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The Sources of Labor Productivity Growth in Norway, South Koreaand Iran: A Structural Decomposition Analysis

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Abstract

In this paper,using a structural decomposition analysis (SDA) and the latest available input-output tables we investigate the sources of labor productivity growth in Norway, South Korea and Iran. Then, the contribution of each source in the growth of labor productivity is discussed. The results show that among six factors, value added coefficient is the most influencing factoracross all three countries regardless of the level of development. In contrast, labor input coefficient shows the smallest effect on labor productivity growth.

Keywords: labor productivity, structural decomposition analysis (SDA)

1- Introduction

A better understanding of the factors that enable sustained GDP growth is a very important issue especially for the developing countries. Among the factors, productivity growth is usually one of the most important driving forces of economic growth.

Since economic progress strongly hinges on productivity growth, the goal of increasing productivity growth is highly important. In fact, higher standards of living and lower poverty rate cannot be achieved without productivity growth. The higher the productivity in a country, the higher the income per capita will be in that country. For developing countries, higher

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level of productivity can assist these countries in 'catching-up' with their developed peers much faster.

Productivity has been and will be a hot topic for economists over decades. Back more than two centuries ago, AdamSmith cited that division of labor leads to productivity improvements and economic growth. He believedthat productivity decrement results in income reduction, and therefore, decreases in level of standard of living. Lower level of standard of living on its own reduces the productivity. Kuznets in more than a century ago also emphasized on the role of productivity in economic growth, in which, in describing the six characteristics of growth common across developed countries he lists high rate of productivity growth among the top two critical factors. On the empirical front, manytop economists including Arrow, Solow, Kendrick, Kuznets, and Grilliches made efforts to compute what portion of increase in national domestic product in a given period have been due to increase in capital, labor, and other factors including productivity.

Given this background, this paper attempts to provide a detailed decomposition of productivity growth which can be useful for policy makers to set the policies precisely and tailor the interventions accordingly. More specifically, the paper investigates the sources of improvements in aggregate labor productivity in Norway, South Korea and Iran using a structural decomposition analysis approach. The methodology uses six sources of increase in labor productivity: value added coefficient (value added per unit of output), labor input coefficient (labor input per unit of output), domestic supply ratio, technological change, change in share of aggregated intra-sectoral final demand, and change in composition of aggregated inter-sectoral final demand.

This paper takes a different sample of countries as opposed to other studies that investigated a specific country, e.g., Lahr and Yang (2010) for China or Jacob (2003) for Indonesia, or a group of homogeneous countries, e.g., Dietzenbacher,Hoen and Loss (2000) for the west European countries. It decomposes the aggregated productivity growth in three countries, Norway, a well-developed country, South Korea, a newly industrialized economy, and Iran, a developing middle-income country mainly dependent on oil revenues. It is interesting to see whether the sources of productivity

growth are different among these countries which are at three deferent levels of development.

Literature review

Lahr and Yang (2010) using Jacob's methodology studied the sources of labor productivity of china over 1987-2005. The results suggest that labor input saving was the most influencing factor in explaining the labor productivity improvements which impacted the food, textile and chemical products industries the most. Technological change stood at second place, however, with negative impacts mainly on primary inputs and governmental businesses. Value added coefficient was the third most influencing factor impacting mainly and positively the metal industry, followed by ratio of domestic supply which impacted negatively and mainly on food, textile, and publishing industries. The other two factors related to the final demand impacted the industries' labor productivity positively but with smaller effects compared to the other four factors.

Lahr and Yang (2009) in another study examined the sources of labor productivity in China's seven regions between 1987-1987 using Dietzenbacher et al. (20000) methodologies. The sources of productivity studied in this paper included labor input, value added coefficient, change in inter-sectoral structure (change in technology, factor substitutions), change in output composition, change in trade structure in terms of goods and services used as intermediate inputs, and change in final demand. The results show that labor saving and change in value added are the most influencing factors in explaining labor productivity improvements.

Jacob (2003) investigated the factors affecting labor productivity of Indonesian economy over 1971-1995 period. The Indonesia underwent an economic liberalization in 1985. The results show that Indonesian economy witnessed improvements in productivity over the whole period, but more over post-liberalization of 1990-1995 period, with mining and oil industries on top. Among the factors, labor input coefficient (labor saving) has impacted improvements in labor productivity the most and technological change with the smallest and negative impacts. In addition, value added coefficient affected the productivity negatively. Among the sectors, services experienced the lowest productivity improvements especially in pre-

liberalization period. The service sector was impacted mainly by the changes in composition of inter-sectoral final demand.

Dietzenbacher,Hoen and Loss (2000) in a study on labor productivity for west European countries including Belgium, Denmark, France, Germany, Italy and Netherlands, over 1975-1985 investigated the factors affecting labor productivity. According to the results, the average productivity improvements for these six countries were 24.5 percent over 1975-1985 period mainly attributable to labor input and value added coefficients. However, input structure and mix of final demand, even though small, impacted negatively. Among the six countries, Netherland been impacted the most by the labor input coefficient, while Germany been impacted the most but negatively by value added coefficient.

