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Measuring Potential Value-Added Tax Capacity in Iran Using Multiregional Input-Output Model

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Abstract

The main aim of the present paper is to measure the potential value-added tax (VAT) capacity in Iran using the multiregional input-output model (MIOM) to answer the following question: "how much indirect value added tax is potentially generated in one region in order to satisfy the production of other regions?" Applying the Leontief's final demand-to-output is not suitable and therefore, Pasinetti's parsimonious production-to-production approach is utilized. For this purpose, we have used a MIOM covering 9 regions for the year 2016. Based on the existing conventional regional theory, we expect that larger regions have tendency to contribute more value-added on other regions. Surprisingly, the overall results confirm the prevailing theory as follows: for example, region 6 (the largest region) generates 5.3% of the total value added of region 1, whereas region 7 (the smallest region) is responsible for 1.7% of total value added of region 1. Similar results have been found on the impact of regions 6 and 7 on the added value of other regions. In addition, based on the logic of VAT system, it is expected that a larger region has a higher impact on VAT capacity in other regions. The overall findings relatively confirm the theoretical prediction as follows: the impact of region 6 on VAT capacity of other regions is 4-12 times more than the impact of the smallest region on the potential VAT capacity of other regions.

Highlights

- The potential VAT capacity can be measured using multiregional input-output model.
- Larger regions have tendency to generate more value added on other regions.
- Larger regions have a higher impact on VAT capacity in other regions that confirm theoretical predictions.

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1. Introduction

VAT is a type of consumption tax gradually received by various firms in different stages of import, production, distribution and consumption chain and is then transferred from one firm to another until finally transmitted to consumers. VAT is simply calculated by deducting the purchase tax (referred to as the purchase tax credit) from the sales tax, which is used in the form of VAT system in most countries. In this system, for instance, a taxpayer (or a firm) is required to receive tax on the supply of goods or services when selling them to the buyer, and after deducting the purchase tax on its input, he must settle the remaining tax into the predetermined accounts of the tax organization (Ebrill et al., 2001; Mohajeri & Sobhanian, 2017).

From a spatial point of view, taxpayers or firms that act as a tax auditor in the VAT system are not concentrated in one region (or province) and are sporadically active; meaning thereby, that firms have to purchase a part of intermediate inputs from firms located outside the region. For example, Iran Khodro factory, located in Tehran province, is one of the most important taxpayers. It needs to buy equipment such as pistons, connecting rods, cylinders, alternators, plugs and so on for producing cars, some of which are produced in Tehran and some are imported from other regions. Iran Khodro is required to pay the seller "purchase tax" when buying each part. If the manufacture of that piece is located in Tehran, the tax will be collected by the tax office located in Tehran, but if the seller is located outside Tehran province, the tax will be collected by the tax office of that province. Therefore, the added value, which is generated in each sector located in one region, is not only bound to other economic sectors of the same region, but also for economic sectors located in other regions; this plays an important role in enhancing the VAT capacity of different provinces. The above observations suggest that in order to quantify VAT capacity in a spatial setting, one needs comprehensive and consistent data to pinpoint interdependence at regional level. For this purpose, a multiregional input-output table (MIOT) covering all Iran's provinces in the form of 9 regions for the year 2016 is introduced.

This issue raises the following question: how much indirect value added is potentially generated in one region for satisfying the production of other regions? From the analytical point of view, this question can be considered as a kind of spillover effect captured in MIOM. In this article, we show that the Leontief's final demand-to-production model for different reasons fails to answer the above question quantitatively.

Therefore, we suggest "production-to-production method" which roots in Sraffa theory of production and distribution. Pasinetti has combined Sraffa's method with Leontief's approach and then introduced an alternative method known as "vertical integration of production". Based on this method, one can derive "production-to-production" approach within Leontief's setting. Applying this approach in a MIOM determines how much each sector located in one region at hand should directly or indirectly produce to satisfy the production of other sectors located in the same region. As in MIOM setting, regions through imports and exports are interconnected; satisfying the production in a region has repercussions on the production of other regions. Taking into account the production chain and measuring VAT capacity in a MIOM are the main objectives of this paper.

For this purpose, the contents of this article are organized into 4 sections. The theoretical frameworks followed by the review of literature are presented in the first section. The second section deals with the methodology of calculating the tax capacity generated by each region for other regions followed by the related statistical bases. The third section presents the results and their analyses. The summary and the main findings are highlighted in the last section.

2. Theoretical Framework and Literature Review

2.1 Theoretical Framework

Since the purpose of this paper is to quantitatively examine the effect of one region's production directly or indirectly on the value added generated in other regions for assessing the VAT capacity, the starting point is to expand the production-to-production approach. Theoretically, this approach is different from conventional approaches such as final demand-to-production and value added-to-price in Leontief's setting. The former demonstrates the direct and indirect effects of final demand on output (production), whereas the dual part of the latter describes the direct and indirect effects of value added on prices. In the same vein, the dual part of production-to-production approach is considered to be a price-to-price approach which means the direct and indirect effects of exogenous change influence the price of one sector on the changes in prices of other sectors (Miller & Blair, 2009).

The production-to-production approach is conceptually rooted in the Sraffa's theoretical framework appeared in a book entitled "Production of Commodities by Means of Commodities" in 1960. Sraffa initially illustrated an economic system merely capable of producing output as much as its own reproduction. In fact, each economic sector in its production process should use the intermediate goods and services. The sum of intermediary needs of economic sectors is exactly the amount of output that is produced in the economy. Therefore, at the end of one year, the assets of the economy would not increase because consumption is equal to the amount of production.

