Iran. Econ. Rev. Vol. 20, No. 3, 2016. pp. 306-325

Investigation for an Approach to Optimise the Structure of Human Force

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Received: 2016/05/21 Accepted: 2016/06/26

Abstract

This paper proposes an approach to find an optimum structure for educational levels of human forces. To this end, a Linear Programming (LP) Model integrated with a Social Accounting Matrix (SAM) was employed. The integrated model was employed using the SAM of Golestan Province of Iran. It was demonstrated that when unemployment is the result of inconsistency between supply and demand for human force, an optimum structure leads to an increase in human force employment and the value of the object. First contribution of this paper concerns with finding an optimum educational structure for human force with respect to the objective function and conditions of a region or country. The second contribution of this approach concerns finding obstacles in the process of obtaining the objective. Proposing a tool for policy making through sensitivity analysis of educational groups of human forces is yet another contribution of the paper.

Keywords: Linear Programming, Social accounting, Human Force Planning, Educational Structure, Sensitivity Analysis.

JEL Classification: C610, I280, J200, O210, R150.

1. Introduction

Education has different effects on the personal and social life of countries. However, due to higher education development in the world, in addition to the lots of expenditures that are paid for educational purposes, a confliction has appeared between the supply of educated human forces and the demand for these human forces. To this end, a number of theories have been proposed to examine an education policy in economic studies.

According to the Becker (1962) theory, investment in human capital is a pervasive phenomenon. Similarly, Mincer (1981)

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concluded to the simultaneously of human capital and economic development. In fact, the human capital theory which is the basis of neo-classical analysis of labour market and economic growth, education leads to a rise in employment and economic growth through increasing the productivity of educated human forces (Temple 1994). So, based on this theory, the over-education phenomenon that is due to increasing in higher education labour supply, is a short-run problem of the labour market. Consequently, this problem will be removed by adjusting production processes of firms.

However, according to Spence's job-screen and Thurow's job-competition models, the over-education phenomenon can be a permanent problem (Tsang & Levin, 2010). To avoid this problem, screening theory argues that the value of higher education is primarily dependent on the potential demand for the ability of such qualifications (Van der Merwe 2010). Thus, according to this theory, the value of higher education depends on the demand for educated human forces.

A huge number of studies have been carried out to determine the role of different levels of education in economic growth and employment. Among them, the role of basic education in economic growth and employment, especially in the early stages of development, has been confirmed practically. So, the Mitch (1984), Lau et al. (1993), Buchert (1994), Glick & Sahn (1997), and Nomura (2007) studies in different countries confirm the positive effect of general education on employment and economic growth.

In contrast to basic education, the experiences in higher education of countries are dependent on the condition of their economies. For instance, although a number of studies such as West & Hore (1989), Moussouris (1998), Carpentier (2006), Zhang & Zou (2007), Greene & Saridakis (2008), Stengos & Aurangzeb (2008), Fadaee Khorasgani (2008), Baldwin et al. (2011), Pradhan (2011) highlighted the positive role of higher education on economic growth and employment in different countries, Quan & Beck (1987), Duggan (1991), Chatterji (1998), O'Higgins & Ivanov (2006), Rehme (2007), De La Croix et al. (2008), Zeira (2009), Nilsson (2010), Ren et al. (2011), Wang et al. (2012), Chan (2015), Mok (2016), and Yeom (2016) have demonstrated that investment, especially on secondary and higher education, in some places has had less return in comparison with other alternatives. In addition, according to the World Bank data sources, the percentage of tertiary educated unemployed labour force has increased in a number of countries (Table 1).

Therefore, irrespective of the stage of the development of countries, although general or vocational education can be taken into account as positive steps for development of regions or countries, evidence indicates that investment on secondary and especially higher education has not always had positive effects on employment and economic growth. Hence, it can be proposed that investment on higher education should be rationally determined.

Table 1: Unemployment with Tertiary Education (Percent of Total Unemployment)

Countries	2009	2010	2011	2012
Armenia	21.8	23.4	26.9	-
Bhutan	3.9	5.5	6.7	13.0
Bosnia and Herzegovina	5.1	7.6	8.4	9.1
Costa Rica	10.5	13.4	15.7	-
Jordan	30.7	34.3	34.4	37.0
Mauritius	6.0	7.9	-	19.9
Moldova	19.3	19.9	21.3	23.5
Morocco	-	17.5	18.3	18.5
Peru	20.2	-	21.2	-
South Africa	5.4	5.8	5.8	-
Thailand	28.3	32.9	33.6	36.1
Venezuela, RB	27.3	29.4	33.4	-

Sources: The World Bank, http://data.worldbank.org/indicator/SL.UEM.TERT.ZS

To this end, a number of methods have been implemented to examine the role of education in employment and economic growth. Among them, the return of the human capital approach was employed by Becker (1993), and Barceinas-Paredes et al. (2000) studies. Hinchliffe (1995) referred to the international comparison procedures based on similarity of labour force growth in all countries in the economic development process that was implemented in East African and Southeast Asian countries. Based on this procedure, an underdeveloped country should follow the structure of the labor force of a developed country if it is selected as a future growth object. A regression analysis was used in the Lau et al. (1993); Graff (1996), and Van der Merwe (2010) studies to examine the role of higher education as human capital. In addition, an economic data base analysis was also implemented by Chatterji (1998). And finally, an elementary game theory model was also used by Correa (2004) to analyse the interaction of government as the supplier of education and the responses of the public to the government decision.

