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Investment Priorities in Iran's Economic Sectors: Application of Input-Output Table[1]

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Abstract

Generating effective employment opportunities is one of the principal challenges faced by development planners in Iran. If investment projects are undertaken on the basis of sectoral priorities in production and employment, the economic and social problems emanating from unemployment will be reduced, helping the Country's process of development. In this paper, an attempt is made to identify key sectors in terms of generating output and employment in the economy of Iran as a results of increased investment. The novelty of our approach is to demonstrate how inter-industry relations (input-output table), investment coefficients, and incremental labor-output and capital-output ratios can be integrated to accomplish the above objective. The empirical application of this approach has revealed the pronounced effect of investment on economic and employment growth potential of the service sector and some of manufacturing subdivisions like clothing and leather, other basic metal industries, food and textile manufacturing and wood paper and printing industries.

Keywords: Employment Multiplier, Investment Coefficient, Input-Output, Incremental Capital and Labor Output Ratio

1- Introduction

Persistent unemployment and underemployment continue to pervade many developing countries, including Iran. The Problem of unemployment in Iran has become intensified since 70 percent of the population is less than 30 years of age (Luxford, 2004). At present, Iran is faced with two considerable internal and one external phenomenon: on the internal side, the young age of the population and the appearance of favorable conditions for domestic and foreign investment

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opportunities and on the external side, the globalization phenomenon and its consequent intensification of competition in international markets.

The above problems reveal the necessity of recognition and measurement of true unemployment and formulation of those economic policies that give priorities to those industries with greatest output and employment potential, given the country's financial, human and capital resource constraints. Output and employment potential means the capability of a sector to generate direct and indirect output and employment throughout the economy. An I-O table helps to identify direct and indirect output as well as employment potential of each sector and thus identify key industries in the economy.

Moreover, on the basis of such policy formulation, investment efficiency increases by directing government efforts to rationally allocate financial investment credits to those economic sectors that have a better chance to generate employment and output. This not only reduces the probability of inefficient and under utilization of human physical and financial resources, but it also provides the greatest tendencies for the creation of job opportunities for the young job-looking population in the country.

Therefore, the simultaneous appraisal of investment, employment and growth feasibility of different economic sectors must be the close focus of the country's planning apparatus. With respect to the intense pressure of international competitiveness, accelerating the rate of economic growth and employment opportunities are so much important that they can undermine all other economic or political problems in today's condition in Iran.

Against the background of the above arguments, the major objective of this paper is to identify the leading output and employment generating sectors in the economy of Iran. Given the rising level of unemployment and underemployment, it is important to identify these sectors, particularly in times of rising unemployment. In other words, if rising and persistent unemployment is deemed to be an important socioeconomic phenomenon, one of the solutions would be to stimulate economic activity in high employment generating industries. The rankings and empirical analysis undertaken in this study will shed some light on the sectoral potential in relation to the creation of jobs in the economy. To accomplish that objective, this study uses a 'closed' I-O technique.

In this regard, the 1999 Input-Output matrix of Iran's economy[1] is used together with sectoral investment coefficients and incremental capital and labor output ratios, based on Iran's national income account data.

The rest of the paper proceeds as follows. Section II discusses briefly static open and closed input-output techniques. Section III presents a summary of the two methodologies that have been used in the literature, namely *open* as opposed to *closed* I-O techniques, to identify key sectors. Section IV briefly discusses the methodological framework of the paper. Section V provides some concluding remarks.

II- I-O as a Development Device

I-O tables are one of the most important tools for economic structure analysis, forecasting and planning. This table can be used for a variety of development plan objectives, from sectoral forecasting of demand, production, employment and investment to technical change and its impact on productivity, profit and wages (Leontief, 1988).

In the study of economic development, I-O analysis shows in detail how changes in one or more sectors of the economy will affect the total economy (Miernyk, 1956; Sadoulet and de-Janvry, 1995). As a theory, I-O analysis is built on a number of assumptions: First, the economy is composed of N endogenous sectors producing N different commodities, and one exogenous sector (final demand). Second, each commodity is produced by one production sector. Third, there is a stable and linear relationship between the inputs and the level of output of that sector. Fourth, there are constant returns to scale such that there are no external economies or diseconomies and finally, there is no substitution of intermediate inputs.

The economists as well as policy makers and development planners have long been interested in measuring the *total* impact upon employment, income and output that result from an increase in final demand. In this regard, a useful analytical technique, the multiplier, was developed by J.M. Keynes. Since

1- This table was provided and kindly submitted to the authors by Dr. Ali Asghar Banouei at University of Allameh Tabatabaie in Iran.

Keynes dealt in broad aggregates, his income and employment multipliers were also highly aggregated.

Although the concept of aggregate multiplier is a useful analytical tool and it can play an important role in public policy decisions, but it has three shortcomings: i) it does not show the details of how multiplier effects are worked out throughout the economy; ii) it ignores the interdependencies of economic activities and iii) it shows the over-all impact, rather than revealing detailed sectoral multipliers.

However, when one recognizes the interdependent nature of economic activities, it becomes apparent that the *total* impact of an investment injected to an economy will not be limited to a sector directly affected. The usefulness of input-output technique as a planning apparatus is that it can be manipulated to: 1) identify labor and capita-intensive sectors of the economy; 2) make consistent disaggregated sectoral output and employment projections for a given change in final demand and 3) Identify priorities that should be given to those economic sectors which have relative advantage in generating output and employment for a given amount of investment undertaken.

Aside from its advantages, the input-output technique has its own limitations such as: i) these tables are models by deterministic nature that do not allow the effect of changes in production technology on estimated results (i.e. income or employment multipliers, etc.) in the short run. Therefore the use of such models is not appropriate for medium and long-term projections and ii) the results obtained from model estimates depend upon the number of sectors in the table and as a consequence, drawing any development plan on the basis of such models is sensitive to the level of table desegregation.

In practical application of static I-o techniques, the relevant literature points to two types of I-O models:

Open Leontief model If, besides the *processing* industries, the model also contains an 'open' sector (say, households) which exogenously determines a final demand (non-input demand) for the product of each processing industry and which supplies a primary input (say, labor service) not produced by those processing industries themselves, the model is called an *open model.* The Leontief inverse of an open model reflects only the *initial*, *direct*, and *indirect* effects of a change in final demand on output of a sector or total output of the economy.

Closed Leontief system. Input-output model where labor and consumption demand are included into the inter-industry transaction table, hence considered as another industry, is called a closed Leontief model. The Leontief inverse of a closed model reflects not only the initial, direct and indirect effects but also induced effects of a change in final demand (Keynesian multiplier effects).

However, calculation of induced effects assumes all household income is spent on consumption. But, in practice, income is also spent on tax, insurance and so on. In addition, closing the model for households assumes the average propensity to consume the output of each sector to be constant and equal to the marginal propensities, an untenable restriction on consumer behavior. Moreover, induced effects exaggerate the magnitude of multiplier estimates and may alter the ranking of the multiplier values estimated using open models (Miller & Blair, 1985).

In our study, we use closed Leontief system because it not only incorporates the induced effects of household consumption into the linkage and multiplier analysis, but it can also be shown that how incremental labor and capital output ratios can be integrated into the output (employment) multipliers to serve the objectives of the paper.

III- Identification of Key Sectors

Determination of key sectors is important for a developing economy where, given scarcity of resources, investment decisions have to be selective. Key sectors play an important role in initiating the process of economic growth and diversification of industrial structure of the economy and a substantial part of investment should be made in the key sectors (Hazari, 1970). The concept of key sector is closely associated with the famous linkage hypothesis advocated by Hirschman (1958). A sector's relationships with the rest of the economy through its direct and indirect intermediate purchases and sales are often referred to as the sector's linkages.

The most important characteristic of a key industry is its ability to utilize a relatively large amount of other industries' output as a result of increased final demand for its own output as well as being capable of expanding its own production to accommodate intermediate demand of other sectors when final demand for their output increase (Rasmussen, 1956). Thus, key industries or sectors are said to be those with highest forward and backward linkages (FBL).

As early as 1958, Hirschman introduced the analytical concept of the key sector of the economy as a sector with FBL above average. Since that time, numerous modifications of the basic procedures for establishing the key sectors and their use on data on different economies can be found in the literature (Strassert, 1968; Hazari,1970; Laumas,1975; Bharadway, 1976; Jones, 1976; Schultz, 1970 &1977, Rao and Harmston, 1979, Hewings, 1989, Dietzenbacher, 1992) It has also been proposed that sectors with strong FBL in their inter-industry relations have been to be stimulant to economic growth and development (Laomass, 1976; Meller *et. al*, 1981).

