

## Choosing Development Path According to Priority Power: Determination of key sector for Iran economy

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### Abstract:

Resources' scarcity, especially in developing countries, has caused allocation essentially among competing activities to create value. The importance of resource allocation would be more understood if we pay attention to growing complexity in societies and economic development problems they face. In the context of the national economic development literature, the notion of "Key or Critical Sectors" has become an accepted component of development strategy. By and large, key sector analysis is an attempt to determine the economic effect of a sector in a given economy.

From macroeconomic point of view, Agriculture and Non Agricultural Manufacturing (NA-Manufacturing) as two parts of production sector, compete for absorbing limited resources. This paper with using 31 indices; factor analysis; numerical taxonomic analysis; and three level of assessment aims to answer the question of which one of these two is the key sector, and be a completion to previous studies which their common deficiency is the lack of indices. Results of this study for Iran economy show that Agriculture sector is preferred to NA-Manufacturing sector.

Keywords: key sector, Non Agricultural Manufacturing, Agriculture, Various Indices, Factor Analysis, Numerical Taxonomy Analysis

JEL Classification: A1, B22, C02

### 1. Introduction

Scarcity of resources, especially in developing countries, has caused allocation essentially among competing activities to create value. The importance of resource allocation would be more understood if we pay

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attention to growing complexity in societies and economic development problems they face. Resource limitation raises the question whether to spread the scarce resources thin over all the sectors to ensure equal rates of growth or to use them selectively in those sectors which have high growth potential. The controversy surrounding this question is referred in the literature as the problem of balanced vs. unbalanced growth. Balanced growth pattern insists on balanced resource allocation among the economic sectors such that no surplus or shortage exists, while unbalanced growth pattern tries to explain that concentrating resources for investment on projects with high forward and backward linkages is highly desirable. (Ndongko 1975: 88-90)

But Hirschman, the first one who emphasized the need for unbalanced growth, fails to stress the importance of agricultural investments. According to him, agriculture does not stimulate linkage formation as directly as other industries. However, empirical studies indicate agriculture has substantial linkages to other sectors; moreover, agricultural growth makes vital contributions to the nonagricultural sector through increased food supplies, added foreign exchange, labor supply, capital transfer, and larger markets. (Nafziger 2006: 161)

In the context of the national economic development literature, the notion of “Key or Critical Sectors” has become an accepted component of development strategy. By and large, key sector analysis is an attempt to determine the economic effect of a sector in a given economy. But this would not be well done if the chosen indices were not adequate enough. Choosing just some either input-output indices or comparative advantages indices is not enough for determining a key sector in national scale. All previous studies in this field have this deficiency or fault; Such as: Marcelo Barrios (1990); Siegfried Bender and Kui-Wai Li (2002); Imre Ferto and Lionel J. Hubbard (2002); Kui-Wai Li (2003); Chan-In Yoon and Kiheung Kim (2003); Zhan Jing (2004); Mike Widgren (2005); Pingsun Leung and Junning Cai (2005); S. Tabata (2006); Cristea Boboila (2007); Ali Kocyigit and Ali Sen (2007); Nevzat Simsek, Dilek Seymen and Utku Utkulu (2007); Mohammad Taghi Fathi and Maedeh Mazinani (2008); Arastou Khatibi (2008); S. Amirteimoori and A. H. Chizari (2008); Jong-Hwa Kim (2009).

But as every sector has potential abilities, making decision about preferring one to another is complicated. This paper with using a group of indices which indicate the most important aspects of respective sectors, factor analysis, and numerical taxonomic analysis, try to be a completion for previous studies, with lack of indices as their common deficiency.

## 2. Agriculture and Manufacturing in Iran

Reviewing the history of agriculture and manufacturing sectors in Iran shows that agriculture was the lead sector for a long time and was in its brilliant stage during the age of SAFAVIAH; not only there were no leakage but also there were excess exported to other countries. But after doing huge efforts for taking pace with industrial economies, the age of advantages and independency turned to the age of disadvantages and dependency. With establishing useless factories which were dependant on foreign technology and foreign specialists and hadn't anything in common with neither Iranian needs nor improving their economy, Iran which was an exporter economy someday turned to a country that needs to importing machines and technology for its outdated manufactures.