To find a structure of labour force in a region or country, this paper proposes a procedure to find an optimum educational structure for labour force in a region or country. To do so, among others, an LP model integrated with a SAM has been devised. The Gross Regional Products (GRP) equation of Golestan Province is employed as the objective function of the LP model. A number of constraints of the economy are also considered as constraints of the LP model.

The model has then been applied to examine the labour force structure of the region in two different schemes. The first scheme, concerns the case in which unemployment of the region is the result of inconsistency between supply and demand for labour force only, hence, an optimum structure of labour force would lead to an increase in labour force employment, as well as improvement in the GRP of the region. But the second scheme concerns a case in which the shortage in production resources is the reason of labour force unemployment of the region. Accordingly, improvement in labour force structure will not increase the employment level and the GRP of the region (Appendix).

This approach has three major contributions to be employed in the structure of human force. First contribution of this approach concerns with finding an optimum educational structure of human force to meet the objective of an economy. The second contribution of this research concerns finding the obstacles of obtaining the objective of a region or country. The shadow price of educational groups of human force in sensitivity analysis that can be considered as an indicator to measure the effect of investment on educational groups is yet another contribution of the paper.

The paper contains four sections. Section 2 is devoted to the methodology including an introduction to the LP model. An empirical result of the model was considered for the Golestan Province in Iran to explore the structure of labour force of the region in the third section. Finally, the concluding section ends the paper.

2. The Model

An LP model linked to a SAM framework has been used in this paper. Although this method has been employed for other purposes such as resource allocation and impact analysis in Sharify & Batey (2006); Harris et al. (2008), and Kim et al. (2011) studies, it seems it is a new implementation for the integrated LP with the SAM model to be used for labour force structure of a region or country. It allows the researchers to find the optimum structure for labour force to obtain an objective of the region or country with respect to its conditions. This is the advantage of this method when compared with other alternatives.

To this end, the GRP of the region is taken into account as the objective function. Several relationships in terms of job creation for different educational groups of human forces, income distribution inequality, mean income for human force and supply and demand constraints for products of sectors are considered as constraints of the model.

Based on the basic equation of the SAM model, we have:

$$\mathbf{X=M.Y} \tag{1}$$

The column vectors **X** and **Y** refer to the endogenous and exogenous parts of the model, respectively. **M** as shown in Equation (2), refers to the matrix of coefficients that can be divided into several blocks such as $\mathbf{M^{v1}}$ that is located between $m_{1,k+1}$ and $m_{k,k+p}$ concerned with the effect of one unit of exogenous increase in final demand for products on the associated production factors holders' income of the region.

$$M = \begin{bmatrix} m_{1,1} & \cdots & m_{1,k} & m_{1,k+1} & \cdots & m_{1,k+p} & m_{1,k+p+1} & \cdots & m_{1,n} \\ \vdots & & & \vdots & & \vdots & \vdots & & \vdots \\ m_{k-1,1} & & m_{k-1,k} & m_{k-1,k+1} & & m_{k-1,k+p} & m_{k-1,k+p+1} & & m_{k-1,n} \\ m_{k,1} & \cdots & m_{k,k} & m_{k,k+1} & \cdots & m_{k,k+p} & m_{k,k+p+1} & \cdots & m_{k,n} \\ m_{k+1,1} & \cdots & m_{k+1,k} & m_{k+1,k+1} & \cdots & m_{k+1,k+p} & m_{k+1,k+p+1} & \cdots & m_{k+1,n} \\ \vdots & & \vdots & \vdots & & \vdots & \vdots & & \vdots \\ m_{k+p,1} & \cdots & m_{k+p,k} & m_{k+p,k+1} & \cdots & m_{k+p,k+p} & m_{k+p,k+p+1} & & m_{k+p,n} \\ \vdots & & \vdots & \vdots & & \vdots & \vdots & & \\ m_{n,1} & & m_{n,k} & m_{n,k+1} & & m_{n,k+p} & m_{n,k+p+1} & & m_{n,n} \end{bmatrix} \quad (2)$$

k and *p* refer to the number of primary factors holders and the number of individual sectors, respectively.

The *GRP* of the region is divided into two parts. The first part includes the value added concerned with private or public production factors that is generated in the region, as examined by Equation (3). If $\mathbf{M}^{\mathbf{v1}}$, a row vector in which $M^{v1}{}_j$ is concerned with the vertical sum of the block $\mathbf{M}^{\mathbf{v1}}$ in matrix **M**, thus $M^{v1}{}_j = \sum_{i=1}^{k} m_{i,j}$ reveals the impact of one unit exogenous final demand generated in the j^{th} sector of the region on the production factors holders' income. Hence, GRP_1 explores the total income generated as a result of responding to the exogenous final demand for products of the region:

$$GRP_1=\mathbf{M}^{\mathbf{v1}}.\mathbf{Y}^*$$

$$= \sum_{i=1}^{k} m_{i,k+1} Y_{k+1} + \sum_{i=1}^{k} m_{i,k+2} Y_{k+2} + \sum_{i=1}^{k} m_{i,k+3} Y_{k+3} \cdots$$
$$+ \sum_{i=1}^{k} m_{i,k+p} Y_{k+p} = M_1^{v1}.Y_{k+1} + M_2^{v1}.Y_{k+2} + M_3^{v1}.Y_{k+3} + \cdots + M_p^{v1}.Y_{k+p} \quad (3)$$

$\mathbf{Y}^*$ is a $p\times 1$ sub-vector of **Y** associated with the exogenous final demand for products of production sectors, including Y_{k+1}, Y_{k+2}, Y_{k+3}, …, Y_{k+p}.