The most widely used analytical technique by policymakers to identify key sectors in the economic system is I-O table. However there are two approaches, *closed* as opposed to *open*, in the use of I-O technique. In the following, we first present briefly quite a number of different approaches that have been undertaken in the literature within an open I-O methodological framework. Then, the closed I-O methodological approach, undertaken in this study, will be discussed in section IV.

Several methods have been proposed in the literature to determine the key sectors. In particular and within the open I-O technique, several principal criteria have been used.

1) Chenery-Watanabe Approach (CWA)

The rationale for measuring linkages between sectors rests on the assumption that the goal of rapid industrialization, hence growth, may be achieved if countries concentrate on promoting those sectors with high linkage effects (inducement) on others. Given the shortage of information on entrepreneurial skills, such an inducement mechanism might stimulate the economic activity of other sectors and thus have a multiplier effect on growth (Jones, 1976).

A number of linkage measures are suggested to capture both direct and indirect linkages; and controversies over them have led to an entire body of literature. Although the controversies are well documented (see Jones, 1976; Hewings, 1982; Cella, 1984; Sonis *et al.*, 1995; Miller & Lahr, 2001 and Sa´nchez-Cho´ liz & Duarte, 2003,), a consensus has yet to be reached.

The early attempts to identify key sectors through quantitative evaluation of FBL have been largely dependent on Chenery-Watanabe (CW) indices which were initially suggested by them to compare production structure of four countries (U.S. Japan, Norway, and Italy)[1]. The strength of the forward and backward linkages of sector i may be defined as:

Chenery-Watanabe forward and backward linkage index

$$FL_i^{CW} = \sum_{j=1}^{n} \frac{X_{ij}}{x_i} = \sum_{j=1}^{n} a_{ij} \quad \text{and} \quad BL_i^{CW} = \sum_{i=1}^{n} \frac{X_{ij}}{x_i} = \sum_{i=1}^{n} a_{ij} \qquad (1)$$

where FL_i^{CW} and BL_i^{CW} denote the forward and backward linkages of sector i for CW method and a_{ij} is an element in the matrix of direct output coefficients. The key sectors are those whose values of both backward and forward linkages are above the corresponding average. For simplicity, the linkage indicators are normalized, such that their average is equal one. The key sector is therefore the sector with both backward and forward indicators larger than one. Based on their approach, economic activities are divided into four following groups, depending on the nature of their output:

1- Intermediate primary product (low BL; high FL)
2- Intermediate product (high BL; high FL)
3- Final primary product (low BL; low FL)
4- Final product (high BL; low FL)

2) Rasmussen-Hirschman Approach (RHA)

The CW method is shown to have some disadvantages. First, they take into account only the *direct* repercussions of an increase in the output of a given industry and ignore the *indirect* repercussions which may be very significant in many cases. Second, they are only average measures and do not bring out the extent of skewness in the input or the deliveries pattern of industries. Third, these are unweighted indices, which imply that all industries are of equal importance in an input-output table. As a matter of fact, different industries occupy different degrees of importance in bringing about a structural change in

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1- Note that their emphasis was on production, rather than employment linkages.

the economy. Therefore, in an effort to identify the key sectors in an economy a weighting structure is needed to bring out the relative strength of various industries (Laumas, 1975).

Later these measures have been modified to incorporate indirect stimuli and measure of variation (Al-Momen, 1996; Jones 1976; Yotoupolos & Nugent, 1976; Schultz, 1974; and Hazari; 1970). In fact, the advancement in the traditional concepts of FBL as well as key industries came from the early work of Rasmussen (1956) and Hirschman (1958). These scholars used the Leontief *inverse* matrix in order to take account of direct as well as indirect effects of a unit increase in production of a particular industry or sector. Hirschman was the first scholar to use FBL to assign priorities to different economic sectors. According to his logic, the first priority should be given to those sectors which demonstrate highest FBL whereas the least priority belongs to those with the lowest FBL. The mathematical presentation of CW approach is as follows:

Thus, based on the Hirchman linkage hypothesis, sectors with significant linkage effects are considered to be key sectors. Many development economists including Rasmussen (1956) and Hirschman (1958) have used linkage indices in the identification of key sectors, where key sectors are defined as the sectors with above average FBL (Soofi, 1992). The mathematical representation of Rasmussen and Hirschman approach can be stated as follows[1]:

Rasmussen-Hirschman

employment coefficient matrix

$$L = \hat{l}[I - A]^{-1}F \qquad (2)$$

Where L is square matrix of employment coefficient (l_{ij} demonstrates the employment generated in sector i for a unit increase in final demand of sector j), $\hat{l}$ is a diagonal matrix with l_i (sector employment coefficient) on the

1- It should be mentioned that herein, the formulae stated for calculation of employment linkage indices with their associated measures of dispersion are analogous to those for output linkages.

diagonal,

$[I - A]^{-1}$ is Leontief inverse matrix and F is final demand vector.

3) Multiplier Analysis (MA)

The second criterion for determination of key industries is multiplier, a proxy for planner's objective(s). This method was originally proposed by Hazari (1970) who argued that, as multipliers give the total impact of an increase in final demand of a given sector, one can rank sectors according to this impact to reflect the planner's objective function. In fact, ranking sectors has been considered common in the identification of key sectors (Matalla and Proops, 1992). Hirschman used only linkage indices to define key sectors. Hazari (1970) and Jones (1976) used both linkage and multiplier criteria. Al-Momen (1997) also included income multipliers.

The employment multiplier (EM) can be shown as the sum of entries in the column vector in the L matrix in the above equation. It shows the amount of employment generated directly and indirectly throughout the economy when final demand of sector i increase by one unit.

Employment multiplier

$$EM = \left(\sum_{j=1}^{n} l_{ij}\right) \quad (3)$$

Similarly, the sum of entries in the row vector in the L matrix $\left(\sum_{i=1}^{n} l_{ij}\right)$ shows the amount of employment generated directly and indirectly when final demand of all sectors increases by one unit.

4) Rasmussen Approach (RA)

Since researchers have been interested in linkage effects of different sectors, the average stimuli by a particular sector has been normalized and compared with the overall average of all sectors. Based on the critic of CW approach, some scholars advocate the use of Rasmussen method which is based on the use of matrix multipliers instead of technical coefficients. Since the sum of the column entries of the matrix of multipliers represents the power of the sectoral backward linkage, Rasmussen called this sum the index of the power of dispersion (PD). On the other hand, the total of the row entries of the matrix of multipliers represents sectoral forward linkages and he named this sum the index of the sensitivity of dispersion (SD). Based on Rasmussen methodology and similar to the measures suggested by Bulmer-Thomas (1982), employment forward and backward linkages can be measured by the following formula:

Rasmussen power of sensitivity and power of dispersion index

$$PD_j = \frac{\frac{1}{N}\sum_{i=1}^{n} l_{ij}}{\frac{1}{N^2}\sum_{i=1}^{n}\sum_{j=1}^{n} l_{ij}} \quad \text{and} \quad SD_i = \frac{\frac{1}{N}\sum_{j=1}^{n} l_{ij}}{\frac{1}{N^2}\sum_{i=1}^{n}\sum_{j=1}^{n} l_{ij}} \qquad (4)$$

l_{ij} is an element in the employment coefficient inverse matrix (L), defined as before. However, the above indices assume linkages are evenly distributed over many sectors. Dominance of the linkage effects by a few sectors can be taken into account by using the coefficient of variation (or standard deviation) of the corresponding row and column entries in the (L) matrix (not shown here). If we call coefficients V_J and V_i respectively, then according to Rasmussen approach, sectors that show $\frac{PD_j}{V_j} \rangle 1$ *and* $\frac{SDi}{V_j} \rangle 1$ are considered key sectors in the economy.

Jones (1976) questions the use of Rasmussen's index of sensitivity of dispersion as a measure of forward linkages, arguing that there is not much economic sense in exploring what happens to an industry if all industries, no matter their size, are to expand their output by an identical unit increase. Jones finds such an identical unit-increase an unlikely situation, and instead proposes to utilize the output inverse matrix, as opposed to the Leontief input inverse matrix as a meaningful measure of forward linkages. The output inverse is calculated from output coefficients and contains elements expressing the increase in output of an industry j required to utilize the increased output brought about by a unit of primary input into an industry i.

