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# Evaluating the Efficiency of Iran's Provincial Tax Offices and Ranking Them by DEA/AHP

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## Abstract

In this paper, we have tried to utilize a combination of qualitative and quantitative model for evaluating and prioritizing the efficiency of Iran's provincial tax offices from 2011 to 2014. For this purpose, the tax offices in each province have been considered as a decision-making unit (DMU) that has several inputs and outputs. At first, the provinces were divided into less developed and more developed provinces, then the efficiency of them was calculated by Data Envelopment Analysis (DEA) model and related values to improve efficiency of inefficient provinces have been offered. By using AHP/DEA model, the provinces have been ranked. Offering the complete rankings of tax offices and utilizing the advantages of both quantitative and qualitative methods for prioritizing the decision making units are the major advantages of this model. The results show that among developed provinces, Isfahan in 2011 and 2014, and Markazi in 2012 and 2013 have the highest ranks. Also, among less developed provinces, West Azarbaijan in 2011, 2012 and 2013, and Kordestan in 2014 have the top ranks.

## Keywords

Analytical Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Efficiency, The integrated model DEA/AHP, Tax.

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## Introduction

In the light of the global financial and economic crisis, the need for assessing public sector performance has become an impressive issue for the sake of the need for reducing costs at all levels. Improving the function of public sector and enhancing the efficiency of public administrations have been perceived as the major action which governments should take in order to face the effect of the crisis on their country's economies. As a result, governments have to supply funds to meet growing demands for public services (Katharaki & Tsakas, 2010).

The severity and inflexibility of public expenditures have the great effect on tax agencies so as to enhance the rate of taxes gathered (Barros, 2005). So as to achieve this, tax offices should improve their efficiency (Katharaki & Tsakas, 2010).

The investigation of technical efficiency of a tax office is a comparative action to handle the agency based on their inputs to achieve related outputs. These outputs will be compared to the maximum potential of office activity which results from production possibility frontier. If a tax office operates more than frontier level, it could be inefficient. As a result, the offices are going to be efficient whenever they function in the frontier (Barros, 2005).

Government expenditure supply via tax has been regarded as one of the main points of vision plan and general policy in our country. As a result, the rising of taxes proportion can provide the current government expenditure (Arabmazar & Dehghani, 2010).

Table 1 shows the government income from 2011 to 2014. Tax income to total government income ratio in these four years are 74%, 66%, 68% and 69%, respectively. Generally, tax incomes include direct and indirect taxes. Direct taxes consist of corporate tax, income tax and property tax. Indirect taxes include import tax, goods and services tax. Table 2 depicts country tax performance based on the kind of tax from 2011 to 2014.

**Table 1. Government income (Billion Rial)**

| Year | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|
| Incomes | 384288 | 544470.4 | 568203.3 | 717384 |
| Tax incomes | 284527.9 | 359451.5 | 395166.7 | 494249.5 |
| Other incomes | 99760.1 | 185018.9 | 173036.5 | 223134.5 |

Source: Treasury of Ministry of Economic Affairs and Finance

**Table 2. Tax performance in Iran from 2011 to 2014 (Billion Rial)**

| Tax types | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|
| Corporate tax | 116500.2 | 157892.6 | 169705.7 | 179969.3 |
| Income tax | 41115.7 | 49612.3 | 62678.1 | 76067.8 |
| Wealth tax | 11132.6 | 12912.7 | 15894.0 | 21845.6 |
| Direct tax | 168748.4 | 220417.6 | 248277.9 | 277882.7 |
| Import tax | 77886.3 | 78929.8 | 76402.9 | 80397.7 |
| Goods and services tax | 37893.2 | 60104.1 | 70485.9 | 135969.1 |
| Indirect tax | 115779.5 | 139033.8 | 146888.8 | 216366.8 |

Source: Central Bank of the Islamic Republic of Iran

Investigations show that in spite of government expenditure growth, the average of tax income has covered 42% of government's current expenditure. Tax to current cost ratio and government's current cost growth from 2011 to 2014 is exhibited in Table 3.

**Table 3. Tax to current cost ratio from 2011-2014 (%)**

| Year | Tax to current cost ratio | Government current cost growth |
|---|---|---|
| 2011 | 43.2 | 11.0 |
| 2012 | 40.8 | 33.1 |
| 2013 | 43.7 | 1.4 |
| 2014 | 41.3 | 34.6 |

Source: Ministry of Economic Affairs and Finance

As a result, the country's tax system could not create major proportion of the government incomes. In other words, it was not effective to reduce government dependency on oil and gas incomes. Therefore, it is necessary to investigate the country's tax system efficiency to improve the performance. So that, we would evaluate provincial tax offices and prioritize them. Moreover, determining efficient provinces as a reference for inefficient ones can be appropriate and constructive.

Provinces are divided into categories according to heterogeneous condition in order to study tax performance accurately: Developed provinces (more developed) and underdeveloped provinces (less developed). Consequently, this research is aimed at evaluating and prioritizing the provincial tax administrations efficiency. We must respond to these three questions to attain this goal:

- Which criteria should be utilized to evaluate and prioritize the provincial tax offices?
- How is the provincial tax offices priority in developed province?
- How is the provincial tax offices priority in underdeveloped provinces?

In this research, the theoretical framework and research backgrounds will be discussed in Section 2. The third section presents the model expression and research method based on date envelopment analysis and DEA/AHP. In the fourth section, the final results of the analysis are discussed. Finally, the last section discusses the conclusions and addresses future research.