Structural Decomposition Analysis: A Background

In calculating productivity, economists use three different approaches including Index Approach, Production Function Approach, and Input-output Approach. The Index Approachlinks the output of an economy, or sector to production inputs, given the specific assumptions on the production function. Under the Production approach, a specific production function is chosen mostly at firm level. Under the Input-Output approach, the focus is on the decomposition analysis which is the subject of the current paper.The decomposition analysis can be grouped into Index decomposition analysis, structural decomposition analysis, shift share analysis, and growth accounting analysis.

Index Decomposition Analysis (IDA) is based on the theory of index figures broadly applied in early 1980s using indices like Laspears, and Marshal-Edgeworth. Later on, and inspired by decomposition analysis in energy literature, Boyed et al (1988) introduced the Divisia Index, and then Liu et al. (1992) addressed Adaptive Weighting Divisia which used as a basis for the General Parametric Divisia method introduced by Ang (1995).

The Structural Decomposition Analysis (SDA) was widely used after the seminal paper by Leontief in 1941 titled as ‘Quantitative relations of input-output in US economy system’. Nowadays, input-output is widely used in quantitative analysis of economies all over the world.

Shift Share Analysis is used mainly in contexts relevant to labor economics and regional sciences. It is not only an analytical tool for

investigating the variations in unemployment and growth in a region, but it is a method for forecasting the future trends.[1]And finally growth accounting approach addresses the share of inputs in economic growth with special emphasis on the impact of productivity (Kendrick, 1961, Jorgenson et al., 1987).

On a comparison basis, Structural Decomposition Analysis uses input-output for decomposing the changes in indices and focuses on large numbers and specific effects, while Index Decomposition Analysis only employs the information at sectoral level. One strength of SDA is that it distinguishes among technological and final demand effects which is not captured under IDA(J.C.J.M, 2003, Hoekstra, R, Van Der Bergh, 2004).

StructuralDecomposition Analysis: Methodology

Productivity growth depends on a host of factors, including management; however, the aim of this is application of an appealing methodology used for the first time by Dietzenbacher, Hoen and Loss (2000), which then some small adjustments adopted by Jacob (2003) and then by Yang and Lahr (2010) in the context of labor productivity. The methodology decomposes the changes in labor productivity is as follows:

N: number of sectors in input-output table,

V: vector of value added (n*1 vector),

e: vector of labor input (n*1vector),

λ: labor productivity (n*1 vector), and $\lambda = {v_i}/{e_i}$,

A: technical coefficient matrix (n*n matrix) with the a_{ij} as typical element denoting the input of product i per unit of output in industry j;

I: identitymatrix (n*n),

B: Normalized final demand (n×k matrix), where each cell is derived as the ratio of the corresponding cell in the final demand matrix to its respective column sum;

1- The details of this method can be found in Perloff et al. (1960) and Stevons and Moors (1980).

y: aggregate final demand for each of k categories (rural consumption, urban consumption, government consumption, gross fixed capital formation, inventory stock, export and other) (k×1 vector);

Ĕ: diagonal matrix with elements e_i as the labor input per unit of output in industry i in the diagonal and '0'off-diagonal,

$\hat{V}$: diagonal matrix with elements v_i as the value-added per unit of output in industry i in the diagonal and '0' off-diagonal (n×n matrix);and,

$\hat{P}$: diagonal matrix (n*n) with elements P_i as the domestic supply ratio (i.e., ratio of total output to total supply) in industry i in the diagonal and '0' off-diagonal (n×n matrix).

Then, the vector of value added can be shown as follows:

$$V = \hat{V}(I - \hat{p}\,\overset{\circ}{A})^{-1}\,\hat{p}BY$$

In which $\overset{\circ}{A}$ is total supply-based technical coefficient matrix and y is the vector of aggregated final demands based on final consumption of sectors including exports, and comprises of urban household consumption, rural household consumption, government consumption, capital formation, change in inventory, and errorterm.

Changes in value added between period 0 and period 1 can be shown as:

$$\frac{V_1}{V_0} = \frac{\hat{v}_1(I - \hat{p}_1\,\overset{\circ}{A}_1)^{-1}(\hat{p}_1 B_1)y_1}{\hat{V}_0(I - \hat{p}_0\,\overset{\circ}{A}_0)^{-1}(\hat{p}_0\,\overset{\circ}{B}_0)y_0}$$

By applying the same approach the changes in employment between period 0 and period 1 can be written as:

$$\frac{e_1}{e_0} = \frac{\hat{E}_1(I - \hat{p}_1\,\overset{\circ}{A}_1)^{-1}(\hat{p}_1 B_1)y_1}{\hat{E}_0(I - \hat{p}_0\,\overset{\circ}{A}_0)^{-1}(\hat{p}_0\,\overset{\circ}{B}_0)y_0}$$

And if the following time indices are available:

$$L_0 = (I - \hat{p}_0 \dot{A}_0)^{-1}$$
$$L_1 = (I - \hat{p}_1 \dot{A}_1)^{-1}$$
$$L_{01} = (I - \hat{p}_0 \dot{A}_1)^{-1}$$
$$L_{10} = (I - \hat{p}_1 \dot{A}_0)^{-1}$$

