**Research Article**

ESTIMATION OF TAX POTENTIAL OF TEHRAN PROVINCE USING NEURAL NETWORK BASED HYBRID ALGORITHM

*Hajar Rahimi*¹ and *Seyed Ahmad Sheibat Alhamdi*²

¹Department of Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran
²Department of Industrial Management, Firoozkooh Branch, Islamic Azad University, Firoozkooh, Iran

*Author for Correspondence*

**ABSTRACT**

Emancipation of volatile revenues from crude oil sales and financing of state budget through the tax system is a key goal of Iran in the tax system. According to the tax system over the past few years indicates that there have been important steps towards reforming the tax system in different aspects such as tax rules reform, rates and tax reform and tax system of the country still has a disadvantage in comparison with many countries of the world (Amini, 2009). One of the most fundamental of these problems is the lack of estimating tax capacity in recent years. This study aims at collecting the province's fiscal capacity using neural network based on algorithm of bees the independent variables as the input layer to be entered the neural network system. The input variables in the model, i.e. inflation, value-added, various sectors of economic and urban household annual income and tax revenue would be considered as the independent variables of the model, and the dependent variable, that is the tax capacity, is considered as the output layer that through value-added of the various economic sectors, the fiscal capacity of the province is estimated, which the share of value added of transportation sector in making tax capacity was the highest than all others, and this is a sign of the capacities in the transport sector, if used in principle, it can provide the development and prosperity context in transportation and economic development of this sector and via this, the government to get more money. The value-added of the industry is also of great importance that should be considered in the context of government revenue.

**Keywords:** Tax Potential, Neural Network, Tax Income, Added-value, Inflation Rate, Annual Revenue of Urban Household

**INTRODUCTION**

Taxes are the most common and important financial resource for supplying general revenues and it is one of the most efficient and effective financial policy means in world that government can provide social and welfare services for people and guide social and economic activities and movements. Unfortunately, understanding of some people from gathering taxes in Iran is limited to obtaining more revenue in order to run public offices and the point which is less considered is that high share of oil revenue and low share of tax revenue in combination of government revenue has undesired effects like dependence of revenue to exporting a good but has deprived the country’s economy from using financial mean. While using this mean, we can guide economic crisis to correct direction. By changing tax foundations, we can create mechanisms that resolve problems like budget deficit, inflation, unemployment, unbalanced revenue distribution, reduction in non-oil export and increase in import, increase in migration to large cities, increase in consumption of lux goods in urban cities and other issues and provide required guarantee for the development of economy and fulfilment of economic, social and political goals (Piraei, 2008). In studies about tax potential of country, it became clear that there is significant gap between potential tax potential and actual received tax. Studies throughout the country show tax gap (Mehrgan, 2004). Tax ratio index is an acceptable global index which is used to measure tax performance of countries. The index shows this fact that Iran is in rank 44 among 46 studied countries during 2000-2006. Calculation of studied index in Iran is %6.5 while mean of countries during 2000-2006 is %18. This shows the fact that country tax potential has reached its threshold (World Bank); therefore, careful and scientific understanding of tax issues can help economic policy-makers in careful and better planning to increase tax potential.
The necessity of research in Tehran is that there is no research about tax potential potential and tax revenue predictions and these predictions are based on coefficient of previous year that has no scientific basis; therefore, this project will lead to scientific predictions. This research studies effective variables on tax capacities and estimates tax potential of Tehran province using metaheuristic bee algorithm based on neural network. Studied variables in this research are: added-value of economic sectors like added-value of industry with current price, added-value of wholesale, retailing, repairing vehicles and goods and added-value of properties, rent and business services with current price and added-value of transportation section, storing and communication with current price and average revenue variable for urban household, inflation rate and total tax income.