## Theoretical Framework and Literature Review

We could use parametric and nonparametric methods for estimating efficiency. Farrell (1957) introduced nonparametric method as a tool for calculating efficiency for the first time. He used inputs and outputs of decision making units instead of guessing product function and shaped efficient frontier as an efficiency criteria. Data Envelopment Analysis (DEA) is one of the most popular techniques which can be employed based on this approach. DEA directly uses the observed data and does not consider pre-assumed function (Alamtabriz et al., 2011).

### Data Envelopment Analysis (DEA)

One of the most prevalent mathematical techniques in evaluating decision making units (DMU) is Data Envelopment Analysis (DEA) which is based on the efficiency frontier. DEA has been employed in order to investigate the performance of similar units which have the same inputs and outputs (Lin et al., 2011). On the other hand, DEA is a nonparametric approach that does not require any assumptions about the functional form of the production function (Sinuany-Stern et al., 2000).

There are two main assumptions with regard to DEA including constant returns to scale (CRS) as well as variable returns to scale (VRS). According to Lin et al. (2011), CRS is concerned with the same increase and decrease in inputs and outputs. For instance, one percent increase in inputs leads to the one percent increase in outputs. Whereas, the VRS deals with circumstances when the CRS assumptions are not fulfilled. Consequently, the efficiency of CRS model is less or equal to VRS efficiency scores. The scale efficiency could be defined by the ratio of CRS to VRS. For those units which operate productively, the degree of scale efficiency is therefore one (Lin et al., 2011). These models are divided into two main groups. The input-oriented model concentrates on the situations when the output values can be fixed in return for reducing inputs. Similarly, the output-oriented model evaluates how much outputs can be increased without changing in the associated inputs. The selection between these two models leans on the firm characteristics (Katharaki & Tsakas, 2010).

The statement of the linear programming model employed here is as follows. In the literature, it is known as the input-oriented CCR (Charnes et al., 1978).

$$Max \sum_{r=1}^{s} u_r y_{rj}$$

Subject to:

$$\sum_{i=1}^{m} v_i x_{i0} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i\, x_{ij} \leq 0 \qquad (1)$$

$$u_r, v_i \geq 0$$

where

$x_{ij}$: The amount of input *i* for unit *j* (*i*= 1, 2... *m*)

$y_{rj}$: The amount of output *r* for unit *j* (*r*= 1, 2... *s*)

$u_r$: Assigned weight to output *r*

$v_i$: Assigned weight to input *i*

Decision making units are divided into two categories based on the efficiency value. Units are efficient when $Z^*_0=1$ and inefficient when $Z^*_0 \leq 1$.

**DEA/AHP Integrated Model**

One of the popular multi-criteria decision making (MADM) techniques which have been used in literature of decision theory is Analytical Hierarchy Process (AHP). AHP utilizes the hierarchical structure in order to rank alternatives based on decision maker's opinion (Lin et al., 2011).

AHP and DEA approaches can resolve the multi-attribute decision making problem with incomplete information. Researches have indicated that DEA/AHP ranking model can be applied for improving DEA usability. The advantage of the DEA/AHP ranking model is that the comparative weight can be derived from inputs/outputs via AHP pairwise comparison (Tseng & Lee, 2009).

The DEA/AHP integrated model proposed in this paper includes two primary phases. First, for creating the pairwise comparison matrices, we utilize DEA based on comparing the pairs of units. Second, AHP will be utilized for prioritizing the units according to pairwise comparison matrix calculated in the previous stage.

One of the main virtues of this model is that the proposed model can eliminate the difficulties of extraction of weights based on decision maker's preferences and pairwise comparison judgments (Gholipour et al., 2014). This model does not require the decision maker' judgments. In order to formulate the model, suppose that we have *n* organizational units which have *m* inputs and *s* outputs, where $X_{ij}$ and $Y_{rj}$ is input *i* and output *r* of unit *j*, respectively. The following DEA model for any pair of units A and B is as follows (Sinuany-Stern et al., 2000):

$$
\begin{aligned}
& E_{AA} = \text{Max } Z_{AA} = \sum_{r=1}^{s} u_r\, y_{rA} \\
& \text{So that: } \sum_{i=1}^{m} v_i x_{iA} = 1 \\
& \quad \sum_{r=1}^{s} u_r y_{rB} \leq 1 \qquad (2) \\
& \quad \sum u_r\, y_{rB} - \sum v_i\, x_{iB} \leq 0 \\
& \quad u_r, v_i \geq 0 \qquad r=1, 2, \ldots, s \qquad i=1, 2, \ldots, m
\end{aligned}
$$

It should be noted that there are $s + m$ variables in this problem and only three constraints (not including the non-negativity ones). Since the optimal solution is a basic solution, there are only one positive $v_i$, one positive $u_r$, and/or one of the slack variables will be positive. If unit A is efficient ($z_{AA}$=1), then the slack of $s2$=0 and $s3$>0, but if unit A is inefficient then $s2$>0 and $s3$=0. The other variables are zero (Sinuany-Stern et al., 2000).