Then the decomposition of value added is derived as follows:

$$= \left(\frac{\hat{V}_1 L_1 \hat{P}_1 B_1^0 y_1}{\hat{V}_0 L_1 \hat{P}_1 B_1^0 y_1}\right)\left(\frac{\hat{V}_0 L_{01} \hat{P}_1 B_1^0 y_1}{\hat{V}_0 L_1 \hat{P}_1 B_1^0 y_1}\right)\left(\frac{\hat{V}_0 L_0 \hat{P}_1 B_1^0 y_1}{\hat{V}_0 L_{01} \hat{P}_1 B_1^0 y_1}\right)\left(\frac{\hat{V}_0 L_0 \hat{P}_0 B_1^0 y_1}{\hat{V}_0 L_0 \hat{P}_1 B_1^0 y_1}\right)\left(\frac{\hat{V}_0 L_0 \hat{P}_0 B_0^0 y_1}{\hat{V}_0 L_0 \hat{P}_0 B_1^0 y_1}\right)$$

Then, the decomposition of labor input changes is derived. By combining these two decompositions the changes of labor productivity is derived as follows:

$$\frac{\lambda_1}{\lambda_0} = \frac{V_1}{e_1} \div \frac{V_0}{e_0} = (1.1) \times (1.2) \times (1.3) \times (1.4) \times (1.5) \times (1.6)$$

Where:

$$(1.1) = \left(\frac{\hat{V}_1 L_1 \hat{P}_1 B_1^0 y_1}{\hat{V}_0 L_1 \hat{P}_1 B_1^0 y_1}\right)$$

$$(1.2) = \left(\frac{\hat{E}_1 L_1 \hat{P}_1 B_1^0 y_1}{\hat{E}_0 L_1 \hat{P}_1 B_1^0 y_1}\right)$$

$$(1.3) = \left(\frac{\hat{V}_0 L_1 \hat{P}_1 B_1^0 y_1}{\hat{V}_0 L_{01} \hat{P}_0 B_1^0 y_1}\right)\left(\frac{\hat{E}_1 L_{01} \hat{P}_1 B_1^0 y_1}{\hat{E}_0 L_1 \hat{P}_0 B_1^0 y_1}\right)$$

$$(1.4) = \left(\frac{\hat{V}_0 L_{01} \hat{P}_1 B_1^0 y_1}{\hat{V}_0 L_0 \hat{P}_0 B_1^0 y_1}\right)\left(\frac{\hat{E}_0 L_0 \hat{P}_0 B_1^0 y_1}{\hat{E}_0 L_{01} \hat{P}_0 B_1^0 y_1}\right)$$

$$(1.5) = \left(\frac{\hat{V}_0 L_0 \hat{P}_0 B_1^0 y_1}{\hat{V}_0 L_0 \hat{P}_0 B_0^0 y_1}\right)\left(\frac{\hat{E}_0 L_0 \hat{P}_0 B_0^0 y_1}{\hat{E}_0 L_0 \hat{P}_0 B_1^0 y_1}\right)$$

$$(1.6) = \left(\frac{\hat{V}_0 L_0 \hat{P}_0 B_0^0 y_1}{\hat{V}_0 L_0 \hat{P}_0 B_0^0 y_0}\right)\left(\frac{\hat{E}_0 L_0 \hat{P}_0 B_0^0 y_0}{\hat{E}_0 L_0 \hat{P}_0 B_1^0 y_1}\right)$$

Equation (1.1): represents the productivity effects resulted from changes in value added per unit of gross output by industry,

Equation (1.2): represents the productivity effects resulted from changes in labor input requirement per unit of industry gross output,

Equation (1.3): represents the effects of domestic supply changes from both intermediate inputs and final demand,

Equation (1.4): represents the effects resulted from changes in inter-industry structure due to technological change, and factor substitution,

Equation (1.5): represents the changes in sectoral composition of each category of final demand (change in share of intra-sectoral final demand)

Equation (1.6): represents the effects of changes in macro final demand among categories (composition of inter-sectoral final demand).

Since the structural change decomposition analysis is not unique, there is another version of decomposition with reversed weights. Dietzenbacher and Hoen (1998) find that the average of these two methods provides results that are very close to the average of all possible decomposition forms, shown as follows:

$$\frac{\lambda_1}{\lambda_0} = \frac{V_1}{e_1} \div \frac{V_0}{e_0} = (2.1) \times (2.2) \times (2.3) \times (2.4) \times (2.5) \times (2.6)$$

And:

$$(2.1) = \left(\frac{\hat{\mathbf{V}}_1 L_0 \hat{P}_0 B_0^0 y_0}{\hat{\mathbf{V}}_0 L_0 \hat{P}_0 B_0^0 y_0}\right)$$

$$(2.2) = \left(\frac{\hat{E}_0 L_0 \hat{P}_0 B_0^0 y_0}{\hat{E}_1 L_0 \hat{P}_0 B_0^0 y_0}\right)$$

$$(2.3) = \left(\frac{\hat{\mathbf{V}}_1 L_{10} \hat{P}_1 B_0^0 y_0}{\hat{\mathbf{V}}_1 L_0 \hat{P}_0 B_0^0 y_0}\right)\left(\frac{\hat{E}_1 L_0 \hat{P}_0 B_0^0 y_0}{\hat{E}_1 L_{10} \hat{P}_1 B_0^0 y_0}\right)$$

$$(2.4) = \left(\frac{\hat{\mathbf{V}}_1 L_1 \hat{P}_1 B_0^0 y_0}{\hat{\mathbf{V}}_1 L_{10} \hat{P}_0 B_0^0 y_0}\right)\left(\frac{\hat{E}_1 L_{10} \hat{P}_0 B_0^0 y_0}{\hat{E}_1 L_1 \hat{P}_1 B_0^0 y_0}\right)$$

