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Revista de cercetare și intervenție socială

ISSN: 1583-3410 (print), ISSN: 1584-5397 (electronic)

Selected by coverage in Social Sciences Citation Index, ISI databases

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Revista de cercetare și intervenție socială, 2015, vol. 48, pp. 83-94

The online version of this article can be found at:

www.rcis.ro, www.doaj.org and www.scopus.com

Published by:

Expert Projects Publishing House



On behalf of:

„Alexandru Ioan Cuza” University,

Department of Sociology and Social Work

and

Holt Romania Foundation

REVISTA DE CERCETARE SI INTERVENTIE SOCIALA

is indexed by ISI Thomson Reuters - Social Sciences Citation Index

(Sociology and Social Work Domains)



Application of Data Envelopment Analysis to Evaluating Elderly Social Welfare Performance

Suh Chen HSIAO¹, Luke HSIAO²

Abstract

The constant development of economic societies allows the elderly enjoying certain social security and increasing the demands for the social welfare of health, medical treatment, public health, and society management; and, the government therefore has declared for reinforcing the social welfare as the key administration. With the increasing expenses but decreasing incomes, the social welfare budget is still increasing. Under the restricted resources, allocation becomes a major challenge for the governmental administration. Modified Delphi Method is utilized in this study for screening the input/output factors. Total 30 copies of questionnaires are distributed, and 22 are effectively responded, with the response rate 73%. Data Envelopment Analysis (DEA) is applied to evaluating the efficiency. The variable data used in this study are open statistical data from Ministry of Interior. The research results show 3 DMUs with strong-form efficiency in the practice of elderly social welfare (efficiency=1), about 15% of all DMUs, revealing the favorable elderly social welfare efficiency; another 3 DMUs present marginal inefficient in the practice of elderly social welfare ($0.9 < \text{efficiency} < 1$), about 15% of all DMUs, revealing the elderly social welfare efficiency being more easily enhanced than other counties and cities; and, 14 DMUs appear distinctly inefficient in the local sustainability efficiency (efficiency <0.9), about 70% of all DMUs.

Keywords: social welfare, elderly society, organizational performance, efficiency evaluation, capacity

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Research background

To cope with the changes in population, family structure and function, labor market, and value, the social environments are continuously changing. The promotion of social welfare aims to solve the problems induced by the changes in social environments. The largely increasing national income and the changes in social, political, and economic structures have enhanced the public demands for social welfare; and, the government has declared for reinforcing the social welfare as the key administration. With the constant development of economic societies, the elderly enjoy certain social security so that the demands for the social welfare of health, medical treatment, public health, and society management are enhancing. How to secure the elderly enjoying the social welfare correspondent to the development of economic societies, to enhance the standard of various public management services for the elderly, and to implement the dignified survival and living of the elderly is related to social justice, social harmony and stability as well as an important issue of communications between generations for every citizen propagating the tradition of respecting and loving the elderly.

Elderly social welfare is closely related to civil rights. The practice of social welfare emphasizes the active movements of the government and requires the formulation of scientific and democratic policies, the participation of independent and mature organizations, and the rights of just and authoritative judgment. The trend of expanding social protection to secure social rights of every person with national promotion is a typical characteristic of social policy development in a welfare country. Improving elderly social welfare is an active movement of a responsible government as well as the respect and protection for the pioneers of social development and advance. Consequently, the research results are expected to be the reference of the government planning budgets so that the budget plan is reasonably allocated, rather than the public sectors following old systems and council divisions bidding for the budgets.

Literature review

Social welfare

Amado *et al.* (2012) mentioned that the essence of social welfare was still based on living guarantee, in spite of the system being constantly expanded. The increase of national income might be able to reduce absolute poverty but could not prevent from relative poverty. The economic essence of social welfare was to prevent the citizens from such poverty for the national minimum security. Bain & Company (2013) indicated that the economic essence of social welfare was not to secure national living with a standard but to protect the citizens in different levels,