The second part of *GRP*, denoted as GRP_2, is concerned with the net indirect taxes received by the government in the region.

$$GRP_2=\mathbf{t}.\mathbf{X}^* \quad (4)$$

where **t**, is a $1\times p$ row vector in which individual elements t_j refer to the net indirect taxes received from a unit of goods or services produced in the j^{th} production sector in the region and $\mathbf{X}^*$ is a $p\times 1$ sub-vector of **X** concerned with the total products of the sectors, including X_{k+1}, X_{k+2}, X_{k+3}, …, X_{k+p}. By means of Equations (1) and (2), $\mathbf{X}^*$ is decomposed into two parts, so Equation (4) can be rewritten as follows:

$$GRP_2=\mathbf{t}.\mathbf{M}^{\mathbf{p}}.\mathbf{Y}^* \tag{5}$$

$\mathbf{M}^{\mathbf{p}}$ is a $p\times p$ sub-matrix of **M** located between $m_{k+1,k+1}$ and $m_{k+p,k+p}$ that measures the effect of a one unit exogenous increase in final demand for products on total production of the region. Now, if we let $\mathbf{C}=\mathbf{t}.\mathbf{M}^{\mathbf{p}}$, where C_1, C_2, C_3… C_p, denoted as the total net indirect tax receivable in the region from a unit increase in Y_{k+1}, Y_{k+2}, Y_{k+3}, …, Y_{k+p}, respectively. Hence, GRP_2 can be rewritten as Equation (6):

$$GRP_2=\mathbf{C}.\mathbf{Y}^* \tag{6}$$

Finally, GRP of the region can be derived by the summation of increasing GRP_1 and GRP_2 that is examined through Equation (7).

$$\begin{aligned} GRP &= GRP_1+GRP_2=(M_1^{v1}+C_1).Y_{k+1}+(M_2^{v1}+C_2).Y_{k+2}+(M_3^{v1}+C_3).Y_{k+3}+\cdots \\ &+(M_p^{v1}+C_p).Y_{k+p}=g_1Y_{k+1}+g_2Y_{k+2}+g_3Y_{k+3}+\cdots+g_pY_{k+p} \end{aligned} \tag{7}$$

Thus **G**, a row vector in which g_j is used instead of $M^{v1}{}_j+C_j$, is considered as the coefficient matrix of the objective function.

The total employment among different groups of workers in various sectors can be computed by Equation (8):

$$\mathbf{L}=\mathbf{l}.\mathbf{X}^* \tag{8}$$

where, **L** and **l** are $h\times 1$and $h\times p$ matrices, respectively. h refers to the number of different education attainment groups of workers.

Thus, L_i, the element of **L** shows the amount of employment in the i^{th} educational category. In addition, l_{ij} the element of **l** refers also to the size of the i^{th} educational group of labour force that is required for a unit of output in the j^{th} sector.

Like Equation (5), **L** can be rewritten as Equation (9):

$$\mathbf{L}=\mathbf{l}.\mathbf{M}^{\mathbf{p}}.\mathbf{Y}^* \tag{9}$$

Let $\mathbf{N=l\times M^p}$. Hence, $\mathbf{N}$ is an $h\times n$ matrix as follows:

$$\begin{bmatrix} l_{11} & l_{12} & \cdots & l_{1p} \\ l_{21} & l_{22} & \cdots & l_{2p} \\ \vdots & \vdots & & \vdots \\ l_{h1} & l_{h2} & \cdots & l_{hp} \end{bmatrix} . \begin{bmatrix} m_{k+1,k+1} & m_{k+1,k+2} & \cdots & m_{k+1,k+p} \\ m_{k+2,k+1} & m_{k+2,k+2} & \cdots & m_{k+2,k+p} \\ \vdots & \vdots & & \vdots \\ m_{k+p,k+1} & m_{k+p,k+2} & \cdots & m_{k+p,k+p} \end{bmatrix} =$$

$$\begin{bmatrix} l_{11}.m_{k+1,k+1} + l_{12}.m_{k+2,k+1} + \cdots + l_{1p}.m_{k+p,k+1} & \cdots & l_{11}.m_{k+1,k+p} + l_{12}.m_{k+2,k+p} + \cdots + l_{1p}.m_{k+p,k+p} \\ l_{21}.m_{k+1,k+1} + l_{22}.m_{k+2,k+1} + \cdots + l_{2p}.m_{k+p,k+1} & \cdots & l_{21}.m_{k+1,k+p} + l_{22}.m_{k+2,k+p} + \cdots + l_{2p}.m_{k+p,k+p} \\ \vdots & & \\ l_{h1}.m_{k+1,k+1} + l_{h2}.m_{k+2,k+1} + \cdots + l_{hp}.m_{k+p,k+1} & \cdots & l_{h1}.m_{k+1,k+p} + l_{h2}.m_{k+2,k+p} + \cdots + l_{hp}.C_{k+p,k+p} \end{bmatrix} =$$

$$\begin{bmatrix} N_{1,1} & N_{1,2} & \cdots & N_{1,p} \\ N_{2,1} & N_{2,2} & \cdots & N_{2,p} \\ \vdots & \vdots & & \vdots \\ N_{h,1} & N_{h,2} & \cdots & N_{h,p} \end{bmatrix} \tag{10}$$

$N_{1,1}$, $N_{1,2}$, ... and $N_{1,p}$ are specified as the total jobs that are created for the first educational attainment group of workers in the whole region's economy by a unit increase in the first, second, … and p^{th} sectors, respectively, as a result of a unit exogenous final demand for the goods or services produced in these sectors.