**Theoretical Framework**

**Effective Factors on Tax Potential**

The tax capacity of a country's economic capacity is to bear the brunt of the variety of tax, in other words, the extent to which people can pay taxes. Given the importance and role of taxes in estimating the fiscal capacity, in order to increase tax revenues in the society, it is of the key issues in economics. The tax capacity is in reality expressing the highest tax that could be obtained the long-term, with respect to its distribution level and composition of income and the laws of every country which is normal if a tax taken is more than the tax capacity, it will reduce the income over the society and tax revenue in the coming years and if less than the potential tax capacity, the state to achieve their own economic goals will be faced with financial problems (Falahati, 2010).

Various definitions have been presented for tax potential. Based on these definitions, tax potential of a country is potential ability of gathering tax based on laws, national revenue volume and revenue distribution pattern. Factors which influence tax potential of country are not fixed but by passing time, some transformations occur in economy which changes these factors. With this in mind, various ideas have presented about the effective factors in tax potential. Generally, effective factors in tax potential can be summarized as extra-organizational and intra-organizational factors (MousaviJahromi, 2008).

**Factors Influencing Tax Potential**

1. Extra-organizational factors, factors influencing ability of people and society in paying tax:
   A. structural factors: per capita income, structure of economy's different sections, condition of macroeconomic variables and revenue distribution;
   B. optional factors: attitude toward government, tax system, responsibility and honesty of people in paying tax;

2. Intra-organizational factors, factors influencing ability of government in gathering tax:
   A. structural factors: tax system structure (tax regulations, basis and rates),
   B. administrative factors: administrative formation of tax organization, implementation, and its costs.

In another definition, effective factors on ability of people and society in paying tax are determined by two structural and optional factor groups. The most important structural factors influencing ability of people for paying tax are per capita income, social texture of society and importance of different economic activities and macroeconomic policies. Higher level of per capita income leads to higher saving level, low illiteracy, and reasonable level of economic development and etc. which facilitates tax gathering; therefore, per capita income is an important factor of tax potential because of its effects on paying tax.

Optional factors influencing ability of people for paying tax include tax culture of society, general attitude toward tax system, responsibility and honesty of people in paying tax and attitude of citizens toward government which may be influenced by quality of public services and costing tax incomes. Generally, developing tax culture in society such that people consider payment of tax as their duty and have correct understanding of government duties to get part of national revenue and spending it for general needs are effective factors in paying tax.

In another definition, effective factors on tax economic potential can be divided into two classes:
Research Article

1. Institutional factors including attitude of society toward tax payment, political and cultural development of society, political stability and urbanism, population dispersion, structure and combination of population and administrative corruption.

2. Economic factors including structure and combination of economic sector, development degree of country, economy openness degree, debt of public sector, economic mechanism, inflation and unemployment.

Another type of classification of factors influencing tax potential, divides these factors into three groups:

1. Production or revenue of people in society;
2. Distribution of revenue and wealth among people in society;
3. Country regulations

On the other hand, one group classifies effective factors in tax potential into four groups which is shown in table (Falahati, 2010).

Table 1: Effective factors in tax potential

| Human factor | In addition to population of a country, depends on reaction of population to tax payment and class combination of people which has root in culture and history of each country. |
| Economic factors | Economic condition governing the country, distribution of economic activities among private, public and cooperation sector, revenue combination and wealth distribution among different classes |
| Political factors | Country is politically faced with different environment threats of other countries like war, international crisis and economic conditions inside country. |
| Legal factors | Tax regulations are important including tax tables, incremental rates and tax incentives. |

Regarding conducted studies, we investigate and calculate effective factors in tax potential like inflation rate, mean revenue of urban household, added-value of industry section, added-value in transportation and communication section, tax income, added-value of wholesale section, retailing, repairing vehicles and goods, added-value of properties section, rent and business services.

Literature Review

Numerous studies have been conducted about tax potential. In below table, summary of internal and external research has been presented.

Research Questions

1. Can we estimate tax potential of Tehran province using neural networks?
2. What are effective factors on tax potential of Tehran province?
3. What is the suitable neural network model for predicting tax potential of Tehran province?