and even to provide the minimum security of relative poverty for the ones with high income. Unless the national income reached the high level, the governmental finance was rich, and the absolute poverty was extinct, social welfare could hardly protect the national high-quality life. Black (2011) mentioned that social welfare should present the minimum security under the economic and social conditions of general countries. An individual pursuing more comfortable life relied on personal efforts; the government did not necessarily and was impossible to offer the security. Morikawa (2014) simply defined social welfare as the minimum security directly or indirectly provided by the government. Nevertheless, some countries included corporate welfare and governmental welfare into the social welfare system to inflate the budget but not to present actual meanings (Schulz, 2010). Chao *et al.* (2011) proposed following welfare resources allocation principles. (1) Attributed Need. The existing systems not satisfying the normative criteria of such demands might be related to the citizens, such as national health insurance in Britain, or to certain groups, like day care for employed mothers. (2) Compensation. The beneficiaries had contribution to the country, such as retired soldiers and social insurance personnel, or the victims suffered from ill social structure, like the ones suffering from ethnic prejudice. (3) Diagnostic Differentiation. The ones were judged by experts for specific demands, like the ones with physical disabilities or emotional disorder. (4) Means-Test. The ones could not purchase the required goods and services because of economic conditions, such as low-income households. Hieda (2012) proposed fiscal welfare and occupation welfare, beyond social welfare. Social welfare contained social welfare, social aids, subsidies for specific groups, and general welfare services. Fiscal welfare indicated the government utilizing the fiscal policies for the income distribution, e.g. an individual could itemize deduction (like donation, medical expenses, loss from natural disasters) when declaring personal income tax. Furthermore, occupation welfare was related to work and was provided by the employers, covering day care and medical services, which are regarded as employee welfare nowadays (Zuidgeest *et al.*, 2011).

Meaning and measurement of performance

Ansah *et al.* (2013) defined organizational performance as the achievement of a “desired end”. In other words, performance referred to the consistency between real output and expected output of an organization; however, how to set “desired end” became an argument among researchers over organization theories.

The theoretical model of performance is generally divided into three models (Bélanger, 2011): (1) *Goal Model*. An organization was assumed a rational system in this model, would formulate feasible approaches according to objective environments and real demands and referring to the capability, and integrated the organizational resources to effectively complete various organizational goals. (2)

System Model. Breland (2010) considered that an organization in the model was regarded as a system, which received resources from external environments, treated and transformed such resources, and output such transformed resources to external environments. Through the “input, transform, and output” process, the organization was capable of acquiring resources and outputting feedback to the environment. In this case, organizational performance depended on the balance between resource input and output in an organization; (3) *Participation-Satisfaction Model.* The satisfaction of the organizational members was emphasized. It considered the success of an organization not relying on the achievement of organizational goals, but the individual performance in the organization. In this model, the survival of an organization depended on individual contribution to the organization that performance was individual satisfaction with the organization and the subjective perception.

Chen *et al.* (2011) pointed out effectiveness as pursuing the achievement of organizational goals, while efficiency focusing on the relationship between input and output and seeking for minimum resource costs. Since organizational resources were restricted, efficiency was emphasized by management levels. Efficiency was regarded as a manager applying certain input to generating more output or using less input to generate certain output. Effectiveness, on the other hand, referred to a manager achieving the organizational goal. The pursuit of efficiency therefore stressed on the use of means, while the pursuit of effectiveness was to measure the ends. As a result, a manager should consider achieving the organizational goals as well as pay attention to the outcomes. Falasca (2011) argued to establish the performance evaluation system, which emphasized that simply presenting the outcomes, without any rewards, would change the entire organization. They indicated that measuring one thing, it would be well done; the success or failure would not be known without measurement; rewards would not be given without knowing what was successful; not rewarding success was like rewarding failure; experiences could not be acquired without knowing what success was; failure could be an example for future; and, the proof of performance could win supports from the public.

Measurement of organizational performance on elderly social welfare

Claes & Loo (2011) stressed on the importance of individual performance in a social welfare organization and measured the performance with long-term and short-term indicators to give considerations to both long-term and short-term objectives. Ippoliti & Falavigna (2012) observed the conflict of performance measurement between internal members of an organization and external people; a Balanced Way was therefore proposed to provide information for managers realizing the performance of an organization on various dimensions. In other words, the performance measurement of a non-profit organization should satisfy the demands of internal and external people.

