Construction of Regional Input-Output Table and Its Applications: the case of Yazd Province

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ABSTRACT

This paper focuses on the construction and application of a regional input-output table for Yazd province in the centre of Iran. This is the first regional input-output table, which will reveal the economic structure of the region and subsequently to be employed for regional planning by Plan and Budget Organization, Yazd Division, in Iran. The table covers twenty two sectors with the separate export and import vectors which is the main advantage of the table as compared to the other tables constructed so far in Iran.

Constructing a survey based regional input-output table is a difficult task especially if the required data for certain region have not been already prepared. According to the literature, it is observed that there are variety of non-survey and semi survey techniques. In the case of Yazd, a semi survey based method has been used to construct a twenty two sector input-output table in which almost eighty percent of necessary data are survey- based and for the rest of data we employed the necessary data collected by survey, data recorded, research projects and finally from the experts.

Key words: Regional input-output table, Yazd, Multipliers

1. Introduction

Much literature have emerged on the method of constructing regional input-output table since was introduced in 1950's. Many different techniques have been introduced. Generally, three main techniques are all the range: survey, semi survey, and non-survey based. Each technique highlighted with an advantage; for survey based accuracy with high cost, for non-survey based low cost and less accuracy and semi survey based technique is at the middle of two other techniques: less accuracy and less cost.

This paper gives details on the technique of constructing a regional input-output table for Yazd province, a province in the centre of Iran. The application of Yazd input-output table will be explored. For this purpose, first we explore the economic structure of Yazd province. Second, describes the technique used in the construction

of the regional input-output table. The third; analysis the regional table and the multipliers calculated from the table. Finally, the results will be drawn.

2. Socio-Economic Structure of Yazd Region

Yazd was a part of Esfahan province until 1973 became an independent province. Yazd province comprises ten cities of: Yazd, Bafgh, Ardakan, Mehriz, Abarkooh, Mehriz, Maybod, Sadoogh, Khatam, Tabas and Taft. Yazd is the fourth largest provinces in Iran with 128.800 kilometer square area (7-8% of total area of Iran). In Figure 1- Yazd is shown at the centre of Iran.

Figure 1- Map of Yazd Province as a central Province of Iran

The province has a population of 891137 people, according to the Plan and Budget Organization estimation and it is almost 1.27% of total population of Iran. Yazd is the fourth least populated province among 28 provinces in Iran (SCI 2003 p. 67). Demographic characteristic population of cities with their shares in Yazd province is described in Table 1. Yazd has a predominantly urban population about 77.7% . the

most populated area is Yazd which is the centre of the province and Tabas and Maybod are the second and third-largest conurbations in the province. Apart from these three cities with Maybod, Ardakan and Abarkooh the rest of the people live in the small towns and rural areas. The human development index (HDI) for province is 0.61689.

Table 1- Demographic Picture of Cities of Yazd Province in 2002 (person)

Citry	Total (person)	Percent	Women (person)	percent	Men (person)	percent	Number of Household	percent
Abarkooh	42553	4.78	20.762	4.79	21.791	4.76	10.212	4.64
Ardakan	6114	6.86	29.968	6.92	31.172	6.80	15.069	6.85
Bafgh	48564	5.45	23.588	5.45	24.976	5.45	11.688	5.31
Taft	5172	5.80	25.603	5.91	26.117	5.70	13.814	6.28
Khatam	3002	3.37	14.596	3.37	15.424	3.37	6.659	3.03
Sadoogh	2816	3.16	13.611	3.14	14.549	3.18	7.108	3.23
Tabas	63973	7.18	31.681	7.32	32.292	7.05	14.912	6.78
Mehriz	45192	5.14	22.407	5.17	23.385	5.10	11.436	5.20
Maybod	62287	6.99	29.606	6.84	32.681	7.13	17.84	8.11
Yazd	456928	51.27	221.189	51.08	235.739	51.46	111.271	50.58
Total	**891137**	**100**	**433.007**	**100**	**458.13**	**100**	**220.009**	**100**

Source: Management and Planning Organization Yazd Division (2004)

According to the last information the labor force in region is 292567 people in 2002. 250938 people were classified as employed and the rest 41629 people unemployed in other word 14.2% unemployment rate, while for the national was 12.4% in the same year. The unemployment rate in Yazd was increased according to experts' estimation in 2003 and 2004, because at the national level is also increased.

