# Estimation of Regional Relative Size Coefficient in the Generation of Regional Input-Output Coefficients (In ten regions of Iran)

**Aliasghar Banouei, PhD**
Associate Professor
Faculty of Economics, Allameh Tabatabaei University
Tehran, Iran
E-mail: banouei9@yahoo.com

**Behrooz Hadizonooz, PhD**
Associate Professor
Faculty of Economics, Allameh Tabatabaei University
Tehran, Iran,
E-mail: bzonooz@yahoo.com

**Mohammad Assiaee, PhD**
Associate Professor
Faculty of Economics, Allameh Tabatabaei University
Tehran, Iran
E-mail: assiaee@atu.ac.ir

**Mohammadreza Montazeri**
PhD student
Faculty of Economics, Allameh Tabatabaei University
Tehran, Iran
E-mail: montazeri.mr@gmail.com

## Abstract

*Determination and identification of the space economy dimensions in generating regional input-output table coefficients as well as its role in the regional economic analysis have been the focus of attention by the regional analyzers since 1950. The impact and the measurement of the space economy and regional tables' coefficients as well as the generation of regional input-output tables' coefficients may be examined by applying location quotient methods. In the present article, whilst the geographical areas homogenous with physical model of Housing and Urban Development Ministry is introduced, the investigation is accomplished with the purpose to examine this basic question as "How much relative size coefficient is estimated for the decuple regions in physical model?" The coefficients are estimated and calculated by applying the location quotient method, based on the Ghosh supply-side model and by minimizing the statistical errors between the estimated production and the actual one. The results show that multiplier ratio of decuple regions' production is less than that of national production. The imports ratio for decuple regions has been also estimated more than those of national imports ratio.*

**JEL Classification:** R12

**Keywords:** region relative size, space economy dimensions, regional input-output coefficients, location quotient methods, homogenous geographical regions

## *Introduction*

Input-output analysis is applied in regional planning including the national one fro the following purposes:

a) To create harmony between the studies and the plan of divisions
b) To identify the economic structure of the region, reciprocal connection between its divisions and also between the region and the outside
c) To forecast production, dealer consumptions and the need to initial factors (work, capital and natural sources) over the time horizon of the plan (Hadi Zonooz, 2006).

Input-output patterns are more flexible than all other common patterns once they explain the economy structure of the region, planning, policy-making and regional development for some factors including the lack of systematic data and statistics in the form of time series and the openness of the regional economy rather than the national economy especially about the flowing of the most of goods, services and inter-regional population movements (Richardson, 1972 , West , 1994 , West & Jackson , 1998).

One of the issues which have been focused by the regional analyzers since 1950 is to determine and identify the spatial economics dimensions' coefficients for the estimation of regional input-output tables and its role in regional economics analysis as well. A great attention have been recently paid to the quantitative examination of the role and the importance of space economy in the form of regional input-output pattern and its applications in spatial planning, policy-making and the related regional development (Banouei & Bazzazan, 2006). We may suggest to some studies done in this field. As an instance, researching different structures of regional-national economics in the form of input-output generated in 9 province of Iran, Banouei and Bazzazan has concluded that basic prerequisites such as compatibility and harmony between regional-national data and statistics, adequate variable(s) in measuring the relative size ratio of the regions, space economy coefficients and their measurement criteria, all have been overlooked (Banouei & Bazzazan, 2006). These working procedures and investigations prepared the ground for more precisely identification of the basic prerequisites correspondent to the common theory of regional economics considering the larger and smaller economy's structure (Banouei et al, 2007).

For this purpose, they measured quantitative correlation between the space economy and input-output coefficients in 28 provinces of Iran in the form of 6 economic divisions. The results of their work shows that adding a specialized division as an additional coefficient of space economy may play a more effective role to explain the correlation between the further coefficients of space economy and their input-output coefficients. In a separate investigation for Tehran province, to what extent may the application of numerous functions of generalized location quotient methods be considered as the basis of calculation of the regional input-output coefficients (Bazzazan et al, 2007), in the existing condition as the lack of regional statistical input-output coefficients in some countries including Iran? The results indicate that determining the most appropriate choice of location quotient functions and also the use of Ghosh supply-side model will help to measure the statistical validity criterion of the estimated input-output coefficients. In this research, the answers to the following two questions have been focused and studied (Banouei et al, 2008):

a) Could the statistical validity criteria of the estimated coefficients for other national economies be measure?
b) Are the estimated coefficients compatible with the common economical theories?

In all the studies done in Iran, the region has been defined the same as province according to "administrative and political" administrative divisions.

In this line, the present article is used for the purpose to employ the administrative divisions analysis unit "geographical and equal to physical model" instead of the administrative divisions analysis unit "administrative and political" which has not been focused by the researchers in Iran, for the purpose to estimate and calculate regional input-output coefficients based on semi-algorithmic modified pattern of specialized division which is one of the new location quotient methods. Furthermore, it is proceeds to investigate on the main question as "In decuple regions in physical model, how much 'regional relative size coefficient ' is estimated in the generation of regional input-output table coefficients for a regional planning and development with a minimum error? For this purpose, the subjects of this article suggests to the section of definitions and basic concepts in the form of different sections. The second chapter is allocated to methodology and the third chapter indicates the data collection. The results and the discussions are presented in chapter 4 and finally it is proceeds to conclusion.

## 1- Basic Definitions and Concepts

The importance of space economy and determination and recognition of its dimensions in the framework of regional input-output table is an issue which has been focused by the regional analyzers since 1950. Recognition of theses dimensions may pave the way truly for regional modeling within the framework of spatial planning and its related policy-makings (Prasad, 1992). In general, two kinds of approach are used to explain the role and significance of space economy in the generation of regional input-output coefficients. These two approaches which have been applied in the recent half-century for the generation of regional input-output tables, consists of "vertical approach" and "horizontal approach"(Imansyah, 1992) with the following conditions:

a) Vertical approach is divided into three sub-approach including different calculation methods of regional input-output coefficients as "top to down", bottom to up" and "top to down and bottom to up". In sub-approach "top to down", national input-output table along with the minimum data and statistical information existing in the region are used for the calculation of regional input-output coefficients. Considering the statistical shortage throughout the region, it is expected that it is not possible to apply "bottom to up" approach in the generation of regional input-output table in Iran. "Top to down and bottom to up" sub-approach contains mixed and/or combined approaches.

b) In vertical approach, the statistical input-output tables of another region are used instead of input-output tables applied at a national level for calculating non-statistical tables of the region (Hewings, 1977).