Now, Iran is a large-developing country with limited resources for investment and really needs to determine the key sector of its economy to correctly find its own way of improving and becoming a developed country. However two important observant shows that Iran couldn't find this way yet and there is a strong necessity for doing this research:

- Iran national accounts show that, yearly investment for NA-Manufacturing sector has been more than twice as many as for Agriculture sector during 1991-2007, Figure 1; but the ratio of Value Added to Investment in each of the sectors, for Agriculture is obviously more than NA-Manufacturing sector in each year during this period, Figure 2. This very interesting fact makes it clear that investing on NA-manufacturing sector hadn't had the productivity that it would be hoped.

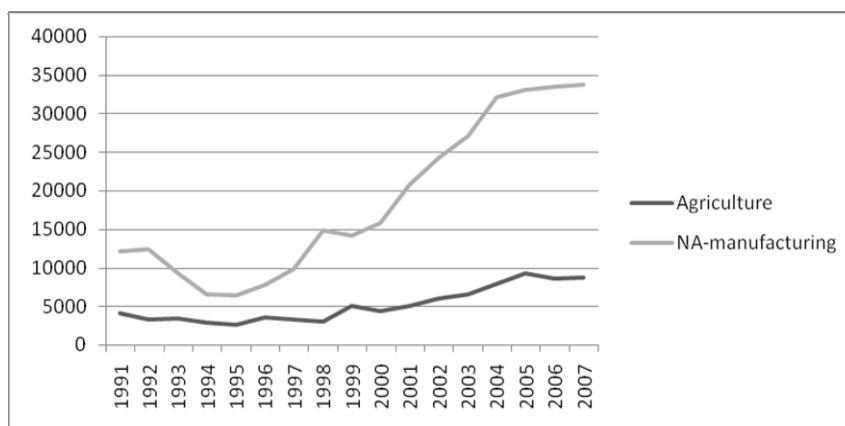


Figure 1- yearly investment for each sector during (1991-2007)

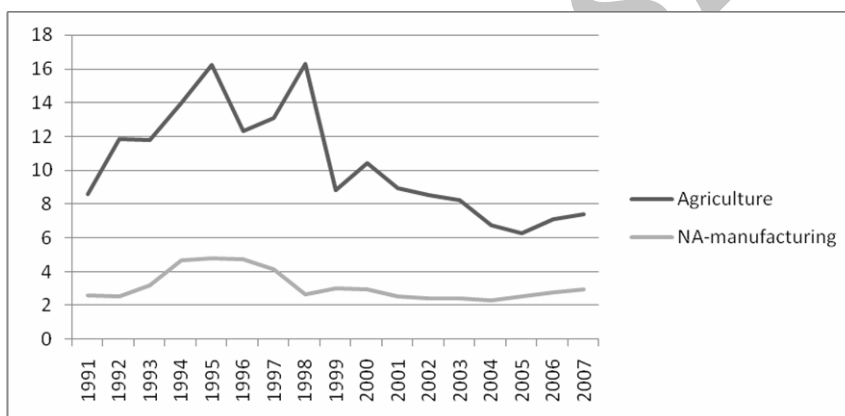


Figure 2-Ratio of value added to investment for each sector during 1991-2007

- Moreover, there always has been a challenge for determining one of these two sectors as the key sector or the lead sector for economic development process. The decision is almost periodic in Development Plans: preferring NA-manufacturing in the first plan, agriculture in the second, NA-manufacturing in the third, agriculture in the fourth and NA-manufacturing in the fifth.

Some may say that the problem of determination of the key sector is not a problem anymore. But they should be aware of this fact that it's

not the problem for economies which had found their own key sector years ago and now have other problems, not for developing countries which don't know the right path to take and always are hesitate about choosing it.

Following sections, in order, illustrate the way that researchers have run for determining the key sector for Iran economy.

### 3. Coordinating ISIC and HS codes

As it mentioned, this paper aims to be a complement to previous studies with using various indices. These elements are made from two different types of classification: International Standard Industrial Classification of All Economic Activities (ISIC) and Harmonized Commodity Description and Coding System (HS). How they can be used altogether? This is the question that this section addresses it and tries to answer it. The answer would be the core key in finding the answer for the prime question of this paper.