By considering Equation (10), $\mathbf{L}$ can be rewritten as Equation (11).

$$\mathbf{L}=\begin{bmatrix} L_1 \\ L_2 \\ \vdots \\ L_h \end{bmatrix} = \begin{bmatrix} N_{1,1} & N_{1,2} & \cdots & N_{1,p} \\ N_{2,1} & N_{2,2} & \cdots & N_{2,p} \\ \vdots & \vdots & & \vdots \\ N_{h,1} & N_{h,2} & \cdots & N_{h,p} \end{bmatrix} . \begin{bmatrix} Y_{k+1} \\ Y_{k+2} \\ \\ Y_{k+p} \end{bmatrix} = \begin{bmatrix} N_{1,1}.Y_{k+1} + N_{1,2}.Y_{k+2} + \cdots + N_{1,p}.Y_{k+p} \\ N_{2,1}.Y_{k+1} + N_{2,2}.Y_{k+2} + \cdots + N_{2,p}.Y_{k+p} \\ \vdots \\ N_{h,1}.Y_{k+1} + N_{h,2}.Y_{k+2} + \cdots + N_{h,p}.Y_{k+p} \end{bmatrix} \tag{11}$$

By setting h equal to 4, corresponding to 4 categories of without-high-school-diploma, high school diploma, first grade educated and master and Ph. D. educational groups, Equations (12) to (15) concern job creation for different groups of education levels:

$$N_{1,1}.Y_{k+1} + N_{1,2}.Y_{k+2} + \cdots + N_{1,p}.Y_{k+p} \leq b_1 \tag{12}$$

$$N_{2,1}.Y_{k+1} + N_{2,2}.Y_{k+2} + \cdots + N_{2,p}.Y_{k+p} \leq b_2 \tag{13}$$

$$N_{3,1}.Y_{k+1} + N_{3,2}.Y_{k+2} + \cdots + N_{3,p}.Y_{k+p} \leq b_3 \tag{14}$$

$$N_{4,1}.Y_{k+1} + N_{4,2}.Y_{k+2} + \cdots + N_{4,p}.Y_{k+p} \leq b_4 \tag{15}$$

b_1 to b_4 display the size of labour force supply of different educational groups. The sign of $\leq$, indicates the possibility of unemployment for a part of the related labour force in the model.

The mean income of the human force is considered as a constraint of the model. The block $\mathbf{M^{v2}}$ located between $m_{1,k+1}$ and $m_{k-1,k+p}$ that measures the effect on private endowment as a result of a one unit exogenous increase in final demand for products of the region, is considered in this circumstance. To formulate the mean income constraint, $M_j^{v2} = \sum_{i=1}^{k-1} m_{i,j}$ the components of $\mathbf{M^{v2}}$ are calculated by Equation (2). Hence, the mean income of the human force is calculated by Equation (16):

$$\mu = \frac{1}{U}(M^{v2}{}_{k+1} \times Y_{k+1} + M^{v2}{}_{k+2} \times Y_{k+2} + \ldots + M^{v2}{}_{k+p} Y_{k+p}) = \quad (16)$$
$$r_{1,1}.Y_{k+1} + r_{1,2}.Y_{k+2} + \cdots + r_{1,p}.Y_{k+p} \geq b_5$$

μ refers to the mean per capita income for human forces of the region, U refers to the number of human forces and $r_{1,j}$ measures the effect of a unit exogenous final demand for products in sector j on the mean income for employed human forces of the region. b_5 is the minimum desired mean income for the human forces that are planned to be employed.

Equation (17) concerns the employed income distribution inequality. The relative mean deviation index, I, promoted by Kakwani (1980) is used which can be written as a linear form with some preparation.

$$I = (1/2 \times U \times \mu) M^{pc} = (1/U \times \mu)(M_1^{pc} \times Y_{k+1} + M_2^{pc} \times Y_{k+2} + \cdots + M_p^{pc} \times Y_{k+p}) = \quad (17)$$
$$a_{1,1} \times Y_{k+1} + a_{1,2} \times Y_{k+2} + a_{1,3} Y_{k+3} + \ldots + a_{1,p} \times Y_{k+p} \leq b_6$$

$\mathbf{M^{pc}}$ is a row vector in which its components, $M_j^{pc} = |p_j - \mu|$, exhibit the difference of sectors production factors' per capita income, p_j, from μ due to a unit exogenous final demand for goods and services produced in these sectors. Hence, $\alpha_{1,j}$ reveals the role of a unit of products that is produced in sector j on income distribution inequality of the region. In addition, b_6 shows a maximum income inequality that is aimed to be obtained for the human forces that are employed in the region.

The size of μ is calculated by Equation (16), but the mean income of current human forces of the region is considered as the initial size of μ. To this end, the model was run through several iterations. However, since the size of the mean income cannot increase infinitely, it is expected that the size of μ converge to a finite level after some iteration.

