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Measuring Value Added Vertical Integration Index of Economic Sectors in Tehran City

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Abstract
In this paper, we show that the output of economic sectors is not an appropriate criterion for assessing the importance of sectors. First, in the context of Leontief quantity model, each sector has two tasks: satisfying its direct and indirect final demand and satisfying the intermediate needs of other economic sectors. Many researchers have observed that the sum of these leads to double counting. Second, the output of sectors is not an appropriate criterion for economic growth and welfare. To address these shortcomings, "product-to-product" approach was used, rooted in the theoretical basis of Serrafa's production system. Pasinetti modified it as a vertical integration of production in the form of Leontief's input-output model as an alternative method for assessing the importance of sectors. In this study, we used this approach to answer the following question, "The service sector, , how much potentially does the service sector, which accounts for a 83% share of the GDP in the city of Tehran, generate indirect value added in other economic sectors"? The input-output table of Tehran city, which has recently been calculated as a research plan, was used for quantitative analysis of the posed question. The overall findings indicated that, first, the vertical integration index of service sector is only 0.04 units, which means that it generates only 4 units of indirect value added in the other economic sectors. Second, the vertical integration indices of four sectors of distribution services, productive services, social services and personal services are 0.08, 0.08, 0.46 and 0.40, respectively, that is, all of them are lower than 1 unit.

Keywords: Vertical Integration Index, Indirect Value Added, Product-to-Product Approach

JEL Classification: C67, R11, R58, P25

1. Introduction and Purpose of the Study
Identifying key sectors plays a key role in determining the economic growth of countries. So, institutions in Iran have always sought to identify and prioritize sectors. For instance, Ministry of Industry, Mines and Commerce, using macroeconomic indicators such as employment share, value added share and

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export share of economic sectors, the Parliament Research Center of Iran using the updated input-output table of 1390 based on traditional methods, characteristic root method and hypothetical extraction method, and the Budget Planning Organization by using the updated input-output table of 1390 and the Leontief production demand driven method, have identified key sectors of Iran. The results show that in the reports of the Ministry of Industry, Mines and Commerce and the Budget and Planning Organization of Iran, heavy industries have been identified as key sectors. Also in the report of the Parliament Research Center of Iran some sub-sectors of agriculture and services have been identified as key sectors. In all of these reports, identifying the key sectors is based on the **output criterion**. However, output is not a suitable criterion for identifying key sectors for two reasons. First, each economic sector has two tasks: satisfying its final demand directly and indirectly and also providing intermediate requirements of other economic sectors. This would lead to double counting. The second reason is that output is not suitable criterion for showing the growth and prosperity of a society while value-added is a more appropriate criterion. Value-added is classified into two categories: a) value-added which is directly generated by economic sectors; b) value-added which is indirectly generated by one sector in connection with other economic sectors. For solving these problems, researchers consider three approaches: 1- The production-to-production approach in the form of vertical integration, two- net linkages approach, and the three-process disruption of production process approach. This paper analyzes the economic sectors of Tehran using the vertical integration of value-added approach and updated input-output table of 1393 of Tehran based on the following question:" how much indirect value-added has been generated by services sector in other economic sectors?"

2. Method

The identification of key sectors in the economy has been based on traditional and modern methods. Traditional methods are based on measuring backward and forward linkages through the technical coefficients matrix or the Leontief inverse matrix whereas modern methods are based on hypothetical extraction of intermediate transactions in input-output table.

2-1. Traditional method

Chenery and Watanabe (1958) measured the backward and forward linkages through the technical coefficient matrix while Rasmosen (1956) measured the backward and forward linkages through Leontief inverse matrix. In both methods, the column sum shows backward linkage and the row sum indicates forward linkage. Traditional methods have two shortcomings. One shortcoming is that in these methods identifying key sectors is just based on intermediate transaction matrix. The second drawback is the calculation of the forward linkage based on Leontief demand-driven model, which has no theoretical foundation. Modern methods solve these two problems.

Volume 9, Number 33, Spring 2020

2-2. Modern method

Strassert (1968) used complete hypothetical extraction method by extracting the complete row and column of a sector for identifying key sectors. Then, Cella (1984) stated that complete extraction of one sector in economy is not logical. So in Cella's method only inter-sectorial linkages were extracted and other linkages were retained. Both Strassert and Cella methods are based on Leontief demand-driven model. In order to solve this problem, Dietzenbacher and Van Der Linden (1997) calculated the backward linkage through Leontief demand-driven through extracting complete intermediate inputs of each sector and forward linkage through Ghosh supply-driven Model. Both traditional and modern methods are based on output criterion. As mentioned above, output is not a suitable criterion for identifying the key sectors. Therefore, researchers suggested Srrafa's production-to-production approach.