$$(2.5) = \left(\frac{\hat{\mathbf{V}}_1 L_1 \hat{P}_1 B_1^0 y_0}{\hat{\mathbf{V}}_1 L_1 \hat{P}_1 B_0^0 y_0}\right)\left(\frac{\hat{E}_1 L_1 \hat{P}_1 B_0^0 y_0}{\hat{E}_1 L_1 \hat{P}_1 B_1^0 y_0}\right)$$

$$(2.6) = \left(\frac{\hat{\mathbf{V}}_1 L_1 \hat{P}_1 B_1^0 y_1}{\hat{\mathbf{V}}_1 L_1 \hat{P}_1 B_1^0 y_0}\right)\left(\frac{\hat{E}_1 L_1 \hat{P}_1 B_1^0 y_0}{\hat{E}_1 L_1 \hat{P}_1 B_1^0 y_1}\right)$$

By taking natural logarithm, the percentage share of each factor in labor productivity is derived.

Data

For Iran the input-output tables of 1991, and 2001 were used. The IO table for 1991 includes 78 sectors and for 2001, 99 sectors. Both tables were aggregated into 10 sectors including 1) agriculture, oil and gas and mining, 2) manufacturing, 3) utilities, 4) construction, 5) trade, restaurant and hotel, 6) transportation, inventory, and communications, 7) financial and monetary institutions, 8) real estate, 9) public, social, personal, and local services, and 10) other services.

For Norway and South Korea, the Input-Output tables for 2000 and 2005 were used. The tables comprise of 48 sectors and were aggregated into 11 sectors, including 1) agriculture, fishery, oil and gas and mining, 2) manufacturing, 3) utilities, 4) construction, 5) transportation, inventory, and communications, 6) financial and monetary institutions, 7) real estate, 8) education, 9) health, 10) public, social, personal, and local services, and 11) other services.

The data on sectoral employment for Iran economy obtained from the IranStatistical Center (ISC) compiled for 14 sectors. It was aggregated into 10 sectors in correspondent to the aggregation of the Input-Output tables. The Norwegian and South Korean employment information extracted from the ILO dataset on employment for 17 sectors for 2000 and 2005. They have also been aggregated into 11 sectors in accordance to their 11 sectors of Input-Output tables.

The Input-Output tables for all three countries were adjusted to constant prices using double adjustment methodology. For computing the price index of the Iran case, 1997 was chosen as the base year, and the value of intermediate consumption by sector was used to compute the intermediate consumption price implicit index. And the value of economic activities' output of 1991 and 2001 were used to compute the output implicit price index. All these data obtained from national accounts published annually byCentral Bank of Iran (CBI). For Norway and South Korea the year 2005 was chosen as the base year in order to compute the price indexes. The data on sectoral value added which were used for calculating the implicit prices indexes for various years obtained from the World Bank.

Results

Tables 1, 2, and 3present the decomposition of changes in labor productivity for Norway, South Korea and Iran are shown. Each table has three columns. The first column presents the findings of the equations (1.1) through (1.6); the second column presents the findings of equations (2.1) through (2.6), and the third column presents the Fischer Index as the geometric mean of the columns 1 and 2. The numbers greater than zero indicates a positive impact while the numbers less than zeroindicatenegative impacts of the factor on labor productivity changes. By taking the natural logarithm, we can obtain the percentages of contribution of each factor.The

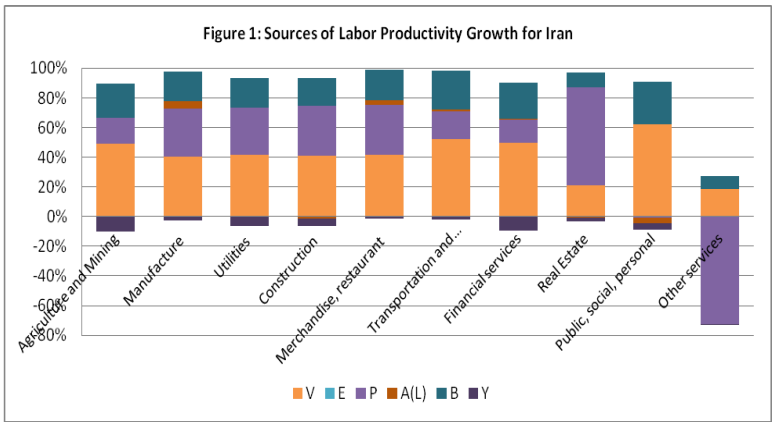
results of the computations are presented in tables (5), (6), and (7) indicating the importance of each factor in changes of labor productivity.

Iran

During the 1991-2001 period,value added per unit of output is the most determining factor in explaining the changes of the labor productivity with the value of 484 percent, mainly in transportation, communication and financial industry. The tendency to products with more value addition, along with the post-war reconstruction led to economic reforms which resulted in improving the competitiveness of the economy. Theimpacts of these reforms and changes on the productivity of the industries have been positive which in turn improved the labor productivity of the economy. The impacts on public services and construction have been trivial.

The second most important factor was changes in share of intra-sectoral aggregated final demand with 237 percent on growth of labor productivity. Transportation and communications sectors were benefited the most while the real estate and social and public sectors were benefited the least.

