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Investigating the Effect of the Green Tax on Iran's Health Sector: A General Equilibrium Approach

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Abstract

Despite the positive aspects of energy consumption, their negative externalities, i.e., environmental pollutions, are considerable. Imposition of the green tax on products and services which are not environmentally friendly has been recommended as an efficient way for improving health indices. With regard to the fact that Iran is among the countries with a high energy consumption per capita; pollution can be considered as a kind of threat to the country. In this regard, the present study benefitted from a general equilibrium model, calibrated by Iran's Social Accounting Matrix in 2011, to examine the effect of green taxes on Iran's health sector. Based on the findings of the present study, green taxes reduced all kinds of environmental pollutions. Furthermore, 62% of health costs was spent on mortality, 26.4% on morbidity, and 11.6% on non-health effects.

1. Introduction

The World Health Organization (2014) estimated that death of about 7 million people in the world in 2012, i.e. 12% of world death rate in the same year, was attributed to weather contamination. This report also indicated that, about 3.7 million people in the world, i.e. about 12% of world death rate in the same year, died because of outdoor pollutants in 2012. A recent study conducted by World Bank (2016) has also revealed weather contamination as the fourth reason for global mortality. Iran's mortality rate caused by air pollution has also been reported to be about 35.3 per 100,000 people, i.e. about 10% of the deaths in the country, in 2012 (WHO statistics, 2016). CO_2, CH_4, and N_2O have been three important air pollutants, from energy consumption, in Iran. Regarding CO_2 emissions, Iran is among the top ten polluting countries. Iran's CO_2 emissions

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have been 171, 418 and 552 million tons in 1990, 2005 and 2015, respectively. This shows a 223% growth in pollutant for only about 25 years (IEA, 2017).

To control pollution, three mechanisms have been provided, namely common law, market-based instruments, and non-market based instruments. Each of these solutions has its own advantages and disadvantages. Common law is described as an unwritten law which has gained public acceptance. Market-based instruments are often used as an efficient method of pricing and a signal to manufacturers, which provides incentives to optimize the use of environmental resources. On the other hand, non-market instruments also use regulations to create specific standards for achieving optimal pollution levels (Ison and Wall, 2003). Pollution tax is one of the non-market based instruments used to achieve an acceptable level of environmental quality. Pollution tax is also called environmental tax or green tax and can help control pollution through generating economic motivation and making relative price adjustments (Kolstad, 2011). It is expected that imposing green tax can help reduce health costs through reducing pollution.

This means that levying an optimal green tax rate on pollutant emissions can be of a high priority for policy makers. In this context, the main objective of the present study is to investigate the effects of green tax scenarios on Iran's health costs. In line with this, a general equilibrium model was used which took into account the interactive effects of economics, energy, environment, and health sectors. The data on 2011 social accounting matrix (SAM) of 2011 for Iran was used to calibrate the model.

Although extensive studies have been conducted to examine the interactions between economy and environment, few studies have investigated the efficacy of green taxes on health indicators. To the present authors' best knowledge, this is the first study in Iran which examines the effect of imposing green tax scenarios on health indicators. The tax levies on major energy products, i.e. natural gas and five petroleum products[1].

With regard to the above, the present study first provides the reader with a brief review of the previous literature. Then, the theoretical foundations and methodology for conducting the present study will be shed light on. Next, the results will be presented and the final section will also be devoted to the study's conclusion and recommendations.

2. Literature Review

There has been an extensive literature on tax and tax reform with a focus on externality effects. In most of these studies, environmental quality has been considered as a separate function; therefore, the effects of feedback from environmental quality on behavior of economic agents have been largely ignored in these studies. In a few of the studies, however, the effects of feedback pollution on the economy have been taken into account (Mayeres and Van

[1] Gasoline, Kerosene, Fuel oil, Liquefied Petroleum Gas (LPG), and Gasoil

Regemorter, 2008). The following parts will provide the readers with a number of important studies in this regard.

Somani (2013) conducted a study on environmental tax reform and economic prosperity in India. He found application of a suitable tax policy as the best way to increase community welfare and to reduce pollution. Saveyn et al. (2012) assessed the economic implications about greenhouse gas emission reduction policies for China, India and Japan through the use of a GEM-E3 model. Their results showed that postponement of regulations on greenhouse gas emissions could make economic interests over time. Siriwardana et al. (2011) investigated the effects of carbon taxes in Australia using a general equilibrium model. They observed that real GDP and consumer prices respectively decreased about 0.68% and 0.75% in the short run. Additionally, based on their findings, CO2 contamination significantly reduced. Dissou and Eyland (2011) examined pollution tax in Canada. Their results showed that by imposing a 40$ carbon tax, GDP decreased 0.13% without BTA and decreased 0.17% with BTA. Mayeres and Van Regemorter (2008) assessed health and environmental policies for EU countries through the use of a GEM-E3 model. Their results showed that environmental policies, including air pollution control, can have a significant impact on the consumption level and employment of consumers and producers. O'Ryan et al. (2005) assessed social and environmental policies of Chile economy through the use of CGE model. Based on their results, paying taxes on PM10 would lead to better environmental outcomes through SO2 and NO2 taxes.