Therefore, in generating and calculating the regional input-output tables, it is essential to pay attention to planning process based on vertical and horizontal approaches. Considering the lack of the related statistical tables throughout the region, we may apply non-statistical methods for generating the regional input-output tables. According to previous investigations and with regard to statistical bases existing at the national and regional levels in Iran, it seems that it is the best option to apply location quotient methods for the generating of regional input-output tables. Space economy dimensions are variables which operate as a connecting bridge between national economy and regional economy. Among them, we may suggest to relative size of supplier sectors of the region, relative size of suppliant sectors of the region, the relative size ratio of the region to that of national one, the ratio intra-divisional exchanges of the region to that of national one and to the relative size of the specialized division of the region (Flegg & webber, 2000; Tohmo, 2004).

Quantitative examination of economical, social and cultural factors requires adequate criteria. In general, among the criterion/criteria considered for the explanation of space economy coefficients, we may suggest to the criteria of production, employment, added value, family consumption, etc (Isard, 1998). It seems that considering the below-mentioned reasons, production criteria is adequate in Iran for the generation of regional input-output table coefficients:

1- Regional and national calculations can truly provide regional-national spatial compatibility at different levels of the regional divisions and the corresponding divisions at a national level.
2- Considering the weakness of comparative statistics of employment at the regional level, it is not simply possible to determine the regional-national space based on the employment criteria and the level of the regional divisions and its compatibility at the levels of corresponding national divisions.
3- It is the absence of assumption for the equality of workforce efficiency at the level of manufacturing sectors in different regions with that of national one which will be problematic.
4- Regional-national space compatibility of the regional and national calculations statistics based on the production (output) is very important.
5- The existence of national input-output tables that indeed indicate the extent to which the statistics and data at the level of different economical sectors are compatible with the huge figures of national calculations.

Therefore, this kind of regional-national compatibility and harmony about the production criterion of the regional economy and about the production of its different sectors will be hold true about the production of corresponding sectors at a national level (Banouei, 2007). The specialists and analyzers of regional sciences have different impressions about the definition of the region. For Isard (1975), the region is defined based on a special issue which is occurred. Thus, the regions are not optionally defined but the it is a significant boundary containing one or several issue and problem and the regional scientist is trying to examine and resolve the above problem(s) through regional planning. About the areas, Glasson (1974) believes that they are as means of gaining access to a target and they are not by themselves as a target. Fisher (1969) and West (1966) have divided various definitions presented by different individuals and intellectual schools into subjective and objective definitions.

The absence of strong theoretical consideration for describing the region and its definition prompted Richardson (1973) to divide the existing methods of describing the region into three typical groups including homogenous, nodal and programming regions. Homogenous region is a region which is homogenous from the aspect of special features including language and dominant agricultural physical status, etc. nodal region is one in which one or several cities are dominant over the full region and programming region is one which is defined based on the law and by the government for the purpose to determine administrative and political boundaries. In the present study, administrative divisions' analysis unit "geographical and homogenous with physical model" is used as the main purpose of the research. In physical model as the main purpose of permanent development planning and territory management, homogenous regions with similar management requirements are at least put together and regionalized (Physical Model, 2006). In physical model approved by higher council of urbanism and architecture in the Ministry of Housing and Urban Development, Iran has been divided into ten programming regions. Therefore, the purpose of the study is to answer this question as" how much is the most adequate 'regional relative significance parameter value' and 'the regional relative size coefficient' for the adjustment of national coefficients for the regions divided and designed based on geographical regional analysis unit and homogenous with physical model with the minimum error.

## 2- Methodology

In general, location quotient (LQ) value is dependent on the form of function and variable by which it is defined. There is a great literature on the methodology of location quotient patterns and the functions they define. Considering the inclusion of space economy coefficient, explanation of economy structure and the regional development, location quotient method are divided into two groups as traditional location quotient patterns and modern location quotient patterns. For the first group, we may suggest to simple location quotient methods of suppliant sector, simple location quotient of supplier sector, traverse location quotient of supplier and suppliant sectors, modified traverse location quotient; and for the second group, may refer to the semi-algorithmic location quotient methods of the suppliant sector's relative size, semi-algorithmic location quotient methods of the supplier sector, semi-algorithmic location quotient of the region's size, modified semi-algorithmic location quotient of the region's size and the modified semi-algorithmic location quotient of the specialized or domestic sector.

### 2-1. The method of applied location quotient

In the countries such as Iran in which there are no statistical tables at the regional level, the non-statistical methods are suggested to be used for generating the regional input-output tables. Considering the statistical calculations in Iran, modern location quotient models may be of the most adequate choices. On the other hand, quantitative examination of the role and significance space economy plays in the form of regional input-output patterns have been fundamentally overlooked until 2001( Banouei & Bazzazan, 2006 & 2007).

Thus, taking space economy dimensions' significance into consideration, modified method of semi-algorithmic location quotient of the region's specialized sector as one of the adequate choices of non-statistical methods is suggested for generating single-regional input-output table which was entered into regional economy literature by Mc Cann and Dewhurst (1998) and then it was applied by Flegg and Webber (2000) and Tohmo (2004) in some studies.

**Modified semi-algorithmic method of location quotient of the region's specialized sector**

$$AFLQ_{ij}^{*} = FLQ_{ij}^{*}\left[\log_2\left(1 + SLQ_j\right)\right]$$

In which:

$$FLQ_{ij}^{*} = ACILQ_{ij} \times \lambda^{*}$$

$$ACILQ_{ij} = CILQ_{ij} \times S\hat{L}Q_i$$

$$CILQ_{ij} = SLQ_i / SLQ_j$$

$$SLQ_i = \left(RO_i / NO_i\right) / \left(TRO / TNO\right)$$

$$SLQ_j = \left(RO_j / NO_j\right) / \left(TRO / TNO\right)$$

$$\lambda^{*} = \left[\log_2\left(1 + TRO / TNO\right)\right]^{\sigma} \qquad 0 < \sigma < 1$$

$$\hat{r}_{ij} = AFLQ_{ij}^{*} \times a_{ij}$$

and the parameters consist of:

$AFLQ_{ij}^{*}$ - modified semi-algorithmic method for the specialized sector of the region

$FLQ_{ij}^{*}$ - modified semi-algorithmic method of the regional size

$ACILQ_{ij}$ - traverse location quotient of supplier and suppliant sectors modified simultaneously

$CILQ_{ij}$ – contemporary traverse location quotient of supplier and suppliant sectors