For this purpose, the economy is partitioned into two agricultural and non-agricultural blocks. The Leontief production balancing equation for the two blocks is expressed as follows:

$$\begin{bmatrix} x_a^R \\ x_o^R \end{bmatrix} - \begin{bmatrix} A_{aa}^R & A_{ao}^R \\ A_{oa}^R & A_{oo}^R \end{bmatrix} \begin{bmatrix} x_a^R \\ x_o^R \end{bmatrix} = \begin{bmatrix} f_a^R \\ f_o^R \end{bmatrix}$$

x_a^R ، x_o^R ، f_a^R and f_o^R are gross production and final demand of two agricultural and non-agricultural blocks, respectively. Also A_{aa}^R and A_{oo}^R denote intra-blocks direct coefficient matrix and A_{ao}^R and A_{oa}^R show the inter-blocks direct coefficient matrix. Assuming that the gross production is only for satisfying the direct and indirect needs of their production, the production-to-production approach of two agricultural and non-agricultural blocks is as follows:

$$x_a^R = (I - A_{aa}^R)^{-1} A_{ao}^R x_o^R$$
$$x_o^R = (I - A_{oo}^R)^{-1} A_{oa}^R x_a^R$$

The direct and indirect value added generated by each block is shown below:

$$\overline{VA_{oa}}^R = \overline{va}^R (I - A_{oo}{}^R)^{-1} A_{oa}^R x_a^R$$
$$\overline{VA_{ao}}^R = \overline{va}^R (I - A_{aa}{}^R)^{-1} A_{ao}^R x_o^R$$

The vertical integration of value-added index used in this paper is calculated as follows:

$$V\,\mathrm{int}_a^R = \frac{\overline{VA_{oa}}^R}{VA_a}$$

Volume 9, Number 33, Spring 2020

$$V\operatorname{int}_o^R = \frac{\overline{VA_{ao}}^R}{VA_o}$$

$V\operatorname{int}_a^R$ indicates how much the share of indirect value-added is generated in non-agricultural block per unit of value-added in the agricultural block. If the index is greater than 1, it means that the indirect value-added is more than direct value-added generated by the sector and vice versa. Therefore the sectors that have vertical integration of value-added index greater than 1 are more important than other sectors.

3. Results and Discussion

The results of calculation of the vertical integration of value-added index are based on two types of aggregated input-output table of 1393 of Tehran. First, the results are presented in six sectors: agriculture, mining, industries, water, gas and electricity, constructions and services. Second, due to the importance of services sector in Tehran's economy, services sector is classified into four categories: distribution services, production services, social services and personal services. About 83% of value-added in Tehran is generated by services sector and 17% by other sectors. The results of final demand- to- value- added approach show that 73% of total direct and indirect value-added is generated by services sector and 13% is generated by constructions sector. Among the four categories of services sector, production services, distribution services and social and personal services generated 35.3%, 18.1% and 19.5% of total direct and indirect value-added of the services sector, respectively. There is a third problem In addition to two problems of final demand-to- production approach. If the final demand for some sectors is negative or zero, the direct and indirect value added of those sectors will be negative or zero (such as agriculture). So production-to-production approach solves this problem. The results of this approach indicate that direct and indirect value-added generated by industries, construction and services are47.5%, 35.9% and 13.7%, respectively. Also direct and indirect value-added generated by distribution services, production services, social services and personal services are, respectively, 7.9%, 9.7%, 15.9% , 5.4% of total direct and indirect value-added of services sector. With respect to the above figures, vertical integration of value-added index for industries and construction are 1.33 and 1.19, respectively. Which means that for each unit of direct value-added for the sector, indirect value-added generated is more than unit. Also this index for distribution services, production services, social services and personal services was 0.08, 0.08, 0.46 and 0.40, respectively. The overall findings reveal that the lower the value-added share, the greater the vertical integration of value-added index.

Volume 9, Number 33, Spring 2020

4. Conclusion

A necessary and sufficient condition in management and policy making of urban economy is to measure the direct and indirect value-added generated by each economic sectors in Tehran. The results of vertical integration of value-added index indicate that despite 83% share of services sector to total value-added, vertical integration of value-added index of this sector is lower than 1 and equal to 0.04, which means that for each unit of direct value-added for the sector, indirect value-added generated is less than unit. This index for distribution services, production services, social services and personal services is 0.08, 0.08, 0.46 and 0. 40, respectively. However, this index respectively is 1.33 and 1.19 for industries and constructions. It means that industries and constructions sectors for each 100 T direct generated value-added, generate 133 and 119 T indirect value-added in Tehran's economy, respectively. According to the above results, development of social and personal services would generate more indirect value-added than the distribution and production services in Tehran. Additionnaly, generally industry and constructions sectors generate more value added than the services sector in Tehran and can be considered as one of the revenue sources of development management of urban economy.

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