Sraffa expanded this economic system and assumed that output generated in the economy was greater than the amount needed to reproduce the economic cycle. Thus, the surplus of production is divided among the owners of labor force (who receive wages) and the owner of the capital (who receive profit). Hence, the surplus of production is distributed among the production factors based on relative prices. Given these explanations, Sraffa's economic system emphasizes the production and distribution of production surplus (which is the value added). Pasinetti has formulated this concept in the form of a vertical integration within the framework of Leontief's approach (Pasinetti, 1973, 1986), as given blow:

$x = (I - A)^{-1} f$ is the Leontief's quantity model which shows the direct and indirect needs to satisfy the final demand of all sectors. Pasinetti introduces the vertical integration of production as follows: $\bar{x} = (I - A)^{-1} \hat{f}$, where, $\hat{f}$ and $\bar{x}$ are respectively diagonal matrix of final consumption and matrix of direct and indirect production. $\bar{x}$ has two interpretations; first, sum of rows ($\bar{x}e$) gives exactly the Leontief's production equation and second, sum of columns ($e\bar{x}$) provides the vertical integration of each sector in Pasinetti's setting, suggesting that direct and indirect requirements of each sector output to satisfy its final demand. The vertical integration is taken as a starting point for measuring the VAT capacity. This issue is elaborated in the methodology section.

2.2 Review of Literature

The literature related to the present paper can be classified into 3 categories. One- research on calculating MIOT, two- research related to estimating the value-added integration, three- studies focusing on estimating the potential revenue capacity of VAT.

In the first category, there is much research calculating MIOT by means of various methods such as "non-survey methods", "hybrid methods", and "ready-made of short-cut techniques". Many articles fall into this category including Tarahhomi, et. al. (2020), Banouei, et, al. (2019) and Dashtbani, et. al. (2018) who calculated MIOT of three regions (in 2011), nine regions (in 2011) and seven regions (in 2001) for Iran respectively, as well as Wu and Liu (2016) who estimated MIOT for 30 provinces of China, Yamada (2015) who constructed MIOT for Nagoya metropolitan area and Boero, et. al. (2018), who focused on calculating MIOT for 50 Provinces of the USA.

In the second area, a review of the research indicates that in some studies, value-added integration indices have been calculated using national and interregional input-output tables. For instance, Dietzenbacher et. al. (1993) proposed a method for quantifying interregional interactions based on MIOM. The methodology of this paper is a generalized type of Strassert hypothetical extraction method used for the European countries during 1970 and 1980. Heimler (1991) measured the importance of China's economic sectors using production-to-production approach. In this study, he used value added rather than output criterion to measure value added created directly and indirectly for other sectors. Vaghef (2017) identified the sectors that create the highest value added for the Iranian economy using national input-output table. Mohajeri, et. al. (2020) applied the product-to-product approach for measuring the value-added vertical integration index of economic sectors in the province of Tehran.

In the third category of studies using input-output table to determine the capacity of VAT, much research can be mentioned. For example, Hutton (2017) introduced a method for calculating the policy gap and compliance gap in the VAT system using input-output table. Novysedlak and Palkovicova (2012) computed the VAT gap using two methods; the input-output tables for years 2000 to 2007, and GDP methods for years 2000-2010. In addition, Aguirre and Parthasarathi (1988) computed the VAT base in 1983 and 1988 using 504 commodity-by-commodity input-output tables of Mexico. In Iran, several researchers have focused on estimating the capacity of VAT (or Indirect Tax) such as Ghiasvand and Movagharisadat Mahalle (2011), Bovard and Nekoamal Kermani (2017), Khaleghi Rekhne et. al. (2012), Mohajeri and Sobhanian (2017), Mohajeri (2018), Mirjalili, et.al. (2019) in the last four articles. VAT capacity is estimated using input-output table.

It should be noted that only one article in this subject was written by Mohajeri (2017) using MIOT including Tehran-Alborz and other regions for 2014. There are two innovations in this paper compared to the aforementioned article. First, a MIOT in the form of 9 regions for 2016 has been calculated for the first time. Second, the interactive effects of 9 regions on added value and VAT capacity are estimated to provide a more accurate picture of the role of each region in generating added value and VAT capacity for other regions.

3. Methodology and Data Base

We have observed in the previous section, that the vertical integration method can be taken as a starting point to arrive at production-to-production approach.

3.1 Production-to-Production Approach for Measuring Value-Added Integration in a MIOM

The gross product of each region consists of two parts: intermediate demand and final demand. To measure the direct and indirect needs of production and to meet the intermediate and final demands, one requires partitioning the production system into two parts following Heimler (1991). For this purpose, the Leontief production system for nine regions is expressed as follows:

$$\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_8 \\ x_9 \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{18} & A_{19} \\ A_{21} & A_{22} & \cdots & A_{28} & A_{29} \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ A_{81} & A_{82} & \cdots & A_{88} & A_{89} \\ A_{91} & A_{92} & \cdots & A_{98} & A_{99} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_8 \\ x_9 \end{bmatrix} + \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_8 \\ f_9 \end{bmatrix} \tag{1}$$

In the above equation, $x_1, \dots x_9$ and $f_1, \dots, f_1$respectively represent the gross product and final demand vectors in nine regions. Diagonal sub-matrices $A_{11}, \dots, A_{99}$ are intraregional trade coefficients of the nine regions, respectively, and the remaining off-diagonal sub-matrices reflect interregional trade coefficients of the nine regions.

Based on equation (1), the balanced production relation for each region can be derived as follows:

$$x_i = \sum_{k=1}^{9} A_{ik} x_k + f_i \quad , \quad i = 1, 2, \dots, 8, 9 \tag{2}$$

$$x_i = \sum_{k=1, k \neq i}^{9} (I - A_{ii})^{-1} A_{ik} x_k + (I - A_{ii})^{-1} f_i \quad , \quad i = 1, 2, \dots, 8, 9 \tag{3}$$

In equations (2) and (3), "i" reflects the supplying region and "j" represents the purchasing region. The right-hand side of the equation (3) consists of nine components:

- The first eight components represent production-to-production approach. For example $x_i = \sum_{k=1,k\neq i}^{9}(I - A_{ii})^{-1}A_{ik}x_k$ in equation (3) states that how much region i (x_i) should produce directly and indirectly to meet the needs of production in remaining 8 regions.