Statistical Population and Sample

Statistical population of this research is all people who have tax case in tax affair organization of Tehran. Because all statistical population is considered in this study, there is no sampling.

Data Gathering

This research is applied in terms of purpose and survey in terms of method that by gathering required data about effective factors in tax, these factors are identified and their effects on tax potential are predicted. Many concepts and information used in this research are drawn from literature and similar thesis. Researcher has used internet and Persian and Foreign books and articles.

Regarding study topic which is gathering data about events that have occurred in past and dependent variables, measuring before and after entering independent variables, post-event or causal-comparative research method has been used.

Scope of the Study

Subject scope: scope of this research relates to understanding research theoretical framework and estimating tax potential of Tehran.
<table>
<thead>
<tr>
<th>Row</th>
<th>Researcher-year</th>
<th>Condition</th>
<th>Research title</th>
<th>Research topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Komjani &amp; Fahim Yahyaee (1994)</td>
<td>domestic</td>
<td>Analysis on combination of taxes &amp; estimation of tax potential in Iran</td>
<td>Industry &amp; service section have higher role in developing tax revenues in developing countries. Service section tax, job tax, tax on properties and tax on service firms</td>
</tr>
<tr>
<td>6</td>
<td>RooshanEisazadeh (1997)</td>
<td>domestic</td>
<td>Economic potential of Isfahan tax</td>
<td>Study of economic potential of Isfahan using added-value calculation &amp; tax on service firms</td>
</tr>
<tr>
<td>7</td>
<td>Mohammad Hossein Ehsanfar (2001)</td>
<td>Domestic</td>
<td>Estimating tax potential of Mazandaran</td>
<td>Financial policy-makers can succeed in tax gathering using policy &amp; reasonable measures</td>
</tr>
<tr>
<td>8</td>
<td>Safari Baktash (2001)</td>
<td>Domestic</td>
<td>Estimation of tax potential of Azerbaijan Sharghi</td>
<td>Effective factors on tax potential: added-value of agriculture, industry, mine, services; amount of received tax is less than estimated potential</td>
</tr>
<tr>
<td>20</td>
<td>KhosroPiraei (2008)</td>
<td>Domestic</td>
<td>Estimation of tax potential in Fars province</td>
<td>Tax attempt of province is less than 1 which shows tax gap in this province</td>
</tr>
<tr>
<td>27</td>
<td>Maryam (2010)</td>
<td>Domestic</td>
<td>Studying tax attempts &amp; estimation of tax economic potential in Iran</td>
<td>Effective factors influencing economic potential in per capita income &amp; openness of economy and tax ratio</td>
</tr>
<tr>
<td>29</td>
<td>Raja (1992)</td>
<td>Foreign</td>
<td>tax attitudes in developing countries</td>
<td>Effective factors on tax potential: economy openness, economic development level and incomes, revenue combination and economic structure</td>
</tr>
<tr>
<td>30</td>
<td>Antonikstelz et al., (2001)</td>
<td>foreign</td>
<td>estimation of tax potential of Spain local governments</td>
<td>Reasons for reduction of tax potential: %35 expenditures, %25 increase in taxes, %40 increase in debt level</td>
</tr>
<tr>
<td>32</td>
<td>Jinlit (2002)</td>
<td>foreign</td>
<td>tax attempts in China</td>
<td>China tax attempt: %43 which is less than standard tax index</td>
</tr>
<tr>
<td>33</td>
<td>LukiAl firman (2003)</td>
<td>foreign</td>
<td>estimating border points of potential taxes</td>
<td>Main tax gap in Indonesian cities: non-competence of public offices, non-update technology, equipment’s and lack of human resource</td>
</tr>
<tr>
<td>34</td>
<td>Hadson &amp; Tira (2004)</td>
<td>foreign</td>
<td>tax performance: comparative study</td>
<td>Countries with high revenue use tax basis more than low revenue countries to increase their revenue</td>
</tr>
<tr>
<td>35</td>
<td>Lee (2012)</td>
<td>foreign</td>
<td>tax potential and tax attempt</td>
<td>Tax systems can influence international decision-making; government attempt: increase in tax income, spending expenditures and limitation of deducting revenue</td>
</tr>
</tbody>
</table>
Research Article

Time scope: time scope of this research includes 11 consecutive years from 2001-2012 i.e. the subject is analyzed in 12 years.