$SLQ_i$ – simple location quotient of the supplier sector

$SLQ_j$ - simple location quotient of the suppliant sector

$RO_i$ – GDP of $i^{th}$ sector at the regional level

$NO_i$ – gross product of $i^{th}$ sector at the national level

TRO – total gross product at regional level

TNO – total gross product at national level

$\lambda^{*}$ - regional relative size coefficient

$\sigma$ – regional relative size coefficient parameter

$\acute{r}_{ij}$ – an element of the intra-regional intermediate exchanges matrix coefficients

$a_{ij}$ - an element of national intermediate exchanges matrix coefficients

In the modified semi-algorithmic method of specialized sector as one of the modern location quotient methods $AFLQij^{*}$, five space factors have been considered simultaneously in adjusting national input-output coefficients ($a_{ij}$). Normally, the more the number of space economy coefficients, the more reasonable image of the regional economy structure ($\acute{r}_{ij}$) will be resulted. Estimate of $\acute{r}_{ij}$ based on $AFLQ_{ij}^{*}$ and $a_{ij}$ is dependent to a great extent on determination and identification of the most appropriate choice of σ in $\lambda^{*}$.

The main criteria to determine the most appropriate choice in this equation as $\lambda^{*} = \left[\log_2\left(1+TRO/TNO\right)\right]^{\sigma}$ , is the minimum statistical errors. Minimum statistical errors are also calculated based on the estimated multiplier coefficients as per different σ values and in accordance with multiplier coefficients of statistical tables, by applying common statistical methods. For the lack of regional statistic tables in Iran, it is not possible to calculate statistical technical coefficients and statistical multiplier coefficients as well. In turn, the production of which the statistics are available will be selected as an appropriate choice. To apply this choice includes two following advantages:

1- It is fully corresponding to spatial coefficients' criteria in modern location quotient methods, i.e. production.
2- It is compatible with the regional calculations of Statistical Center of Iran in production method. The estimated production is also calculated in accordance with Gosh supply-side model for different σ values (Banouei et al, 2007; Bazzazan et al 2007).

Ghosh supply-side model in the cycle t+1 is stated as follows (Ghosh 1958, Sengupta 1987):

$$\hat{O}_{t+1} = V_{t+1}^{r}(I - B_t^{r})^{-1}$$

In which:

$\hat{O}^{r}_{t}+1$ – regional sector production in the cycle t+1

$V^{r}_{t}+1$ – regional value added vector in the cycle t+1

$B_t^r = \frac{O_{ij}^r}{O_i^r}$ - Ghosh coefficients matrix per certain values of parameter σ

Statistical error value between sector's estimated production and actual production is gained by the equation $E = \hat{O}_{t+1}^{r} - O_{t+1}^{r}$ which calculates the rate of error through the difference between corresponding elements of the estimated production vector and actual production vector in the cycle t+1. For the calculation of statistical rate of error, the following equations may be applied:

$$E = \sum_j E_j = \sum_j (\hat{O}_j - O_j)$$ Total simple error

$$WPE = \sum_j W_j\, E_j / O_j = \sum_j W_j (\hat{O}_j - O_j)/O_j$$ Total relative weighing error

$$WAPE = \sum_j W_j\, |E_j| / O_j = \sum_j W_j\, |\hat{O}_j - O_j| / O_j$$ Total absolute value of weighing error

$$WSPE = \sum_j W_j (E_j / O_j)^2 = \sum_j W_j \left[(\hat{O}_j - O_j)/O_j\right]^2$$ Total squares of relative weighing error

Based on the mentioned equations, any value of σ which minimizes the estimation error, is considered as the most appropriate choice for $\lambda^{*}$, i.e. the regional relative size coefficient. After calculating regional input-output coefficients, imports coefficient of different sectors of each region as well as the production multiplier coefficients of the sectors are computed and compared with multiplier coefficients at national level and all other issues will be theoretically examined and analyzed.

## 3- Data Collection

To determine and calculate regional input-output table coefficients and all other coefficients including regional relative size, production multiplier coefficients and regional imports coefficients and to measure statistical validity of the estimated coefficients based on the minimum statistical error, two groups of statistical bases are required including national input-output table and the regional calculations.

### 3-1. National input-output table

National input-output table coefficients for the regions in this study have been adjusted based on the latest national input-output table generated in 2001 and published in 2007 by the Statistical Center of Iran. Furthermore, assuming the sector technology, sectional homographic table which is based on ISIC (International Standard Industrial Classification) and is fully compatible and in harmony with the calculations of Statistical Center of Iran.

### 3-2. Regional Calculations

The statistics of regional production calculations of all provinces of Iran in 2001have been used to adjust national input-output table coefficients and to calculate input-output coefficients, production multiplier coefficients as well as the imports' coefficients. On the other hand, statistical bases of regional production calculations of the provinces of Iran for the years 2002-2005 have been applied to measure the statistical validity of the estimated regional tables' coefficients.

### 3-3. Aggregation of the sectors

To calculate and estimate the regional input-output tables' coefficients, we have applied the statistical bases of national input-output table, 2001 which is generated in the form of a symmetric sectional table with the sector technology assumption in 99 × 99 dimensions as well as the statistical tables of Iranian regional calculations for the years 2001 to 2005 including 72 sectors. These tables have been converted to a 30-section table through gathering the sectors which are nearly homogenous. The sections aggregated as the statistical bases of national input-output tables and the regional calculations are presented in table (1).

### 3-4. Regions

In this study, homogenous regions as the basis for the physical model division by the study and research center of urbanism and architecture of Housing Ministry has been considered as analytical unit. Decuple regions and their inclusive provinces are shown in table (2).

## *4- Results Analysis*

Modified Semi-algorithmic location quotient pattern of specialized sector was used for adjustment of national technical coefficients and calculation of regional input-output table coefficients. Statistical validity extent of the estimated coefficients were examined and measured by minimizing statistic errors between production actual figures of the sectors and their estimated quantity, based on the suggested Ghosh supply-side model. In line with the main purpose of this investigation and for answering the main research question and considering the fact that regional relative size coefficient is a parameter of modified semi-algorithmic approach in the specialized sector $AFLQ^*_{ij}$ in a functional form which may take different values, it is found that as it changes, the estimated coefficients of regional input-output table will change as well. Thus, according to the results of calculations, the answer to the main question has been presented in table (3). Parameter value of the region's significance σ has been recognized for all regions and as a result, regional relative size coefficient $\lambda^*$ as the main purpose of the study, has been also estimated for decuple regions of Iran. The calculation of the mentioned parameters results in minimum statistical errors E which is shown in Table (3). Furthermore, the results of average production multiplier coefficients' estimation, average national imports' coefficients and the ratio of regional relative production to that of national one for decuple regions, all are shown in table (4).