- The ninth component ($(I - A_{ii})^{-1}f_i$) reflects the amount of production for meeting the final demand of region "i".

Now, in order to avoid double counting, it is assumed that the gross domestic output of nine regions is only to satisfy the direct and indirect needs of each region assuming that$f_1 = f_i = \cdots = f_9 = 0$. Then, the following new equations relating to production-to-production approach for the nine regions can be derived:

$$x_i = \sum_{k=1,k\neq i}^{9}(I - A_{ii})^{-1}A_{ik}x_k \quad , \quad i = 1, 2, \ldots, 8, 9 \tag{4}$$

Equation (4) specifies how much directly and indirectly region "i" should produce to meet the production needs of each of other eight regions.

To measure the direct and indirect value added, that is generated in nine regions, two further steps have to be taken. First is to estimate the direct value added coefficients: $va = VA[x]^{-1} \Rightarrow VA = va.x$, for nine regions as follows:

$$va_i = VA_i[x_i]^{-1} \ \rightarrow VA_i = va_i x_i \quad , \ i = 1, 2, \ldots, 8, 9 \tag{5}$$

Second, substituting the equation (4) with equation (5) and using vertical integration approach, we can get nine matrices of direct and indirect value added generated for the nine concerned regions as follows:

$$\overline{VA}_i = \sum_{k=1,k\neq i}^{9} VA_{ik} = \sum_{k=1,k\neq i}^{9} \widehat{va}_i (I - A_{ii})^{-1} A_{ik}\hat{x}_k \quad , \ i = 1, 2, \ldots, 8, 9 \tag{6}$$

Each equation has eight components. For example, for i=1 in equation (6), the first component ($VA_{12} = \widehat{va}_1 (I - A_{11})^{-1}A_{12}\hat{x}_2$) states that how much region 1 should produce directly and indirectly to meet the production of region 2. This production in region 1, due to production in region 2 in turn, can stimulate as to how much value added is generated in region 1. The second component ($VA_{13} = \widehat{va}_1 (I - A_{11})^{-1}A_{13}\hat{x}_3$) demonstrates the direct and indirect value added generated in region 1 duo to the requirement of production of region 3. In the same way, six other components can be interpreted. Sum of the eight components provides us with value-added matrix of region 1 ($\overline{VA}_1$). A similar explanation can be provided for other 8 regions.

Each of the eight matrices in equation (6) for nine regions (that is 72 sub-matrices) has two distinct interpretations. One is output side known as horizontal integration, i.e. sum of each row of the matrices. The second is input side known as vertical integration, i.e. sum of each column of the matrices. In this article, horizontal integration is used because VAT is applied to the sellers of output and not to the buyers of input. Matrices $\overline{VA}_i \ , \ i = 1, 2, \ldots, 8, 9$ can be considered as a starting point to measure VAT capacity in the nine concerned regions.

3.2 Production-to-Production Approach for Measuring VAT Capacity in MIOM

Considering equation (6), we can derive 72 matrices to determine the effects of each of nine regions on VAT capacity of other eight regions as below:

$$VAT_{ik} = \hat{t}.\widehat{va}_i\,(I - A_{ii})^{-1}A_{ik}\hat{x}_k \quad , \ i = 1, 2, \dots, 8, 9, k = 1,2, \dots, 8, 9 \, , i \neq k \qquad (7)$$

VAT_{ik} for $i = 1, 2, \dots, 8, 9, k = 1,2, \dots, 8, 9 \, , i \neq k$ are matrices of direct and indirect VAT capacity generated in each region to satisfy the output of other regions. For example, for i=1 and k=2, VAT_{12} suggests how much direct and indirect VAT capacity is generated in region 1 in order to satisfy the output of region 2. The similar explanation can be expressed for other 71 matrices. $\hat{t}$ is a diagonal vector which reflects the uniform sectoral official tax rates for all regions.

3.3 Data Base

In order to calculate the interactive effects of each of nine regions on VAT capacity of other eight regions, MIOT of 2016 is estimated in the form of nine regions. For this purpose, in the first step, using extensive data bases, especially "income-expenditure of Iranian household", "the survey of industrial enterprises of 10 employers and above", "the survey of operating mines", "national accounts in 2016","budget performance", "cattle and poultry census", "the census of population and housing", "seasonally national accounts and economic balance sheet", the input-output table was calculated via GRAS method for 2016. In the second step, MIOT is estimated based on Cross Industry Location Quotient (CILQ) method[1] and the use of regional accounts[2]. All activities in each of nine regions are aggregated into 30 economic sectors.

Table 1 shows how to classify 31 provinces in the form of 9 regions and the share of each region in the GDP and VAT revenues. As can be seen, the highest and lowest shares in GDP and VAT revenues belong to region 6 and region 3, respectively.

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[1] Although Flegg Location Quotient (FLQ) and Augmented Flegg Location Quotient (AFLQ) methods are preferable to calculating multiregional input-output tables compared to CILQ method, but estimating optimal value of δ in those methods required access to survey based regional input-output tables, which have not yet been calculated for the provinces in 2016. On the other hand, using the Gosh method to estimate the optimal value of δ according to the paper of Bazazan et. al. (2007) is not possible, because using the mentioned method, the optimal value of δ of all nine regions cannot be calculated.

[2] For more information on the process of calculating multiregional input-output table see Banouei, et. al. (2019).