A comparison has been made between the relative share of employment by sector of the Yazd province with the national level in Table (2). The result reveal that sectoral profile in region is not so close to the national average especially with in providing lower order for agriculture sector and strongly higher orders in manufacturing sectors with more than 40% of employment for both. So, is not too wrong if we entitle this province as a manufacturing province. Whereas, the differences for other sectors are not significant.

Yazd is located in the very dry area and the climate is not proper for agriculture. Furthermore, lots of mining types are to be found in the region so that the region has a larger mining sector than national relatively with potential for producing types of

tiles. Among manufacturing sub-sectors, non-metal industry has the most important role and then the textile industry.

Table 2- Relative share of employment by sector in Yazd province compared with the National in 2002

Sector	Employment[1] (person)	Yazd[2] (percent)	National[3] (percent)
Agriculture	66775	13.4	26.9
Fishing	100	0.02	0.5
Mining	6478	1.3	0.7
Manufacturing	139878	28.07	19.2
Utility	5930	1.19	1
Construction	58303	11.7	9.8
Wholesale and retailer	63436	12.73	14
Restaurant and hotel	2242	0.45	0.7
Transport and communication	40414	8.11	7.3
Banking	7674	1.54	1.1
Estate	5282	1.06	1
Defense	37972	7.62	6.8
Education	38769	7.78	7
Health and social security	11262	2.26	1.9
Other services	13853	2.78	2.1
Total	**498319**	**100**	**100**

Sources: 1- Authors' Estimation according to the employment at national level and the share of Yazd province from the national in 2002.
2- Statistical Letter of Yazd Province 2002. 3- Statistical Centre of Iran, 2003Year Book

The share of output in region is 1.28% of gross national product (GDP) (SCI 2003 p. 782) and its values added is 1.26% of national value added. With this information we can conclude that productivity of the population in Yazd is about average of national, *i.e.* 1.28% of total population have 1.28% of the GDP production.

3. Historical background of Regional Input-Output Tables

Historical background of providing regional input-output table in Iran can be classified into three steps: first: the period of 1972-1990, the second 1990's and the last period 2000's. Each period is given details briefly in the following:

First, The Battelle Institute made a contract in 1972 with the Plan and Budget Organization (PBO) to prepare a regional plan within the Fifth Five-Year Plan before the Islamic Revolution. First, they provided an 18-sector national IO table and then used this table as a base to estimate the regional inputs coefficient. So they provided eleven regional[4] tables for 1972, and used these for planning by taking 1978 as the time horizon, and using the adjusted RAS method and benefiting from the help of Iranian expert opinion for the input coefficients. This method is debatable especially in the case of Iran. Although the experts' opinions are useful, in a high aggregated IO table in which each sector is composed of many various products, it was not easy to find an expert who is proficient in all the activities in one sector. For example in agriculture it was not possible to find a person who was an expert in farming, livestock, fishing, and forestry. On the other hand, the use of many experts for each sector would have incurred a huge cost. These tables are well known as the first regional IO tables in Iran and were rarely put into operation for planning purposes[5] (Banouei 1993).

Second, the first serious attempt on the regional analysis refers to the 1990's in which at least eight regional input-output tables were compiled in an academic context (MA dissertations, PhD thesis, or reports) or by Regional Plan and Budget Organizations. These regions are as follows: Esfahan (Plan an Budget Organization of Esfahan 1999), East Azarbayjan (industrial Management Organisation of East Azarbayjan 2003), Fars (Gholizadeh 1996), Khorasan (Ain Afashr 2002), Kordestan (Javaheri 2003) , Kerman (Dashtban 1994) and Mazandaran (Naseri 2001). These tables were constructed mostly by non-survey method *i.e.* Simple Location Quotient (SLQ) technique for each single region, with a residual net regional export vector. Tables use mainly secondary data to adjust National Tables to represent more closely local regional economies (Banouei and Banouei 2002).

Third, providing regional accounts for twenty eight provinces of Iran by SCI (SCI 2000) [6] brought opportunity for planners to compile regional IO for all the provinces. Among them Yazd regional input-output table is the first regional table in Iran in which sectoral export and import vectors have been estimated separately from survey

[4] In the Battelle Project Iran had been divided into 11 regions.
[5] The period of preparation concurred with the onset of the Islamic Revolution in 1979.
[6] Iran has been divided into 28 provinces, which for the purposes of the division will be used to describe for region.

data and is the most advantage of this table. Details of constructing Yazd IO table are described in the next section.