In order to cross-evaluate unit B, using the optimal weights of unit A, we calculate EBA (Sinuany-Stern et al., 2000).

$$
\begin{aligned}
& E_{BA} = \text{Max } Z_{BA} = \textstyle\sum_{r=1}^{s} u_r\, y_{rB} \\
& \text{So that: } \textstyle\sum_{i=1}^{m} v_i x_{iB} = 1 \\
& \quad \textstyle\sum_{r=1}^{s} u_r y_{rB} \le 1 \\
& \quad \textstyle\sum u_r\, y_{rA} - E_{AA} \sum v_i\, x_{iA} = 0 \\
& \quad u_r, v_i \ge 0 \qquad r=1,2,\dots,s \qquad i=1,2,\dots,m
\end{aligned} \tag{3}
$$

$E_{BA}$ represents the optimal cross-evaluation of unit B followed by $E_{BB}$ and $E_{AB}$ based on calculating the problems BB and AB. Consequently, the pairwise comparison matrix required for AHP will be constructed (Sinuany-Stern et al., 2000).

$$
a_{jk} = \frac{E_{jj}+E_{jk}}{E_{kk}+E_{kj}}, \qquad a_{ij} = 1 \tag{4}
$$

It should be noted that the element $a_{jk}$ (result from paired DEA results) in AHP shows the evaluation of unit $j$ over unit $k$. so that, if $a_{jk}$< 1, it means that unit $j$ is evaluated less than unit $k$. We have considered the sum of the evaluations for unit $j$ by the models of both units $E_{jj}$ and $E_{jk}$ and divide it by the sum of the evaluation given to unit $k$ by the models of both units $E_{kk}$ and $E_{kj}$ (Sinuany-Stern et al., 2000).

We must firstly demonstrate the eigenvector for units' prioritization by normalizing pairwise comparison matrix. This eigenvector indicates weights of each unit. In this research, we utilize column normalization to calculate these weights (Scholars can employ eigenvector method, logarithm least square, or approximation method). The subjective judgment does not exist in this way due to weights extracted from comparison matrix via DEA, eventually matrices are consistent and inconsistency test in AHP is not necessary.

## Literature Review

Several papers have been conducted about evaluating the efficiency of tax offices in Iran and other countries. Mosavi Jahromi and Zayer (2007) ranked provinces by using TOPSIS and taxonomy based on effective factors on tax capacity. They utilized 22 indices including institutional and economic factors based on the information in 2005. Arabmazar and Dehghani (2010) estimated income tax efficiency of all provinces by using Stochastic Frontier Analysis (SFA) from 2001 to 2007. The results showed that income tax in the developed provinces (excluding Tehran) and for the underdeveloped provinces were about 72.3% and 66.5%, respectively.

Talebnia et al. (2014) identified and prioritized operational budgeting development variables. They studied implementation possibility of these variables in Iranian National Tax Administration. The main variables included policy-making, adoption, and control in system development.

Askari and Charkhkar (2015) determined and evaluated relative efficiency in Tehran Tax Administration by using DEA. They investigated twelve tax offices from 2011 to 2012. The results indicated that the number of Legal Entities (LE) paying taxes and value added in Tehran Province was efficient and reference unit and other administrations were inefficient.

Monjazeb and Mousavi (2015) studied performance tax in petroleum sector and national tax administration efficiency by using DEA and Gini coefficient. They concluded that performance without tax in 2009 and 2012 were productive but in 2010 and 2011 were local efficient solely. As well as domestic researches, there are some major articles related to tax system and tax offices.

Vlassenko (2001) investigated the efficiency of property tax systems in some European countries including Britain, France, and Sweden. For this purpose, he considered eight indices based on efficiency and fairness, and compared the countries according to integrated indices. The results showed that the French system is the least efficient while the Swedish system is the most efficient.

Moesen and Persoon (2002) evaluated the efficiency of 289 regional tax offices in Belgium. They utilized Free Disposal Hull (FDH) and DEA models. Human resource (labor) was a unique input and non-monetary outputs were considered such as the number of audited returns of category and the number of audited returns of category that led to an increase in the tax base. Both of the techniques were articulated in constant returns to scale (CRS) and variable returns to scale (VRS) modes. Also, observed differences in efficiency based on culture, managerial skills and organizational structure were investigated (Moesen & Persoon, 2002).

Barros (2005) assessed tax offices performance by using Stochastic Frontier Model (SFA). He studied tax offices in Portugal by considering the number of workers, personal taxes, and corporate taxes. He utilized Cobb-Douglas function to calculate efficiency. The results showed that most tax offices in Portugal were efficient along the period.

Lee (2009) analyzed overall technical efficiency, pure technical efficiency, and scale efficiency in the 173 medium-sized audit firms by using DEA. The results showed that overall technical efficiency of 24 audit firms is 1. Those audit firms which have the larger number of employees and partners significantly performed better compared to others. As well as this, those firms with higher total expenditures had higher operational efficiency.

Katharaki and Tsakas (2010) evaluated the efficiency of 27 Greek tax offices by using window analysis DEA from 2001 to 2006, in order to find efficiency trends over time. Inputs included labor, number of computers, number of natural persons and number of legal entities in each tax office; on the other hand, outputs consisted of the incoming taxation funds related to natural persons and legal entities.

The results underline that scale size and the structure of regional economy where tax offices operate are important factors affecting their efficiency.

Singh and Agrawal (2012) investigated the similarity and dissimilarity in the perception of taxpayers in Assam state, India. They collected related data from officials and questionnaire. The results showed that social marketing is a major tool in order to improve unfavorable perceptions among taxpayers.

González and Rubio (2013) evaluated the efficiency of tax administrations in Spain by using DEA in 2008. Settlement acts income was a unique output, but input included goods and services expenditure, number of declarations and staffing. The results indicated that the degree of technical efficiency among tax offices have significant disparity in Spain.