***Table 1. Nine regions and the share of each of them in GDP[3] and VAT revenue in* 2016**

Number of region	The name of pr[1]ovinces	Share in GDP (%)	Share in total VAT collections (%)
1	Gilan, Mazandaran, Golestan, Semnan	8.06%	4.96%
2	East Azarbaijan, West Azarbaijan, Ardabil, Kordestan	7.61%	5.37%
3	Hamedan, Kermanshah, Lorestan, Ilam	5.01%	2.07%
4	Isfahan, Chaharmahalva Bakhtiari, Khozestan	19.01%	21.71%
5	Fars, Bushehr, KohgiluyehvaBoyr-Ahmad	12..47%	8.24%
6	Tehran, Qom, Alborz	27.54%	29.42%
7	Zanjan, Qazvin, Markazi	4.68%	10.84%
8	Yazd, SistanvaBaluchestan, Kerman, Hormozghan	9.34%	12.99%
9	North Khorasan, South Khorasan, Khorasan Razavi	6.02%	4.39%

***Source**: The calculations based on Regional Accounts and Regional VAT Revenues.*

4. Results and Analysis

The results of the total interregional value-added and the interregional VAT capacity for nine regions are presented in two sections. The first section deals with the value-added generated by 8 regions for other regions, and in the second section, we analyze the results of VAT capacity.

4.1 Results of Value-Added Integration in MIOM

In consonance with equation (6), the results are organized in Table 2. This Table has 72 elements. For instance, V_{12} indicates that region 1 sells output as input to satisfy the output of region 2 which in turn is responsible for generating indirect added value for region 1. The similar interpretation can be expressed for other 71 elements. Delving more deeply on the results of Table 2, we can make the following observations:

[3] Since calculating the interactive effects of regions in generating value added and VAT capacity requires the use of multiregional input-output table, so in order to provide consistent contents in line with the estimations presented in the next part of this article, value added data of the year 2016 is the basis of analysis. It should be noted that recently the initial estimates of value added for regions for 2019 have been provided by the Statistical Center of Iran, but in the absence of other statistical bases to calculate the multiregional input-output table, focusing only on value added data in 2019 leads to distortion compatibility between experimental analysis and the contents of this section.

Table 2. Total interregional value-added

(Milliard Rials in Current Prices)

Name of matrix	Horizontal summation	Name of matrix	Horizontal summation	Name of matrix	Horizontal summation
VA_{12}	21,734	VA_{41}	38,651	VA_{71}	11,367
VA_{13}	5,617	VA_{42}	53,710	VA_{72}	35,942
VA_{14}	45,923	VA_{43}	29,145	VA_{73}	5,888
VA_{15}	9,689	VA_{45}	84,802	VA_{74}	16,209
VA_{16}	63,084	VA_{46}	153,175	VA_{75}	11,133
VA_{17}	20,678	VA_{47}	56,987	VA_{76}	42,685
VA_{18}	8,313	VA_{48}	71,523	VA_{78}	5,926
VA_{19}	5,873	VA_{49}	28,023	VA_{79}	4,824
VA_{21}	18,300	VA_{51}	25,109	VA_{81}	32,245
VA_{23}	11,791	VA_{52}	60,130	VA_{82}	26,157
VA_{24}	19,725	VA_{53}	12,397	VA_{83}	9,681
VA_{25}	27,781	VA_{54}	47,304	VA_{84}	57,350
VA_{26}	38,405	VA_{56}	108,919	VA_{85}	23,217
VA_{27}	37,077	VA_{57}	32,223	VA_{86}	99,753
VA_{28}	18,157	VA_{58}	54,048	VA_{87}	32,221
VA_{29}	10,399	VA_{59}	6,048	VA_{89}	13,924
VA_{31}	9,003	VA_{61}	73,804	VA_{91}	12,156
VA_{32}	18,819	VA_{62}	43,755	VA_{92}	22,084
VA_{34}	18,756	VA_{63}	21,448	VA_{93}	11,694
VA_{35}	20,912	VA_{64}	88,176	VA_{94}	19,628
VA_{36}	46,676	VA_{65}	86,818	VA_{95}	21,539
VA_{37}	21,907	VA_{67}	27,929	VA_{96}	40,624
VA_{38}	13,633	VA_{68}	53,901	VA_{97}	14,778
VA_{39}	5,339	VA_{69}	27,601	VA_{98}	18,857

Source*: The calculations are based on MIOT and equation (6).*

One- the total indirect value-added generated in region 1, due to satisfying the output of other eight regions, is 180,914 Billion Rials that is more than 15% of total value added of region 1. As can be seen in Figure 1, satisfying the needs of these two major regions (regions 6 and 4) generates the highest added-value for region 1.

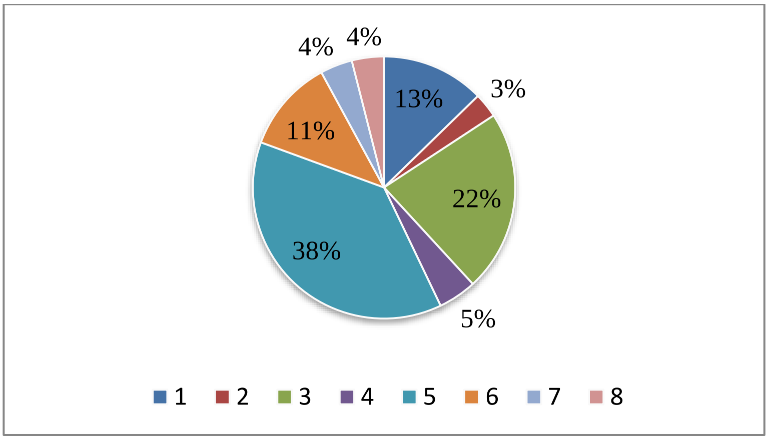

Figure 1. The share of each of the 8 regions in generating value added for region 1
***Source**: Research findings*

Two- the total indirect value-added generated in region 2, due to satisfying the output of other eight regions, is 181,638 Billion Rials that is more than 16% of total value added of region 2. As can be seen in Figure 2, satisfying the needs of the largest region, regions 6, generates more than one-fifth of interregional added value for region 2.