Because our definition of Agriculture and NA-Manufacturing sectors may not be clear enough, it's important to introduce them first. In this paper, Agriculture involves all subsectors and activities relating to agriculture, and NA-Manufacturing involves all other subsectors and activities that are not involved in agriculture, service and oil sectors. For example, the subsector of food industries involves in agriculture but the subsector of mineral industries involves in NA-Manufacturing.

As the definition of ISIC and HS tell us, ISIC classifies activities and HS classifies commodities. It's clear that these two can't be used together. Then indices made from input-output table and international trading data which are respectively based on ISIC and HS classifications can't be used together neither. For using these two groups of indices, indices derived from input-output table and ones from international trading data, together we need to join them and create new subsectors under the name of coordinated or joint-subsectors. In this context, Agriculture contains two joint-subsectors: Agri-Fishing and Food-Beverage, and NA-Manufacturing contains other 9 joint-subsectors: Mineral, Wearing, Wood, Paper, Chemical, Mineral-Non Metal, Metal, Machinery, and Other Manufactured Products. Table 1 shows what these subsectors consists of according to ISIC and HS codes.

**Table 1- Coordinated Codes and Joint Subsectors**

ISIC Codes	HS Codes	Joint- Subsector Code	Joint- Subsector name
01-9	01-15	1	Agri-fishing
10-14	16-24	2	Mineral
15-16	25-27	3	Food-beverage
17-19	28-43	4	wearing
20	44-46	5	wood
21-22	47-49	6	Paper
23-25	50-67	7	chemical
26	68-71	8	Mineral-non metal
27-28	72-83	9	Metal
29-32,34-35	84-92	10	Machinery
33,36-37	93-99	11	Other manufactured products

In the rest of this paper, “joint-subsector” shorts for “subsector” and some where may we use Agriculture or NA-Manufacturing without the suffix of “sector”.

#### 4. Materials and Methods

Indices, which are the main data for our analyses, are derived from updated input-output table of 2005 (latest version), Iran National Accounts and a four-year range of exports and imports data (2005-2008) of International Trade Center (ITC). The complete list of indices used in this paper is as follows:

- 1- Backward Linkage Index: it's the ratio of intermediate inputs to total product, for each section.
- 2- Backward Dependency Index: ratio of each section intermediate cost to all sections' intermediate cost (= total intermediate cost).
- 3- Forward Linkage Index: ratio of intermediate demand to total demand, for each section.
- 4- Forward dependency index: ratio of intermediate demand of each section to intermediate demand of all sections (= total intermediate demand).
- 5- Combined backward and forward linkages: arithmetic average of backward and forward indices.

- 6- Power of dispersion index: a fraction which its numerator is product of number of sections (in input-output table) and vertical sum of Leontief inverse, and its denominator is total sum of Leontief inverse.
- 7- Multiplier index: vertical sum of Leontief inverse, for each section.
- 8- Sensitivity index: it's a fraction which numerator is horizontal sum of Leontief inverse and denominator is total sum of Leontief inverse.
- 9- Ratio of value added to imports.
- 10- Ratio of imports to intermediate consuming of each section.
- 11- Ratio of imports to production.
- 12- Ratio of value added to gross domestic product (GDP).
- 13- Induced value added index: vector product of direct coefficients of value added (=ratio of value added of each section to its production) and inverse Leontief.
- 14- Indirect value added index: subtraction direct coefficient from value added of induced value added index.
- 15- Induced imports rate index: vector product of direct coefficients of imports and inverse Leontief.
- 16- Indirect imports rate index: subtraction direct coefficients from imports (=ratio of imports of each section to its production) of induced imports rate index.
- 17- Induced employment index: vector product of direct coefficients of employment (=ratio of employment of each section to its production) and inverse Leontief.
- 18- Indirect employment index: subtraction direct coefficients of employment from induced employment index.
- 19- Importance index: after omitting column and row of section (each section we want to determine this index for it) of technology coefficient matrix, new Leontief matrix would be inversed. Then this new inverse Leontief multiply by new vector of final demand (=previous vector of final demand without mentioned section). Product of this multiplication would be new production. The ratio of previous production to new production is importance index. Measures of greater than one show the importance of the section.
- 20- Dependency to oil section index: share of intermediate demand of oil (as input) for each section.
- 21- Ratio of value added to intermediate demand of oil.