In accordance with the results of calculations, maximum relative production ratio is 36% as for region (4) and the minimum regional relative production ratio to that of national one is related to region (7) as 3%. Average regional production multiplier coefficients are less than that of national one as 1.51. The uttermost production multiplier coefficient is for region (4) with a value as 1.40 and the least production multiplier coefficients are related to region (7) with a value as 1.17. On the contrary, imports' ratio average for all regions has been more than import's coefficients average at the national level as 0.1. The maximum rate of estimated imports with a value of 0.55 is allocated to region (7), i.e. southern coastal regions and the minimum one with a value of 0.20 is for region (4) including southern Alborz region which has been included the uttermost production multiplier coefficient. Considering diagram (1) which shows a comparison between the production relative ratio and that of national one, production multiplier coefficient average and international imports' coefficient average for decuple regions, it is seen that the trend of changes for production multiplier coefficient average in each region is contrary to the trend of changes for average imports' ration of the same region. In other word, everywhere the average production multiplier coefficient is increased, the imports' ratio average of the same region will decrease and vice versa; it means that where production multiplier coefficient average has been falling, the trend of shift and change in average imports' ratio has been raising.

Table (5) indicates the calculations of production multiplier coefficients as in 30 separate economic sectors for all decuple regions which have been compared with those of corresponding sectors at national level. The results suggest that the production multiplier coefficient of the regional economic sectors is less than those in the corresponding sectors at the national level. In table (6), the calculation of figures related to the ratio of decuple regions' imports in 30 separate economic sectors is specified and compared to imports' coefficients of similar sectors at the national level. The results showed that imports' coefficients of 30 economical sectors for the regions are bigger than those of similar sectors at the national level. Furthermore, the rate and percentage of relative errors in calculating the mentioned parameters for decuple regions in 30 separate economical sectors are presented and estimated in table (7). Therefore, the calculation of the above-mentioned tables is a good answer to the main research question and a good explanatory of some results as follows:

- Production multiplier coefficients in decuple regions are less than those of national one.
- Imports' coefficients for decuple regions are more than that of national one.
- In general, considering the openness of decuple regions' economy compared to that of national one, thus there may be seen a reverse correlation between the imports' coefficients and the regional relative size.

### *5- Conclusions*

The purpose of the present study is to examine this basic question as "what is the most appropriate parameter value for regional relative significance?" for adjusting national coefficients in explaining the structure and economical development of the regions which have been divided and designed based on the geographical regional analysis unit homogenous with physical model along with minimum errors? Meanwhile, it appears as a look at the pattern created by "an appropriate location quotient method for generating regional input-output coefficients with regard to spatial economics dimensions and statistical bases available in Iran". For this purpose, it was suggested by presenting basic concepts and showing how to adjust statistical bases to 30 economical sectors that considering the significance of space economy dimensions, modified semi-algorithmic location quotient method of regional specialized sector as an appropriate choices of non-statistical methods, has been suggested and applied for generating the regional input-output coefficients of Iran. "Regional relative significance parameter" value and as a result, "regional relative size coefficient" are considered as the parameters of modified semi-algorithmic pattern of specialized sector $AFLQ^*_{ij}$ in the form of functions which may take different values. Therefore, with their changes, the estimated regional input-output table coefficients will also change. These two parameters were calculated and presented for decuple geographical regions homogenous with physical method including the minimum error. In addition to "regional relative size coefficient", production multiplier coefficients, imports' ratio and the rate of calculating errors are estimated for 30 separate economic sectors in explaining the structure, planning and economical development of Iranian regions.

The results of calculations suggest that production multiplier coefficients of economic sectors of Iranian regions are less than those of corresponding sectors at the national level and on the contrary, imports' coefficients of economic sectors of Iranian regions are more than those of similar sectors at the national level. Furthermore, according to these results, production multiplier coefficients in Iranian decuple regions are less than those of national one. Imports' coefficients for decuple regions have been estimated more than those of national imports. Therefore, considering the openness of economy in decuple regions compared with national economy, there is a reverse correlation between the imports' coefficients and the regional relative size from the aspect of regional economy. For further studied, in case the current weaknesses in comparative statistics will be removed or minimized at the level of Iranian regions, it is appropriate to use employment criteria to identify the regional specialized sector.

## *References*


- Banouei, A.A. & Bazzazan, F. (2006). *The role and significance of spatial economics dimensions on generating regional input-output table: a phenomenon forgotten in Iran*. Iranian Economic Researches quarterly journal, No. 27, pp. 89-115.(in Persian)
- Banouei, A.A. & Bazzazan, F. & Karami, M. (2007). *Quantitative examination of the correlation between space economy and input-output coefficients in 28 provinces in Iran.* Iranian Economic Researches quarterly journal, No. 29, pp. 143-170.(in Persian)