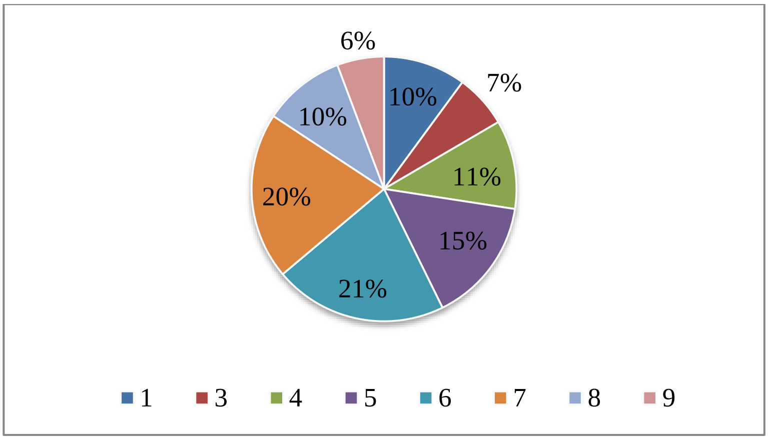

Figure 2. The share of each of the 8 regions in generating value added for region 2
***Source**: Research findings*

Three- the total indirect value-added generated in region 3 due to satisfying the output of other eight regions is 155,048 Milliard Rials that is more than 20% of total value added of region 3. As can be seen in Figure 3, satisfying the needs of the largest region, regions 6, generates more than 30% of interregional added value for region 3.

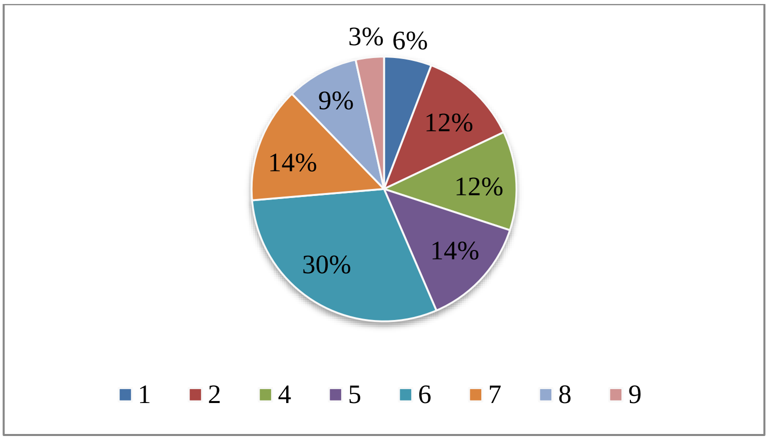

Figure 3. The share of each of the 8 regions in generating value added for region 3
Source: *Research findings*

Four- the total indirect value-added generated in region 4, due to satisfying the output of other eight regions, is 516,019 Billion Rials that is more than 18% of total value added of region 4. As can be seen in Figure 4, satisfying the needs of the largest region, regions 6, generates approximately 30% of interregional added value for region 4.

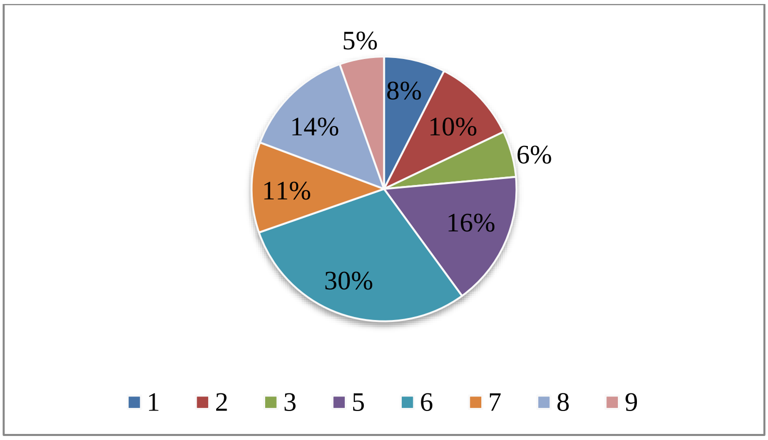

Figure 4. The share of each of the 8 regions in generating value added for region 4
Source: *Research findings*

Five- the total indirect value-added generated in region 5, due to meeting the output of other eight regions is 349,182 Billion Rials that is more than 19% of total value added of region 5. As can be seen in Figure 5, satisfying the needs of the largest region, regions 6, generates about one-third of interregional added value for region 5.

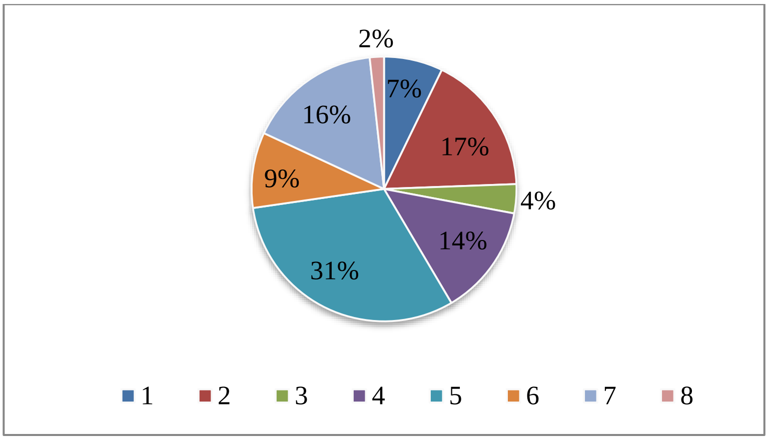

Figure 5. The share of each of the 8 regions in generating value added for region 5
***Source**: Research findings*

Six- the total indirect value-added generated in region 6, due to satisfying the needs of other eight regions is 423,435 Billion Rials that is more than 10% of total value added of region 6. As can be seen in Figure 6, satisfying the needs of the two largest buying regions, regions 4 and 5, generates more than 40% of interregional added value for region 6.