- 22- Share of exports.  
 23- Ratio of exports to production.  
 24- Ratio of exports to final demand.  
 25- Ratio of exports to imports.  
 26- Profitability index: ratio of difference between production and intermediate cost of the section to difference between total production and total intermediate cost.  
 27- Productive investment index: ratio of production to investment (just for comparing amount of investment in a sector and the production which it has).  
 28- Hillman condition (HI): Hillman (1980) developed a necessary and sufficient condition for using Balassa index (RCA) effectively and meaningfully. But surprisingly the majority of empirical studies which use RCA ignore this important conditional index. In general terms, this index deals with monotonicity of exports of a country and the measure of its size. More specifically, let  $x_{i,t}^j$  be the exports of sector j, country I in period t. Hillman's condition is then given by:

$$1 - \frac{X_{i,t}^j}{\sum_i X_{i,t}^j} > \frac{X_{i,t}^j}{\sum_j X_{i,t}^j} \left( 1 - \frac{\sum_j X_{i,t}^j}{\sum_i \sum_j X_{i,t}^j} \right). \quad [4]$$

- 29- Revealed comparative advantages (RCA): According to the main idea of revealed comparative advantage, a diversity range of RCA indices have been suggested, however the most widely acceptable in empirical studies is Balassa RCA index (Balassa 1965):

$$RCA = \frac{X_i / X_w}{\sum X_i / \sum X_w}$$

Where:  $X_i$  is example country exports of sector i,  $X_w$  is the world export of sector i,  $\sum X_i$  is example country total exports and  $\sum X_w$  is the total exports of entire world. [5]

This index almost shows the specialization of a country in exports. A value above 1 indicates the country is more export oriented in that



specific good than the world average, and so it displays a revealed comparative advantage in that particular commodity. [2]

30- Revealed comparative disadvantages (RCD): This index is very similar to RCA index. The only difference of these two is that instead of exports for a particular good in RCA index we put imports measures of that good in RCD index. A value greater than 1 for this index means that the given country reveals a comparative disadvantage in the good.

$$RCD = \frac{M_i / M_w}{\sum M_i / \sum M_w} \quad [2]$$

31- Intra-industry trade share of total trade (ITT): the measure of this index as calculated using Grubel and Lloyd's formula:

$$ITT = \left[ 1 - \frac{|X_i - M_i|}{(X_i + M_i)} \right]$$

Where:  $X_i$  stand for exports and  $M_i$  for imports of sector i. [1]

In the present study, we have used a compound method based on Factor Analysis and Numerical Taxonomy Analysis; the statistical method of Factor analysis is used to identify variability among a large number of observed (or real) variables and offer a smaller number of unobserved (or unreal) variables under the name Factor, and Numerical taxonomy analysis aims to construct clusters of units by means of a quantitative measure of their affinity. Our compound method composed of two steps in each level of assessing; the first step is factor analysis which gives us some factors instead of our numerous indices, the second step is numerical taxonomy analysis which classifies and ranking sectors in terms of factors.

Our study for finding the key sector for Iran economy is composed of three levels: ranking Agriculture and NA-Manufacturing sectors, ranking 11 joint-subsectors, ranking two sectors and 11 joint-subsectors simultaneously.

In the first level, the prime  $38 \times 38$  input-output table is integrated into a  $4 \times 4$  table which contains 4 sectors: Agriculture, NA-Manufacturing, Oil, and Services. Then indices are calculated.

In the second level, after coordinating ISIC and HS codes and introducing new subsectors (Table 1),  $38 \times 38$  input-output table is aggregated into a  $12 \times 12$  input-output table which consists of 11 joint-subsectors and one more sector which contains all those that have not been included in previous 11 joint-subsectors. After calculating indices, both those of input-output table and those of international trade data, factor analysis is done to remove any unnecessary index and make a more summarized set of data and afterwards the numerical taxonomic analysis would be done to rank 11 joint-subsectors.