5) Hazari Approach (HA)

One of the shortcomings of Rasmussen methodology is that it assumes all sectors or industries are of equal degree of importance in the economy and thus, are given equal weight in the estimation of FBL. It is evident that different sectors have different degree of importance in the inter-industry (I-O) linkage system (Yotopoulos and Nugent, 1976). Different measures for weighting industries according to their relative degree of importance have been suggested in the literature (Laumas, 1976). Hazari (1970) has clearly shown that the identification of key industries must be related to what he called '*policymaker's preference function*'. He claimed that this function should be conformed to the final demand of each sector relative to the total economy's final demand. Thus, in order to rank industries according to their employment generating potential, Hazari's formula can be shown as follows:

Hazari formula

$$\frac{\sum_{i=1}^{n}\left(\frac{l_i A_{ij} F_j}{W_i}\right)}{F_j} \qquad (5)$$

However, since many countries and regions provide development plans with multiple objectives, sectoral weighting schemes need a more elaborate methodology. A scheme which is based only on relative contribution of each sector to total economy's final demand seems not to be sufficient:

First, there is no simple mapping from final demand vector to policy preference function, because final demand is not a homogeneous aggregate and thus its impact on the economy could not be measured by a simple relative share of each sector final sales to total final demand. Second, final demand is comprised of different components; it is highly unlikely that the impact of each component be equal to that of another component.

In an another attempt to make up for some of the deficiencies of the linkage measures based on coefficient matrices, Cuello et al. (1992) incorporated information from outside the Leontief inverse matrix in order to obtain a more accurate measure of the economy wide importance of key industries. Cuello et al. use the original Rasmussen definition as the starting point in calculation both types of indices, i.e. also in the case of the forward linkage measure is the Leontief inverse based on input coefficients used.

Cuello et al. reformulate the traditional linkage approach by including a vector of parameters which is used in weighing the coefficients in the Leontief inverse matrix. Two different vectors are used in the analysis: the relative importance of final demand and the importance of total sectoral output

6) Diamond Approach (DA)

The employment multiplier estimates provided by most past studies ignored the extent to which employment effects are spread evenly across other sectors (Diamond, 1975). Employment linkage indices can be estimated to overcome this shortcoming. Employment policy, according to Diamond, may concentrate on maximizing employment effects in a way that such effects spreads out as much as possible throughout the economy. In that case, the primary goal of employment policy is to maximize indirect employment effects.

Based on this argument, Diamond criticized Hazari approach and argued that not only the uniform employment effects of each sector on other sectors have been ignored (i.e. ignoring V_i and V_j) but also his indices are based on the total linkage effects and also, the net effects as well as secondary indirect induced effects are not incorporated into the analysis. So, he transformed Rasmussen (L) matrix into two new matrices (L') and (L"). In the first transformation, direct labor input coefficient of each sector is subtracted from the corresponding entry in the diagonal of the labor coefficient inverse matrix (L). In the second transformation, the elements in the diagonal of the (L) matrix are substituted by zero numbers. With the use of newly derived matrices, the above Rasmussen indices are then computed.

7) Elasticity Approach (EA)

Mattas and Shrestha (1991) argued that the linkage and multiplier approaches, which are widely used in the literature, could mislead decision makers about the identification of the key sectors because the sectoral ranking based on employment linkages may identify relatively small industries as very important, or large-sized sectors as unimportant. So, they proposed input-output elasticity approach that can provide a new insight for the determination of sectoral priorities.

They claimed that their approach was better than linkage and multiplier analysis because it takes into account the sectoral share of output. Their approach allows policy makers to concentrate not only on the highest linkages and multipliers, but also on the sector's share of an economy. Their approach helps decision makers' attempts to identify key industries in their development strategy (Imansyah, *et. al.*, 2000). It can be shown that the total output and employment elasticities can be measured in the following way:

Input-Output production and employment elasticities

$$TOE_{XF_J} = (\sum_{i=1}^{n} r_{ij})\frac{F_j}{X} \text{ and } TEE_{XF_j} = \left[\frac{\sum_{i=1}^{n}(\frac{L_i}{X_j})r_{ij}}{(\frac{L_j}{X_j})}\right]\left[\frac{F_j}{X}\right] \quad (6)$$

where *TOE* measure output elasticity, *TEE* measures employment elasticity, X_j output of sector j, X total output, r_{ij} an element in the Leontief inverse coefficient matrix, F_j final demand of sector *j*, and L_i is employment in sector *i*.

8) Hypothetical Extraction Approach (HEA)

8-1- The Original Extraction Method Strassert (1968) suggested the extraction method for the first time. The basic idea of Strassert's method is to extract one sector hypothetically from an economic system. In brief, Strassert.s original method compares the actual production with the production in the case where all intermediate deliveries to and from a particular sector are hypothetically extracted. In other words, the differential between the hypothetical and actual economy's output will measure the linkage effect of the extracted sector on total output.

Schultz (1977) followed Strassert's methodology in order to identify key economic sectors without separate estimation of FBL. In his approach, first the row and column vector of an industry is omitted from the Leontief matrix and then, the new Leontief inverse matrix is computed. With respect to the final demand of this new reduced form of I-O table, the hypothetical economy's production is estimated and compared with the actual economy's level of production. Then, the differential between the hypothetical economy's output (employment), excluding sector (i), and actual output may measure the linkage effect of the extracted sector on the total economy. It is evident that BFL can not be separated in this approach.

Cella (1984) and Klement (1990) followed Schultz's methodology, but instead of omitting an industry from input-output matrix totally, they assigned zero values to its row and column vectors, assuming that industry neither sells nor buys intermediate output in its relation to other industries. Then, the total linkage of that industry was considered to be the difference between the actual and hypothetical level of output. Further, by decomposing the total linkage into FBL, they demonstrated that the total linkage estimated by Schultz methodology underestimates the true total linkage.

8-2- Non-Complete Hypothetical Extraction Method (NHEA) There are two shortcomings of the above original extraction method. First, it does not distinguish the total linkages into backward and forward linkages (Cella, 1984). Second, the hypothesis of simply scrapping an entire sector from the economy seems to be rather excessive (Temurshoev, 2004).

Recognizing the two deficiencies of Strassert.s extraction method, Dietzenbacher and van der Linden (DL) improved the methodological framework suggesting a non-complete extraction method. Dl method is among the latest ones in the literature. The use of this method gives a summary measure of the power of mutual linkages in the economy. Their approach is based on the assumption that backward linkages should reflect sectors interdependence on inputs that are produced within the economy. Therefore, only these intermediate inputs should be hypothetically eliminated (it is assumed that the required inputs are imported) in order to measure the backward linkages. Then the sum of difference in the total output of actual production and production in the hypothetical case, where a particular industry does not depend on domestic sectors, measures the total backward linkages.

In the same way, the forward linkages are determined. Since forward linkages reflect others sectors dependence on a particular sector's deliveries, it is further assumed that this sector does not provide any deliveries to other production sectors. Since the primary concern of linkage analysis is the structure of production, the size effect of sectors should be eliminated in the linkage measurements. Hence Dietzenbacher and van der Linden suggest normalizing the solute forward and backward linkage figures by dividing them to the value of sectoral output.

9) Multi-rank Index Approach (MRI)

Three shortcomings are evident from many of the previous approaches in identifying key sector. First, the concept of key sector implies existence of non-key sectors. The cut-off point between the two is not identified in any of these approaches or related studies. Second, they relied on cardinal indices to identify key sectors. As all sectors in the economy are important in one way or another, identification of key sectors may only be justifiable on ordinal terms. That is, some sectors are key *relative* to others. Finally, they used more than one method, but each yielded different results, so it may be difficult to choose key sectors, using only one of the above approaches.

Thus, key sectors can be determined for output (or employment) growth by using a multiple-rank index (MRI). The methodology runs as follows:

Sectors are ranked according to a particular index to generate a list of sectors by order of importance. Several indices can be used (i.e. output, income, employment, tax revenue multipliers, linkage and dispersion indices, etc.)

The number of sectors that would be considered key under each criterion is determined ((top ten can be chosen, as an example), so that if number of indices are p, the sample size will be S =10P.

The frequency with which each of the sectors appears in S is determined. Thus, the higher the frequency of a sector in S, the more it is likely to be identified as a key.