Forsund and Edvardsen (2015) evaluated the productivity of 98 tax offices in Norway by using DEA and Malmquist productivity indices. The cost of deployment of resources including manpower, offices and current expenses were input, and six output categories of the main service activities carried out by tax offices were number of people relocated during the year registered by home address, immigrations and emigrations, returns from non-incorporated businesses and false registrations, tax returns from employees and pensioners, complaints on tax assessment and corporate tax returns. They concluded that changes in cost plus productivity were classified into four categories including efficient cost increase, interest to policymakers, efficient and inefficient cost saving, and inefficient cost increase.

Conducting literature reviews shows that a quantitative method such as Data Envelopment Analysis (DEA) has been used to prioritize tax offices based on efficiency, while utilizing a quantitative and subjective integrated method can cover the disadvantage of a quantitative one. So, outstanding aspect in this research is employing DEA and AHP integrated method in order to use advantages of both techniques for prioritizing provincial tax offices and extracting pragmatic and objective results. The efficiency of tax office in each province is articulated based on inputs and outputs in DEA, while in DEA/AHP, each province in formatting equation is compared to other provinces and efficiency is calculated. Eventually, some provinces get high weights and top ranks meaning they are more efficient in comparison with others. Using the integrated method in this case and ranking provinces have been another innovative approach in this research for four years. It can help policy-makers to develop a plan in order to attain higher efficiency and ranks.

As well as conducting literature review about tax system, there are many articles in literature which have employed the hybrid model based on AHP and DEA. Cai and Wu (2001) in their research focused on another integration of AHP and DEA. Primarily, they analyzed and modified classification of financial evaluation system by using AHP and created four groups of financial indices. Secondarily, they presented a model which depicted the efficient unit via DEA.

Li and Chen (2004) addressed the weakness and strength points of quantitative and qualitative methods by comparative study and concluded that utilizing each group separately could not result in effectiveness.

Korpela et al. (2007) studied the inventory system selection by using AHP and DEA integrated model. At first, they extracted inventory system efficiency via DEA, then by employing AHP, relative vectors of each system were calculated and the best alternative was selected.

Azadeh et al. (2008) utilized DEA/AHP hybrid model for optimizing and improving railroad system. In the research, qualitative index was extracted by DEA and eventually the ranking of factors and indices in railroad system by using AHP has been done.

Lin et al. (2011) evaluated the local government in China based on economic performance by using AHP/ DEA integrated model in 2011. They believed that the hybrid model was the most powerful in comparison with when using them separately. So, this integration model could evaluate and prioritize various alternatives. Moreover, Malmquist index was utilized in order to compare the economic performance over time.

## Methodology

The required data have been collected from Statistical Center of Iran, economic and financial indicator of provinces, operational planning information of National Tax Administration, economic indicator's monthly report of Central Bank of the Islamic Republic of Iran. Input and output indices were identified based on the literature review and available data. Inputs including current cost and labor number of province tax office, were driven from Forsund and Edvardsen (2015), González and Rubio (2013), Katharaki and Tsakas (2010), Barros (2005), Moesen and Persoon (2002), Arab Mazar and Mousavi (2010). Outputs indices consist of corporate tax, income tax, wealth tax and goods and services tax, extracted from González and Rubio (2013), Katharaki and Tsakas (2010), Barros (2005), Moesen and Persoon (2002), Arab Mazar and Mousavi (2010).

We divided provinces into two groups (developed and underdeveloped), for investigating efficiency of provincial tax offices, because of existing the heterogeneous provinces based on the degree of development. The categorization has been done based on President Deputy of Strategic Planning and Control Report which is depicted in Table 4. It is necessary to state that Tehran should not be compared to other provinces because of its specific circumstances. Most of the tax gain includes large corporations' taxes in public and private sector in Tehran Province. Besides this, we ignored two provinces based on the economic structure; Bushehr Province due to South Pars Condensate field and its gaining tax from contractor and subcontractor, and Hormozgan Province because of the customs office.

**Table 4. Categorization of provinces**

| | |
|---|---|
| **Developed** | East Azerbaijan- Isfahan- Razavi Khorasan- Khozestan -Zanjan- Semnan- Fars- Qazvin-Qom- Kerman-Gilan -Mazandaran-Markazi-Hamadan- Yazd |
| **Underdeveloped** | West Azerbaijan- Ardabil- ILam- Chaharmahal Bakhtiari- South Khorasan- North Khorasan-Sistan and Baluchestan- Kurdistan- Kohgiluyeh and Boyer-Ahmad- Kermanshah-Golestan- Lorestan |

We utilized CCR input-oriented model for calculating provincial tax office efficiency with constant returns to scale based on the above categorization by DEA Frontier 2007 from 2011 to 2014. Then, for ranking provinces, DEA/AHP was used. Figure 1 depicts the research model for calculating weights and prioritizing units.