The third most influential factor, however negative, was the composition of inter-sectoral final demand. It impacted the financial sector the most with -17 percent. The minimum negative effect belongs to other services.



The fourth factor is the effect of changes in ratio of domestic supply to the intermediate inputs and final demand. This factor represents the degree of capability of the domestic demand to satisfy the production needs of intermediate inputs and final demand. The impacts are positive on all sectors

but social and public sector and other services. The negative effects point to the substitution of the domestic supply by the imports. Using more imported goods and services results in labor saving and therefore increasing the idle capacity for the labor. It can also reduce the share of value added if imports substitute the high- productivity domestic products. The highest impact was on merchandise, restaurants and hotel sector with 58 percent.

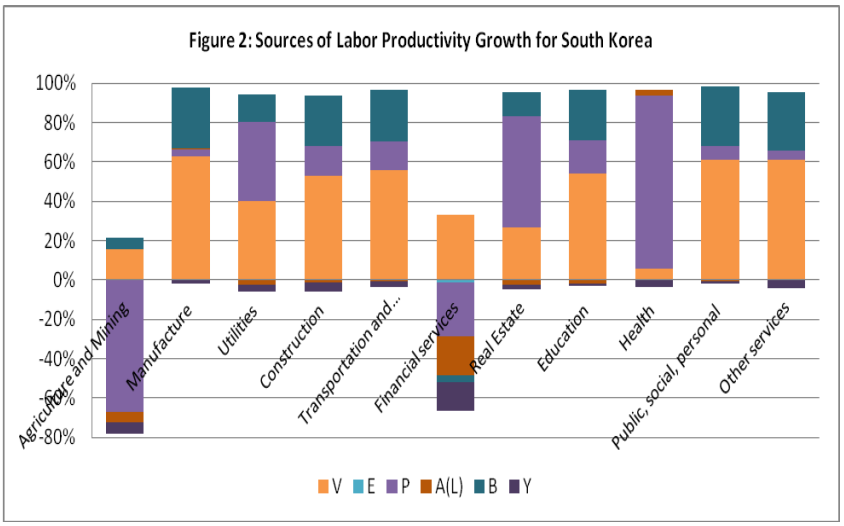
The fifth factor in terms of impacts belongs to the technological change with 12 percent share, with insignificant effect onagriculture and mining, construction and social and public services. It impacted manufacturing, merchandise, restaurant and hotel the most.

The least important factor is the labor input coefficient or change in labor input needed per each unit of gross output. Its value is 1.18 percent and impacted the sectors negatively with highest belongs to the other services. Its effects on most of the sectors are very low and negative.

South Korea

During 2000-2005 period, the first and most important factor in labor productivity improvement was value added coefficient, i.e., changes in value added per each unit of gross output of sectors, at 283 percent. The impacts on all sectors are positive with highest impact on social and public sectors with 103 percent. The minimum impact, 1 percent, was on health and financial sectors.

The second place belongs to the changes in share of aggregated intra-sectoral final demand. The effects on health and financial sectors are negative even though very low. The impacts on all other sectors are positive with social and public service sectors with highest impact at 50 percent.



The domestic supply ratio is the third factor. Its impact on labor productivity improvement was 77 percent with highest impact on health care services and real estate and lowest negative impact on financial sector.

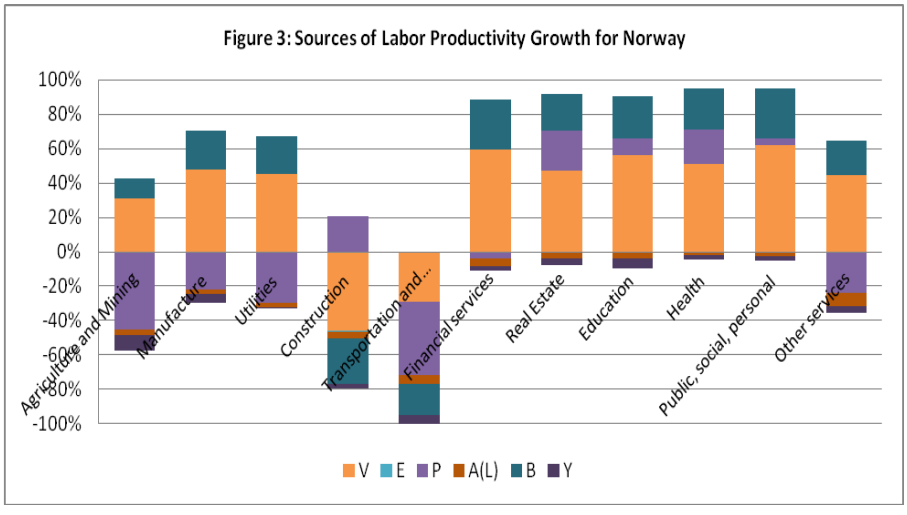
Changes in inter-sectoral final demand is the fourth factor , however, with negative impact with the most impact on construction and the least on utilities, transportation and communication, real estate, education and health care sectors.

Technological change stands in fifth place but with negative impact. The effects on all sectors are negative and low, however, the most negative impacts on social and public sector and education sector. The lowest impact is on other services at -0.006 percent. Last is the labor input coefficient with very low and decreasing impact, with the most effect on transportation and communication sectors.