4. Methodology

According to the literature on the constructing regional input-output table, three main methods have been established: survey base, semi-survey (hybrid or partial-survey) base, and non-survey base methods. Traditional survey based method is based on a careful compilation of the results with high cost and time consuming with high accuracy. On the other side, non-survey base method mostly rely on data from national input-output table together with limited regional data which is less expensive but may be of questionable with respect to accuracy. Semi – survey based has appeared in response to dissatisfaction with the cost of survey method and limited accuracy of non-survey method. To distinguish between semi-survey and non-survey technique, is the use of secondary and survey data may exist in the region to modify individual elements of the table whose other components are derived with synthetic techniques. So, hybrid method combines non-survey technique for estimating regional direct requirements table with superior data, which can be obtained from experts, surveys and any other reliable data.

Difficulty of compiling input-output table for a single region appears to be much more than national table. As the national economy has its own precise border but may not exist in a region for export and import of goods and services, which makes work tedious. Moreover, labor and capital are freely transferable in regions. As a result the regional economy is much more open than the national. Although national economy is less open, export and import data are prepared but for regional economy to have access to such data have not been already prepared in Iran.

We used a semi survey based method of constructing Yard IO table in which more than 80% of the used data are collected by survey, sample collection or registered data, and the rest, from the experts. This table is constructed according to the regional accounts, that were prepared by SCI (2000). Moreover, we also employed more than 50 sample surveys that were also prepared by SCI for same year. Furthermore, we also got benefit from balance sheet and financial statement of many organizations:

plan and budget Yazd division, Regional power company, Water organization, and in some cases, data collected by sampling.

5. Construction of Regional Table

This part outlines the construction of Yazd province IO table. A series of steps has been involved in developing IO table:

- Defining regional sectors
- Transaction table
- Final demand Table
- Value added Table
- Export and import vectors

In the current study table includes 22 sectors, the main restriction for the number of sectors was data availability in the region in 2000. Sectors are as follows;

- Agriculture,
- Livestock,
- Mining,
- Food and Drink Industry,
- Textile and Leather Industry,
- Woods Industry,
- Paper and Printing Industry,
- Chemical Industry, Nonmetal Industry,
- Nonmetal industry
- Metal Industry,
- Machinery Industry,
- Other Industry,
- Utility,
- Construction,
- Wholesale and Retailer,
- Hotel and Restaurant,
- Transportation,
- Communication,
- Entertainment,

- Insurance and Banking,
- Education,
- Other Services.

Transaction Table is a square $N \times N$ matrix in which N is the number of sectors. The number of sectors in the table depends on the data availability directly. For this approach, 22 sectors are selected. Transaction table is provided mostly according to the results of the basic project on the region and if not, we use the national data with adjusted according to the expert's opinion. The total intermediate consumption and total output for each activity are collected from regional accounts.

Sectoral value added is derived from the difference between total output's activity and total intermediate consumption. Total value added by sector includes two parts: compensation of employment and operation surplus. As the data on regional sectoral compensation of employment are not accessible, we estimated them from the national sectoral wages and adjusted according to the number of regional sectoral employment and help from experts.

Final Demand Table includes: household expenditure, government expenditure, nonprofit organization expenditure, capital formation, inventory, and export. Regional household expenditure used from the detailed result of annual reports on rural and urban household income and expenditure. Whereas for the non profit organizations are obtained from the recorded data in the region. Data of the government expenditure come from Budget Law for regional economy. Capital formations are obtained from the results of statistical projects and recorded data. Inventory is calculated from the results of statistical projects on manufacturing, mining and for the rest consider as a balanced items.

Calculation of the sectoral regional export and import could be considered to be the most advantage of the regional input-out table of Yazd province and the main contribution of this paper. For estimation of sectoral exports and imports, the following steps have been followed:

First: the physical data on exported goods from Yazd provice to the rest of the economy and imported goods from the rest of the economy have been taken directly from Transportation Terminal Organization Report in 2000.

Second: each good (imports and export) have been multiplied by their corresponding average prices in 2000.

Third: all goods (imports and export) have been classified according to the sectors of the Yazd table.

Fourth: since the information on exports and imports services were not available, they estimated on net basis using demand supply pool approach while balancing the final table.