- Banouei, A. (2007). *Generation of input-output in Golestan Province and its social and economical applications in the policy-making of the province*. Planning deputy of governor-generl of Golestan province, research model.(in Persian)
- Banouei, A.A., Bazzazan, F., Parvin, S., Karami, M. & Azad, S.I. (2008). *An examination on the correlation between relative size and regional imports' coefficients: a case study on 28 provinces of Iran*. Quantitative Economy quaretly. No.16, pp. 1-25.(in Persian)
- Bazazan, F. & Banouei, A.A. & Karami, M. (2007). *Further contemplation about the new functions of location quotient between spatial economics dimensions and regional input-output coefficients*: A case study for Tehran Province. Iranian economical researches quarterly, No. 30, pp. 31-54.(in Persian)
- Flegg, A.T. & Webber, C.D. (2000). *Regional size, regional specialization and the FLQ Formula*, Regional studies, No .36, pp. 563-569.
- Flegg, A.T. &Webber, C.D. and Elliot, M.V. (1997). *On the appropriate use of location quotients in generating regional input-output tables*. Regional Studies, No. 31, pp. 547-561.
- Fisher, J.L. (1969). "Regional planning determining the public interest" in M. M. Hufschmidt(ed) regional planning challenge and prospects, Frederick. A. Praeger, PP. 7-8.
- Ghosh, A. (1958). *Input – output approach to an allocation system*, Econometrica, No.25, pp. 58-64.
- Glasson, J. (1974). The conceptual basis of regional planning, Oxford University. Chap. 1.
- Hadi Zonooz, B. (2006). Suggested model for generating regional input-output table of Tehran Province. Management and Planning organization.(in Persian)
- Hewings, G. J. D. (1977). *Evaluating the possibilities for exchanging regional input – output coefficients*. Environment and planning, No. 9, pp. 927 – 944.
- Isard, W. (1975). Introduction to regional science, Englewood Cliffs, New Jersey.
- Isard, W. (1998). Location analysis for industry and service trade; comparative cost and other approaches, in Isard et.al (eds). Methods of Interregional and Regional Analysis, Asgate, USA.
- Imansyah, M. H. (2001). An experiment of small region input-output model, Third conference Indonesia Regional Association, Jakarta.
- Mc Cann, p. and Dewhurst J.H.LI. (1998). *Regional size, industrial location and input – output expenditure coefficients*, Regional studies. No. 32, pp. 435-444.
- Miller, R. E. & Blair, P.D. (1985). Input-output analysis, foundations and extensions, Englewood Cliffs, New Jersey.
- National physical model of Iran. (2006). The report of Iranian national physical model. The publications of study and research center of urbanism and architecture, the Ministry of Housing.(in Persian)
- Prasad, K. N. (1992). Spatial planning in input-output framework. Planning & Development Unit, Department of Economics, University of Bombay, India.
- Richardson, H. W. (1972). Input – output and regional economics, Cambridge, University press, London, chap. 3.
- Richardson, H. W. (1973). Regional growth theory, Mc Millan, London, chap. 2.
- Sengupta, A. (1987). *Input-output allocation model for India*: A Note, Anvesak, No. 2, pp. 103-107.
- Statistical Center of Iran. (2007). Input - output table in 2001. Tehran, Statistical Center of Iran.(in Persian)
- Statistical Center of Iran. Regional production calculations. Tehran, Statistical Center of Iran. (2001-2005). (in Persian).
- Tohmo, T. (2004). *New developments in the use of location quotients to estimate regional input- output coefficients and multipliers*, Regional studies, Vol. 38, No. 1, pp. 43-54.
- West, E. G. (1966). *Regional planning, fact and fallacy*, Lloyds Bank Review, April 1966, No. 80. pp. 33-50.
- West, G. R. (1994). The queensland impact projection model, The Household Sector, Economic System Research, Vol. 6, pp. 363-383.
- West, G. R. & Jackson, R.W. (1998). *Comparing regional econometric, input – output models*, Journal of Regional Analysis and Policy, No.28, pp. 33-45.

## Appendixes

### Table 1. Aggregated Sectors based on statistical base of Iranian Institute of Statistics

| Row | Title of Sector |
|---|---|
| 1 | Agriculture, gardening and forestry |
| 2 | Ranching, aviculture, sericulture, beekeeping and haunting |
| 3 | Fishing |
| 4 | Mining |
| 5 | Foods, beverage and tobacco industries |
| 6 | Textiles, clothing and leather industries |
| 7 | Wood & Paper industries |
| 8 | Chemical, rubber and plastic industries |
| 9 | Non-metallic mineral products industries |
| 10 | Basic metals and metallic fabric products except machineries and equipments |
| 11 | All other industries |
| 12 | Provision of water, electricity and natural gas |
| 13 | Residential buildings |
| 14 | All other buildings |
| 15 | Wholesale, retailing, vehicles and goods repair |
| 16 | Hotel & restaurant |
| 17 | Transportation & storage |
| 18 | Post & telecommunication |
| 19 | Financial brokerage |
| 20 | Real state |
| 21 | Rental and business services |
| 22 | Public affairs, city services and social security |
| 23 | Defense and police affairs |
| 24 | Elementary education |
| 25 | General secondary education, technical and vocational secondary education |
| 26 | Higher education |
| 27 | Adults' education |
| 28 | Health and social work |
| 29 | Entertainment, cultural and sportive |
| 30 | All other services |

**Source**: Statistical Center of Iran

### Table 2. Decuple regions of physical model in Iran specified by the provinces

| Regions | | Provinces |
|---|---|---|
| Region (1) | Azerbaijan | Eastern Azerbaijan, Western Azerbaijan and Ardabil |
| Region (2) | Central Zagros | Hamedan, Kermanshah, Lorestan, Kordestan and Ilam |
| Region (3) | Khuzestan | Khuzestan and Kohkiloye va Boyer Ahmad |
| Region (4) | South Alborz | Semnan, Tehran, Alborz, Markazi, Qom, Qazvin and Zanjan |
| Region (5) | Fars | Fars |
| Region (6) | North Coastal | Gilan, Mazandaran and Golestan |
| Region (7) | South Coastal | Hormozgan and Bushehr |
| Region (8) | Central | Yazd, Isfahan and Cheharmahal va Bakhtiari |
| Region (9) | Khorasan | Northern Khorasan, Khorasan Razavi and Southern Khorasan |
| Region (10) | Eastern South | Kerman and Sistan va Baluchestan |

**Source:** Ministry of Housing and Urbanism of Iran, Physical Model

**Table 3. Estimated σ, $\lambda^*$ and E (error) values of the regions**

| Regions | | σ | $\lambda^*$ | E (%) |
|---|---|---|---|---|
| Region (1) | Azerbaijan | 0.1 | 0.80 | 1.90 |
| Region (2) | Central Zagros | 0.05 | 0.88 | 5.32 |
| Region (3) | Khuzestan | 0.05 | 0.92 | 5.05 |
| Region (4) | South Alborz | 0.04 | 0.97 | 8.18 |
| Region (5) | Fars | 0.1 | 0.76 | 5.26 |
| Region (6) | North Coastal | 0.05 | 0.89 | 4.28 |
| Region (7) | South Coastal | 0.3 | 0.40 | 2.31 |
| Region (8) | Central | 0.1 | 0.81 | 3.19 |
| Region (9) | Khorasan | 0.1 | 0.79 | 4.33 |
| Region (10) | Eastern South | 0.03 | 0.92 | 7.63 |