Introducing variables

Tax potential is influenced by some factors that by using them, we can apply bee algorithm:

\[ (GDP/T) = f(\text{Inf}, \text{Inc}, \text{AvInd}, \text{AvSer}, \text{AvJob}, \text{AvTra}, \text{Tax}) \]

In above formula, there is a relationship between tax ratio and explanatory variables that this tax ratio is considered as a tax performance index or tax economic potential (we refer to it as tax potential).

Used data were from Iran Statistic Center and time-series database of Central Bank. The purpose is that information related to independent variables used to predict dependent variables of tax potential.

As above formula shows, tax potential in Tehran province is function of following variables.

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T/PDG</td>
<td>dependent</td>
<td>tax revenue to GDP ratio</td>
</tr>
<tr>
<td>2</td>
<td>Inf</td>
<td>independent</td>
<td>inflation rate</td>
</tr>
<tr>
<td>3</td>
<td>cnI</td>
<td>mean household revenue</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AvInd</td>
<td>industry section added-value to current price ratio</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>AvTra</td>
<td>added-value of transportation, storage &amp; communication</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Tax</td>
<td>tax revenue</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>AvSer</td>
<td>added-value of wholesale, retailing, repairing vehicles and goods by current price</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>AvJob</td>
<td>added-value of real estate, hiring and business services</td>
<td></td>
</tr>
</tbody>
</table>

Data Analysis

Modelling using Bee Algorithm

Software Matlab is used to build the model of bee colony algorithm. This application is a technical language with a strong performance in computing over the continuous years and according to the needs of users has been subjected to a lot of changes and reforms.

The neural networks have a lot of components and different architectures that use of all these components and architectures are drawn outside the scope of this study.

In this study, due to previous research of the field of tax capacity of neural networks, we use artificial bee colony algorithm.

Bees’ Story

They are divided into 3 categories:
1. The worker bees
2. The guard bees
3. The leading wasps

The worker bees for the first phase will start randomly to seek in the search area. And the bees are randomly distributed and in the area (plain) seek the nectar and every worker selects randomly the neighboring bee and moves toward it randomly.

If the new location (the new food region) would be of better quality (more nectar), the bees remained in the new area otherwise returned to the previous area; and one unit was added to this bee’s trial indicator.

Trial Indicator

This index would be considered as a numerator the frequency of consecutive movement of the bee along with the lack of improvement, and if a bee has been given much more value to its trial indicator than the certain, this means that no nectar is found at that food area and the area should be left.

According to the worker bees are dancing, the guard bees find out which is a better quality area and they using the roulette wheel choose these regions, that is, the areas that have better quality have a greater chance of being selected.

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)
Figure 2: Input and output diagrams
The leading bees leave the region identified as the poor in terms of nectar and assigned to other areas of their choice randomly. Provided that the stop condition, the algorithm is stopped, otherwise we go to the beginning of the loop is the worker bees’ movement.

The data used in this study was calculated from the Statistical Center of Iran and time-series data bank of the Central Bank of Iran, in this section we want using the variables that are related to tax capacity to anticipate the potential one in Tehran province. These effective variables are known as input layer of bee algorithm and tax potential is output layer or dependent variable. As previous studies show, the relationship between independent variable and dependent variable should be studied.

In order to study effect of inputs on outputs of neural network and considering that using several neurons in middle layer can cause non-linear effects on output, we consider two-layered neural network with one neuron in middle layer in order to find a suitable criterion to measure effect of inputs on outputs to estimate the input weights.

Care should be taken because sigmoid function which is first layer activation function, is in region 1 and -1 of linear function. For correct judgment about the amount of input effects, inputs should be placed here that is obtained by deducing each input from maximum and dividing it on difference between maximum and minimum input normalization.