Equation (18) is used as the constraint of the model to consider the supply and demand for products of production sectors of the region. Hence, Equation (18) is representative of p constraints for products of p production sectors in which d_i show the maximum possible products of sector i.

$$\mathbf{X}^* = \mathbf{M}^\mathbf{p} \times \mathbf{Y}^* \leq d_i \qquad ,i = 1,\cdots,p \tag{18}$$

Finally, since all of the decision variables are considered as exogenous final demand for products of sectors, Y^*_is would be greater than or at least equal to zero, as shown in Equation (19).

$$Y_i^* \geq 0 \qquad ,i = 1,\cdots, p \tag{19}$$

3. Results and Discussion

To examine the model, the SAM of Golestan Province of Iran, a province with different natural resources as well as a great deal of higher educated human forces, was employed (Sharify, 2000). The matrix has 54 dimensions with 52 endogenous parts including 27 production sectors. The social accounting model was used to calculate the related coefficients of the model. Other information including the target amounts of labour force and maximum sectors' production level, have been estimated using the regional situation in the base year.

To examine the model, the education constraints were considered for two scenarios A and B. The amounts of supply and demand for products of 24 sectors are the same. The difference of these scenarios originates from the amounts of supply and demand for products of three critical sectors that are displayed in Table 2. The level of supply and demand for sectors in scenario A concerns the real cases of the region. However, due to critical effects of the levels of supply and demand of these sectors on the results of the model, to demonstrate the ineffective role of education constraint when unemployment is due to insufficient capacity of production sectors, the amounts of these levels in scenario B are supposed to be about one tenth of their real size.

To reveal the effect of the educational constraint in different cases, each scenario is considered in two schemes. In the first scheme, the education of the labour force is considered, so four different educational groups of labour force are considered separately in the model. Whereas, in the second scheme, irrespective of the education level of labour force, a combined labour force constraint is used instead of four different educational labour force constraints. Hence, four models were derived based on scenarios A and B conditions with respect to the labour force as a whole or separated into four different levels of education.

Table 2: Maximum Supply and Demand of Sectors in Scenarios A and B (Million Rials)

Sectors	Scenario A	Scenario B
Industrial Husbandry	1668	167
Industrial Hen-breeding	102337	10234
Forestry	277205	27720

Source: findings of the research

Using the model, in the case of scenario A, with respect to the size of the slack variable and shadow price of human force and sectors, as shown in Table 3 and Table 4, the first scheme suffers from the shortage of supply and demand for a number of sectors' products as well as without-high-school-diploma human force. In spite of the other three educational groups of human forces, the relevant shadow prices demonstrate a unit increment in the right hand side of without-high–school-diploma labour force will increase the *GRP*. Thus, although there is plenty of unused capacity in several sectors, a considerable amount of labour force remains unemployed due to inconsistency between labour force's demand and supply and lack of capacity in other sectors.

To find an optimum structure of labour force, one labour constraint rather than four has been considered in the second scheme. A comparison of the results associated with the first and second schemes in Table 3 demonstrates that the economy of the region is capable of creating jobs for a larger number of some groups of its labour forces with an acceptable mean income, income distribution and higher *GRP* if there is no inconsistency between labour force supply and demand. On the other hand, the economy of the region needs more without-high-school-diploma labour force instead of those with higher education. Hence, so long as the economy is not faced with structural, i. e., technological, as well as supply and demand changes, investing in the other groups' education will lead to the wasting of resources, more unemployment and no increase in economic growth of the region. Therefore, in a comparable situation in which the region suffers from the structure of different groups of human forces, it is possible to find an adequate education policy.

Table 3: The Results of Scenario A on Economic Parameters of the Region (Thousands Rials/Persons)

Title	First* scheme	Second* scheme	Target**	Slack Variables First scheme	Slack Variables Second scheme	Shadow Price First scheme	Shadow Price Second scheme
GRP	169221803	169748481	-	-	-	-	-
Under HS diploma	38193	43478	38193	0	-5285	672	-
HS diploma	595	635	7889	7294	7254	0	-
Undergraduate	1807	2025	6310	4503	4285	0	-
Postgraduate	77	74	221	144	147	0	-
Total job creating	40672	46211	52613	11935	6402	-	0
Mean Income	3810	3373	3323	487	50	-	-
Income Distribution	29	32	34	05	02	-	-

* The results of indicators of scenario A in different schemes

** The target value for different indicators in the region

Sources: findings of the research

Table 4 displays the unused capacity of sectors as slack variable of different scenarios and schemes. On the other word, irrespective of different scenarios and schemes, a part of these capacities remained unused due to other constraints of the models. In addition, because of some critical constraints that are considered in scenario B (see table2), the structure of labour force has no effect on the results, so unused capacity of sectors are the same in two schemes. In contrast, the sizes of unused capacity of sectors in the second scheme of scenario A are generally greater than those of the first scheme. Hence, in addition to the results of the schemes in table 3, the educational constraints of human force lead to more unused capacity of sectors.

Table 5 is about scenario B. Like scenario A, all conditions except the labour constraints are the same in the two schemes. The labour force constraints were derived like those of scenario A, but the results in the two schemes are the same. On the other hand, the condition of labour force has no effect on the economy of the region. According to the sensitivity analysis, as shown in Table 4, it is demonstrated that human force unemployment is due to insufficient resources of production sectors. So, as it is shown in Table 5, the slack variable of all groups of labour forces is positive, with zero value of shadow prices.