The most convenient way to determine the cut-off point in S is to calculate the simple average frequency so that, if a sector has above average frequency it is considered 'key'

IV- The Methodology

The objective of this paper is to identify those sectors of the Iranian economy which have the greatest potential as far as their contribution to economic growth and employment expansion is concerned. To select the most appropriate type of sectoral investment, it is important to pay attention to two criteria, namely production and employment expansion emanating from investment. These two criteria, together, have considerable impact on the pattern of income distribution as well as economic growth. The feasibility of any development plan objectives, particularly output and employment, requires that attention be paid to the devise and estimation of important planning instruments such as output and employment multipliers. The methodology undertaken in this study to accomplish the above objective is as follows:

i) at the beginning, a *closed* Leontief matrix of inter-industry relations is constructed that incorporates the household's row and column vectors into the processing sector.

ii) with the help of this matrix, labor-input coefficients (ALOR, ILOR) are imputed in order to:

identify capital intensive and labor-intensive sectors of the economy.

estimate two types of employment multipliers

iii) the labor input coefficients are then integrated with capital-input coefficients to reveal how much investment is needed to create job by one unit in different economic sectors. One of the advantages to integrate these two input coefficients along with I-O technical coefficients is that one can consequently find which economic sectors have priority for investment purposes in an '*growth and employment-oriented*' development plan, taking inter-industry relations into consideration.

IV-1- Employment Multipliers

The first step in obtaining sectoral employment multipliers is to "close" the original transaction table with respect to households sectors. This means moving the household row and column vectors from the payment and final demand sectors respectively to the inter-industry or processing sector. It should be recalled that in the original transactions table, it is not necessary for the sum of household row to equal the sum of household column. The only restriction in that table is that the sum of all final demand columns has to equal the sum of all rows in the payment sector. However, when any row and its corresponding column are moved to the processing sector, the sum of the row entries must equal the sum of column entries. Thus, in moving the household row (labor service compensation) and column (household consumption) vectors into the processing sector, it is necessary to reconcile the row and column totals by adjusting some of the other entries in the final demand and payments sectors. In this adjustment, the household row or column entries, comprising the lower sum, are remained unchanged and the corresponding column (or row) entries are made smaller proportionately. Although it seems that this type of adjustment is ignored in many similar I-O related studies, but we make the above adjustment is our empirical work.

When the original transactions table is closed with respect to households and a new table of technical coefficients is computed, one of the important characteristics of the processing sector industries becomes apparent, namely their relative labor intensity. The next step in this process is to compute direct and indirect requirements per unit (i.e. Rial) of final demand for the new system which includes households in the processing sector. From the entries in the table of direct and indirect coefficients, it now becomes possible to compute various types of income and employment multipliers for the industries included in the processing sector of the original transactions table. The multiplier coefficients that are computed in this study are restricted to output and employment multipliers and are based on a method used by Hirsch [1959] in his study of Saint Louis Metropolitan area in the US and recommended by Miernyk [1965].

There are different methods to compute employment multipliers. One method uses directly the input-output table, based on the linear homogeneous employment-production functions. In other words, it is assumed that changes in employment are proportional to changes in output. Thus, it uses sectoral employment statistics (i.e. man-years) only for the year that the table has been constructed and sectoral outputs in nominal monetary units. This approach was first used by Moore and Petersen [1955]. Their method was a more general approach designed to provide estimates of total employment effects, industry by industry, due to a change in final demand for the output of one or more industries in the economy. The slope of each linear homogeneous employment-production function which measures the rate of change in employment as output changes is used to measure the direct change in employment associated with a one monetary unit change in final demand. Since these slopes are different for different economic sectors, an equal changes in the gross outputs of all industries results in changes in employment of some sectors different from others. A linear functional form of the relation between employment and output is as follows:

Production-employment function for a typical sector

$$E_j = a + \pi_j X_j \qquad (12)$$

where, E_j is employment in sector j, X_j is production of sector j, π_j is the slope of employment–output linear homogeneous function for sector (j)

IV-1-1- Employment Multiplier: Type I

The type (I) employment multiplier takes into account only the direct and indirect changes in employment resulting from a direct increase in employment in all industries in the processing sectors due to a change in the output of a specific industry by one unit. In order to measure direct and indirect employment change in sector (j), the total demand directly and indirectly from sector (i) for the delivery of one unit of sector (j) output to its final demand (coefficients in column vector j in the standard Leontief inverse matrix) is multiplied in the slope (π_j coefficient) of employment-production function of sector (i) and the results are aggregated over all sectors. The employment multiplier coefficient is derived by dividing direct and indirect employment change to direct employment change shown in the following diagram:

The employment multiplier coefficient for sector j -Type (I)

$$\sum_{i=1}^{n} \frac{b_{ij}\Pi_i}{\Pi_j} = \text{Employment multiplier of sector (j) -type I} \qquad (8)$$

where b_{ij} is a coefficient in column vector (j) in the standard Leontief inverse table, π_j is the slope of employment–output linear homogeneous function for sector (j). What do these multipliers show?

First, they reveal that different numbers of job (man-years) are generated by different sectors of the economy even if we assume that each sector expands its output by the same amount. Type (I) multipliers are limited to the direct and indirect effects on employment of a given change in output, but the type (II) multipliers also show "the chain reaction of inter-industry reactions in income, output and once more on consumer expenditures" [F.T. Moore, 1955].

Generally speaking, the more interdependencies exist inside the economy, or stating it differently, the less dependency exit on imports, the more direct income and employment of households that result from an expansion of output. A labor-intensive industry causes more direct income and employment change relative to an industry, which is more capital intensive. However, larger direct income and employment change does not always mean larger income and employment multipliers. It is totally possible that once direct and indirect changes are taken into account, the situation might be reversed. Thus, it is quite possible that direct and indirect changes in income and employment of capital-intensive industries become larger than those of labor-intensive industries, resulting in larger income and employment multipliers for those sectors.

IV-1-2- Employment Multiplier: Type II

The type II multiplier is a more realistic measure, which takes into account, the direct and indirect effects indicated by the input-output model plus the induced changes in employment resulting from increased consumer spending. In other words, due to inter-industry relations, this type of multiplier takes into account the effects of "subsequent rounds" of consumer expenditures. The type II measures the ratio of direct, indirect and induced employment change to direct employment change. These effects are measured by the expansion of inter-industry matrix by moving household row and column vectors into the processing sector:

The employment multiplier coefficient for sector j -Type (II)

$$\sum_{i=1}^{N} \frac{b*ij\Pi_i}{\Pi_j} = \text{Employment Multiplier of sector (j) -type II} \qquad (9)$$

where b^*_{ij} is coefficients in column vector (j) in the standard Leontief inverse table. There are two points of importance regarding induced employment change:

First, there is some logic behind the linking consumption changes and employment changes. An initial change in final demand will lead to direct plus indirect changes in output and these lead to employment changes described by the "simple" employment multiplier. The change in employment, in turn, leads to a change in income, and hence to a change in consumer spending. Each of these changes set off a "chain reaction" which leads to further adjustment in output, employment, income and consumer expenditures, with each "round" of new effects being smaller than the one before. The total employment change is then computed by a number of successive "rounds" of changes in output, income, consumer spending and employment. The results are estimates of the direct, indirect and induced employment changes resulting from a given change in output for each industry included in the table.

The second is about the type of consumption functions implicit in type (II) multiplier estimation. Although the type (II) employment multiplier tries to capture induced income and consumption changes, but this is done under some restrictive assumption, namely that sectoral consumption functions are linear and homogeneous. This assumption means that changes in consumption expenditures are proportional to the changes in income. Some scholars (Moore and Petersen 1955; Hirsch 1959) have pointed out that the linear homogeneity assumption of consumption function results in income and employment change bias. Moore and Petersen by estimating non-homogeneous linear functions and Miernyk in an effort to eliminate the linear homogeneity of consumption functions, tried to correct the coefficients. But, such adjustments require time series of households' consumption expenditures for disaggregated sectors of the I-O table and other statistics that unfortunately do not exist in many developing countries, including Iran.

V- Investment Criteria

An important issue that must be considered in the application of employment multipliers is the fact if ranking economic sectors according to the size of such multipliers is desired, then it does not necessarily mean that sectors with high ranks still have priority in terms of their total employment generating potential resulting from an equivalent change in the output of all industries. In other words, high employment multiplier in one sector should not be taken to mean that with an equal investment and output expansion in all industries, that sector still has the same rank and degree of importance in term of total employment that it generates in the economy.

It must be remembered that the expansion of productive capacities of the economy in general and its disaggregated sectors in particular necessitates the act of investment. Therefore, in order to evaluate the employment creation capabilities of the national economy, looking at investment effects on employment in each sector of the economy is of profound importance.