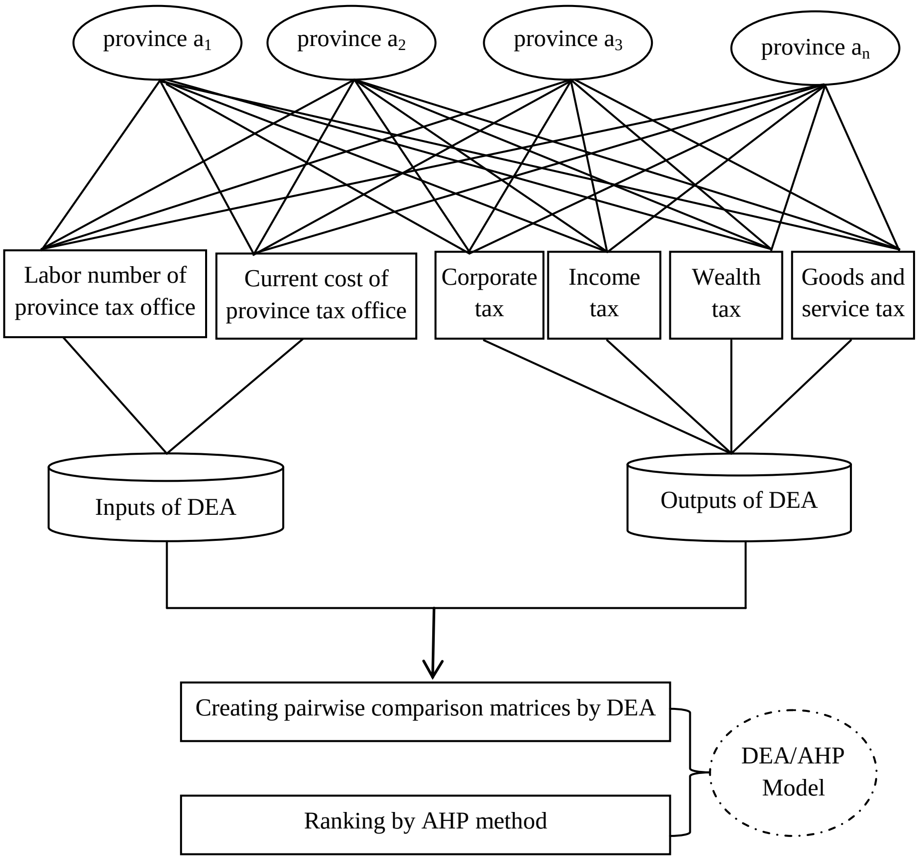


**Fig. 1. Research model**

## Results

### Using DEA for Calculating Efficiency

The efficiency values of developed and underdeveloped provinces in 2011, 2012, 2013, and 2014 have been depicted in Table 5, 6, 7 and 8, respectively. In these tables, efficiency for every province was calculated and compared to others in its category.

Table 5 shows that Isfahan, Qazvin, Kerman, and Markazi were efficient (the efficiency was 100%) while Hamedan with 41% efficiency was the least rank among the developed provinces. In underdeveloped provinces, West Azerbaijan and Sistan and Baluchestan were the most efficient and Kohgiluyeh and Boyer-Ahmad with 46% have the lowest efficiency.

**Table 5. Efficiency of provincial tax offices in 2011**

| Developed provinces | | Underdeveloped provinces | |
|---|---|---|---|
| East Azerbaijan | 0.6695 | West Azerbaijan | 1 |
| Isfahan | 1 | Ardabil | 0.53 |
| Razavi Khorasan | 0.6664 | ILam | 0.502 |
| Khozestan | 0.8691 | Chaharmahal Bakhtiari | 1 |
| Zanjan | 0.589 | South Khorasan | 0.782 |
| Semnan | 0.9459 | North Khorasan | 0.664 |
| Fars | 0.6271 | Sistan and Baluchestan | 1 |
| Qazvin | 1 | Kurdistan | 0.939 |
| Qom | 0.9345 | Kermanshah | 0.71 |
| Kerman | 1 | Kohgiluyeh and Boyer-Ahmad | 0.4619 |
| Gilan | 0.4538 | Golestan | 0.654 |
| Mazandaran | 0.4363 | Lorestan | 0.627 |
| Markazi | 1 | | |
| Hamadan | 0.416 | | |
| Yazd | 0.8427 | | |

**Table 6. Efficiency of provincial tax offices in 2012**

| Developed provinces | | Underdeveloped provinces | |
|---|---|---|---|
| East Azerbaijan | 0.6198 | West Azerbaijan | 1 |
| Isfahan | 1 | Ardabil | 0.624 |
| Razavi Khorasan | 0.5357 | ILam | 0.995 |
| Khozestan | 0.836 | Chaharmahal Bakhtiari | 1 |
| Zanjan | 0.5374 | South Khorasan | 0.692 |
| Semnan | 0.7706 | North Khorasan | 0.846 |
| Fars | 0.687 | Sistan and Baluchestan | 0.9941 |
| Qazvin | 1 | Kurdistan | 0.7592 |
| Qom | 0.9184 | Kermanshah | 0.9227 |
| Kerman | 1 | Kohgiluyeh and Boyer-Ahmad | 1 |
| Gilan | 0.3489 | Golestan | 0.5926 |
| Mazandaran | 0.3773 | Lorestan | 0.8152 |
| Markazi | 1 | | |
| Hamadan | 0.3877 | | |
| Yazd | 0.859 | | |

Table 6 indicates that, in developed provinces, Isfahan, Qazvin, Kerman, and Markazi were efficient, while Gilan with 36% efficiency was the least rank in 2012. In underdeveloped provinces, West Azerbaijan and Sistan and Baluchestan were the most efficient and Golestan with 59% has the lowest efficiency.