**Source:** Research Calculations

**Table 4. Average production multiplier coefficients and average imports' coefficients (national-regional)**

| Regions | | Production Relative Ratio (TRO/TNO) | Average production multiplier coefficient (national) | Average production multiplier coefficient (regional) | Average imports' coefficient (national) | Average imports' coefficient (regional) |
|---|---|---|---|---|---|---|
| **Region (1)** | Azerbaijan | **0.08** | **1.51** | **1.32** | **0.10** | **0.27** |
| **Region (2)** | Central Zagros | **0.06** | **1.51** | **1.31** | **0.10** | **0.29** |
| **Region (3)** | Khuzestan | **0.13** | **1.51** | **1.23** | **0.10** | **0.34** |
| **Region (4)** | South Alborz | **0.36** | **1.51** | **1.40** | **0.10** | **0.20** |
| **Region (5)** | Fars | **0.04** | **1.51** | **1.29** | **0.10** | **0.32** |
| **Region (6)** | North Coastal | **0.08** | **1.51** | **1.34** | **0.10** | **0.28** |
| **Region (7)** | South Coastal | **0.03** | **1.51** | **1.17** | **0.10** | **0.55** |
| **Region (8)** | Central | **0.09** | **1.51** | **1.36** | **0.10** | **0.23** |
| **Region (9)** | Khorasan | **0.07** | **1.51** | **1.32** | **0.10** | **0.27** |
| **Region (10)** | Eastern South | **0.04** | **1.51** | **1.34** | **0.10** | **0.24** |

**Source:** Research Calculations

**Table 5. The comparison between multiplier coefficients at regional and national level in separate sectors**

| Sector | National | Region (1) | Region (2) | Region (3) | Region (4) | Region (5) | Region (6) | Region (7) | Region (8) | Region (9) | Region (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.39 | 1.28 | 1.31 | 1.19 | 1.26 | 1.33 | 1.30 | 1.14 | 1.29 | 1.28 | 1.32 |
| 2 | 1.91 | 1.76 | 1.75 | 1.37 | 1.56 | 1.67 | 1.77 | 1.25 | 1.61 | 1.77 | 1.61 |
| 3 | 1.65 | 1.41 | 1.38 | 1.32 | 1.49 | 1.35 | 1.48 | 1.41 | 1.44 | 1.39 | 1.52 |
| 4 | 1.05 | 1.03 | 1.03 | 1.04 | 1.05 | 1.03 | 1.03 | 1.02 | 1.04 | 1.03 | 1.03 |
| 5 | 2.24 | 2.08 | 2.08 | 1.46 | 1.66 | 1.89 | 2.10 | 1.27 | 1.90 | 2.09 | 1.88 |
| 6 | 1.72 | 1.57 | 1.54 | 1.22 | 1.59 | 1.38 | 1.46 | 1.18 | 1.66 | 1.54 | 1.45 |
| 7 | 1.70 | 1.40 | 1.34 | 1.29 | 1.61 | 1.30 | 1.57 | 1.22 | 1.39 | 1.37 | 1.53 |
| 8 | 1.55 | 1.26 | 1.23 | 1.40 | 1.38 | 1.25 | 1.18 | 1.30 | 1.35 | 1.20 | 1.24 |
| 9 | 1.71 | 1.38 | 1.50 | 1.41 | 1.57 | 1.36 | 1.40 | 1.29 | 1.58 | 1.39 | 1.43 |
| 10 | 1.74 | 1.30 | 1.29 | 1.51 | 1.57 | 1.25 | 1.31 | 1.18 | 1.64 | 1.29 | 1.54 |
| 11 | 1.61 | 1.31 | 1.19 | 1.23 | 1.55 | 1.21 | 1.24 | 1.13 | 1.37 | 1.25 | 1.39 |
| 12 | 1.76 | 1.40 | 1.44 | 1.38 | 1.65 | 1.52 | 1.59 | 1.23 | 1.61 | 1.46 | 1.55 |
| 13 | 1.90 | 1.48 | 1.48 | 1.49 | 1.74 | 1.42 | 1.47 | 1.25 | 1.71 | 1.48 | 1.63 |
| 14 | 1.98 | 1.55 | 1.54 | 1.54 | 1.79 | 1.46 | 1.53 | 1.43 | 1.74 | 1.54 | 1.70 |
| 15 | 1.29 | 1.17 | 1.16 | 1.14 | 1.26 | 1.16 | 1.19 | 1.14 | 1.20 | 1.19 | 1.18 |
| 16 | 1.79 | 1.67 | 1.67 | 1.28 | 1.54 | 1.59 | 1.70 | 1.15 | 1.52 | 1.68 | 1.46 |
| 17 | 1.48 | 1.31 | 1.26 | 1.27 | 1.45 | 1.27 | 1.27 | 1.35 | 1.35 | 1.30 | 1.26 |
| 18 | 1.27 | 1.15 | 1.16 | 1.08 | 1.26 | 1.15 | 1.20 | 1.09 | 1.16 | 1.16 | 1.19 |
| 19 | 1.27 | 1.15 | 1.15 | 1.09 | 1.24 | 1.15 | 1.18 | 1.08 | 1.16 | 1.16 | 1.17 |
| 20 | 1.22 | 1.13 | 1.13 | 1.08 | 1.19 | 1.14 | 1.16 | 1.05 | 1.16 | 1.13 | 1.14 |
| 21 | 1.25 | 1.14 | 1.14 | 1.09 | 1.22 | 1.13 | 1.16 | 1.08 | 1.15 | 1.15 | 1.16 |
| 22 | 1.27 | 1.15 | 1.17 | 1.09 | 1.24 | 1.15 | 1.19 | 1.08 | 1.16 | 1.19 | 1.17 |
| 23 | 1.38 | 1.23 | 1.20 | 1.09 | 1.34 | 1.17 | 1.20 | 1.08 | 1.20 | 1.20 | 1.23 |
| 24 | 1.12 | 1.07 | 1.09 | 1.05 | 1.10 | 1.07 | 1.09 | 1.04 | 1.08 | 1.07 | 1.08 |
| 25 | 1.16 | 1.10 | 1.09 | 1.07 | 1.14 | 1.09 | 1.11 | 1.06 | 1.10 | 1.10 | 1.11 |
| 26 | 1.30 | 1.19 | 1.18 | 1.13 | 1.25 | 1.17 | 1.20 | 1.11 | 1.20 | 1.19 | 1.19 |
| 27 | 1.36 | 1.22 | 1.22 | 1.16 | 1.32 | 1.21 | 1.25 | 1.14 | 1.25 | 1.23 | 1.24 |
| 28 | 1.34 | 1.22 | 1.18 | 1.18 | 1.30 | 1.20 | 1.19 | 1.15 | 1.25 | 1.19 | 1.19 |
| 29 | 1.32 | 1.20 | 1.21 | 1.12 | 1.28 | 1.20 | 1.23 | 1.10 | 1.21 | 1.21 | 1.22 |
| 30 | 1.53 | 1.36 | 1.35 | 1.23 | 1.45 | 1.33 | 1.38 | 1.18 | 1.38 | 1.37 | 1.34 |