V-1- The Impact of Sectoral Investment on Total Employment

As already mentioned, the problem of creating employment opportunities through investment plans must also be evaluated within a development planning framework. In fact, the application of employment multipliers estimated by measuring the effect of output expansion on employment is insufficient and incomplete without such evaluation. But, such assessment requires information about incremental capital-output ratios (ICOR) for different industries and sectors as a principal device in measuring the quantitative impact of investment on employment in each sector. The use of (ICOR) in the evaluation of employment change due to investment can be expressed by the following relation:

The impact of sectoral investment on national employment

$$Tem_j = [1/ICOR]^* \pi_j * Em_j \qquad (10)$$

where, Tem_j is total employment generated by investment in sector j, $ICOR_j$ is incremental capital-output ratio of sector j, Π_j is direct labor input coefficient of sector j and Em_j is type (II) employment multiplier of sector j.

VI- Data

To estimate the employment multipliers of the 26 sectors of the 1999 I-O of the national economy, including its 12 manufacturing sub-divisions, estimation of regression equations pertinent to production-employment relationships was needed. But the lack of time series data for employment as well as real output values of manufacturing sub-divisions prevents the estimation of the above regressions. Moreover, if some of the labor-input coefficients thus estimated do not appear to be statistically meaningful and significant, then the validity of the employment multipliers estimated will be questioned. On other hand, the probability errors of the estimated multipliers is more and the level of their accuracy is less, if a cross-section (one year) data of employment and output is used in such related studies.

In order to overcome these shortcomings, an attempt was made to make the best possible use of the existing information. In this regard, it was first necessary to make (ISIC)[1] classification consistent with the industry sub-sectors' definition of the I-O table (see the end notes). Then, it was decided to use employment and nominal output values of large manufacturing establishments (see the end notes) according to (ISIC-Rev.3) for a five year interval (1995-1999) as well as price indices of industrial output for the above classification (see the end notes).

For computing the (ICOR), unfortunately there are no time series data regarding capital assets of different economic sectors in Iran. However, investment data can be substituted for 'incremental capital'. But, there was another problem measuring 'incremental output'. The real output of some sectors showed decline during some of the years, resulting in negative (ICOR) coefficients. Overall, the estimation of average (ICOR) coefficients for the whole period studied showed to be negative for 5 sectors.

As investment is perceived to have positive impacts on employment generating capacity of industries, the use of negative (ICOR) coefficients will reveal unrealistic results (reduced employment). Therefore, it was decided that an investment coefficients[2] and their averages for the total period to be used instead. These coefficients not only do not reveal negative numbers (unless there is disinvestment) but they are expected to fairly approximate (ICOR) over a long period of time.

VII- Empirical Results

VII-1- Labor-intensity in Iran's Industries

As already mentioned, one way to evaluate the labor intensiveness of industries, it is necessary to '*close*' the original transaction table with respect to

1- International Standard Industry Classification (ISIC).

2- The ratio of investment to output (I/Y).

household sector. In order to make the necessary reconciliation between the household row and column vector totals, some adjustments in other entries in the final demand and payment sectors (including the household sector) of the table were needed. In making this reconciliation, the smaller household row total was chosen in the 1999 I-O table of the economy of Iran (the row total of the labor service compensation amounted to 93249 billion Rials whereas the column total of the household consumption amounted to 283070 billion Rials).

After closing the table with respect to households sector, one of the important characteristics of industries comprising the inter-industry matrix, that is their relative labor intensity, is revealed. Table (1) ranks these labor-input coefficients for every 1000 Rials of production in each sector. As can be seen from that table, most service sub-sectors as well as agricultural sector, are shown to be relatively more labor intensive. These activities paid up to 14 percent of their total output value to the labor input in 1999.

On the other hand, activities such as those at the bottom of the table can be considered as relatively more capital intensive. One of the shortcomings of this approach is the fact that one can not draw a line to make a clear cut distinction between labor and capital intensive sectors. Furthermore, sectors such as real state can not really be considered a capital-intensive one, as table suggests. As the table suggests, the per capita 'output' (income) of real estate agents are relatively large in the economy of Iran.

However, as far as industry sub-sectors are concerned, textile and food manufacturing can be considered as rather labor intensive. These two industries showed to pay 3 to 3.5 percent of their total output to employed labor services. On the contrary, other basic metal industries, petroleum products, manufacturing of clothing and leather, and wood, paper, printing and publishing industries can roughly be considered as capital-intensive which paid less than one percent of the value of their products to labor.

VII-2- The Impact of Output Expansion on Employment

The output expansion as the result of growth in final demand, through direct, indirect and induced effects, spreads waves of new employment opportunities throughout the economy. To estimate the employment generating potential of each sector, employment-production functions must first be estimated. Table (2) shows the average of labor-output ratios for the five year period (1995-1999)[1]. As can be seen from that table, the output expansion by one unit in many service sub-sectors as well as construction industry results in most direct employment in those industries whereas other basic metal industries, iron and steel basic industries and petroleum products rank the lowest. But this only shows the direct employment impact.

Table (3) ranks different economic activities based on the size of employment multipliers. It can be observed that in spite of having the highest direct employment coefficients, many service sectors as well as construction have the lowest employment multipliers (type I & II). On the contrary, food manufacturing, other basic metal industries and manufacture of chemical and petroleum products, while having the lowest direct employment coefficients, are showing highest employment multipliers (type I & II) which are far distant apart from other sectors' multipliers. There are two important points that should be mentioned at this juncture:

First, since the proportionate labor-output ratios have been used instead of incremental labor-output ratios in estimating employment multipliers, and the former is usually larger than the later, the multiplier results are subject to overestimation bias.

Second, given the approach to construct employment multipliers, investment and production in sectors with high employment multiplier coefficients does not necessarily result in largest total employment expansion (as it is evident from Table 4). In other words, sectors with high employment multipliers should not be taken as sectors with high employment generating potential in the total economy, if an equal expansion of output occurs in all industries.

In regard to the last point, take other basic metal industries, manufacture of chemical products and manufacture of petroleum products as an example. These three industries have shown to have the highest employment multipliers (Table 3; column 5 & 6, rows 2, 3 & 4). However, by increasing their output by one billion Rials (in constant 1990 prices), these industries can generate direct employment of 20, 50 and 40 jobs respectively (Table 3; column 2), each of

1- These averages are computed by dividing units of labor to real output values (in 1980 constant prices) in each year and then taking the average over the whole period.

which in turn result in 10 thousand jobs in the whole economy (Table 3; column 4 and Table 4, column 2). On the contrary, by increasing its real output by one billion Rials, food manufacturing can generate direct employment of 50 jobs (Table 3; column 2), which in turn results in more than 30 thousand jobs in the whole economy (Table 3; column 4 and Table 4, column 2). On the other hand, most service sub-sectors as well as construction, public utilities and agriculture with the lowest employment multipliers, have the highest employment generating capacity in the total economy for the same amount of output expansion (compare column 4, 5 & 6 in Table 3).

VII-3- The Impact of Investment on Employment

It is evident that expansion of productive capacity of the economy in general and its subsequent sub-sectors in particular necessitates investment. Thus, it is important to look at the effect of investment on employment[1]. As mentioned above, if employment multipliers are complemented by (ICOR) coefficients then it becomes possible to evaluate how many employment opportunities can be generated in the economy per equal investment fund in different sectors. Consequently, in an employment oriented development plan, one can determine which sectors have priority for investment purposes. The advantage of complementing employment multipliers with (ICOR) coefficients is that the inter-industry relations will be taken into account in appraising the effect of sectoral investment on employment.

The estimated average (ICOR) coefficients are presented in Table (6). There were some difficulties in estimating those coefficients for some of the economic sectors in the (I-O) table. At the beginning, there was a lack of time series sectoral capital data. The remedy seemed to be the substitution of sectoral investment for capital data. But, since the real output of 5 sectors showed decline in some years, some ICOR coefficients turned out to be negative. As investment is expected to have positive impact on generating employment opportunities, the use of those negative (ICOR) coefficients seems to lead to unrealistic results (decline in employment). The only solution seemed to

1- Due to data limitation, some of the sectors in the table were forced to be aggregated and this resulted in the number of sectors to be reduced from 26 to 18.

substitute the average of investment coefficients (I/y) for the whole period (1995-1999) for ICOR coefficients of each sector. The results are presented in Table (7).