Table 4: Slack Variable and Maximum Size of Supply and Demand for Products of Sectors

	Sectors	Scenario A		Scenario B		D_j^*
		First Scheme	Second Scheme	First Scheme	Second Scheme	
1	Farming	20	0	14991591	14991591	31855796
2	Traditional Livestock	7685572	8288386	30274535	30274535	41229000
3	Industrial Husbandry	398581	414436	0	0	See Table 2
4	Industrial Hen-breeding	95003556	98253500	7944675	7944675	See Table 2
5	Fish-breeding	0	0	32055550	32055550	32252361
6	Forestry	276170918	260033025	27604270	27604270	See Table 2
7	Fishery	10277199	12033040	12192120	12192120	12687600
8	Mining	1177490	1175824	1241371	1241371	1349430
9	Food Processing Industries	3819971	3729244	7267964	7267964	15925520
10	Textile industries	1247570	622657	1961195	1961195	5585530
11	Carpet	182160171	176660036	194637334	194637334	194978600
12	Wood Products	0	0	6021794	6021794	6641249
13	Publication & Paper	42379	115249	152024	152024	358540
14	Chemical Products	65556	61524	137773	137773	31537
15	Non-metals Products	26779549	26797949	28006941	28006941	29257600
16	Metal Products	1	8	50108	50108	126780
17	Machinery Products	16	9	1077771	1077771	4872900

18	Other Industry	102271	124744	176021	176021	272617
19	Water, Electricity and Gas	86795	77881	1513561	1513561	3184642
20	Construction	717897	1090505	13232805	13232805	27866900
21	Communication	8321580	8456406	8635555	8635555	9363500
22	Transportation	8484519	8609034	12358899	12358899	17571970
23	Bank and Insurance	10	30169037	30228389	30228389	31590900
24	Education	328400	387849	731073	731073	1617758
25	Health	13	402813	661120	661120	1192096
26	Public Services	70919889	60986618	24752645	24752645	86468900
27	Personal Services	17501240	17475169	30557135	30557135	56570550

* Refer to the maximum capacity of supply or demand for products of sectors

Source: findings of the research

Table 5: The Results of Scenario B on the Economic Parameters of the Region (Thousands Rials /Persons)

Title	First* scheme	Second* scheme	Target**	Slack Variables		Shadow Price	
				First scheme	Second scheme	First scheme	Second scheme
GRP	110055356	110055356	-	-	-	-	-
Under HS diploma	23587	23587	38193	14606	14606	0	-
HS diploma	113	113	7889	7776	7776	0	-
Undergraduate	3015	3015	6310	3295	3295	0	-
Postgraduate	84	84	221	137	137	0	-
Total job creating	26799	26799	52613	25814	25814	-	0
Mean Income	4107	4107	3323	784	784	-	-
Income Distribution	16	16	34	18	18	-	-

* The results of indicators of scenario B in different schemes

** The target value for different indicators in the region

Source: findings of the research

Hence, since a part of all labour force groups are unemployed, the shadow prices of the resources are zero. Hence, the labour force constraints do not have an effective role in influencing optimum solutions. In fact, as it is shown in appendix A, in a graphical analysis, the labour constraints are out of the feasible solution area. Thus, considering the whole labour forces constraint instead of partitioned labour forces, the results would not change.

4. Conclusion

Through studying different views associated with education, it can be concluded that the investment on higher education should be made according to the regions' or countries' condition. Although several procedures have been proposed for this purpose, none of them leads to an optimum structure for human force. Hence, the first contribution of this paper concerns proposing a procedure to find an optimum structure of human force. To this end, an LP model integrated with a SAM framework in which the GRP of the region is the objective function of the model, as well as several constraints in terms of job creation for different educational groups of labour force, mean income for human force, income distribution inequality, and supply and demand constraints for products are proposed. In addition, the model can be employed to find the optimum structure of human force for regions or countries with other objects and conditions. Moreover, this approach is capable of being employed to specify an optimal structure for human forces with respect to the subject and level of education in future studies.

Implementing the proposed model, it was demonstrated that in the case in which unemployment originates from inconsistency between supply and demand for labour force, using an optimum structure of labour force, with respect to the condition of the region, would lead to a higher level of employment for human forces and a higher GRP for the region. In contrast, in case the problem originates from some reasons such as shortage of other economic resources, using this approach will not affect the results. Accordingly, in addition to the optimum structure of human force, the approach allows the researchers to specify the main obstacle to obtain the object of the region or country.

And finally, a large part of the investment is used for education in a region or country. Using a shadow price indicator allows the researchers to evaluate the payment on education. Thus, the third contribution of the paper concerns proposing sensitivity analysis for investment on education.

Appendices

Constraints have an important role in the maximisation of LP models. In fact, as the first scheme, each effective constraint acts as a barrier that prevents the objective function to pass to a higher maximum position beyond that barrier. Hence, it seems that through combining these constraints, concerning the second scheme, it is possible to improve them to some extent.

