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The Effect of Structural Changes in Higher Education Sector on Regional Output (Case study: Sistan and Baluchestan Province)

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Abstract

The aim of this study is of the effect of structural changes in higher education on changes of output in Sistan and Baluchestan Province using structural decomposition analysis (SDA). The input-output tables of this region for the period 2006-2011 have been employed as the database of the model. The structural changes were decomposed into two factors: changes in share of specific sector in total intermediate inputs that were used by higher education sector (input substitution effect) and changes in total intermediate inputs that were used by this sector (backward linkage effect). The changes in final demand is also decomposed to share of higher education in total final demand of region (structure of final demand) and total final demand of this sector (level of final demand). The results at regional level show that the change in level of final demand in the higher education sector is the main source of increasing in total output of the region. Changes in input substitution, backward linkage, and composition of final demand in this sector lead to a decrease in regional output.

Keywords: Higher Education, Input-Output Table, Sistan and Baluchestan Province, Structural Decomposition Analysis.
JEL Classification: I25, I21**,** Q56.

1. Introduction

In recent years, the higher education sector in Iran has expanded and has generated economic and employment potentials in the country and related regions. One of these regions that have a rapid growth in higher education sector is Sistan and Baluchestan province. The higher education sector has an important role in the social and economic development of a region. One of the main contributions of this sector in regional growth is the provision

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and development of knowledge and human capital. New economic growth models emphasize the role of human capital in economic growth and define this factor as a basis of the growth of regions. The other contribution of this sector in economic development is creating value added, output and employment in regional economy. Based on the interdependence of industries in a regional economy, this sector uses the products of other regional sectors as input and promotes the regional outputs. The more interdependence in regional economy, the more increase in regional output.

A common method for identifying the role of any changes in economy is the input-output structural decomposition analysis (SDA). For example, when there are two sets of input- output tables for an economy, we can disaggregate the total change in gross outputs between two periods into that part associated with changes in technology and that part related to changes in final demand over the period. Based on this method, we can also identify the role of changes in each sector such as higher education sector on regional output.

This paper employs a regional input- output SDA approach to identify the effect of changes in higher education sector on changes in sectoral output at regional level during 2006-2011. The changes in sectoral output in regional economy are attributed to four factors containing changes in input substitution of higher education sector, changes in backward linkage, structural composition of final demand, and level of aggregate final demand effects. The paper contains five sections. Section 2 provides a brief review of literature. Section 3 introduces the methodology and data resources of the research. The results of implementation of the model in Sistan and Baluchestan province are presented and discussed in section 4. Finally, the concluding section ends the paper.

2. Literature review

When there are two sets of input–output tables for an economy, we can decompose the total change in gross outputs between two periods into that part associated with changes in the structure of economy and that part related to changes in final demand over the period using structural decomposition analysis (SDA). One of the first studies that used this method was Chenery et al. (1962) to identify the sources of economic growth in Japan during 1914–1954. In the study of Liu and Saal (2001) changes in gross outputs are decomposed to more factors such as private consumption, investment spending, government spending, exports, and import substitution in South Africa over 1975–1993. Dietzenbacher and Hoekstra (2002) identified the changes in output over 1975–1985 in the Netherlands for 25 sectors. Bokaei and Banouei (2011) have used this method to investigate the sources of growth

in Iran during 1886-2006. In this study change in output is decomposed into changes in domestic final demand, changes in export, and changes in technology and imports substitution. Ansari et al. (2012) investigated the sources of output growth in the agriculture sector of Iran. Zuhdi (2012) investigated the influence of creative industry sector to the national economic structural changes by decomposition analysis for Indonesia's sectors. The results show that creative industry sectors have a significant influence on Indonesia's national economic structural changes from 1990 through 2005. Zuhdi and Prasetyo (2014) analyzed the dynamics of total output of Japanese Information and Communication Technology (ICT) sectors caused by final demand changes. This study used the conditions which final demand changes appear in all of Japanese industrial sectors. The results showed that export has the main impact on total output. Hosseinzadeh and Sharify (2014) decomposed economic growth factors in Golestan Province of Iran, emphasizing the role of spillovers and feedback effects during 2001-2010.