On the other hand, due to the above considerations as well as data limitations, some of the (I-O) sectors had to be aggregated and hence new sectoral employment multipliers were to be estimated (Table 8)[1]. It should be emphasized that due to data constraint which forced the aggregation of some sectors, the estimated labor-input coefficients and the subsequent employment multipliers showed considerable differences with their previous counterparts. Usually, more disaggregated tables provide more precise estimates of such coefficients relative to more aggregated tables.

With the use of employment multipliers (type II) together with investment coefficients, the total employment impact of equal output expansion in every sector was estimated, As can be seen from Table (9), other service sector has the first priority for investment in regard to employment. Every billion Rials (in constant 1990 prices) investment in that sector will result in more than 630 thousands job in the economy.

Among 12 manufacturing sectors, about half have been ranked from 2 to 10 with respect to employment generating investment. In particular, manufacture of clothing, leather & related products ranked the 2nd. The results show that this industry is capable of generating 107 thousands job in the economy for every thousand million Rials investment (at constant 1982 prices). On the other hand, wood, paper, printing & publishing industry with the 3rd rank, is capable of generating more than 60 thousand jobs for that same amount of investment. These two industries together with food manufacturing have considerable backward linkages with agricultural sector which itself has high investment generating employment potential (5th rank). Among other industry sub-sectors, non-metal mineral product manufacturing has the least priority and is capable of generating only 14 thousand jobs in the economy for that same amount of investment.

1- When a more aggregated table was used, employment multipliers showed to be significantly different for some sectors. Generally, more accurate results are expected from a more disaggregated table.

The least priority sectors in regard to employment generating investment are public utilities, mining extraction and construction. It can be claimed that if more disaggregated data were available; these results could have been different, particularly with respect to construction sector.

VIII- Conclusion

This article attempted to present a quantitative appraisal of sectoral priorities in terms of their employment generating potential through investment activity, based on input-output analysis and incremental labor and capital output ratios. It is to be emphasized that the objective of a precise determination of quantitative employment impact that can be realized for a specific amount of investment and output expansion in each economic sector can hardly be achieved in all analytical papers of this kind. Because such an objective is hard to come by purely quantitative approach, ignoring many social and policy related issues. Rather, the objective has been simply showing the relative importance (ranking) of economic sectors in their tendencies to generate employment opportunities in the overall economy by investing and the output expansion, through a quantitative employment forecasts,

It should not be ignored that due to the absence of relevant detailed time series data on price indices, investment and employment as well as aggregation problem, assumptions and other model constraints, like fixing technology coefficients in the I-O table, the resulting empirical outcome (employment figures) can be different from what can actually be realized in the economy. The fact is that economic analysis that are undertaken within specific model frameworks, can not lead to precise and totally correct economic forecast results, since many limiting conditions are usually imposed on such analysis which are either economic, social or even political in nature. However, what has been obtained in this attempt is identification of key economic sectors based on their capability to generate employment one due to output growth, and another due to capital growth.

From the stand point of output growth, the top ten in both 26 and 18 I-O sector analysis (Table 4&9), jointly point to the relative importance of construction, other service sector, agriculture and food manufacturing, and thus can be considered as *key* sectors. However, there are some differences in the list of top ten in the above two classification, pointing to different results that can be obtained due to the level of disaggregation.

From investment point of view, other service sector, manufacture of clothing & leather, wood, paper, printing and publishing, other basic metal industries, food manufacturing, textile, petroleum products, iron & steel basic industries and other manufacturing, together with agriculture, can be considered as the "*great winners*" in generating aggregate employment due to investment. Since the private sector makes the most investment contribution in the above sectors, making the appropriate grounds for more private sector activity is warranted, since this will spread employment opportunities all over the economy with a faster pace.

There are some arguments that agricultural sectors in LDCs have few employment linkage effects (Sadoulet and d-Janvry, 1995). But, contrast to what has been noted in part of the literature; agricultural sector in Iran is found to be a key sector both from the stand point of output and investment in generating employment. Similar to our finding (though with different applied method), Hazari (1970) showed that, regarding employment, 80 percent of the top 15 sectors in India belong to agriculture. He argued that sectors which generate significant employment for each unit increase in final demand are mainly agricultural sub-sectors. Thus, he concluded that this view point that '*agricultural sector is not capable of generating significant employment*' is not correct.

An analytical paper, using open Leontief model of Iran, comprising (30×30) sector, and applying four different approaches (RA, HA, and DA) to identify key industries in terms of their employment generating capabilities, reached the conclusion that key economic sectors are different if one looks at the employment rather than output growth (Esfandiari, 1996). It was shown that as far as employment potential is concerned, key sectors are not in the domain of industry. In three out of four approaches undertaken in the above study, agriculture was shown to have the first rank and other key sectors were more close to services, a result which resembles the outcome of the present study.

It should not be ignored that provision of necessary employment grounds for a non-inflationary sustainable economic growth necessitates paying careful attention to those economic activities that have more employment and output generating capacity in the economy per unit of investment. To identify those sectors, production multipliers and investment coefficients (or ICOR) can be used. Table 9 (Columns 2, 3 and 4) makes it possible to compare different economic sectors in terms of their investment-related contribution to economic and employment growth. The results of this comparison brought up interesting results: agriculture and other services together with industries like manufacture of clothing and leather, other basic metal industries, wood, paper, printing and publishing industry, food and textile manufacturing, are those that have contemporaneous contribution to economic and employment growth and thus must be given priority in any " *growth and employment-oriented* " development plan.

Table 1: Direct Household Input Coefficients (DHIC) Based on the I-O (1999) Table

No	Sector	DHIC	No	Sector	DHIC
1	Agriculture	140.07	14	Non-Metallic Mineral Products	22.70
2	Other Services	88.80	15	Manufacturing of Machinery	20.44
3	Trade Services	58.22	16	Other Manufacturing Products	18.30
4	Other Transportation, Comm. & Storage	57.47	17	Manufacturing of Chemical Products	17.99
5	Public Affair Services	49.49	18	Iron & Steel Basic Industries	13.46
6	Other Construction	43.24	19	Automobile Industries	13.33
7	Banking, Finance & Insurance	43.09	20	Wood, Paper, Printing & Publishing	9.92
8	Business Services	38.95	21	Manufacture of Clothing, Leather	8.82
9	Road Transportation Services	38.84	22	Petroleum Products	7.05
10	Textile Manufacturing	36.15	23	Water, Electricity & Natural Gas	5.62
11	Food Manufacturing	29.76	24	Other Basic Metal Industries	5.32
12	Mining Extraction	26.58	25	Defense & Police Services	0.59
13	Residential Construction	25.40	26	Real State Services	0.58

Table 2: The Average Direct Labor-input Coefficients based on Constant 1980 Output Values (1995-1999)

No	Sector	ALOR*	No	Sector	ALOR*
1	Other Transportation, Comm.& Storage	0.00012600	14	Real State Services	0.00000048
2	Public Affair Services	0.00007265	15	Manufacturing of Machinery	0.00000015
3	Defense & Police Services	0.00004726	16	Non-Metal Mineral Products	0.00000013
4	Residential Construction	0.00002671	17	Automobile Industries	0.00000011
5	Other Construction	0.00002671	18	Manufacture of Clothing & Leather	0.00000011
6	Agriculture	0.00002651	19	Other Manufacturing Products	0.00000011
7	Other Services	0.00002538	20	Textile Manufacturing	0.00000010
8	Road Transportation Services	0.00002335	21	Wood, Paper, Printing & Publishing	0.00000009
9	Water, Electricity & Natural Gas	0.00002173	22	Food Manufacturing	0.00000005
10	Trade Services	0.00002070	23	Chemical Products Manufacturing	0.00000005
11	Banking, Finance & Insurance	0.00000959	24	Petroleum Products	0.00000004
12	Business Services	0.00000886	25	Iron & Steel Basic Industries	0.00000003
13	Mining Extraction	0.00000233	26	Other Basic Metal Industries	0.00000002