6. The Structure of Input-Output Model

The notion of input-output analysis can be traced to the early development of economic thought. Input-output analysis is a method of systematically quantifying the mutual interrelationships among the various sectors of a complex economic system. The economic system may be as large as a nation or even the entire world economy, or as small as the economy of a region or metropolitan area or even a single enterprise. The size of economic system does not affect the approach. Since the fundamental principle of the input-output framework is to analyse the interdependence of industries in an economy, the term inter-industry is also used for input-output analysis (Leontief 1985). An input-output model in its basic form consists of a system of linear equations, in which each equation describes the distribution of an industry's economy (Miller and Blair 1985). It is constructed from observed data for a specific economic area. The economic activity in the area must be divisible into a number of segments or producing sectors. These inter-industry or intersectoral flows are measured for a particular time period and, in monetary terms, in what is known as a transaction table.

The main body of the transaction table consists of a collection of industries and sectors and shows the intersectoral flows, providing many links between different sectors and industries within the economy. An input-output table is made up of rows and columns, rows representing sectoral output and the columns representing sectoral purchases. The figures entered in each column of the table describe the input structure of the corresponding sector, whereas each row shows what happens to the corresponding output sector.

An input-output table also consists of final demand and value added sections. As in an economy there are sales to purchasers who are more external or exogenous to the industrial sectors that constitute the producers in the economy, e.g. households, government, and foreign trade. The demand for these units and the magnitudes of their purchases from each of the industrial sectors are generally determined by

considerations that are relatively unrelated to the amount being produced in each of the units. The demand from these external units, since it tends to the much more for goods to be used as such and not to be used as an input to an industrial production process, is generally referred to as final demand (Miller and Blair 1985). Final demand covers total consumption (private or public), capital formation, and exports. The row sum of intermediate demand and final demand equals the gross value of production. Similarly, the column sums of intermediate demand plus value added also equal the gross values of production of an industry.

The transaction table is the statistical basis of the input-output system, and is applied to calculate what is called unit cost structure or technical coefficients. Technical coefficients describe inputs required from each industry to produce one dollar's worth of a given industry. These coefficients are calculated by dividing each entry in an industry's column by the total gross output for that industry. If input coefficients are relatively stable or if they can be adjusted on the basis of new information, the usefulness of the table of direct coefficients is apparent. By making use of such a table, the management of a typical firm in an industry could tell in advance how much it would have to buy directly from each of its supplying industries when it adds to its own total production.

If the economy is divided into N sectors, and if we denote by X_i the total output of sector i , X_{ij} the inter-industry sales by sector i to sector j, and Y_i the total final demand of sector i's product, we can write:

$$X_i = X_{i1} + X_{i2} + \cdots + X_{in} + Y_i \quad (1)$$

According to the definition of a technical coefficient, in equation 2.1, we may write

$$X_i = a_{i1} X_1 + a_{i2} X_2 + \cdots + a_{in} X_n + Y_i$$

If we write the above equation for all N sectors the results are as follows:

$$X_1 = a_{11} X_1 + a_{12} X_2 + \cdots + a_{1n} X_n + Y_1$$
$$X_2 = a_{21} X_1 + a_{22} X_2 + \cdots + a_{2n} X_n + Y_2$$
.
.
.
$$X_n = a_{n1} X_1 + a_{2n} X_2 + \cdots + a_{nn} X_n + Y_n$$

These equations serve to make explicit the dependence of inter-industry flows on the total outputs of each sector. In these equations $Y_1, Y_2, ..., Y_n$ are given numbers, a_{ij} are known coefficients, and the $X_1, X_2, ..., X_n$ are unknown and to be found. Therefore, if bringing all X terms to the left and reduce them a set of linear equations with N unknowns, $X_1, X_2, ..., X_n$, N equations are produced as follows:

$$(I - a_{11})X_1 - a_{12}X_2 - \cdots - a_{1n}X_n = Y_1$$
$$-a_{21}X_1 + (I - a_{22})X_2 - \cdots - a_{2n}X_n = Y_2$$
$$.$$
$$.$$
$$.$$
$$-a_{n1}X_1 - a_{2n}X_2 - \cdots + (I - a_{nn})X_n = Y_n$$

and the reduced form of the above equations and solving for X we can write;

$$X = AX + Y$$
$$X = (I - A)^{-1}Y \qquad (2)$$

Equation 2 helps us to calculate sectoral output, the direct and indirect effects of changes in final demand on output. The direct effect shows the direct purchases of a given industry from all other industries within the processing sector for each dollar's worth of current output. But it does not show the total addition to output due to additional sales to final demand. An increase in final demand for the products of an industry within the processing sector will lead to both direct and indirect increases in the output of all industries. The static model (2) explains the mutual interdependence of the distinct sectors of the national (or regional) economy in terms of a given set of structural coefficients, a_{ij} and Leontief inverse $(I - A)^{-1}$. With the help of Leontief inverse index, is possible to obtain sectoral multipliers at regional or national level in which they are prepared.