Efthymios *et al.* (2010) pointed out five primary factors in the operation of social welfare organizations, namely service subject (C), business operation to create value (O), financial and object resources (R), participants (P), and created and provided services (S). The operation and coordination among the five factors presented the good performance of a social welfare organization. It was considered that a social welfare organization should design the strategic performance indicators from the aspects of mission achievement, social acceptance, efficiency, degree of input, satisfaction, balance, and conversion degree.

Referring to the performance measurement system in National Conservancy, Hsieh *et al.* (2012) divided the performance measurement system into Impact, Activity, and Capacity, and designed the questionnaire to interview 30 managers of non-profit organizations; and, the interview results were analyzed for the conclusion and suggestions. It was considered that the performance measurement of some non-profit organizations was not connected with the aims, and other non-profit organizations merely focused on some of the three domains that the performance measurement was biased. Johansson (2010) pointed out the problems derived from ageing population, including more complete planning and security against economic security, more long-term care for prolonging life expectancy and weakening family functions, and group assistance in emotional support. An ounce of prevention is worth of a pound of cure. Merely the provision of diversified welfare services could satisfy distinct demands of the elderly and allow them happily participating in and possess quality and dignified life. Ageing is a part of life; being elder could be a golden or a dark period in the life. It is expected that all seniors could enjoy the results striven in the youth and have a happy elderly life (Willans & Seary, 2011).

Research design

Screening of input and output

To combine the selection of input/output factors with expert opinions, reduce input costs, and avoid fuzziness in the interview process, Modified Delphi Method is utilized for screening the input/output factors. For the special consideration, brainstorming open-ended questionnaire is omitted; and, the structural questionnaire is directly developed, after referring to large amount of literatures, for the first run of questionnaire survey. With Modified Delphi Method, the structural questionnaire is directly used for the first run survey in order to reduce time and have the experts focus on the research subject, without guessing open-end questions. Total 30 copies of questionnaires are distributed, and 22 copies are effectively responded, with the response rate 73%. The variable data used in this study are the open statistical data from Ministry of Interior.

The variables are defined as below:

- Input variable: (1) Multi-service center for the elderly. The number of welfare centers for senior citizens set up by departments of social welfare; (2) Number of social welfare personnel, including administrators, social workers, and professionals; (3) Budget for elderly social welfare. invested budget for practicing elderly social welfare.
- Output variable: (1) Budget implementation efficiency. Efficiency in the practice with invested budget; (2) Person-time of social welfare activities. Planning to give senior subsidies and the number of beneficiaries of elderly honored activities.

Efficiency evaluation and analysis

From the view of economics, the less input but the more output of a unit presents the better Performance. To measure such performance, Efficiency could be used as the evaluation standard. From the comparison between input and output, efficiency could be defined as $\text{efficiency} = \frac{\text{sum of weighted output}}{\text{sum of weighted input}}$. The maximum output function received with different input mix is called Product Function. When the maximum output received from general input is less than the production of product function, the product function is the maximal frontier of production, also called Production Frontier. Geometrically, the principle of envelope is utilized for reflecting inputs and outputs of all evaluated DMUs to a space so as to evaluate the relative efficiency of an organization and search for the efficiency envelope which could envelope all observation data to form the efficiency frontier. The distance between the observation value of an individual DMU and the efficiency envelope could be used for calculating the relative efficiency.

Data Envelopment Analysis (DEA) is utilized for evaluating efficiency in this study. Different from traditional regression analysis, which seeks for an average path from a series of data, various samples are enveloped to find out the relationship that it presents advantages of a favorable efficiency evaluation model. Such a method applies linear planning, considers the factors in performance measurement among various DMUs, and compares the performance of DMUs with similar characteristics.

Farrell first replaced the common Default Function with Non-default Production Function to estimate the efficiency in 1957 and applied mathematical planning to calculate the production efficiency frontier, i.e. efficiency production function. Two elements of efficiency were proposed: (1) Technical efficiency (TE) responded the maximum output with fixed input.; (2) Allocative efficiency (AE) or price efficiency (PE) responded the optimal proportion of input under the concerned input. In this case, Farrell first divided overall efficiency into technical

efficiency related to real input/output and allocative efficiency related to the optimal elements, under the assumption of constant return to scale and constant input price; and, the product of the two was the total economic efficiency. The following assumptions were used by Farrell: (1). The production frontier consisted of the most efficient DMUs, and insufficient DMUs appeared under the frontier (i.e. right back of the frontier); (2) The production frontier was a convex point and the slope was negative. 3. Constant return to scale appeared between outputs and inputs.