Employment (man-year) per one Rial value of output in constant 1980 prices

Table 3: Employment Multipliers for Twenty Six Economic Sectors of Iran-1999

No	Sector	Direct Employment Change*	Direct & Indirect Employment Change*	Direct, Indirect & Induced Employment Change*	Type (I) Employment Multiplier	Type (II) Employment Multiplier
	1	2	3	4	5	6
1	Food Manufacturing	0.00000005	0.00003	0.00003	485.36	579.316
2	Other Basic Metal Industries	0.00000002	0.00001	0.00001	220.39	388.499
3	Manufacture of Chemical Products	0.00000005	0.00001	0.00001	127.95	232.499
4	Petroleum Products	0.00000004	0.00001	0.00001	157.52	231.032
5	Iron & Steel Basic Industries	0.00000003	0.000003	0.00001	101.65	203.269
6	Textile Manufacturing	0.00000010	0.00001	0.00002	68.72	175.769
7	Wood, paper, Printing & Publishing	0.00000009	0.00001	0.00001	94.46	163.639
8	Manufacture of Clothing & Leather	0.00000011	0.00001	0.00002	53.86	156.643
9	Automobile Industries	0.00000011	0.00001	0.00001	57.87	103.761
10	Non-metal Basic Industries	0.00000013	0.00001	0.00001	46.08	95.768
11	Other Manufacturing Products	0.00000011	0.000004	0.00001	34.41	63.039
12	Manufacturing of Machinery	0.00000015	0.000003	0.00001	21.46	47.375
13	Real State Services	0.00000048	0.000002	0.000002	3.69	4.908
14	Business Services	0.00000886	0.00001	0.00002	1.31	2.714
15	Banking, Finance & Insurance	0.00000959	0.00001	0.00002	1.26	2.382
16	Mining Extraction	0.00000233	0.000003	0.00001	1.400	2.193
17	Agriculture	0.00002651	0.00004	0.00004	1.47	1.677
18	Road Transportation Services	0.00002335	0.00003	0.00004	1.31	1.527
19	Water, Electricity & Natural Gas	0.00002173	0.00003	0.00003	1.40	1.508
20	Residential Construction	0.00002671	0.00003	0.00004	1.18	1.447
21	Other Construction	0.00002671	0.00003	0.00004	1.17	1.419
22	Trade Services	0.00002070	0.00003	0.00003	1.26	1.394
23	Defense & Police Services	0.00002538	0.00003	0.00004	1.16	1.393
24	Public Affair Services	0.00007265	0.00008	0.00009	1.08	1.279
25	Other Transportation, Comm. Services	0.00012600	0.00014	0.00015	1.08	1.203
26	Other Services	0.00004726	0.00005	0.00005	1.11	1.142

* Employment (man-year) per one Rial value of output in constant 1980 prices

Table4: The Impact of Equal Output Expansion on Total Employment (man-years)

No	Sector	Total employment change per constant (10^9) Rials output change in the sector	Total employment change per unit employment change in the sector (Type I multiplier)
	1	2	3
1	Other Transportation, Comm. & Storage	151540	1.08
2	Public Affair Services	92880	1.08
3	Defense & Police Services	53990	1.11
4	Agriculture	44463	1.47
5	Residential Construction	38659	1.18
6	Other Construction	37899	1.17
7	Road Transportation Services	35650	1.31
8	Other Services	35351	1.16
9	Water, Electricity & Natural Gas	32780	1.4
10	Food Manufacturing	31182	485.36
11	Trade Services	28854	1.26
12	Business Services	24042	1.31
13	Banking, Finance & Insurance	22848	1.26
14	Manufacture of Clothing & Leather	17255	53.86
15	Textile Manufacturing	16974	68.72
16	Wood, Paper, Printing & Publishing	14172	94.46
17	Non-Metal Mineral Products	12743	46.08
18	Chemical Product Manufacturing	11598	127.95
19	Automobile Industries	11518	57.87
20	Other Basic Metal Industries	8937	220.39
21	Petroleum Products	8925	157.52
22	Manufacturing of Machinery	7268	21.46
23	Other Manufacturing Products	6846	34.41
24	Iron & Steel Basic Industries	6335	101.65
25	Mining Extraction	5117	1.4
26	Real State Services	2355	3.69

Table 5: The Estimated Real Output Values for I-O Industry Sectors (1982=100)

No	Sector	1374	1375	1376	1377	1378
1	Agriculture	3688.4	3822.9	3957.6	4333.6	4320.6
2	Mining Extraction	84.2	88.2	91.0	94.6	98.4
3	Food Manufacturing	790.2	849.1	399.9	728.2	798.5
4	Wood, paper, printing and Publishing	119.7	134.8	543.5	138.5	9.5
5	Non-metal Mineral products	396.9	431.8	410.5	381.7	416.5
6	Textile Manufacturing	505.5	502.6	579.1	493.7	522.4
7	Clothing, Leather and Related Products	96.0	97.6	77.0	61.2	60.7
8	Petroleum Refinery Products	96.2	98.8	217.7	250.2	249.6
9	Chemical Product Manufacturing	385.8	451.5	425.8	357.9	402.4
10	Iron & Steel Basic Industries	569.6	665.5	647.1	526.3	542.1
11	Other Basic Metal Industries	165.7	146.7	170.0	171.0	201.5
12	Manufacturing of Machinery	222.3	278.0	305.2	194.9	289.8
13	Automobile Industries	96.3	137.0	150.8	95.0	194.3
14	Other Manufacturing Products	220.9	295.5	353.2	324.7	377.8
15	Water, Electricity & Natural Gas	397.3	424.9	443.9	466.8	490.1
16	Construction	623.8	707.8	686.0	613.4	687.0
17	Transportation, Communication & Storage	1105.6	1167.2	1345.4	1306.8	1372.1
18	Other services	4919.0	5171.9	5263.5	5292.8	5508.9

Table 6: The Average ICOR Coefficients Based on 1982 Constant Prices (1995-1999)*

NO	Sector	1374/1375	1375/1376	1376/1377	1377/1378	Average
1	Agriculture	1.121	1.176	0.369	-11.531	-2.216
2	Mining Extraction	34.554	27.561	23.699	31.113	29.232
3	Food Manufacturing	0.366	-0.0528	0.076	0.339	0.182
4	Wood, Paper, Printing & Publishing	0.364	0.011	-0.020	-0.043	0.078
5	Non-Metal Mineral Products	1.831	-1.095	-1.212	1.067	0.148
6	Textile Manufacturing	-4.553	0.258	-0.173	0.580	-0.972
7	Manufacture of Clothing & Leather	0.762	-0.051	-0.092	-1.191	-0.143
8	Petroleum Products	4.724	0.039	0.107	-3.233	0.409
9	Manufacturing of Chemical Products	0.287	-3.230	-0.255	0.388	-0.703
10	Iron & Steel Basic Industries	0.412	-0.989	-0.085	1.179	0.129
11	Other Basic Metal Industries	-0.120	0.063	24.445	0.152	6.135
12	Manufacturing of Machinery	0.180	0.437	-0.129	0.148	0.1595
13	Automobile Industries	0.223	0.921	-0.156	0.086	0.269
14	Other Manufacturing Products	0.180	0.252	-0.516	0.317	0.058
15	Water, Electricity & Natural Gas	13.116	19.095	11.013	11.704	13.732
16	Construction	18.459	-69.372	-18.909	20.816	-12.251
17	Transportation & Communication	5.268	2.179	-9.329	5.965	1.021
18	Other Services	0.0500	0.135317	0.435802	0.063915	0.1713

* ICOR was calculated by ($I / \Delta Y$), where I is investment and ΔY change in output.

Table 7: Annual and Average Investment Coefficients (I/Y) in Economic Sectors (1982 =100)

NO	Sector	1374	1375	1376	1377	1378	Average
1	Construction	2.253	2.191	2.204	2.238	2.230	2.223
2	Mining Extraction	3.233	1.567	0.848	0.902	1.201	1.550
3	Water, Electricity & Natural Gas	0.697	0.852	0.817	0.540	0.556	0.693
4	Transportation, Communication & Storage	0.273	0.278	0.289	0.276	0.284	0.280
5	Wood, Paper, Printing & Publishing	0.046	0.041	0.009	0.060	0.583	0.148
6	Non-Metal Mineral Products	0.070	0.148	0.057	0.0912	0.089	0.091
7	Manufacturing of Chemical Products	0.049	0.042	0.195	0.0482	0.043	0.075
8	Automobile Industries	0.062	0.066	0.084	0.091	0.044	0.070
9	Manufacturing of Machinery & Equipment	0.043	0.036	0.039	0.073	0.048	0.048
10	Other Manufacturing Products	0.059	0.045	0.041	0.045	0.045	0.047
11	Petroleum Products	0.038	0.124	0.021	0.014	0.008	0.041
12	Other Basic Metal Industries	0.004	0.016	0.009	0.141	0.023	0.038
13	Iron & Steel Basic Industries	0.041	0.059	0.028	0.019	0.034	0.037
14	Agriculture	0.032	0.039	0.040	0.032	0.035	0.036
15	Food Manufacturing	0.025	0.025	0.059	0.034	0.030	0.035
16	Textile Manufacturing	0.030	0.026	0.034	0.030	0.032	0.030
17	Manufacture of Clothing & Leather	0.010	0.012	0.014	0.024	0.011	0.014
18	Other Services	0.002	0.002	0.002	0.002	0.002	0.002