Norway

For Norway during 2000-2005, same as Iran and South Korea, value added is the most effective factor on labor productivity which contributed around 109 percent. The impacts are positive on all sectors except for construction, transportation and communication.

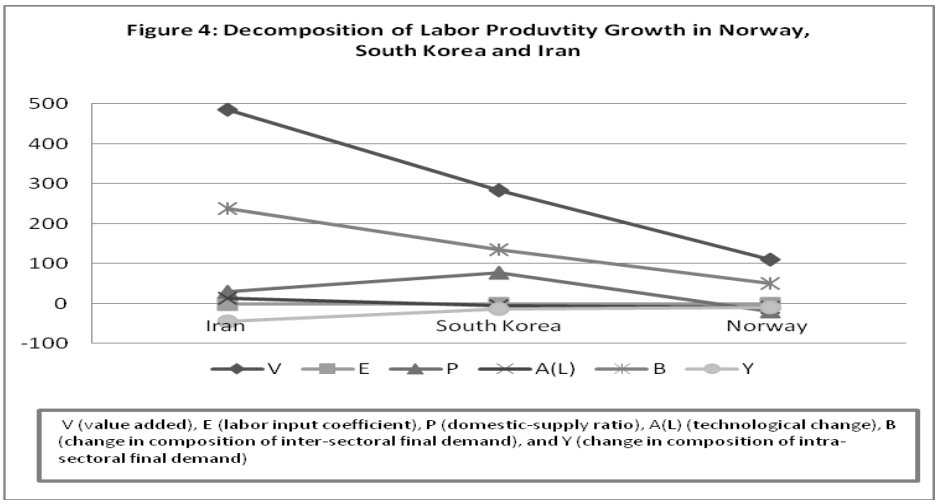
The change in share of intra-sectoral final demand is the second factor on improving labor productivity with highest impact on financial sector and utilities. Its effects on agriculture and mining are also positive but very low at 1.6 percent. Like value added, change in consumption of each categories of final demand had a decreasing impact on construction, transportation and communication sectors.



The domestic supply ratio is the third factor, however, with dampeningeffect. Its highest impact is on the utilities with -12 percent and lowest impact, but positively, on education, social and public sectors. Its impact on financial sector is also negative.

Technological change and change in inter-sectoralfinal demand between categories are the fourth and fifth factors which impacted negatively the labor productivity. Technology affected the labor productivity of financial sector and other services at most, and the agriculture and mining at least. However, the effects of the change in inter-sectoralfinal demand between categories, manufacturing, agriculture and mining affected the most negatively, and construction sector the least. Finally labor input coefficient is the sixth and least influential factor on labor productivity with trivial impact. It affected the health sector the most and almost no impact on utilities.

Countries comparisons



The results show that in Iran, South Korea and Norway the value added is the most important factor on growth of labor productivity followed by changes in share of intra-sectoral final demand. The third factor for South Korea and Norway is the domestic supply ratio which is positive for South Korea but negative for Norway. The negative impact for Norway implies that this country has substituted some of the domestic supply with foreign supply (imports) which led to labor saving of activities and therefore increased the idle capacities for the labor force. For Iran change in inter-sectoral composition of final demand categories (i.e., Y) is the third factor, however, the effect is negative.

The fourth factor for Iran economy is the domestic supply ratio with positive impacts. For South Korea change in composition of iner-sectoral final demandand for Norway technological change was the fourth factor having negative impact on labor productivity. It is interesting that the change in inter-sectoral mix of final demand for all three countries were negative.

For Iran and South Korea the fifth factor are technological change, however, its impact is positive for Iran but negative for South Korea. This result looks reasonable since South Korea is more advanced than Iran in terms of technology. In other words, Iran's economy has still some room to catch-up. For Norway, the composition of intra-sector final demand is the fifth factor. Finally, the sixth factor for all three countries is labor input coefficient with the smallest and negative impact on labor productivity.

Table 7: Comparisons of results across three countries

	V	E	P	A(L)	B	Y
Norway	109.191	-0.509	-19.552	-9.817	49.772	-9.045
South Korea	283.790	-0.586	77.574	-5.276	134.840	-13.151
Iran	484.732	-1.182	30.526	12.497	237.387	-45.099

Note: V (value added), E (labor input coefficient), P (domestic-supply ratio), A(L) (technological change), B (change in composition of inter-sectoral final demand), and Y (change in composition of intra-sectoral final demand)

5- Concluding Remarks

In this paper using a structural decomposition analysis method we decomposed the sources of labor productivity into six components for Iran, South Korea and Norway including value added, labor input coefficient, domestic supply ratio, technological change, change in share of intra-sectoral final demand, and change in composition of inter-sectoral final demand.

The results show that regardless of the level of developments for Norway, South Korea and Iran the constituent parts of labor productivity growth behave similarly across all these three countries. The main difference lies on the magnitude of each factor in labor productivity growth.

Value added was the most influential factor in growth of labor productivity across all three countries and especially on service sub-sectors. Its biggest impact for Iran was on transportation and communication and financial sector. For South Korea the biggest impact was on social and public services and for Norway on construction, transportation and communication sector.

The results also imply that Iran still has more room for benefiting from adopting cutting-edge technologies as the impact of this factor on Iran economic sectors are higher than the other two countries.