Empirical analysis of elderly social welfare performance

Analysis of elderly social welfare performance

According to the input/output indicators in this study, the total production efficiency and the pure technical efficiency of elderly social welfare practiced in various counties and cities were calculated with CCR and BCC models; and, the return to scale was acquired by dividing the two. Total production efficiency, pure technical efficiency, scale efficiency, and return to scale are organized in Table 1.

Table 1. Relative efficiency of elderly social welfare

Country/city public sector	Total efficiency	Technical efficiency	Scale efficiency
Taipei City	0.83	0.87	0.80
New Taipei City	1.00	1.00	1.00
Taichung City	0.98	0.97	0.95
Tainan City	1.00	1.00	1.00
Kaohsiung City	1.00	1.00	1.00
Keelung City	0.86	0.86	0.86
Hsinchu City	0.70	0.72	0.70
Jiayi City	0.88	0.89	0.86
Taoyuan City	0.94	0.95	0.93
Hsinchu County	0.74	0.73	0.74
Miaoli County	0.62	0.64	0.60
Changhua County	0.90	0.91	0.90
Nantou County	0.77	0.78	0.76
Yunlin County	0.72	0.71	0.73
Jiayi County	0.69	0.67	0.70
Pingtung County	0.85	0.86	0.83
Yilan County	0.83	0.85	0.80
Hualien County	0.76	0.77	0.75
Taitung County	0.80	0.82	0.79
Penghu County	0.67	0.68	0.66

From Table 1, New Taipei City, Tainan City, and Kaohsiung City were relatively efficient with the total efficiency $\hat{1}$, while the rest counties and cities presented low total production efficiency; especially, Miaoli County, with the lowest total efficiency, was relatively the most insufficient county. In other words, 17 DMUs were relatively inefficient, except the ones with the total production efficiency $\hat{1}$. The factor in inefficiency might be not effectively applying inputs or not achieving the optimal scale of production. It required further analyses.

Sensitivity Analysis

The risk evaluation in this study aimed to analyze and find out the key factors in the practice of elderly social welfare with Sensitivity Analysis. The input and output variables were removed one by one for DEA in order to understand the efficiency sensitivity. The research results revealed the change of sensitivity as the evaluation criteria, including susceptibility factor multi-service center for the elderly, number of social welfare personnel, budget for elderly social welfare, budget implementation efficiency, and person-time of social welfare activities. From Table 2,

- (1) The efficiency of all DMUs, except Taipei City, Miaoli County, and Penghu County, decreased after removing Multi-service Center for the Elderly. In other words, multi-service centers for the elderly presented higher importance for all DMUs, while the efficiency of Taipei City, Miaoli County, and Penghu County increased after the removal because of worse efficiency of elderly service centers.
- (2) The efficiency of all DMUs, except Taipei City, decreased after removing Number of Social Welfare Personnel. In other words, social welfare appeared higher importance for all DMUs, while the efficiency of Taipei City increased after the removal because of insufficient social welfare workers.
- (3) The efficiency of all DMUs decreased after removing Budget for Elderly Social Welfare, presenting the higher importance of education sectors for all DMUs.
- (4) The efficiency of all DMUs decreased after removing Budget Implementation Efficiency, revealing the higher importance of environmental load for all DMUs.
- (5) The efficiency of all DMUs decreased after removing Person-time of Social Welfare Activities, showing the higher importance of economic efficiency for all DMUs.