Structural decomposition analysis was used in different studies to decompose changes in employment, value added, energy use, etc. These include examining sources of change in international trade in the study of Chen and Wu (1995) and Wu et al. (2007) for Taiwan, as well as Kanemitsu and Ohnishi (1989) in Japan. This method was applied to the investigation of technological change in Oosterhaven and Van der Linden (1997) in an inter-country study in European economy, Sterner (1985) in Mexican manufacturing industry, Lin and Polenske (1995) in south Africa, Bekhet (2013) in Malaysian economy, and Wang et al. (2014) in China. Gunluk-Senesen and Senesen (2011) utilized structural decomposition of labour demand in Turkey, Vries et al. (2012) decomposed the employment growth in Brazil, Russia, India and China, and Teen (2014) decomposed the labor demand of Malaysia's economy. The SDA Studies related to the environment include Sharify and Hosseinzadeh (2013), Sadeghi et al. (2013), Fotros et al. (2014) in Iran, Su and Ang (2013) in China, and Wang and Wang (2015) in Xinjiang region of China during 2002-2007.

3. Methodology and Data

Input- output structural decomposition analysis is commonly used to investigate the effect of different factors in output changes over time. This method mainly relies on I-O total output model written as:

$$Q = (I - A)^{-1}.Y = C.Y \quad (1)$$

where Q denotes the amount of total outputs, A refers to the technical coefficient matrix, C and Y is the Leontief inverse matrix and final goods and services, respectively.

Based on Eq. (1), we can decompose the change of total output as follows (Miller and Blair, 2009):

$$Q = (I - A)^{-1}.Y = C.Y \Rightarrow \Delta Q = \Delta C \times (\frac{Y_t + Y_{t-1}}{2}) + (\frac{C_t + C_{t-1}}{2}) \times \Delta Y \qquad (2)$$

Leontief inverse matrix, (*C)*, is decomposed into *M* and *Z*. *M* represents the share of each sector in producing specific goods or services in which m_{ij}, the element of this matrix, is equal to $C_{ij} \Big/ \sum_i^n C_{ij}$. Z refers to a diagonal matrix, in which its diagonal elements are equal to $\sum_i^n C_{ij}$, the backward linkage of sectors. Thus, we can decompose the Leontief inverse matrix, (*C)*, as follows:

$$C = M.Z \qquad \Rightarrow \Delta C = \Delta M \times (\frac{Z_t + Z_{t-1}}{2}) + (\frac{M_t + M_{t-1}}{2}) \times \Delta Z \qquad (3)$$

In a similar procedure, *Y*, the column vector of final demand, can be decomposed into *S* and *F*. *S* is an *n×1* matrix that represents the share of industries in total final demand in which $[s_i] = [Y_i] \Big/ [\sum_i^n Y_i]$ and *F* is a scalar of aggregate final demand. Using structural decomposition method, we can decompose the changes of this matrix as follows:

$$Y = S.F \qquad \Rightarrow \Delta Y = \Delta S \times (\frac{F_t + F_{t-1}}{2}) + (\frac{S_t + S_{t-1}}{2}) \times \Delta F \qquad (4)$$

Substitution of Eq. (3) and (4) in Eq. (2) yields

$$\begin{aligned}
&\Delta Q = (\Delta M).\left(\frac{Z_t + Z_{t-1}}{2}\right).\left(\frac{Y_t + Y_{t-1}}{2}\right) && 1-5 \\
&\left(\frac{M_t + M_{t-1}}{2}\right).(\Delta Z).\left(\frac{Y_t + Y_{t-1}}{2}\right) && 2-5 \\
&\left(\frac{C_t + C_{t-1}}{2}\right).(\Delta S).\left(\frac{F_t + F_{t-1}}{2}\right) && 3-5 \\
&\left(\frac{C_t + C_{t-1}}{2}\right).\left(\frac{S_t + S_{t-1}}{2}\right).(\Delta F) && 4-5
\end{aligned} \qquad (5)$$

Eq.(5-1) represents the changes in output of different regional sectors caused by changes in the share of each sector in total intermediate inputs of higher education sector (input substitution effect). Eq. (5-2) represents the effects of change in backward linkage. Eq. (5-3) represents the changes in the share of higher education sector in total final demand (mix effect). The effect of change in the size of aggregate final demand (level effect) is shown in term (5-4).

The data used are based on the regional input-output tables of Sistan and Baluchestan province for the period 2006-2011 which were prepared from national input-output tables using the AFLQ method that was proposed by Flegg and Tohmo (2011). Other sources of data include Annual National Accounts; Annual regional Accounts for construction of regional input-output tables were prepared from the Statistics Center of Iran. Price indices of sectors that were used to calculate fixed price tables were prepared from the Central Bank of the Islamic Republic of Iran (CBI) website. These indices are calculated by dividing the sectoral output at current prices to sectoral output at constant prices.