**Source:** Research Calculations

**Table 6. The comparison between imports' coefficients at regional and national level in separate sectors**

| Sector | National | Region (1) | Region (2) | Region (3) | Region (4) | Region (5) | Region (6) | Region (7) | Region (8) | Region (9) | Region (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.15 | 0.23 | 0.18 | 0.26 | 0.24 | 0.19 | 0.20 | 0.37 | 0.19 | 0.19 | 0.17 |
| 2 | 0.01 | 0.05 | 0.11 | 0.15 | 0.33 | 0.18 | 0.05 | 0.61 | 0.16 | 0.11 | 0.10 |
| 3 | 0.00 | 0.13 | 0.42 | 0.18 | 0.19 | 0.37 | -0.03 | 0.12 | 0.36 | 0.33 | 0.08 |
| 4 | 0.01 | 0.38 | 0.08 | 0.01 | 0.34 | 0.14 | 0.39 | 0.09 | 0.25 | 0.15 | 0.22 |
| 5 | 0.13 | 0.16 | 0.14 | 0.95 | 0.62 | 0.32 | 0.15 | 1.44 | 0.32 | 0.18 | 0.24 |
| 6 | 0.46 | 0.60 | 0.59 | 1.63 | 0.58 | 1.01 | 0.85 | 2.14 | 0.53 | 0.66 | 0.88 |
| 7 | 0.37 | 0.78 | 0.81 | 0.81 | 0.50 | 1.01 | 0.45 | 1.90 | 0.80 | 0.80 | 0.70 |
| 8 | 0.41 | 0.90 | 1.18 | 0.32 | 0.70 | 1.03 | 1.74 | 0.64 | 0.80 | 0.89 | 0.91 |
| 9 | 0.05 | 0.29 | 0.15 | 0.29 | 0.17 | 0.31 | 0.43 | 0.51 | 0.19 | 0.33 | 0.19 |
| 10 | 0.29 | 0.98 | 0.94 | 0.86 | 0.47 | 1.47 | 1.07 | 3.01 | 0.41 | 1.23 | 0.29 |
| 11 | 0.54 | 1.21 | 1.51 | 1.16 | 0.68 | 1.32 | 1.18 | 1.44 | 1.05 | 1.23 | 1.12 |
| 12 | 0.00 | 0.18 | 0.22 | 0.09 | 0.13 | 0.07 | 0.09 | 0.26 | 0.07 | 0.06 | 0.24 |
| 13 | 0.00 | 0.26 | 0.27 | 0.28 | 0.08 | 0.32 | 0.28 | 0.60 | 0.11 | 0.26 | 0.14 |
| 14 | 0.00 | 0.24 | 0.26 | 0.29 | 0.08 | 0.34 | 0.27 | 0.37 | 0.13 | 0.25 | 0.13 |
| 15 | 0.00 | 0.00 | 0.01 | 0.08 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 |
| 16 | 0.05 | 0.14 | 0.15 | 0.45 | 0.09 | 0.21 | 0.07 | 0.45 | 0.17 | 0.10 | 0.25 |
| 17 | 0.08 | 0.16 | 0.20 | 0.29 | 0.08 | 0.24 | 0.15 | 0.27 | 0.13 | 0.21 | 0.26 |
| 18 | 0.08 | 0.18 | 0.12 | 0.25 | 0.12 | 0.04 | 0.08 | 0.11 | 0.11 | 0.05 | 0.05 |
| 19 | 0.01 | 0.11 | 0.11 | 0.16 | 0.01 | 0.10 | 0.08 | 0.16 | 0.10 | 0.11 | 0.08 |
| 20 | 0.00 | 0.08 | 0.24 | 0.12 | -0.02 | 0.05 | 0.02 | 0.11 | 0.04 | 0.02 | 0.11 |
| 21 | 0.11 | 0.28 | 0.20 | 0.29 | 0.11 | 0.20 | 0.23 | 0.32 | 0.19 | 0.17 | 0.21 |
| 22 | 0.00 | 0.06 | 0.04 | 0.12 | 0.03 | 0.09 | 0.03 | 0.15 | 0.08 | 0.04 | 0.07 |
| 23 | 0.00 | 0.08 | 0.10 | 0.21 | 0.01 | 0.13 | 0.11 | 0.21 | 0.11 | 0.10 | 0.08 |
| 24 | 0.00 | 0.01 | -0.01 | 0.02 | 0.04 | 0.01 | 0.00 | 0.05 | 0.01 | 0.02 | 0.01 |
| 25 | 0.00 | 0.01 | 0.02 | 0.04 | 0.03 | 0.00 | 0.01 | 0.09 | 0.03 | 0.01 | 0.04 |
| 26 | 0.16 | 0.22 | 0.23 | 0.26 | 0.20 | 0.21 | 0.20 | 0.33 | 0.20 | 0.19 | 0.23 |
| 27 | 0.01 | 0.06 | 0.10 | 0.12 | 0.03 | 0.04 | 0.03 | 0.13 | 0.09 | 0.10 | 0.04 |
| 28 | 0.00 | 0.08 | 0.11 | 0.10 | 0.00 | 0.09 | 0.07 | 0.14 | 0.04 | 0.07 | 0.13 |
| 29 | 0.05 | 0.12 | 0.10 | 0.16 | 0.09 | 0.05 | 0.07 | 0.23 | 0.10 | 0.03 | 0.15 |
| 30 | 0.01 | 0.02 | 0.06 | 0.13 | 0.06 | 0.15 | 0.04 | 0.28 | 0.11 | 0.12 | 0.09 |