This case can be studied mathematically. To this end, in a two-independent-variables case; P, R and Q are assumed as Equations (A.1) to (A.3):

$$P=\{(x,y)/\ ax+by\leq c\} \tag{A.1}$$

$$R=\{(x,y)/\ a'x+b'y\leq c'\} \tag{A.2}$$

$$Q=\{(x,y)/\ (a'+a)x+(b'+b)y\leq (c'+c)\} \tag{A.3}$$

where P, R and Q are associated with the sets of feasible solutions that can be considered as constraints of an LP model, it can be proved $P\cap R\subset Q$:

Based on inequalities properties, if:

$$\begin{cases} ax+by\leq c \\ \\ a'x+b'y\leq c' \end{cases} \Rightarrow (a+a')x+(b+b')y\leq (c+c') \tag{A.4}$$

Hence, for any:

$$(x,y)\ \in P\cap R\Rightarrow\ (x,y)\in Q\Rightarrow P\cap R\subset Q \tag{A.5}$$

This problem for a three-independent-variables case in which:

$$P_3=\{(x,y,z)/\ ax+by+cz\leq d\} \tag{A.6}$$

$$R_3=\{(x,y,z)/\ a'x+b'y+c'z\leq d'\} \tag{A.7}$$

$$Q_3=\{(x,y,z)/\ (a'+a)x+(b'+b)y+(c'+c)z\leq d+d'\} \tag{A.8}$$

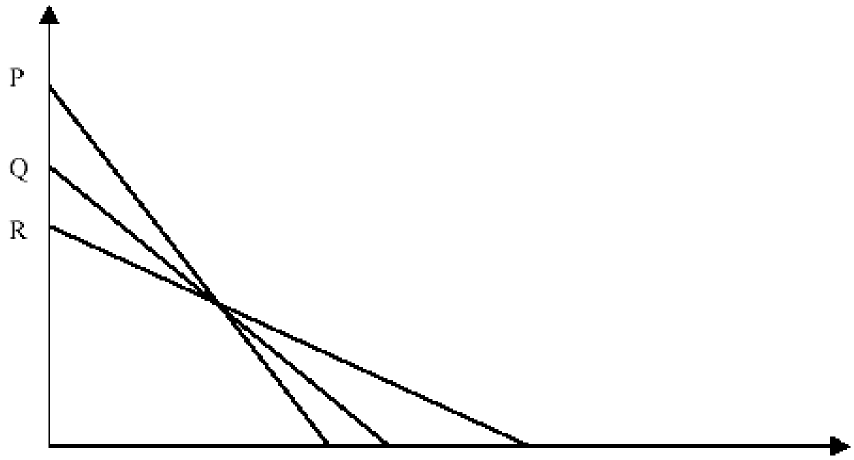
can be proved:

$$(x,y,z)\ \in P_3\cap R_3\Rightarrow\ (x,y,z)\ \in Q_3\Rightarrow P_3\cap R_3\subset Q_3 \tag{A.9}$$

In addition, this theme can be extended to an *n* variables case that can be supposed to be drawn in an *n* dimensions space. Hence, it is proved that combining of constraints generally leads to a larger feasible solution area.

Furthermore, Figure 1 illustrates a two variables case graphically. In fact, when two inequalities are not dependent on each other, their combination, sum of left- hand sides and right-hand sides together, respectively, leads to an expansion and improvement in the feasible solution area. As can be seen in Figure 1, the constraint Q, which is obtained by adding constraint P and R, expands as well as improves the feasible solution area from under P and R constraints area to under that of Q constraint area. Obviously, in this case, it causes an increase in the optimum solution if it is not located on the intersection of these constraints.

Figure 1: The Effect of Combined Constraints on the Feasible Solution Area



References

Baldwin, J. N., Borrelli, S. A., & New, M. J. (2011). State Educational Investments and Economic Growth in the United States: A Path Analysis. *Social Science Quarterly, 92*(1), 226-245.

Barceinas-Paredes, F., Oliver_Alonso, J., Raymond-Bara, J. L., Roig-Sabate, J. L., & Weber, B. A. (2000). Unemployment and Returns to Education in Europe. *Universitat Autonoma de Barcelona, Working Paper, 56.7*, Retrieved from http://www.etla.fi/PURE/Retunemp.pdf.

Becker, G. S. (1993). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education* (3rd Ed.). Chicago: The University of Chicago Press.

--------------- (1962). Investment in Human Capital: A Theoretical Analysis. *The Journal of Political Economy, 70*(5), 9-49.

Buchert, L. (1994). Education and Development- A Study of Donor Agency Policies on Education in Sweden, Holand and Denmark. *International Journal of Education Development, 14*(2), 143-157.

Carpentier, V. (2006). Public Expenditure on Education and Economic Growth in the USA in the Nineteenth and Twentieth Centuries in Comparative Perspective. *Paedagog, 42*(6), 683-706.

Chan, W. K. (2015). Higher Education and Graduate Employment in China: Challenges for Sustainable Development. *Higher Education Policy, 28*(1), 35-53.

Chatterji, M. (1998). Tertiary Education and Economic Growth. *Regional Studies, 32*(4), 349-354.

Correa, H. (2004). A Game Theoretic Analysis of Public/Government Interactions in Human Capital Formation. *Journal of Socio-Economics, 33*(4), 409-425.

De la Croix, D., Lindh, T., & Malmberg, B. (2008). Swedish Economic Growth and Education since 1800. *Canadian Journal of Economics, 41*(1), 166-185.

Duggan, S. J. (1991). Education and Economic-Development in Thailand. *Journal of Contemporary Asia, 21*(2), 141-151.