4. Results and Discussion

To reveal the effect of changes of different factors in higher education sector on changes in regional output during the period 2006-2011, the proposed model was employed. According to the results, the level of output in Sistan and Baluchestan province has increased 77.48 billion Rials because of the changes in higher education sector during 2006-2011. As it is shown in Table 1, the change in level of final demand in the higher education sector is the main source of increase in total output of the region.

Table 1. changes of total output caused by higher education sector during 2006-2011

Factors	Billion Rials	Share in total
Input substitution effect	-55.32	-71.4
Backward Linkage effect	-2.18	-2.8
Structural composition of final demand effect	-42.96	-55.44
Level of aggregate final demand effect	177.94	229.65
Total changes	77.48	100

Source: Author's calculations

Changes in input substitution and backward linkage in this sector lead to a decrease in regional output. Input substitution is the main source of decrement in total output of the region. One reason of this phenomenon is that the higher education sector imports the intermediate inputs from other regions more. Another reason is that this sector has strong linkages with the sectors that have low output multiplier in the region and less output generation sectors.

In a more detailed investigation, Table 2 displays the role of changes in higher education sector on changes in sectoral output through various

sources. Column M of Table 2 shows the effect of changes in input substitution in higher education sector on output in different sectors.

Table 2. Changes in sectoral output caused by higher education during 2006-2011. (billion Rials)

sector	M	Z	S	F	Total
1. Agriculture	-14.30	-0.52	-10.28	34.69	9.58
2. Mining	-0.04	0.00	-0.03	1.25	1.18
3. Food industries	-0.62	-0.03	-0.64	9.01	7.72
4. Textile and clothes	-0.40	-0.01	-0.27	2.06	1.37
5. Chemical industries	0.35	-0.01	-0.26	1.70	1.78
6. Plastic industries	-0.32	-0.01	-0.22	0.60	0.05
7. Non-metal industries	-1.23	-0.05	-0.96	2.84	0.59
8. Basic metal industries	0.01	0.00	-0.01	1.40	1.39
9. Metal industries	-0.25	-0.01	-0.18	1.35	0.90
10. Other industrial sectors	-0.12	-0.01	-0.10	1.94	1.70
11. Electricity, Gas & Water distribution	-7.31	-0.34	-6.78	5.98	-8.45
12. Construction	-6.04	-0.22	-4.32	23.01	12.43
13. Trade	-4.77	-0.21	-4.12	21.18	12.08
14. Restaurants & Hotels	-3.20	-0.12	-2.33	1.77	-3.88
15. Transport	-2.61	-0.10	-1.95	9.09	4.43
16. Communication	-4.49	-0.16	-3.10	1.52	-6.22
17. Banking and insurance services	-2.20	-0.08	-1.63	2.66	-1.24
18. Estate services	-0.48	-0.02	-0.41	19.64	18.73
19. Professional services	-1.22	-0.05	-0.99	1.41	-0.84
20. Public administration	-0.91	-0.04	-0.70	13.65	12.01
21. Other educations	-0.46	-0.02	-0.34	9.94	9.12
22. Health	-0.45	-0.02	-0.32	8.21	7.42
23. Cultural, sport, and entertainment services	-2.10	-0.07	-1.45	1.33	-2.30
24. Other services	-2.17	-0.08	-1.56	1.72	-2.09

Source: Author's calculation

As it is shown in Table 2, this factor has a negative effect on output of all sectors except "Chemical industries" and "Basic metals". This is due to reduction in share of sectors in total intermediate inputs of higher education sector. The share of "Chemical industries" and "Higher education" sector in total inputs of higher education sector is increased. Output of "Agriculture", "Electricity, Gas & Water distribution" and "Construction" is most affected by input substitution in higher education sector. This is due to a sharp decline in the share of these three sectors in the total inputs used in higher education sector.

Column Z of Table 2 shows the effect of changes in backward linkage in higher education sector. As it shown in the table, this effect is negative in all sectors. This is due to the reduction of total intermediate inputs of this sector that is provided by domestic sectors. In other words, higher education sector imports the intermediate inputs from other regions or abroad. These phenomena led to a reduction in demand of output in regional domestic sectors. Thereby, their production has been reduced.

Column S of Table 2 shows the effect of changes in share of higher

education in total final demand of region on sectoral output. The results show that these two factors have a negative effect on the output of all sectors. "Agriculture", "Electricity, Gas & Water distribution", and "Construction" had the most reduction in output through these three factors.

