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Sectoral Efficiency Measurement: An Application with Input-Output Table and Data Envelopment Analysis

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Extensive Summary

Input - Output analysis is a general equilibrium model that examines the interdependence between the economic structure of the constituent units of production and consumption in terms of multi-sectors and numerically. This modelling is based on the input-output tables showing the flows of cross-sector goods and services. In this study, taking into account of the sectors in input - output tables, key sectors determined according to Hirschman classification in the input-output analysis were obtained. Efficient sectors and key sectors were compared and whether the key sectors are efficient or not have been examined. On the other hand, potential improvements to make the key sectors efficient were investigated and policy recommendations have been put forward to make them efficient.

Two main methods have been employed in this study, which are input-output analysis for key sectors and DES (Data Envelopment Analysis) to determine the efficiency level. Input-Output model, in simplest terms a general equilibrium model that examines the interdependence between the economic structure of the constituent units of production and consumption in terms of multi-sectors and quantitative manner and the mathematical structure is a simple general equilibrium model. Total linkage effects are obtained through the $R = (I - A)^{-1}$ equation, with the inverse matrix of Leontief i^{th} row and j^{th} column with r_{ij} values. Since forward and backward linkage effects cover both direct and indirect effects, they are a comprehensive indicator of an industrial interdependence. In order for total forward and backward linkages to be compared, they have to be put in numeric values through index process. After calculating the index values for all the sectors with a value less than 1 could be classified as high and low with backward and forward linkages. Sectoral linkages effect is an indication of how important a sector is in the economic structure. A forward linkage effect shows how important the output of a sector an intermediate input and backward linkage effect is the

Data Envelopment Analysis is commonly employed to measure efficiency and productivity. It was first developed by Charnes, Cooper and Rhodes (1978) to measure the comparative efficiency of similar decision making units in terms of goods and services. Besides, inputs and outputs are independent of units of measurement. Hence, it is possible to measure the different aspects of an establishment. (Karsak and İşcan, 2000, s.2 - 3). DEA determines the efficient decision making units but it is not possible to ranks the efficiency degrees of the units under consideration. To serve this purpose, Andersen and Petersen (1993), stated that efficient decision making units could be ranked within their own. This approach is called Super Efficiency Model in the literature of DEA.

The data sources used in the study are latest the input – output tables with 59 sectors of domestic in 2002 and import tables prepared by TURKSTAT. The sectors were examined with DEA through such variables as labour, capital, sectoral intermediate aggregate inputs, complementary import for input variables and sectoral interim aggregates and sectoral total demand.

The striking point obtained in this study is not all the key sectors, the stimulating and feeding in terms of economic development, are efficient. According to the results of Input –Output analysis, of the key sectors, only Food Products and Beverage Production (15) and Operation of Travel Agencies (63) are more efficient according to the result of DEA. It is highly important that efficient sectors should be assessed within themselves with reference to super efficiency model. On the other hand, potential improvements have also been calculated for the inefficient key sectors as a part of DEA. In order for textile products sector to be efficient, the input level without changing the output level should be increased with reference to sectors of coal and refined oil production (23) by 0,55%, motor vehicle production (34) by 0,4%, reappraisal (37) by 178,45%, airline transport (62) by 3,92%, and not elsewhere classified affiliated establishments (91) by 0,22%. The inefficiency of the sector results from the excessive number of input and output variables. In this case, in the event that the sector decreases the amounts of labour, capital, intermediate input and import input by 3,95%, 4,1%, 4,08 % and 4,14 %, respectively, as well as the intermediate demand output by 0,03%, the sector will turn into efficient mode.

The results of the Input-Output analysis suggest that food products and beverage production (15), textile production (17), paper and derivatives production (21), chemical substances and products (24) plastic and rubber products (25), non-metal other mineral products (26), metal industry (27), except for machinery and equipment; metal ware industry(28), electricity, gas, steam and hot water production and distribution, (40) and supporting and secondary transport operations (63) have been defined as key sectors. The important point here is that in terms of stimulation and feeding effects, the sectors that will revitalize the economy are not efficient. It is seen that the efficient sectors obtained through DEA analysis and key sectors obtained through Input-Output analysis. According to the result of Input-Output analysis only Food Products and Beverage Production (15) and Operation of Travel Agencies (63) are more efficient according to the result of DEA. According to the results of super efficiency model, among the efficient sectors, the top five are auxiliary operation to financial intermediate establishment (67), not elsewhere classified affiliated establishments (91), forestry, logging and related services (2), coal and refined oil production (23) and reappraisal sector (37) in the order.