https://likumi.lv/doc.php?id=68488 (accessed 1 June 2019).

Parliament of the Republic of Latvia (2019*) Administratīvi teritoriālās reformas iespējamā ietekme uz publiskās infrastruktūras tīklu* [Potential Impact of Administrative-territorial Reform on the Public Infrastructure Network]. Available at: https://www.saeima.lv/petijumi/Administrativi_teritoriala_reforma.pdf (accessed 19 January 2021).

Procházková J. (2011) *Efficiency of hospitals in the Czech Republic: DEA & SFA Applications*. Available at: https://www.semanticscholar.org/paper/Efficiency-of-hospitals-in-the-Czech-Republic-%3A-DEA-Proch%C3%A1zkov%C3%A1/b3d908d62f1809e92e58e17cb658481017873569 (accessed 22 March 2020).

Rajevska F. (2018) *ESPN Thematic Report on Challenges in long-term care Latvia*. Brussels: European Commission.

Rezaei S., Zandian H., Baniasadi A., Zahirian Moghadam T., Delavari S., Delavari S. (2016) Measuring the Efficiency of a Hospital based on the Econometric Stochastic Frontier Analysis (SFA) Method. *Electronic Physician*, 8 (2): 2025–2029.

Schnelle J., Simmons S., Harrington C., Cadogan M., Garcia E., M. Bates-Jensen B. (2004) Relationship of Nursing Home Staffing to Quality of Care. *Health Services Research*, 39 (2): 225–250.

Shapiro E., Tate R. (1995) Monitoring the Outcomes of Quality of Care in Nursing Homes Using Administrative Data. *Canadian Journal on Aging*, 14 (4): 755–768.

Spasova S., Baeten R., Coster S., Ghailani D., Peña-Casas R., Vanhercke B. (2018) *Challenges in Long-Term Care in Europe, A Study of National Policies*. Brussels: European Commission.

Theodoridis A., Anwar M. (2011) A Comparison of DEA and SFA Methods: A Case Study of Farm Households in Bangladesh. *The Journal of Developing Areas*, 45 (1): 95–110.

Toloo M., Nalchigar S. (2009) A New Integrated Dea Model for Finding Most BCC-efficient DMU. *Applied Mathematical Modelling*, 33 (1): 597–604.

Tran A., Nguyen K., Gray L., Comans T. (2019) A Systematic Literature Review of Efficiency Measurement in Nursing Homes. *International Journal of Environmental Research and Public Health*, 16 (12): 2186.

Weech-Maldonado R., Pradhan R., Dayama N., Lord J., Gupta S. (2019) Nursing Home Quality and Financial Performance: Is There a Business Case for Quality? *The Journal of Health Care Organization, Provision, and Financing*, (56): 004695801882519.

Wiener J. (2003) An Assessment of Strategies for Improving Quality of Care in Nursing Homes. *The Gerontologist*, 43 (l–2): 19–27.

Yoshino N., Kim C., Sirivunnabood P. (2019) *Aging Population and its Impacts on Fiscal Sustainability*. Available at: https://t20japan.org/policy-brief-aging-population-impacts-fiscal-sustainability/ (accessed 23 November 2019).

Wang Z., Tao C. (2010) Regional production efficiency and its influence factors analysis in China – Based on 2001–2008 inter-provincial panel-data and SFA method. *Systems Engineering – Theory & Practice*, 30 (10): 1762–1773.

Önder Ö., Deliktaş E., Karadağ M. (2003) The Comparison of DEA and SFA Methods in the Efficiency of the Turkish Manufacturing Industry. *Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, http://hdl.handle.net/20.500.12397/1572.