Following diagrams show each input with approximate function.

Table 4: Data differentiation by training samples, test, and validation

<table>
<thead>
<tr>
<th>1 hidden layer with 5 neuron</th>
<th>Samples</th>
<th>MSE</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>100</td>
<td>3.17 e-1</td>
<td>0.30</td>
</tr>
<tr>
<td>Validation</td>
<td>20</td>
<td>2.5 e-1</td>
<td>0.21</td>
</tr>
<tr>
<td>Testing</td>
<td>24</td>
<td>5.86 e-1</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Source: research findings

Evaluation of Results

In order to evaluate the performance of neural network, it is necessary to test the data. Following diagram shows network error for training, testing and validation data that after three training steps, suitable error has been reached.

Figure 3: Network error. Source: research findings

It is clear that network error for evaluation data in this step is suitable. Following diagrams show difference in network output with real value which is close to optimal output with good approximation.
Weight of network is as following vector.

Table 5: Importance and percent of variables

<table>
<thead>
<tr>
<th>Input</th>
<th>Inflation rate</th>
<th>Urban income</th>
<th>Industry added-value</th>
<th>Service added-value</th>
<th>Business added-value</th>
<th>Transportation added-value</th>
<th>Tax income</th>
</tr>
</thead>
<tbody>
<tr>
<td>significance</td>
<td>0/731</td>
<td>0/536</td>
<td>0/656</td>
<td>0/632</td>
<td>0/11</td>
<td>0/922</td>
<td>0/214</td>
</tr>
</tbody>
</table>

Conclusion and Observation

This study aims to investigate and estimate the tax potential of Tehran province during 2001-2012 using bee algorithms. Since neural network has considerably lower error and better prediction and as diagrams show that predictions of neural network is closer to real value, this is a suitable method for predicting tax potential and the training characteristic leads to better prediction. Neural network is a non-linear pattern that in the case of available input variables, it predicts results with non-linear pattern better.
Three factors are effective in tax potential in order to estimate tax potential:
Economic factors, institutional factors and legal factors. Generally, some of the important variables are applied to estimate and model the tax potential of Tehran city. Important variables in estimating tax potential are inflation rate %19.232 and tax revenue %5.6300. Added-value of different economic sectors can be used in order to estimate tax potential of this province that contribution of transportation sector was higher than other sectors and if it is used correctly, it can provide the ground for development of this section and economic growth and by this way, it increase revenue of government. Industry sector added-value has also high importance which should be considered.
Added-value of various economic sectors can be used to estimate tax potential of provinces that contribution of added-value of transportation sector in tax potential was higher and this shows the potential of transportation sector that if it is used correctly, it can provide the ground for development of this section and economic growth and by this way, it increase revenue of government. Industry sector added-value has also high importance which should be considered.

Solutions and Suggestions
Suggested solutions for reducing tax gap of Tehran and predicted revenue will be presented here:
1. Annual predictions of tax revenue in Tehran based on scientific methods in order to prevent naïve statements.
2. Identifying relative advantages of province in transportation sector.
3. Studying the role of transportation and industry sector of Tehran in paying tax.
4. Because inflation or devaluationsresources value of money capital and tax potential which leads to tax escape, it is suggested that Tehran province tax affairs organization cooperate with careers and organizations in order to identify these taxpayers and prevent tax disorder.

REFERENCES
### Research Article

**Luky Alfirman (2003).** Estimate of stochastic frontier tax potential: can Indonesian local government increase tax revenues under decentralization?, working paper 02-19.


**Mousavijahromi Y and Zayer A (2008).** Comparison if performance and decision-making model with multicriteria. Case study: ranking provinces based on tax potential effective factors.


**SID (No Date).** Scientific Information Database. Available: www.sid.ir.

**Statistical Center of Iran (No Date).** Presidency of the IRI management and planning organization. Available: http://www.amar.org.ir.