Economists have been interested in measuring the economic impact upon one variable from a given change in other variables. The multipliers are very useful analytical tools in an IO framework, which shows the details of how multiplier effects are worked out throughout the economy. The impacts on the industries most directly affected can be measured with little difficulty. But, when one recognises the interdependence of economic activities, it is apparent that the total impacts will not be limited to those industries directly affected. Impact analysis is one of the most important uses of input-output, it is usually employed when the changes are expected to occur in the short-run.

When longer term and broader changes, for example more than five years, then we are dealing with forecasting and projection. According to definition, multiplier yields on the differences between the initial effect of an exogenous (final demand) change and the total effects of that change. Total effects can be defined in two ways: direct and indirect effects (simple) and direct and indirect and induced (total) effects. Three of the most frequently used types of multiplier are those that estimate the impacts of the exogenous changes on a) outputs of the sectors in the economy (output multiplier), b) income earned by households because of the new outputs (income multiplier), and c) employment that is expected to be generated because of the new output (employment multiplier). "An output multiplier is defined as the total value of production in all sectors of the economy that is necessary in order to satisfy a dollar's worth of final demand for sector *j*'s output" (Miller and Blair 1985). In other words, an output multiplier is the ratio of direct and indirect effects to the initial effect. If the initial effect is noted by ΔY, and changes in output by ΔX, the output multiplier is $\Delta X / \Delta Y$. An income multiplier shows "the impacts of final demand spending changes on income received by households" (labour supply) (Miller and Blair 1985).

7. Regional Multipliers

After a review of theoretical background of the input-output analysis, in this section attempt has been made to calculate the regional multipliers for Yazd province and compare them with the national levels. Although we were also interested in the measure of income and employment multipliers, because of lack of enough data on sectoral employment and income in detail were not able to work out all. In this part output multipliers are reported. Calculated were made using the input-output software Package GRIMP (West 1993). The full set of output, employment, and income multipliers are shown in the Table 3. These figures can give the guideline to policy makers in the region formulate their decisions.

The largest output multipliers are in the construction sector, then Textile and Leather industry and livestock are followed up. While wood industry and wholesale and retailer have relatively small multipliers and are located at the bottom of the Table 3. The results of output multipliers are broadly in line with our expectation respect to the Yazd economy which is mostly based on textile industry and livestock.

The outcomes of employment multipliers be evidence of after other industry, education has most potential to create more jobs. Moreover, communication, textile and leather industry and wholesale and retailer are the following sectors. Chemical, machinery and metal industries located at the least important sector respect to the employment multipliers.

The results of income multipliers revealed that the group of services has high potential to create income for the region. Education, insurance and banking, recreation, other services, and construction sectors are 5 top of income creation in Yazd region. Whereas, woods industry, agriculture, and chemical are the least income creation sectors.

Table 3- Regional Output, Employment, and Income Multipliers

Sector/ industry	Output Multiplier	Output Multiplier Rank	Employment Multiplier	Employment Multiplier Rank	Income Multiplier	Income Multiplier Rank
Agriculture	1.34	11	0.009	17	0.038	21
Livestock and Fishing	1.61	3	0.024	8	0.072	16
Mining	1.32	13	0.009	18	0.118	11
Food and Drink	1.46	6	0.009	16	0.059	19
Textile and Leather	1.61	2	0.039	4	0.162	9
Woods	1.15	21	0.032	7	0.032	22
Paper and Printing	1.25	18	0.008	19	0.064	17
Chemical	1.25	17	0.002	22	0.054	20
Nonmetal	1.43	7	0.011	15	0.175	8
Metal	1.32	12	0.006	20	0.092	14
Machinery	1.31	14	0.004	21	0.063	18
Other industry	1.42	8	0.065	1	0.104	13
Utility	1.47	5	0.011	14	0.184	7
Construction	1.71	1	0.026	6	0.256	5
Wholesale and retailer	1.10	22	0.026	5	0.079	15
Hotel and Restaurant	1.55	4	0.023	10	0.110	12
Transportation	1.28	15	0.016	13	0.145	10
Communication	1.18	20	0.041	3	0.192	6
Insurance and Banking	1.26	16	0.020	11	0.448	2
Recreation	1.39	9	0.025	9	0.387	3
Education	1.21	19	0.049	2	0.767	1
Other Services	1.34	10	0.019	12	0.329	4