Fadaee Khorasgani, M. (2008). Higher Education Development and Economic Growth in Iran. *Education, Business and Society: Contemporary Middle Eastern Issues, 1*(3), 162-174.

Glick, P., & Sahn, D. E. (1997). Gender and Education Impacts on Employment and Earnings in West Africa: Evidence from Guinea. *Economic Development and Cultural Change, 45*(4), 793-823.

Graff, M. (1996). On the Contribution of Education to Economic Development. *Kolner Zeitschrift fur Soziologie und Sozialpsychologie, 48*(3), 274-297.

Greene, F., & Saridakis, G. (2008). The Role of Higher Education Skills and Support in Graduate Self-Employment. *Studies in Higher Education, 33*(6), 653-672.

Harris, T., Alevy, J. E., Kim, M. K., & Fadali, B. (2008). *Development and Initial Application of an Integrated Linear Programming/Social Accounting Model: Rangeland Livestock Application*. In the Southern Agricultural Economics Association Annual Meeting, Dallas, Texas, USA, Retrieved from http://ageconsearch.umn.edu/bitstream/8213/1/sp08ha01.pdf.

Hinchliffe, K. (1995). *Manpower Analysis, In Martin (ed.), International Encyclopaedia of Economics of Education, 277-282*. Oxford: Peygamon Press.

Kakwani, N. C. (1980). *Income Inequality and Poverty: Methods of Estimation and Policy Applications.* New York: Oxford University Press.

Kim, M. K., Zhu, E. J., Harris, T. R., & Alevy, J. E. (2011). Measuring Regional Economic Impact from Wildfire: Case Study of Southeast Oregon Cattle-Ranching Business. *UAA, Working Paper, WP 2011-05*, Retrieved from http://www.econpapers.uaa.alaska.edu/repec/ala/wpaper/ALA201105.pdf.

Lau, L. J., Jamison, D. T., Liu, S. C., & Rivkin, S. (1993). Education and Economic Growth Some Cross- Sectional Evidence from Brazil. *Journal of Development Economics, 41*(1), 45-70.

Mincer, J. (1981). Human Capital and Economic Growth. *NBER, Working Paper, 803*, Retrieved from http://www.nber.org/papers/w0803.pdf.

Mitch, D. (1984). Underinvestment in Literacy? The Potential Contribution of Government Involvement in Elementary Education to Economic Growth in 19th Century England. *The Journal of Economic History, 44*(2), 557-566.

Mok, K. H. (2016). Massification of Higher Education, Graduate Employment and Social Mobility in the Greater China Region British. *Journal of Sociology of Education, 37*(1), 51-71.

Moussouris, L. (1998). The Higher Education-Economic Development 'Connection' in Massachusetts: Forging a Critical Linkage? *Higher Education, 35*(1), 91-112.

Nilsson, A. (2010). Vocational Education and Training - An Engine for Economic Growth and a Vehicle for Social Inclusion? *International Journal of Training and Development, 14*(4), 251-272.

Nomura, T. (2007). Contribution of Education and Educational Equality to Economic Growth. *Applied Economics Letters, 14*(9), 627-630.

O'Higgins, N., & Ivanov, A. (2006). Education and Employment Opportunities for the Roma. *Comparative Economic Studies, 48*(1), 6-19.

Pradhan, R. P. (2011). Education, Openness and Economic Growth in India: Evidence from Cointegration Analysis. *International Journal of Education Economics and Development, 2*(2), 103-112.

Quan, N. T., & Beck, J. H. (1987). Public Education Expenditures and State Economic Growth Northeast and Sun-belt Regions. *Southern Economic Journal, 54*(2), 361-376.

Reheme, G. (2007). Education, Economic Growth and Measured

Income Inequality. *Economica, 74*(295), 493-514.

Ren, S., Zhu, Y., & Warner, M. (2011). Human Resources, Higher Education Reform and Employment Opportunities for University Graduates in the People's Republic of China. *International Journal of Human Resource Management, 22*(16), 3429-3446.

Sharify, N. (2000). *An Economic Regional Planning Model for the Golastan Province of Iran* (PhD's Thesis). University of Liverpool, UK.

Sharify, N., & Batey, W. J. P. (2006). Social Accounting and Regional Economic Planning: an Integrated Model for Policy Analysis and Optimisation. *Annals of Regional Science, 40*(3), 639–660.

Stengos, T., & Aurangzeb, A. (2008). An Empirical Investigation of the Relationship between Education and Growth in Pakistan. *International Economic Journal, 22*(3), 345-359.

Temple, M. (1994). *Regional Economics*. New York: ST Martin's Press.

Tsang, M. C., & Levin, H. M. (2010). Does Human Capital Theory Explain the Value of Higher Education? A South African Case Study. *Economics of Education Review, 3*(1), 107-118.

Wang, D., Liu, D., & Lai, C. (2012). Expansion of Higher Education and the Employment Crisis: Policy Innovations in China. *On The Horizon, 20*(4), 336-344.

West, L. H. T., & Hore, T. (1989). The Impact of Higher Education on Adult Students in Australia: Part 1, Employment. *Higher Education, 18*(3), 341-352.

Zeira, J. (2009). Why and How Education Affects Economic Growth. *Review of International Economics, 17*(3), 602-614.

Zhang, Q., & Zou, H. F. (2007). Returns to Education, Productivity, and Economic Growth in China. *Journal of Comparative Policy Analysis, 9*(3), 293-308.