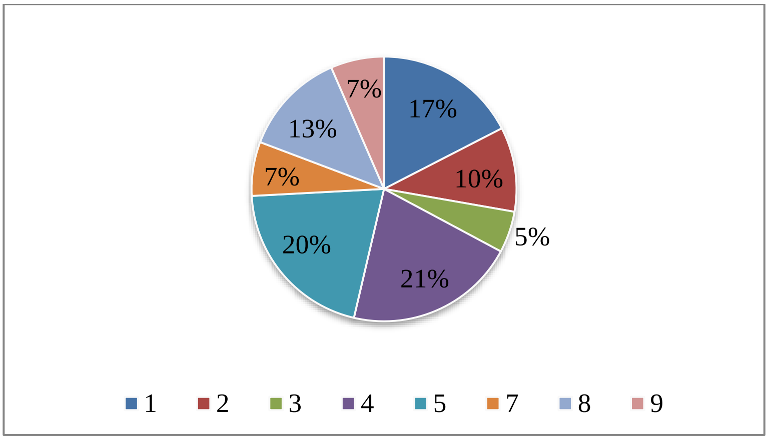

Figure 6. The share of each of the 8 regions in generating value added for region 6
***Source**: Research findings*

Seven- the total indirect value-added generated in region 7 due to satisfying the needs of other eight regions is 133,976 Billion Rials that is more than 19% of total value added of region 7. As can be seen in Figure 7, satisfying the needs of the largest buying region, region 6, generates approximately one-third of interregional added value for region 7.

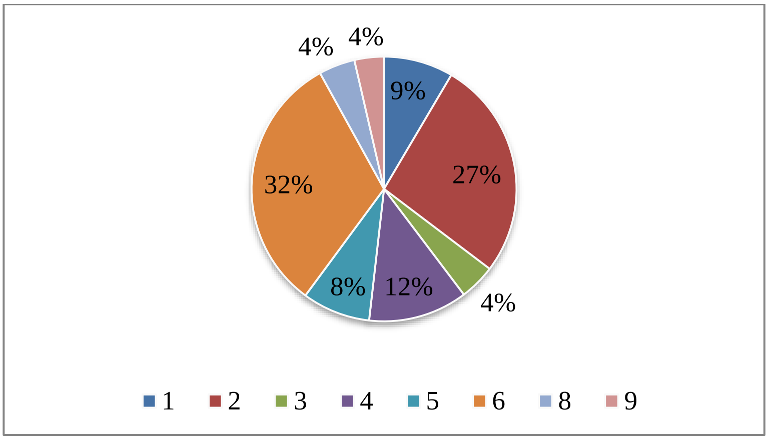

Figure 7. The share of each of the 8 regions in generating value added for region 7
***Source**: Research findings*

Eight- the total indirect value-added generated in region 8 due to satisfying the needs of other eight regions is 299,553 Billion Rials that is more than 21% of total value added of region 8. As can be seen in Figure 8, satisfying the needs of the largest buying region, region 6, generates more than one-third of interregional added value for region 8.

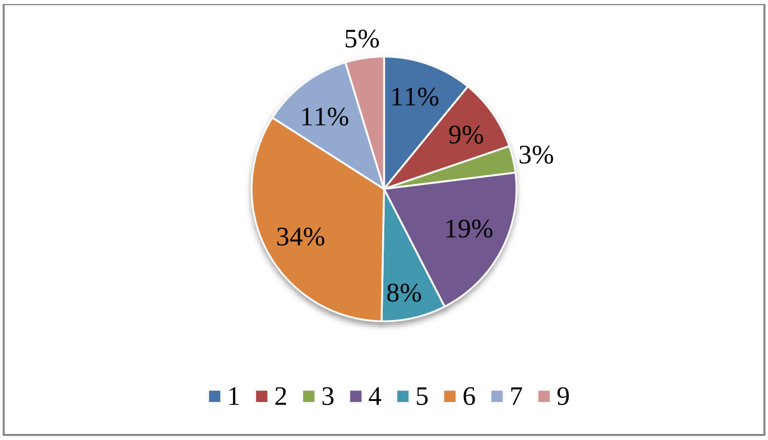

Figure 8. The share of each of the 8 regions in generating value added for region 8
***Source**: Research findings*

Nine- the total indirect value-added generated in region 9 due to satisfying the needs of other eight regions is 161,364 Billion Rials that is more than 17% of total value added of region 9. As can be seen in Figure 9, satisfying the needs of the largest buying region, region 6, generates more than one-fourth of interregional added value for region 9.

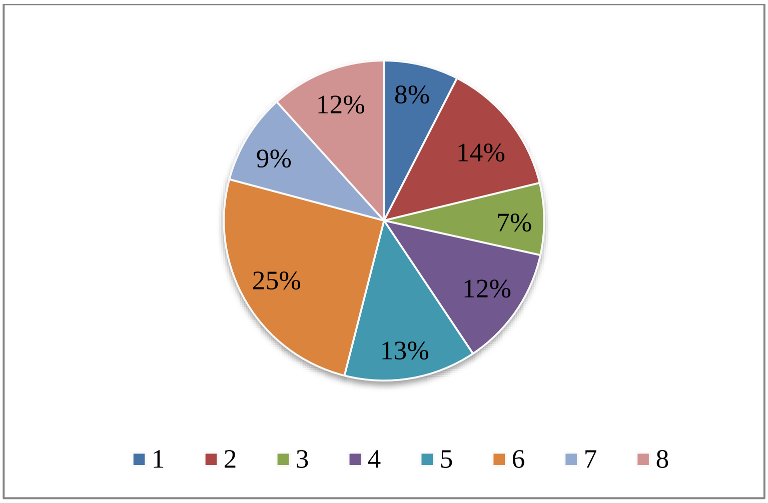

Figure 9. The share of each of the 8 regions in generating value added for region 9
***Source**: Research findings*

Ten- Based on the aforementioned findings, larger regions are able to generate more added values for other regions. In fact, satisfying the needs of larger regions generates higher added values for each of nine regions.