Source: Authors' calculation

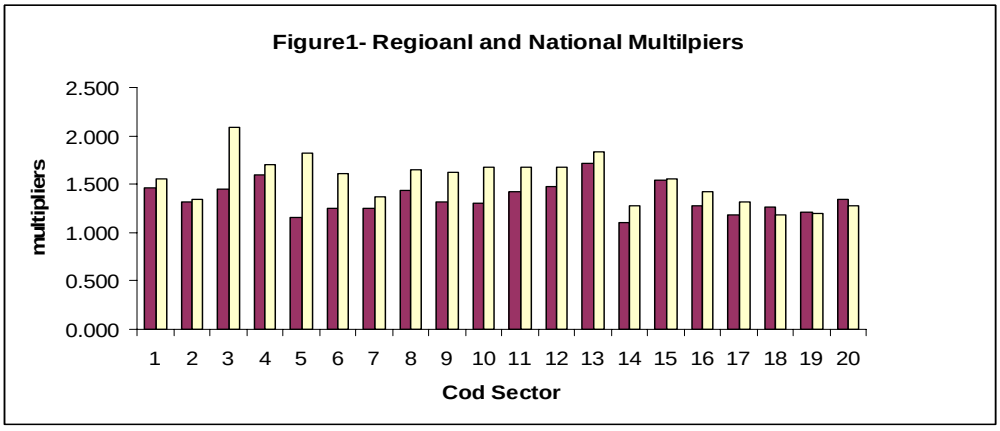
Moreover a comparison has been made between regional output multipliers and national multipliers for the same year (2000) from national input-output tables. National IO table for 2000, was constructed by Ministry of Power in the 45-sector

classification whereas regional table has a 22-sector classification. For this purpose national table has to be aggregated in to 20 sectors for consistency with regional table. The relative magnitudes of the Yazd and national multipliers are as expected *i.e.* almost all of the national multipliers are greater than regional except for insurance, banking and education. The results of comparison are shown in Table 4 and Figure 1.

Table 4- Comparison Between National and Regional Multipliers

Sector	Cod sector	Yazd Multipliers	National Multipliers
Agriculture	1	1.337	1.555
Mining	2	1.321	1.342
Food and Drink industry	3	1.456	2.085
Textile and Leather industry	4	1.602	1.698
Woods industry	5	1.154	1.828
Paper and Printing industry	6	1.253	1.603
Chemical industry	7	1.254	1.374
Nonmetal industry	8	1.430	1.653
Metal industry	9	1.322	1.616
Machinery industry	10	1.305	1.679
Other industry	11	1.421	1.673
Utility	12	1.472	1.677
Construction	13	1.712	1.835
Wholesale and retailer	14	1.098	1.271
Hotel and Restaurant	15	1.537	1.557
Transportation	16	1.280	1.429
Communication	17	1.179	1.315
Insurance and Banking	18	1.261	1.185
Education	19	1.210	1.202
Other Services	20	1.344	1.273

Source: Authors' calculation



8. Conclusions

This paper focuses on the construction and application of a regional input-output table for Yazd province in the centre of Iran. We used a semi survey based method of constructing Yard IO table in which more than 80% of the used data are collected by survey, sample collection or registered data, and the rest, from the experts. This table is constructed according to the regional accounts, that were prepared by SCI (2000). Moreover, we also employed more than 50 sample surveys that were also prepared by SCI for same year. Furthermore, we also got benefit from balance sheet and financial statement of many organizations: plan and budget Yazd division, Regional power company, Water organization, and in some cases, data collected by sampling.

Yazd input-output table is constructed in twenty-two sectors in which calculation of the sectoral regional export and import could be considered to be the most advantage of the regional input-out table of Yazd province and the main contribution of this paper. For estimation of sectoral exports and imports, products are divided into two groups: physical goods and services. data on the exported and imported goods are available. Since the information on exports and imports services are not accessible, they estimated on net basis using demand supply pool approach while balancing the final table. The application of this process can be applied to all provinces in Iran to give help to the planner in the region making decisions.

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