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Table 1: Labor productivity decomposition of Iran, 1991 and 2001

	Value Added (V)		*Fischer Index*	Labor Input coefficient (E)		*Fischer Index*	Domestic supply ratio (P)		*Fischer Index*	Technological (A) change		*Fischer Index*	Change in share of intra-sector final (B) demand		*Fischer Index*	Change in composition of intra-sector final demand (Y)		*Fischer Index*
Agriculture and Mining	1.40	1.40	1.40	1.16	0.86	1.00	1.01	1.26	1.13	1.00	1.00	1.00	0.99	1.40	1.17	0.89	0.98	0.93
Manufacture	1.50	1.50	1.50	1.45	0.69	1.00	1.23	1.58	1.39	1.11	1.00	1.05	0.99	1.50	1.22	0.98	0.97	0.98
Utilities	1.49	1.49	1.49	1.19	0.84	1.00	1.05	1.75	1.35	1.02	0.98	1.00	0.99	1.49	1.22	0.90	0.99	0.94
Construction	1.22	1.22	1.22	1.37	0.73	1.00	1.00	1.37	1.17	1.00	0.99	0.99	0.99	1.22	1.10	0.99	0.97	0.98
Merchandise, restaurant, hotel	2.06	2.06	2.06	2.11	0.47	1.00	1.31	2.46	1.79	1.15	0.98	1.06	0.99	2.06	1.43	0.98	0.98	0.98
Transportation and communication	2.61	2.61	2.61	1.75	0.57	1.00	1.10	1.81	1.41	1.05	0.98	1.02	1.00	2.61	1.61	0.96	0.98	0.97
Financial services	2.55	2.55	2.55	2.10	0.48	1.00	1.10	1.64	1.34	1.05	0.99	1.02	0.99	2.55	1.58	0.74	0.95	0.84
Real Estate	1.15	1.15	1.15	2.32	0.43	1.00	1.00	2.32	1.52	1.00	0.99	0.99	0.99	1.15	1.07	0.98	0.99	0.99
Public, social, personal and household services	1.21	1.21	1.21	1.05	0.95	1.00	0.96	1.04	1.00	0.98	1.00	0.99	0.99	1.21	1.09	0.99	0.98	0.99
Other services	1.77	1.77	1.77	0.01	89.65	0.99	1.01	0.01	0.11	1.01	1.00	1.00	0.99	1.77	1.33	1.00	0.98	0.99

Table 2: Labor productivity decomposition of South Korea, 2000, 2005

	Value Added (V)		*Fischer Index*	Labor Input coefficient (E)		*Fischer Index*	Domestic supply ratio (P)		*Fischer Index*	Technological change (A)		*Fischer Index*	Change in share of intra-sector final demand (B)		*Fischer Index*	Change in composition of intra-sector final demand (Y)		*Fischer Index*
Agriculture and Mining	1.03	1.03	1.03	0.81	1.23	1.00	0.98	0.79	0.88	0.99	0.99	0.99	0.99	1.03	1.01	1.00	0.98	0.99
Manufacture	1.56	1.56	1.56	0.99	1.01	1.00	1.04	1.01	1.02	1.02	0.99	1.00	1.00	1.56	1.25	0.99	0.98	0.99
Utilities	1.07	1.07	1.07	1.11	0.90	1.00	1.01	1.12	1.07	1.01	0.99	1.00	0.98	1.07	1.02	0.99	1.00	0.99
Construction	1.27	1.27	1.27	1.15	0.87	1.00	1.00	1.15	1.07	1.00	0.99	0.99	0.99	1.27	1.12	0.99	0.97	0.98
Transportation and communication	1.30	1.30	1.30	1.13	0.88	1.00	1.01	1.14	1.07	1.00	1.00	1.00	0.99	1.30	1.13	0.99	0.99	0.99
Financial services	1.02	1.02	1.02	0.99	1.01	1.00	0.98	0.99	0.99	0.99	0.99	0.99	0.98	1.02	1.00	0.99	0.99	0.99
Real Estate	1.10	1.10	1.10	1.50	0.67	1.00	1.00	1.50	1.22	1.00	0.99	0.99	0.99	1.10	1.04	0.99	0.99	0.99
Education	1.47	1.47	1.47	1.32	0.76	1.00	0.97	1.30	1.12	0.99	0.99	0.99	0.99	1.47	1.20	1.00	0.99	0.99
Health	1.02	1.02	1.02	1.51	0.66	1.00	1.04	1.54	1.27	1.02	1.00	1.01	0.98	1.02	1.00	0.99	1.00	0.99
Public, social, personal and household services	2.83	2.83	2.83	1.38	0.72	1.00	0.95	1.34	1.13	0.98	1.00	0.99	0.98	2.83	1.66	0.99	0.98	0.98
Other services	1.28	1.28	1.28	1.01	0.99	1.00	1.02	1.02	1.02	1.01	0.99	1.00	1.00	1.28	1.13	0.98	0.98	0.98