Table 8: Employment Multipliers of Eighteen Economic Sectors in the 1999 I-O Table

No	Sector	Direct Employment Change	Direct & Indirect Employment Change	Direct, Indirect & Induced employment Change	Type (I) Employment Multiplier	Type (II) Employment Multiplier
1	Other Basic Metal Industries	0.00000007	0.00000033	0.00000038	4.96	5.66
2	Food Manufacturing	0.00000019	0.00000106	0.00000151	5.49	6.68
3	Petroleum Products	0.00000011	0.00000042	0.00000046	3.91	4.21
4	Manufacture of Chemical Products	0.00000015	0.00000053	0.00000066	3.58	4.32
5	Iron & Steel Basic Industries	0.00000009	0.00000031	0.00000036	3.27	3.76
6	Textile Manufacturing	0.00000029	0.00000069	0.00000086	2.39	2.84
7	Manufacture of Clothing & Leather	0.00000032	0.00000076	0.00000088	2.35	2.66
8	Automobile Industries	0.00000031	0.00000073	0.00000086	2.39	2.75
9	Non-metal Basic Industries	0.00000040	0.00000082	0.00000092	2.07	2.28
10	Manufacturing of Machinery	0.00000028	0.00000045	0.00000052	1.63	1.85
11	Other Manufacturing Products	0.00000032	0.00000053	0.00000060	1.65	1.85
12	Water, Electricity & Gas	0.00000038	0.00000065	0.00000071	1.70	1.82
13	Transportation, Communication & Storage	0.00000080	0.00000101	0.00000120	1.26	1.48
14	Wood, paper, Printing & Publishing	0.00000089	0.00000135	0.00000150	1.52	1.64
15	Agriculture	0.00000084	0.00000126	0.00000190	1.49	1.81
16	Other Services	0.00000112	0.00000129	0.00000173	1.15	1.50
17	Construction	0.00000253	0.00000288	0.00000303	1.14	1.19
18	Mining Extraction	0.00000149	0.00000154	0.00000159	1.03	1.06

Table 9: The Impact of Equal Output and Investment Expansion on Total Employment (man-years)

Rank	Sector	Total employment generated per constant (10^9) Rials investment	Total employment generated per constant (10^9) Rials output	Total Output generated per constant(10^9) Rial investment	Total employment generated per unit direct employment change
		1	2	3	4
1	Other Services	632942	1683	772.4	1.5
2	Manufacture of Clothing & Leather	106793	854	276.4	2.66
3	Wood, paper, Printing & Publishing	60268	1455	86.7	1.64
4	Other Basic Metal Industries	55942	378	209.8	5.66
5	Agriculture	44284	1525	66.3	1.81
6	Food Manufacturing	43230	1283	91.7	6.68
7	Textile Manufacturing	41373	817	110.1	2.84
8	Petroleum Products	36951	453	101.7	4.21
9	Iron & Steel Basic Industries	15600	351	61.9	3.76
10	Other Manufacturing Products	15293	591	41.4	1.85
11	Automobile Industries	15273	844	38.3	2.75
12	Manufacture of Chemical Products	15115	642	44.6	4.32
13	Manufacturing of Machinery	15092	509	46.4	1.85
14	Non-metal Basic Industries	14406	905	29.9	2.28
15	Transportation, Communication & Storage	5451	1183	9.1	1.48
16	Construction	1469	3012	1.2	1.19
17	Mining Extraction	1327	1583	1.1	1.06
18	Water, Electricity & Gas	1204	699	2.8	1.82

Appendix

Data Sources and Construction

1- Sectoral Output at Constant Prices

A) Non-industry Sectors: The time series I-O sectoral outputs (except industry sub-sectors) were taken from the 2000 Iran National Income Account given in PDS[1] Aside from nominal values however, this account gives real output values at 1992 prices. Since the year 1980 has been considered the base year in other statistics, the nominal output values had to be converted to real values at 1982 prices. This was accomplished by the use of producer price index given by the Central Bank of Iran. However, this approach could not be used for some of the I-O sectors as explained below:

- There were some I-O sectors that were part of a larger sector in the national account for which output at constant prices could not be computed by using the above method. Thus, a different approach was needed to compute their real output values. These sectors were road transportation and other transportation and communication services as part of total transportation and communication services and real state and business services on the one hand and public affair and defense and police services on the other hand as parts of larger sectors in the national account. To compute the real values, the ratio of the nominal output values of the above sub-sectors to the nominal values of the larger sector to which they belong was first calculated. Then, these ratios were multiplied by the real output value of the corresponding more aggregated sectors in the national account.
- In another case, an I-O sector, namely trade services, was more aggregated than its counterpart in the national account (restaurant & hotel and wholesale & retail services). Thus, the constant values of the above two sub-sectors in the national account at 1980 prices were first computed and then they were simply added.

1- Persian Data Source (PDS).

B) Industry Sub-Sectors: The national income account statistics gives both nominal and real value added figures (based on 1990 prices). Since real value added data was needed on the basis of 1982 prices, some adjustments to the data deemed necessary. In the first step, value added price indices for the years 1995-1999, were calculated for the total industry using nominal and real values (1982 as the base year) given in the PDS data source. In the next step, total industry value added price indices for the above years was again calculated, this time the1990 as the base year, using national income account as data source. Then, the 1982 price indices were divided into 1990 price indices for each year and these ratios were then multiplied by industry sub- sector (2-digit ISIC) 1990 price indices. The resulting figures are estimated price indices for industry sub-sectors, based on 1982 prices. In the final stage, the above results were used to convert nominal output values of large industry establishment sub-sectors to real values. When necessary, those real output values were aggregated in order to obtain real output of industry sectors listed in the I-O table. Table (9) in the appendix presents the results. Then, estimation of ICOR coefficients on the basis of these real output values became feasible which are presented in Table (6) in the appendix..

2- Non-Industry Price Indices

There were no explicit prices indices for some of the I-O sectors needed to compute their real output values. Thus an indirect approach was taken to overcome this shortcoming:

- The price index of trade services sector was estimated as a weighted average of whole sale & retail trade as well as consumer price indices. These indices were taken from the Iran Central Bank Economic Indicators.
- The price index of public affair and defense services was estimated as the weighted average of education, health and social help services.

3- Employment by Sectors (1966-1996)

The Ministry of Planning and Management in Iran renders sectoral employment data only for the Census years (with 10 year interval) and at times for more aggregated economic sectors. In order to estimate employment for the years under study (1997, 1998 and 1999), the Excel software was used. Those estimates were based on moving average method and two sub-periods were considered for that purpose (1966-1996 and 1989-1996). It seemed that the best estimates were those made for the (1989-1996) period. The employment for some of the I-O sectors was estimated as follows;

- Residential and Other Construction: First, the share of residential construction and other construction output to total construction output was first computed. Then these shares were applied to the total employment in the construction sector to estimate the employment in each of the above sub-sectors.
- Electricity, Water and Gas: The total employment of this sector had be broken down to its two sub-sectors (water & electricity; gas). The share of these two sub-sectors in total employment in the 1996 Census year was computed and then applied to total employment in the years considered.
- Transportation and Communication: Like above, the total employment of this sector had to be broken down to its two components (road transportation; other transportation services). The method used for this decomposition was exactly the same as that explained above.
- Real State, Public Affair, Defense and Other Services: The employment figures in those sectors were given in aggregate form and the same method explained above was used for its break-down.

4- Investment by Sectors

Persian Data Source (PDS) presents investment data, both in nominal and real terms (at constant 1982 prices), for 7 main economic sectors. From this source of information, real investment values were derived for 6 sectors, namely agriculture; mining extraction; transportation; communication and storage services; construction; water, electricity, oil and gas; and other services for the years 1995-1999.

In order to estimate disaggregated industry investment in constant prices, first investment price indices for the mining and manufacturing sector were obtained by dividing nominal investment values to real values for those years. Then, these price indices were applied to current investment figures in the large industrial establishments for more disaggregated industry (based on I-O table) classification.

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