**Table 7. Efficiency of provincial tax offices in 2013**

| Developed provinces | | Underdeveloped provinces | |
|---|---|---|---|
| East Azerbaijan | 0.5575 | West Azerbaijan | 1 |
| Isfahan | 1 | Ardabil | 0.6456 |
| Razavi Khorasan | 0.5213 | ILam | 0.8501 |
| Khozestan | 0.7528 | Chaharmahal Bakhtiari | 0.9216 |
| Zanjan | 0.4977 | South Khorasan | 0.6712 |
| Semnan | 0.6893 | North Khorasan | 0.952 |
| Fars | 0.499 | Sistan and Baluchestan | 1 |
| Qazvin | 0.6025 | Kurdistan | 0.916 |
| Qom | 0.7604 | Kermanshah | 0.9105 |
| Kerman | 1 | Kohgiluyeh and Boyer-Ahmad | 1 |
| Gilan | 0.2752 | Golestan | 0.6094 |
| Mazandaran | 0.3443 | Lorestan | 0.8295 |
| Markazi | 1 | | |
| Hamadan | 0.3278 | | |
| Yazd | 0.8242 | | |

Table 7 indicates that, in developed provinces, Isfahan, Kerman, and Markazi were efficient while Gilan with 27% efficiency was the least rank in 2013. In underdeveloped provinces, West Azerbaijan and Sistan and Baluchestan were the most efficient and Golestan with 60% has the lowest efficiency. It is necessary to mention that Alborz Province was established in 2012, and we eliminated it due to the lack of data transparency.

**Table 8. Efficiency of provincial tax offices in 2014**

| Developed provinces | | Under developed provinces | |
|---|---|---|---|
| East Azerbaijan | 0.6524 | West Azerbaijan | 1 |
| Isfahan | 1 | Ardabil | 0.8067 |
| Alborz | 0.5161 | ILam | 0.4837 |
| Razavi Khorasan | 0.7973 | Chaharmahal Bakhtiari | 0.6823 |
| Khozestan | 0.7854 | South Khorasan | 1 |
| Zanjan | 0.5232 | North Khorasan | 0.9845 |
| Semnan | 0.3866 | Sistan and Baluchestan | 1 |
| Fars | 0.4639 | Kurdistan | 0.9230 |
| Qazvin | 0.7018 | Kermanshah | 0.8329 |
| Qom | 0.8130 | Kohgiluyeh and Boyer-Ahmad | 0.7045 |
| Kerman | 1 | Golestan | 0.6521 |
| Gilan | 0.3122 | Lorestan | 0.8603 |
| Mazandaran | 0.3567 | | |
| Markazi | 1 | | |
| Hamadan | 0.3267 | | |
| Yazd | 0.8292 | | |

Table 8 depicts that, in developed provinces, Isfahan, Kerman, and Markazi were efficient while Gilan with 31% efficiency was the least rank in 2014. In underdeveloped provinces, West Azerbaijan, South

Khorasan and Sistan and Baluchestan were the most efficient and Ilam with 48% has the lowest efficiency.

**Using DEA/AHP for Prioritizing Provinces**

In this method, a DEA model was developed for a couple of provinces in each category in every year without considering other ones. Then, pairwise comparison matrices were constructed by using the results from the model solving in previous section. The calculations were conducted for both categories in every year separately via DEA Frontier. This procedure resulted in eight pairwise comparison matrices. Finally, prioritizing was done by using AHP. The weight outputs and ranking of developed and underdeveloped provinces are shown for every year based on DEA/AHP in Tables 9 and 10.

**Table 9. The weight outputs from 2011 to 2014**

| Developed provinces | Province weights | | | |
|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 |
| East Azerbaijan | 0.06591 | 0.06354 | 0.06448 | 0.06568 |
| Isfahan | 0.07425 | 0.07458 | 0.07618 | 0.07116 |
| Alborz | - | - | - | 0.05904 |
| Razavi Khorasan | 0.06693 | 0.06313 | 0.06382 | 0.06281 |
| Khozestan | 0.07022 | 0.07253 | 0.07349 | 0.06637 |
| Zanjan | 0.06396 | 0.06277 | 0.06322 | 0.06155 |
| Semnan | 0.07227 | 0.06851 | 0.06723 | 0.05708 |
| Fars | 0.06625 | 0.06788 | 0.06342 | 0.05887 |
| Qazvin | 0.06941 | 0.07189 | 0.06751 | 0.06554 |
| Qom | 0.06725 | 0.06704 | 0.06601 | 0.06296 |
| Kerman | 0.06808 | 0.06907 | 0.07018 | 0.06737 |
| Gilan | 0.06087 | 0.05856 | 0.05578 | 0.05502 |
| Mazandaran | 0.05901 | 0.05548 | 0.05839 | 0.05536 |
| Markazi | 0.06729 | 0.07639 | 0.08090 | 0.06905 |
| Hamadan | 0.05733 | 0.05601 | 0.05509 | 0.05338 |
| Yazd | 0.0709 | 0.07211 | 0.07424 | 0.06870 |
| **Underdeveloped provinces** | **Province weights** | | | |
| | **2011** | **2012** | **2013** | **2014** |
| West Azerbaijan | 0.09444 | 0.08889 | 0.08841 | 0.08525 |
| Ardabil | 0.08159 | 0.07158 | 0.08033 | 0.08387 |
| ILam | 0.08151 | 0.08135 | 0.08298 | 0.07853 |
| Chaharmahal Bakhtiari | 0.08399 | 0.08425 | 0.08434 | 0.08197 |
| South Khorasan | 0.0832 | 0.08182 | 0.08134 | 0.08334 |
| North Khorasan | 0.08274 | 0.08803 | 0.08342 | 0.08549 |
| Sistan and Baluchestan | 0.08327 | 0.08315 | 0.08328 | 0.08388 |
| Kurdistan | 0.08348 | 0.08363 | 0.08565 | 0.0857 |
| Kermanshah | 0.08302 | 0.08606 | 0.08594 | 0.08521 |
| Kohgiluyeh and Boyer-Ahmad | 0.07927 | 0.08599 | 0.08328 | 0.08049 |
| Golestan | 0.08068 | 0.07773 | 0.07809 | 0.08125 |
| Lorestan | 0.08280 | 0.08206 | 0.08288 | 0.08502 |

Table 10 represents the prioritization of provincial tax offices efficiency from 2011 to 2014. We can show the province efficiency increase or decrease via the rank comparison for each of them in four years.