The effect of growth of final demand level in higher education sector on changes of output in different sectors is displayed in *F* column of Table 2. According to the results, "Agriculture", "Construction", and "Trade" have had the main positive effect on output through level of final demand.

The effect of total changes in higher education sector on changes of output in different sectors is displayed in the last column of Table 2 and Figure 2. According to the results, "Estate services", "Construction", and "Trade" have had the main positive effect from total changes in higher education sector.

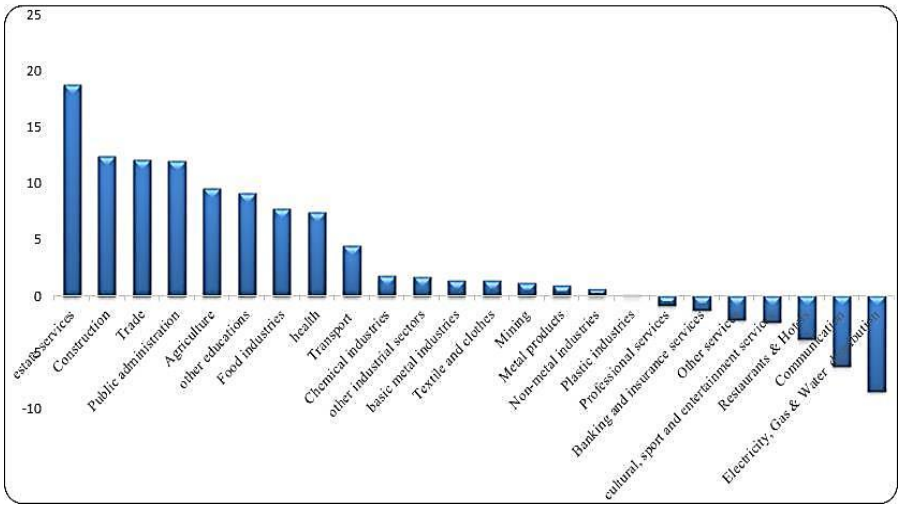

Fig. 1. Changes in sectoral output caused by higher education sector

Source: Author's calculation

5. Concluding remarks and policy implications

The structural decomposition analysis is a useful tool for exploring the overall and partial changes in output. This model was employed to investigate the effect of different sources of changes in higher education sector on sectoral output in Sistan and Baluchestan province of Iran during 2006-2011. According to the results, total output in Sistan and Baluchestan province has increased 77.48 billion Rials because of the changes in higher education sector during 2006-2011. Change in the level of final demand in higher education sector is the main source of increase in total output of the

region. Changes in input substitution, backward linkage, and share of final demand in this sector lead to a decrease in regional output.

Input substitution is the main source of decrement in total output of the region. In a more detailed investigation, input substitution in higher education sector has a negative effect on output of all sectors except "Chemical industries and basic metals". The share of "Chemical industries" and "Higher education" sector in total inputs of higher education sector is increased. Input substitution in higher education sector has the most negative effect on Output of "Agriculture", "Electricity, Gas & Water distribution" and "Construction". This is due to a sharp decline in the share of these three sectors in the total inputs used in higher education sector. Investigation of import coefficient of this sector from other sectors of other regions shows that this coefficient is increased for all sectors especially in "Agriculture" sector. On the other hand, "Agriculture" sector is one of the key sectors in the economy of this region. For these reasons, reduction of share of this sector in total intermediate inputs of higher education sector caused a great negative effect on total output of the region. Thus, for a greater effect of higher education sector on regional economy, the linkages of this sector must be increased with domestic key sectors in the region, such as "Agriculture" and "Food industries", and agriculture and food products that are required in this sector must not be imported from other regions.

Backward linkage has a negative effect on output of all sectors. "Agriculture", "Electricity, Gas & Water distribution", and "Construction" had the most reduction in output through this factor. Backward linkage of higher education sector is decreased from 1.08 in 2006 to 1.01 in 2011. One reason for this phenomenon is that imported inputs of this sector increased during the study period. One reason for increase of imported inputs is the reduction of investment in regional economy and therefore reduction in production capacity and also linkage of sectors in regional economy. Another reason is increment of smuggling goods such as "Agriculture" products and "Textile and clothes" in the regional economy. Unfortunately, due to the fact that this province is located on the border of the country, smuggled goods are very abundant in it. The use of smuggled goods reduces the linkage of domestic sectors. Therefore, regional policymakers should pursue appropriate policies to reduce smuggling in this province.

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