4.2 Results of the VAT Capacity in MIOM

In the previous section, the total value-added generated in supplying a region, due to the impact of the output of purchasing regions, was analyzed. Based on the logic of VAT system, VAT is a kind of sale tax. In this system, a taxpayer (or a firm) is required to receive tax on the supply of goods or services when selling them to the buyer, and after deducting the purchase tax on its input, he must settle the remaining tax into the predetermined accounts of the tax organization. It should be noted that some products have been exempted from VAT. For example, agricultural products, regardless of geographical location of suppliers, are not subject to VAT, because under article 12 of the VAT law, the supply of these products is exempted from VAT. With respect to the above observation, we have estimated the VAT capacity of nine regions, and results are shown in Table 3.

Table 3. Estimating the interactions between the regions on the VAT capacity

Supplying Regions	Purchasing Region	Name of Matrix	VAT Capacity generated in the Supplying Regions due to satisfying the Needs of purchasing Regions (Milliard Rials)	Ratio of VAT Capacity generated to Total VAT Revenue in the Supplying Regions (%)
1	2	VAT_{12}	312	2.67%
	3	VAT_{13}	75	0.64%
	4	VAT_{14}	550	4.72%
	5	VAT_{15}	116	0.99%
	6	VAT_{16}	926	7.93%
	7	VAT_{17}	282	2.41%
	8	VAT_{18}	95	0.83%
	9	VAT_{19}	97	0.83%
2	1	VAT_{21}	226	1.79%
	3	VAT_{23}	107	0.85%
	4	VAT_{24}	370	2.93%
	5	VAT_{25}	387	3.06%
	6	VAT_{26}	617	4.88%
	7	VAT_{27}	368	2.91%
	8	VAT_{28}	244	1.93%
	9	VAT_{29}	212	1.68%
3	1	VAT_{31}	112	2.30%
	2	VAT_{32}	265	5.43%
	4	VAT_{34}	187	3.83%
	5	VAT_{35}	178	3.66%
	6	VAT_{36}	549	11.27%
	7	VAT_{37}	160	3.29%
	8	VAT_{38}	155	3.18%
	9	VAT_{39}	70	1.44%
4	1	VAT_{41}	500	0.98%
	2	VAT_{42}	609	1.19%
	3	VAT_{43}	411	0.80%
	5	VAT_{45}	828	1.62%
	6	VAT_{46}	1853	3.63%
	7	VAT_{47}	344	0.67%
	8	VAT_{48}	733	1.43%
	9	VAT_{49}	382	0.74%
5	1	VAT_{51}	385	1.99%
	2	VAT_{52}	963	4.97%
	3	VAT_{53}	191	0.99%
	4	VAT_{54}	610	3.15%
	6	VAT_{56}	1359	7.01%
	7	VAT_{57}	312	1.61%
	8	VAT_{58}	743	3.83%
	9	VAT_{59}	67	0.34%

Table 3(Continued). Estimating the interactions between the regions on the VAT capacity

Supplying Regions	Purchasing Region	Name of Matrix	VAT Capacity generated in the Supplying Regions due to satisfying the Needs of purchasing Regions (Milliard Rials)	Ratio of VAT Capacity generated to Total VAT Revenue in the Supplying Regions (%)
6	1	VAT_{61}	1213	1.75%
	2	VAT_{62}	689	0.99%
	3	VAT_{63}	332	4.80%
	4	VAT_{64}	1596	2.31%
	5	VAT_{65}	1092	1.58%
	7	VAT_{67}	367	0.53%
	8	VAT_{68}	795	1.15%
	9	VAT_{69}	456	0.66%
7	1	VAT_{71}	256	1%
	2	VAT_{72}	681	2.67%
	3	VAT_{73}	121	0.47%
	4	VAT_{74}	404	1.59%
	5	VAT_{75}	216	0.85%
	6	VAT_{76}	807	3.17%
	8	VAT_{78}	112	0.44%
	9	VAT_{79}	113	0.44%
8	1	VAT_{81}	483	1.58%
	2	VAT_{82}	415	1.36%
	3	VAT_{83}	148	0.48%
	4	VAT_{84}	725	2.37%
	5	VAT_{85}	226	0.74%
	6	VAT_{86}	1383	4.53%
	7	VAT_{87}	291	0.95%
	9	VAT_{89}	113	0.37%
9	1	VAT_{91}	174	1.69%
	2	VAT_{92}	384	3.72%
	3	VAT_{93}	186	1.80%
	4	VAT_{94}	227	2.19%
	5	VAT_{95}	226	2.19%
	6	VAT_{96}	533	5.17%
	7	VAT_{97}	149	1.43%
	8	VAT_{98}	239	2.31%

***Source**: The calculations are based on Equation (7).*

The table has five columns. Columns (1) and (2) reveal nine supplying regions. Each region supplies its output used as an input for eight other purchasing regions (column 2). The third column reflects the names of 72 sub-matrices. Column (4) reveals the amount of estimated VAT capacity in nine regions. Column (5) indicates the percentage ratios of the estimated VAT capacity to the total revenue of each supplying region. From the results of Table 3, we can make the following observations:

One- the impact of eight regions on the VAT capacity of region 1 is 2,457 Billion Rials. The respective ratio of VAT capacity generated in region 1 is 21% of the total VAT revenue in this region. The impact of the ratios of VAT capacity of region 6 and region 3 on region 1 is 7.93% and 0.64%, respectively; this shows the impact of region 6 on region 1 is 12 times more than region 3 on region 1.