**Table 10. Prioritization of provincial tax offices efficiency from 2011 to 2014**

| **developed provinces** | **Province ranks** | | | |
|---|---|---|---|---|
| | **2011** | **2012** | **2013** | **2014** |
| East Azerbaijan | 11 | 10 | 9 | 6 |
| Isfahan | 1 | 2 | 2 | 1 |
| Alborz | - | - | - | 11 |
| Razavi Khorasan | 9 | 11 | 10 | 9 |
| Khozestan | 4 | 3 | 4 | 5 |
| Zanjan | 12 | 12 | 12 | 10 |
| Semnan | 2 | 7 | 7 | 13 |
| Fars | 10 | 8 | 11 | 12 |
| Qazvin | 5 | 5 | 6 | 7 |
| Qom | 8 | 9 | 8 | 8 |
| Kerman | 6 | 6 | 5 | 4 |
| Gilan | 13 | 13 | 14 | 15 |
| Mazandaran | 14 | 15 | 13 | 14 |
| Markazi | 7 | 1 | 1 | 2 |
| Hamadan | 15 | 14 | 15 | 16 |
| Yazd | 3 | 4 | 3 | 3 |
| **Underdeveloped provinces** | **Province ranks** | | | |
| | **2011** | **2012** | **2013** | **2014** |
| West Azerbaijan | 1 | 1 | 1 | 3 |
| Ardabil | 9 | 12 | 11 | 7 |
| ILam | 10 | 7,8 | 8 | 12 |
| Chaharmahal Bakhtiari | 2 | 6 | 4 | 9 |
| South Khorasan | 5 | 10 | 10 | 8 |
| North Khorasan | 8 | 2 | 5 | 2 |
| Sistan and Baluchestan | 4 | 7,8 | 6,7 | 6 |
| Kurdistan | 3 | 5 | 3 | 1 |
| Kermanshah | 6 | 3 | 2 | 4 |
| Kohgiluyeh and Boyer-Ahmad | 12 | 4 | 6,7 | 11 |
| Golestan | 11 | 11 | 12 | 10 |
| Lorestan | 7 | 9 | 9 | 5 |

## Discussion and Conclusion

In this research, we try to investigate efficiency of Iran's provincial tax offices. So, the provinces are prioritized by using DEA/AHP integrated model. Then, the prioritization of provinces has been done by AHP based on pairwise comparison matrices resulted from DEA. One of the major drawbacks of AHP which causes concern among decision makers would be that subjective judgment in comparison matrices may result in bias in prioritization. We have modified this challenge by using DEA. It is the first approach in evaluating efficiency of provincial tax offices. The comparison with outstanding researches about provincial tax offices in their country and other countries shows that they utilized these two techniques separately. For instance, Askari and Charkhkar (2015) evaluated twelve tax offices and employed Data Envelopment Analysis as a quantitative technique solely. Arab Mazar and Mousavi (2010) calculated efficiency of provincial tax office by using DEA from 2004 to 2005. Moreover, Moosavi Jahromi and Zayer (2007) ranked provinces based on effective factors on tax capacity via taxonomy and TOPSIS.

Katharaki and Tsakas (2010) evaluated the efficiency of 27 tax offices in Greece by employing DEA. González and Rubio (2013) studied the efficiency of tax administrations in Spain by using DEA in 2008. Forsund et al. (2015) evaluated the productivity of tax offices in Norway by using DEA and Malmquist productivity indices. As well as this, Barros (2005) employed stochastic aspect in his research via Stochastic Frontier Analysis (SFA).

Our proposed model has the increasing potential in order to be employed in various industries and services parts as long as appropriate data and information about inputs and outputs exist in the system. However, this hybrid model has some drawbacks like other techniques. The most important one would be that missing data cause some problems for creating pairwise comparison matrices via DEA. Moreover, organizations and companies have to develop the efficient recording systems.

The results show that underdeveloped provinces, based on their resources and facilities, have done better comparing to developed ones. The overall outputs determined that relative efficiency values of all provincial tax offices are low. Based on reviewing the literature and related articles in this field, we could conclude that objective approach was dominant in the most researches. Therefore, this research represents the novel methodology to confront the gaps in the tax study via subjective-objective integrated model. According to province prioritization, Isfahan in 2011 and 2014, Markazi in 2012 and 2013 have the best ranks among developed provinces; while in underdeveloped provinces, West Azerbaijan in 2011, 2012, and 2013, and Kurdistan in 2014 achieve the highest ranks. These results indicate that these provinces are more efficient by considering inputs and outputs compared to other provinces.

The inefficient provinces can improve their performance according to the inputs which DEA advised. Indeed, we employed a combination of goal-setting based on input and output for enhancing productivity and efficiency. We propose that inefficient provinces should decrease current cost and number of personnel as the inputs and increase taxes until to receive efficiency subject to inputs. So, policy-makers can set the goals for tax offices via combination of input-oriented and output-oriented strategies. On the other hand, enhancement of tax culture in society and structural reforms in overall tax system by macro level manager can improve the importance of country's tax official.