Table 3: Labor productivity decomposition of Norway, 2000, 2005

	Value Added (V)		Fischer Index	Labor Input coefficient (E)		Fischer Index	Domestic supply ratio (P)		Fischer Index	Technological change (A)		Fischer Index	Change in share of intra-sector final (B) demand		Fischer Index	Change in composition of intra-sector final (Y) demand		Fischer Index
Agriculture and Mining	1.05	1.05	1.05	0.87	1.15	1.00	1.01	0.88	0.94	1.00	0.99	1.00	0.99	1.05	1.02	0.99	0.99	0.99
Manufacturing	1.12	1.12	1.12	0.91	1.09	1.00	0.99	0.91	0.95	1.00	0.99	0.99	1.00	1.12	1.05	0.99	0.98	0.99
Utilities	1.21	1.21	1.21	0.80	1.25	1.00	0.98	0.79	0.88	0.99	0.99	0.99	1.00	1.21	1.10	1.00	1.00	1.00
Construction	0.93	0.93	0.93	1.08	0.92	1.00	0.99	1.08	1.04	1.00	0.99	0.99	0.99	0.93	0.96	1.00	1.00	1.00
Transportation and communication	0.96	0.96	0.96	0.90	1.11	1.00	0.99	0.90	0.94	0.99	0.99	0.99	0.99	0.96	0.98	0.99	0.99	0.99
Financial services	1.28	1.28	1.28	1.02	0.98	1.00	0.96	1.01	0.98	0.98	0.98	0.98	1.00	1.28	1.13	0.99	0.99	0.99
Real Estate	1.11	1.11	1.11	1.12	0.89	1.00	1.00	1.12	1.06	1.00	0.99	0.99	0.99	1.11	1.05	0.99	0.99	0.99
Education	1.10	1.10	1.10	1.03	0.97	1.00	1.00	1.03	1.02	1.00	0.99	0.99	0.99	1.10	1.04	0.99	0.99	0.99
Health	1.18	1.18	1.18	1.14	0.88	1.00	1.00	1.14	1.07	1.00	0.99	0.99	0.99	1.18	1.08	0.99	0.99	0.99
Public, social, personal and household services	1.17	1.17	1.17	1.06	0.95	1.00	0.98	1.04	1.01	0.99	1.00	0.99	0.99	1.17	1.07	0.99	0.99	0.99
Other services	1.11	1.11	1.11	0.96	1.04	1.00	0.95	0.94	0.94	0.97	0.99	0.98	0.99	1.11	1.05	0.99	1.00	0.99

Table 4: Share of each factor in labor productivity of Iran (percent) over 1991-2001

sector	V	E	P	A(L)	B
Agriculture and Mining	33.289	-0.032	11.914	-0.001	15.990
Manufacture	40.547	-0.048	33.063	5.113	19.872
Utilities	40.079	-0.031	30.296	0.229	19.436
Construction	19.474	-0.068	15.717	-0.654	9.032
Merchandise, restaurant, hotel	72.271	-0.099	58.354	5.811	35.734
Transportation and communication	95.820	-0.093	34.530	1.681	47.860
Financial services	93.413	-0.054	29.529	2.035	45.951
Real Estate	13.540	-0.026	42.142	-0.604	6.419
Public, social, personal and household services	19.145	-0.035	-0.124	-1.160	8.867
Other services	57.154	-0.697	-224.897	0.048	28.226
Total	**484.732**	**-1.182**	**30.526**	**12.497**	**237.387**

Table 5: Share of each factor in labor productivity of South Korea (percent) over 2000-2005

sector	V	E	P	A(L)	B	Y
Agriculture and Mining	3.053	-0.064	-12.950	-1.106	1.175	-1.109
Manufacture	44.276	-0.059	2.262	0.337	21.887	-1.410
Utilities	6.579	-0.050	6.490	-0.305	2.279	-0.603
Construction	24.216	-0.062	6.945	-0.604	11.706	-2.076
Transportation and communication	26.082	-0.091	6.724	-0.101	12.286	-1.359
Financial services	1.686	-0.054	-1.411	-1.005	-0.167	-0.753
Real Estate	9.349	-0.034	20.023	-0.754	4.273	-0.803
Education	38.254	-0.058	11.711	-1.207	18.422	-0.956
Health	1.489	-0.019	23.566	0.790	-0.062	-0.805
Public, social, personal and household services	103.886	-0.044	12.233	-1.316	50.831	-1.562

Other services	24.920	-0.052	1.980	-0.006	12.209	-1.715
Total	**283.790**	**-0.586**	**77.574**	**-5.276**	**134.840**	**-13.151**

Table 6: Share of each factor in labor productivity of Norway (percent) over 2000-2005

sector	**V**	**E**	**P**	**A(L)**	**B**	**Y**
Agriculture and Mining	4.402	-0.021	-6.427	-0.453	1.648	-1.
Manufacture	10.975	-0.059	-4.962	-0.653	5.287	-1.
Utilities	18.897	0.000	-12.442	-1.157	9.298	-0.
Construction	-7.796	-0.058	3.454	-0.653	-4.451	-0.
Transportation and communication	-4.082	-0.054	-6.034	-0.702	-2.544	-0.
Financial services	24.295	-0.020	-1.640	-1.817	11.947	-1.
Real Estate	10.706	-0.059	5.371	-0.754	4.850	-1.
Education	9.349	-0.051	1.525	-0.603	4.121	-0.
Health	16.297	-0.073	6.326	-0.553	7.595	-0.
Public, social, personal and household services	15.444	-0.046	1.041	-0.653	7.169	-0.
Other services	10.706	-0.068	-5.764	-1.820	4.850	-0.
Total	**109.191**	**-0.509**	**-19.552**	**-9.817**	**49.772**	**-9.**