And finally in the last level, for taking into account both two sectors and 11 joint-subsectors, we need to calculate indices for sectors. As there are no data for sectors, neither in input-output table nor in international trading data we have to use Geometric mean to calculate indices for sectors based on their subsectors indices. Then in this step we have 13 sectors and subsectors all together with 30 indices for each sector or subsector. After doing factor analysis on  $13 \times 30$  elements and getting  $13(\text{sectors and subsectors}) \times 7(\text{factors})$ , we do a Numerical Taxonomy Analysis on  $13 \times 7$  elements to find out what is the ranking of sectors and subsectors when they come round and considered all together.

## 5. Results and Discussion

Having done all those three level of assessing, we realized that, Agriculture sector has an obvious priority over NA-Manufacturing sector and then should be considered as the key sector. Now let's look at the results in details:

Results for HI index for all sectors and subsectors show that using RCA index does not mislead us and it is worth to measure it and take it into account with other indices.

Results of factor analysis for second and third levels show that total variance explained by these 7 factors was 98.07% and this shows high degree of explanation of these 7 factors which will be used instead of 30 main indices. Needless to say that for the sample was small ( $\text{indices} \times \text{sectors} = 30 \times 2 < 100$ ) neither factor analysis nor numerical taxonomy analysis used in the first level.

The results of three level analyses are respectively shown in Table 2, Table 3 and Table 4.

**Table 2- Results of the first level: Comparing Two Main Sectors**

Main Sectors	Agriculture	NA-Manufacturing
Sum of input-output indices scores	43.29697	20.70779
Sum of comparative advantages indices scores	0.442286	0.720955
Total Score	43.739256	21.428745

**Table 3- Results of the second level: 11 joint-Subsectors Ranking**

Rank	Subsector Name	F
<b>1</b>	<b>Food-beverage</b>	<b>0.485634</b>
2	Mineral	0.631697
3	Mineral-non metal	0.68211
4	Agri-fishing	0.744488
5	chemical	0.756798
6	wearing	0.758005
7	wood	0.807304
8	Metal	0.813975
9	Paper	0.841439
10	Machinery	0.878505
11	Other manufactured products	0.917846

**Table 4- Results of the third level: Ranking Mixed Set of Sectors and 11 joint-Subsectors**

Rank	Sector or subsector name	F
1	Food-beverage	0.584128
<b>2</b>	<b>agriculture</b>	<b>0.693958</b>
3	chemical	0.717407
4	Mineral	0.717411
5	Metal	0.749086
6	Mineral-non metal	0.765714
7	wearing	0.771805
<b>8</b>	<b>NA-manufacturing</b>	<b>0.79688</b>
9	Machinery	0.830591
10	Agri-fishing	0.845553
11	Paper	0.874654
12	wood	0.8802
13	Other manufactured products	1.014273

According to Table 2, the total score of Agriculture is more than twice as many as the total score of NA-Manufacturing. This result indicates that, in spite of all inconsiderations, Agriculture, in Iran, has an obvious priority to NA-Manufacturing. In second and third levels of assessing, 'food-beverage' subsector has achieved the first rank which shows the importance and effectiveness of this subsector in Iran economy. Moreover, the results of the third level support the results of the first level.

Now it's clear that all investments in NA-Manufacturing sector could have better results for the economy if they were spent on Agriculture sector and its subsectors specially those industries that form 'food-beverage' joint-subsector. Using variety of indices, assessing in different levels and applying factor analysis that reduces probable errors, can assure us about finding the most likely key sector. Our result about the lead sector for Iran economy is coordinated with the economic history in Iran; as it mentioned in previous sections the brilliant age of our economy was at the time of SAFAVIAH for considering to Agriculture and its related subsectors as the lead or key sector of economy.

However some may say that without a powerful manufacturing sector a subsector such as "food-beverage" could not have an everlasting shiny future; however they should be told that no one wants to put aside the manufacturing sector, all this paper suggests is that the manufacturing sector should be in service of the agriculture sector and try to improve it by means of technology. That's the way we suggest to the politicians to choose if they aim to pass the developing stage and climb up to the third step which is a developed economy.

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