The main limitation of this research was lack of updated data in some provinces. It is obvious that we can provide accurate results by adding data in recent years. So, it is offered to prioritize provincial tax offices by collecting newer data and employing the proposed model to other studies. Also, they can investigate the trend of change in time duration. We advise to design a scenario-based approach for improving the performance of tax officials of underdeveloped provinces.

## References

Alamtabriz, A., Saiedy, H., & Deilami Moezi, S. (2011). Using composed approach of DEA and AHP for efficiency evaluation faculties of Shahid Beheshti University. *Journal of Management Futures Research (Journal of Management Research)*, *23*(89), 25-36. (In Persian)

Arab Mazar, A., & Mousavi, S. Y. (2010). The efficiency calculation and tax efforts made by tax organization of different provinces of the country: Data envelopment analysis. *Journal of Economic Research Review, 10*(37), 139-165. (In Persian)

Arabmazar, A. A., & Dehghani, A. (2010). An estimation of business and profession/corporate income tax efficiency in provincial tax offices. *Journal of Tax Research*, *7*(17), 45-64. (In Persian)

Askari, A., & Charkhkar, M. (2015). The determination and assessment of the relational efficiency indicators of Tehran City's and Provinces' tax affairs general directorates with data envelope analysis approach (DEA). *Journal of Tax Research*, *23*(27), 36-62. (In Persian)

Azadeh, A., Ghaderi, S. F., & Izadbakhsh, H. (2008). Integration of DEA and AHP with computer simulation for railway system improvement and optimization. *Journal of Applied Mathematics and Computation, 195*, 775-785.

Barros, C. P. (2005). Performance measurement in tax offices with a stochastic frontier model. *Journal of Economic Studies*, *32*(6), 497-510.

Cai Y., & Wu, W. (2001). Synthetic financial evaluation by a method of combining DEA with AHP. *International Transactions in Operational Research*, *8*(5), 603-609.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, *2*(11), 429-444.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of Royal Statistical Society*, *120*(3), 253-281.

Forsund, F. R., & Edvardsen, D. F. (2015). Productivity of tax offices in Norway. *Journal of Productivity Analysis*, *43,* 269-279. Retrieved from http://econpapers.repec.org/RePEc:kap:jproda:v:43:y:2015:i:3:p:269-279.

Gholipour, R., Jandaghi, G., & Rajaei, R. (2014). Contractor selection in MCDM context using fuzzy AHP. *Iranian Journal of Management Studies*, *7*(1), 151-173.

González, P. E. B., & Rubio, E. V. (2013). The Efficiency of the regional management centres of the tax administration in Spain. *Journal of US-China Public Administration*, *10*(1), 49-56. Retrieved from http://www.davidpublisher.com/index.php/Home/Article/index?id=7305.html.

Katharaki, M., & Tsakas, M. (2010). Assessing the efficiency and managing the performance of Greek tax offices. *Journal of Advances in Management Research*, *7*, 58-75. Retrieved from http://www.emeraldinsight.com/doi/abs/10.1108/09727981011042856.

Korpela, J., Lehmusvaara, A., & Nisonen, J. (2007). Warehouse operator selection by combining AHP and DEA methodologies. *International Journal of Production Economics*, *108*, 135-142.

Lee, C. C. (2009). Analysis of overall technical efficiency, pure technical efficiency and scale efficiency in the medium-sized audit firms. *Expert Systems with Applications*, *36*, 11156-11171.

Li, C. C., & Chen, C. Y. (2004). Incorporating value judgment in to DEA to improve decision quality for organization. *The Journal of American Academy of Business*, *3*, 423-427.

Lin, M. I., Lee, Y. D., & Ho, T. N. (2011). Applying integrated DEA/AHP to evaluate the economic performance of local governments in China. *European Journal of Operational Research*, *209*, 129-140.

Moesen, W., & Persoons, A. (2002). Measuring and explaining the productive efficiency of tax offices: A non-parametric best practice frontier approach. *Tijdschrift voor Economic en Management*, *47*(3), 399-416.

Monjazeb, M., & Moosavi, S. E. (2015). The impact of tax on oil company's performance and tax organization efficiency (data envelopment analysis approach). *Journal of Tax Research*, *23*(27). 195-210. (In Persian)

Monthly Reports of Economic Indices, The central bank of I.R.I. (In Persian)

Mosavi Jahromi, Y., & Zayer, A. (2007). Comparison of two multiple attribute decision making models case: Ranking the Iran's provinces based on the factors affecting tax capacity. *Journal of Economic Research Review*, *4*, 15-44. (In Persian)

Performance-Based Planning of the Iranian National Tax Administration. (In Persian)

Singh, R., & Agarwal, S. (2012). Return and assessment perception of assesses under VAT. *Iranian Journal of Management Studies*, *5*(2), 31-47.

Sinuany-Stern, Z., Mehrez, A., & Hadad, Y. (2000). An AHP/DEA methodology for ranking decision making units. *International Transactions in Operations Research*, *7*(2), 109-124.

Statistical Yearbook of Iran, Statistical center of Iran. (In Persian)

Talebnia, G., Hassasyeganeh, Y., Vakilifard, H., & Mohammadipour, R. (2014). Identification and prioritization of variables for implementation of performance-based budgeting in Iranian national tax administration. *Journal of Tax Research*, *22*(22), 188-220. (In Persian)

Tseng Y., & Lee T. (2009). Comparing appropriate decision support of human resource practices on organizational performance with DEA/AHP model. *Expert Systems with Applications*, *36*, 6548-6558.

Vlassenko, I. (2001). Evaluation of the efficiency and fairness of British, French and Swedish property tax systems. *Property Management*, *19*(5), 384-416.