Two- Satisfying the needs of eight regions leads to generating 2,533 Billion Rials of VAT capacity for region 2 which is equivalent to 20% of the total VAT revenue in this region. The impact of the ratios of VAT capacity of region 6 and region 3 on region 2 is 4.88% and 0.85%, respectively. This indicates that the effects of region 6 on region 2 is approximately 6 times more than region 3 on region 2.

Three- Meeting the demands of eight regions can generate 1,677 Billion Rials of VAT capacity for region 3 equivalent to 34% of total VAT revenue in this region. The impact of the ratios of VAT capacity of region 6 and region 9 on region 3 is 11.27% and 1.44%, respectively. This finding implies that the impact of region 6 on region 3 is approximately 8 times more than region 9 on region 3.

Four- Eight purchasing regions create a VAT capacity of 5,658 Billion Rials for region 4 which accounts for 11% of total VAT revenue in this region. The impact of the ratios of VAT capacity of region 6 and region 7 on region 4 is 3.63% and 0.67%, respectively; which means the impact of region 6 on region 4 is approximately 5 times more than region 7 on region 4.

Five- The VAT capacity generated in region 5 to satisfy the needs of other eight regions is 4,630 Billion Rials which is about 10.5% of total VAT revenue in this region. The impact of the ratios of VAT capacity of region 6 and region 3 on region 5 is 7.01% and 0.99%, respectively. This result reveals that the impact of region 6 on region 5 is approximately 7 times more than region 3 on region 5.

Six- Supplying the needs of eight regions by region 6 can generate 6,540 Billion Rials of VAT capacity which forms 9.4% of total VAT revenue in this region. The impact of the ratios of VAT capacity of region 4 and region 3 on region 6 is 2.31% and 0.48%, respectively. This implies that the impact of region 4 on region 6 is approximately 5 times more than region 3 on region 6.

Seven- 10.6% of total VAT revenue in region 7 which is 2,711 Billion Rials, is rooted in meeting the needs of other eight regions. The impact of the ratios of VAT capacity of region 6 and region 9 on region 7 is 3.17% and 0.44%, respectively. This demonstrates that the impact of region 6 on region 7 is approximately 7 times more than region 9 on region 7.

Eight- Due to the provision of goods purchased by other eight regions, a VAT capacity of 3,785 Billion Rials will be generated for region 8. The respective ratio of VAT capacity generated in region 8 is 12.4% of total VAT revenue in this region. The impact of the ratios of VAT capacity of region 6 and region 9 on region 8 is 4.53% and 0.37%, respectively. This reveals that the effect of the region 6 on region 8 is approximately 12 times more than region 9 on region 8.

Nine- 20.5% of VAT capacity of region 9, which is equal to 2,117 Billion Rials, results from meeting the demand of other eight regions. The impact of the ratios of VAT capacity of region 6 and region 7 on region 9 is 5.17% and 1.43%, respectively. This connotes that the impact of region 6 on region 9 is approximately 3.6 times more than region 7 on region 9.

Ten- The above findings indicate that region 6, as the largest purchasing region, has the highest impact on the VAT capacity of other 8 regions. In fact being larger (smaller) leads to a higher (less) impact on the VAT capacity of other regions.

Eleven- Smaller (larger) region, the more (less) part of its VAT capacity is influenced by satisfying the needs of other regions. Calculations demonstrate that the ratio of VAT capacity generated in region 3 is 34% of total VAT revenue, while the same ratio for region 6 is less than 10%.

5. Summary and Concluding Remarks

In this paper, two distinct issues are appraised; First- assessing the spatial dimensions of the interregional total value-added, and second- analyzing the relationships among regional value-added and measuring the potential VAT capacity within MIOM setting. These issues raise the following questions: how much value-added can be generated in one region for satisfying the output of other regions?

From the methodological point of view, we observe that the conventional Leontief's final demand-to-production model is unable to answer the question posed. As a way out, we propose production-to-production approach of Sraffa subsequently modified by Pasinetti within Leontief's approach known as vertical integration of production. Using this approach, one can integrate production to value-added based on which the potential VAT capacity can be quantitatively assessed. For this purpose, we have utilized MIOT of Iran for year 2016, covering 9 regions. Regions 7 and 3 with 4.68% and 5.01% shares of GDP of country are the smallest, and regions 6 and 4, respectively with shares of 27.54% and 19.07%, are the largest regions.

According to the existing conventional regional theory, we expect that larger regions have tendency to contribute more value-added to other regions. Surprisingly, the overall results confirm the prevailing theory as follows: for example, region 6 (the largest region) generates 5.3% of the total value added of region 1, whereas region 7 (the smallest region) is responsible for 1.7% of total value added of region 1. The share of regions 6 and 7 in the value added of region 2 is 3.4% and 3.3%, respectively, in region 3 is 11.2% and 2.09%, respectively, in region 4 is respectively 3.6% and 2% , in region 5 is respectively 5.9% and 1.7%, , in region 8 is respectively 4.5% and 2.4%, and in region 9 is 4.4% and 1.6%, respectively.

With respect to the VAT capacity of the nine regions, the percentage ratio of VAT to the total revenue of each region has been taken as a criterion for measuring the potential VAT capacity. For example, the results indicate that the ratio of VAT capacity generated in region 3 is 34% of the total VAT revenue, while the same ratio for region 6 is less than 10%. This finding indicates that regarding smaller (larger) region, the more (less) part of its VAT capacity is affected by satisfying the needs of other regions. In addition, region 6, as the largest purchasing region, has the highest impact on the VAT capacity of other 8 regions. In fact being larger (smaller) leads to a more (less) impact on the VAT capacity of other regions.

Part of the sustainable resources of local government (i.e. municipalities) and the central government is by means of VAT revenues. According to the current VAT law, the share of municipalities in VAT revenue is determined based on the VAT receipts of the respective region, and it is necessary to consider the interactive effects of regions in order to improve the accuracy in determining the aforementioned shares.

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