**Source:** Research Calculation

**Table 7. The rate of estimated relative error for regional input-output coefficients in separate sectors (%)**

| Sector | Region (1) | Region (2) | Region (3) | Region (4) | Region (5) | Region (6) | Region (7) | Region (8) | Region (9) | Region (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.09 | 0.06 | 0.28 | 0.15 | 0.27 | 0.68 | 0.81 | 0.05 | 0.28 | 2.39 |
| 2 | 0.45 | 0.08 | 0.09 | 0.47 | 0.11 | 0.04 | 0.68 | 0.15 | 0.29 | 0.46 |
| 3 | 0.01 | 0.02 | 0.02 | 0.01 | 0.02 | 0.05 | 0.58 | 0.01 | 0.00 | 0.21 |
| 4 | 0.05 | 0.27 | 0.16 | 0.09 | 0.06 | 0.10 | 0.07 | 0.29 | 0.07 | 0.91 |
| 5 | 1.91 | 0.20 | 1.29 | 1.10 | 0.04 | 1.65 | 0.74 | 0.79 | 2.18 | 0.17 |
| 6 | 0.69 | 0.41 | 0.05 | 0.13 | 0.12 | 0.13 | 0.07 | 0.64 | 0.19 | 0.03 |
| 7 | 0.15 | 0.07 | 0.04 | 0.10 | 0.08 | 0.06 | 0.02 | 0.19 | 0.08 | 0.20 |
| 8 | 0.87 | 0.52 | 0.83 | 0.95 | 0.48 | 0.45 | 3.50 | 1.80 | 0.28 | 0.47 |
| 9 | 0.16 | 0.10 | 0.07 | 0.16 | 0.20 | 0.33 | 0.02 | 0.23 | 0.18 | 0.15 |
| 10 | 0.70 | 0.55 | 0.44 | 0.57 | 1.20 | 0.47 | 0.83 | 2.03 | 0.50 | 0.00 |
| 11 | 1.23 | 0.67 | 0.09 | 3.01 | 0.59 | 0.96 | 1.63 | 1.46 | 1.24 | 0.43 |
| 12 | 0.18 | 0.04 | 0.32 | 0.00 | 0.20 | 0.22 | 1.28 | 0.60 | 0.16 | 0.09 |
| 13 | 0.70 | 0.94 | 0.23 | 0.12 | 1.51 | 0.78 | 0.05 | 1.40 | 0.85 | 0.07 |
| 14 | 0.24 | 0.72 | 0.99 | 0.02 | 0.64 | 0.91 | 1.39 | 0.45 | 0.78 | 0.59 |
| 15 | 0.04 | 0.45 | 0.28 | 0.66 | 0.13 | 0.01 | 0.21 | 0.13 | 0.18 | 0.21 |
| 16 | 0.16 | 0.17 | 0.09 | 0.04 | 0.09 | 0.02 | 0.21 | 0.19 | 0.12 | 0.23 |
| 17 | 0.45 | 0.12 | 0.54 | 0.26 | 0.24 | 0.09 | 0.25 | 0.19 | 0.43 | 0.64 |
| 18 | 0.13 | 0.27 | 0.04 | 0.02 | 0.27 | 0.02 | 0.11 | 0.22 | 0.06 | 0.06 |
| 19 | 0.14 | 0.15 | 0.06 | 0.14 | 0.11 | 0.15 | 0.09 | 0.14 | 0.18 | 0.17 |
| 20 | 0.66 | 0.56 | 0.26 | 0.31 | 0.22 | 0.17 | 0.26 | 0.31 | 0.14 | 0.63 |
| 21 | 0.10 | 0.13 | 0.03 | 0.01 | 0.09 | 0.10 | 0.09 | 0.12 | 0.08 | 0.12 |
| 22 | 0.08 | 0.30 | 0.08 | 0.80 | 0.29 | 0.11 | 0.27 | 0.13 | 0.09 | 0.22 |
| 23 | 0.08 | 0.04 | 0.22 | 0.00 | 0.10 | 0.21 | 0.23 | 0.02 | 0.27 | 0.33 |
| 24 | 0.01 | 0.05 | 0.01 | 0.02 | 0.01 | 0.00 | 0.02 | 0.01 | 0.02 | 0.03 |
| 25 | 0.04 | 0.04 | 0.04 | 0.02 | 0.06 | 0.04 | 0.08 | 0.04 | 0.09 | 0.13 |
| 26 | 0.01 | 0.06 | 0.02 | 0.03 | 0.05 | 0.03 | 0.03 | 0.04 | 0.04 | 0.11 |
| 27 | 0.01 | 0.01 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 | 0.00 | 0.02 | 0.01 |
| 28 | 0.07 | 0.16 | 0.09 | 0.20 | 0.03 | 0.29 | 0.16 | 0.04 | 0.22 | 0.36 |
| 29 | 0.05 | 0.11 | 0.02 | 0.02 | 0.10 | 0.04 | 0.02 | 0.07 | 0.01 | 0.03 |
| 30 | 0.05 | 0.00 | 0.01 | 0.01 | 0.03 | 0.01 | 0.02 | 0.03 | 0.05 | 0.03 |

**Source:** Research Calculations

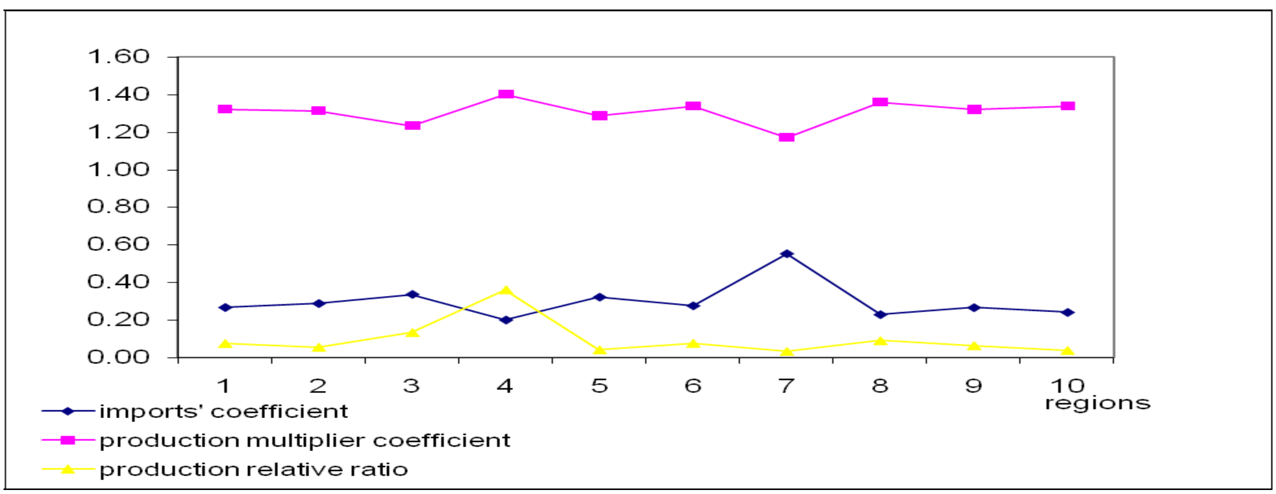


Diagram 1. Production relative ratio, average production multiplier coefficients and average imports' coefficients **(regions)** **Source:** Research Calculations.