Table 2. Sensitivity Analysis of single input and output being removed one by one

DMU	Original relative efficiency	Remove multi-service center for the elderly	Remove number of social welfare personnel	Remove budget for elderly social welfare	Remove budget implementation efficiency	Remove person-time of social welfare activities
Taipei City	0.83	0.96	0.92	0.81	0.80	0.81
New Taipei City	1.00	0.91	0.97	0.92	0.93	0.97
Taichung City	0.98	0.93	0.90	0.95	0.91	0.96
Tainan City	1.00	0.93	1.00	0.93	0.94	0.98
Kaohsiung City	1.00	1.00	1.00	0.90	0.95	0.92
Keelung City	0.86	0.83	0.81	0.84	0.80	0.81
Hsinchu City	0.70	0.65	0.63	0.61	0.67	0.62
Jiayi City	0.88	0.82	0.84	0.80	0.83	0.81
Taoyuan City	0.94	0.91	0.88	0.89	0.90	0.92
Hsinchu County	0.74	0.70	0.68	0.65	0.68	0.71
Miaoli County	0.62	0.65	0.60	0.58	0.51	0.53
Changhua County	0.90	0.81	0.83	0.85	0.87	0.88
Nantou County	0.77	0.73	0.71	0.75	0.70	0.74
Yunlin County	0.72	0.64	0.70	0.63	0.68	0.66
Jiayi County	0.69	0.62	0.61	0.67	0.65	0.60
Pingtung County	0.85	0.83	0.80	0.76	0.79	0.80
Yilan County	0.83	0.81	0.79	0.71	0.76	0.72
Hualien County	0.76	0.73	0.69	0.72	0.64	0.62
Taitung County	0.80	0.76	0.74	0.71	0.70	0.77
Penghu County	0.67	0.69	0.61	0.62	0.61	0.60
Number of efficient DMU	3	1	2	0	0	0

Data source: Self-organized in this study

Conclusion

According to the efficiency and variable information acquired from DEA, 3 DMUs present strong-form efficiency in the practice of elderly social welfare (efficiency=1), about 15% of all DMUs, revealing the favorable efficiency; another 3 DMUs show marginal inefficiency in the practice of elderly social welfare ($0.9 < \text{efficiency} < 1$), about 15% of all DMUs, presenting that the efficiency can be more easily enhanced; and, 14 DMUs appear distinctly inefficient on the local sustainability efficiency (< 0.9), about 70% of all DMUs, in which Miaoli County presented the lowest local sustainability efficiency. Based on the DEA results, the service contents and amount offered by departments of social welfare show the highest budget scale allocation on elderly social welfare, while the total budget scale is not reduced with decreasing budget in the inflation. In this case, the budget scale for other policies would be reduced because of increasing social welfare budget. The ageing problem is getting serious in Taiwan that the total budget would appear negative growth, i.e. the total budget would not be able to increase the quota for social welfare. As a result, the overall social welfare budget policy should be re-evaluated.

Suggestions

By introducing clusters in this study, the following suggestions are proposed.

- (1) Performance as the consideration of resource allocation. The governmental administration should base on the maximum welfare of the citizens. Under resource restrictions, allocation becomes a primary problem. The financial conditions in Taiwan are worse than it in the past that every penny needs to be carefully considered to make the maximum benefit. Based on the research results, it is suggested that the practice efficiency is regarded as the reference of resource allocation. New Taipei City, Tainan City, and Kaohsiung City, with favorable practice efficiency, are offered more budgets to create higher efficiency. The ones with worse efficiency, like Miaoli County, are reduced the budget allocation to cut down insufficient expenses. The budget allocation quota should be adjusted annually till the efficiency standards of various counties and cities are about the same. Budget allocation could be the optimal allocation for maximizing the practice efficiency.
- (2) Establishment of database with various complete social welfare results for evaluation. Register statistics aims to collect administrative data. It is suggested that departments of social welfare should divide the register statistics in detail, according to the demands, for convenient comparison and reference of appropriate and real-time information for decision-makers.

(3) The idea of group living of the elder is different from it in the previous generation. They reveal stronger demands for welfare projects of culture, sports, and health and spiritual and cultural products. Such changes in social consumption structure facilitate the adjustment of markets and product structure and the development of relevant industries. The government simply improves the management contents and method in some traditional field, but not taking certain common preference for policy supply into account that the social welfare output would be largely reduced. Based on understanding the current situations of social welfare, elderly rights, and elderly social welfare, the improvement path to develop regular social welfare needs to be selected and the social welfare improvement measure needs to be implemented so that the elderly could acquire better security in the social welfare and harmonious development.

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