Furthermore, various studies in Iran have used general equilibrium modeling to examine the effects of green taxation on economic and environmental indicators. Jafari and Alizadeh (2016), for instance, reported that with an increase in green tax rates, there was also an increase in economic growth. In comparison to the base scenario, with a maximum tax rate of 40%, there was a 0.07% increase in economic growth. Also, in all the scenarios, in their study, tax has a positive effect on pollution reduction. Nematollahi et al. (2015) indicated that target subsidies for energy products reduced output increased prices of goods and services, and reduced household consumption. They found that in both of their scenarios (government price and market price for gasoline and diesel after targeted subsidies for energy carriers), GDP decreased by 14.17% and 16.78%, respectively. Farajzadeh and Bakhshoodeh (2015) found that an increase in prices of energy products was accompanied with a reduction in emission of pollutants. By implementing this policy and re-distributing resources, GDP will decreased at least by 15% and consumer price index increased by 10%. Shahnoushi et al. (2012) observed that fuel taxes reduced intermediate demand and consumption of fossil fuels. In all the scenarios involved in their study, changes in welfare were desirable in that welfare increased with an increase in the tax rate. None of the aforementioned studies, however, have considered the health sector.

Some studies, such as Aloi and Tournemaine (2011), Baccini et al. (2017), Castro et al. (2017), Chaabouni and Saidi (2017), Chen et al. (2013), Falahati et al. (2013), Ghozikali et al. (2015), and Oueslati (2015) have examined the impacts of air pollution on health indicators. In general, the results of these studies indicate that there is a positive and statistically significant relationship between air pollution and health costs.

Most of the aforementioned studies were conducted through partial equilibrium models which took only one market into account and assumed an exogenous state for the rest of the markets. Their claims are, therefore, far away from realities of economy. Specifically, the effects of pollution tax policy can be directly or indirectly attributed to other economic sectors, and thus the use of general equilibrium models which consider all markets in their estimations is more rational. The most important features of these models are according to the microeconomic framework, optimization of households and firms' behavior, concentration on the relationships between different economic sectors and reliance on relatively small amounts of information. Therefore, we use a Computable General Equilibrium (CGE) model, which is more effective in evaluating the effects and consequences of economic policies and shocks.

Consequently, the effects of green tax policy on health indicators has been examined through the use of a CGE model.

3. Theoretical Foundations and Methodology

CGE model is originally attributed to Walras (1969) General Equilibrium Theory. In this model, simultaneous equations are used to explain interactions between different macroeconomic factors. It can help producers to maximize profits and to reduce costs under resource constraints (Liang et al., 2007). Furthermore, it can help consumers to maximize utility under budget constraint and to demand the commodity. Prices are set through the equilibrium under supply and demand. This can be satisfactory for both the manufacturer and the consumer, and help the whole economy be in a state of equilibrium. CGE Model is a well-known method, used as a policy analysis model, for analyzing taxation policies which have been widely used since the late 1970s. It can help economic researchers analyze the effects of policy changes or exogenous factors of economic sectors (Bergman, 2005; Lofgren et al., 2002; Gunning and Keyzer, 1995).

A large number of studies have been done on the green tax. To investigate the effect of the green tax on pollution and health indicators, a GCE model can be used by taking into account the relationships between economy, environment, and the energy sector. The standard version of the model can help estimate costs and benefits of environmental policy proposals (Mayeres and Van Regemorter, 2008). This model includes a pollution-related environmental quality function, which influences social welfare through a profit function. The quality of environment, as a separate function, affects consumer welfare. The present study benefits from this model and includes the environmental, pollution and the health sectors.

In this standard framework, Iran has been considered as an open economy, and markets of factors of production are in a state of full employment.

In the present study, the Iranian economy has been divided into 11 sectors, namely agriculture, crude oil and natural gas, other mines, manufacturing, electricity, natural gas distribution, water, buildings, transportation, healthcare, and services. Factors of production have been divided into three parts, namely labor, capital and energy. Considering the objectives of the study and with regard to the energy sector, six types of energy carriers, namely Gasoline, Kerosene, Fuel oil, Liquefied Petroleum GAS (LPG), Gasoil and Natural Gas have been considered. Pollution indicators also includes eight pollutants, namely NO_X, SO_2, SO_3, CO, SPM, CO_2, CH_4, and N_2O. The health indicators includes of mortality, morbidity, hospital days and medical costs associated with pollution. To calculate changes in welfare, the equivalent variation (EV) criterion has been used. For the production sector, the constant elasticity of substitution (CES) function and for the consumption sector, linear expenditure (LES) functions have used. As presenting all the relevant equations is beyond the space of the present study, the following sections has mainly focused on tax and health relationships. According to Mayeres and Van Regemorter (2008), in the household sector of the present model, the impacts of air pollution on health indicators have been considered. In all sectors, CRS assumption and cost optimization have been made. The supply of capital, energy, and labor were also exogenous.

3.1 Firm

Production technology was considered based on a nested structure and constant elasticity of substitution. Through cost minimization, each sector uses inputs of capital, labor, and energy to generate domestic production (X_D) (O'Ryan et al., 2001):

$$Min \quad P_{KEL_i} KEL_i + P_{ABND_i} ABND_i$$

$$s.t. \quad XP_i = \left[a_{kel,i} KEL_i^{\rho_i^P} + a_{abnd,i} ABND_i^{\rho_i^P}\right]^{\frac{1}{\rho_i^P}} \tag{1}$$

where KEL_i refers to non-energy intermediate inputs, i.e. labor and capital, and energy inputs, $ABND_i$ represents pollution, from energy and non-energy sources, P is the relevant price and XP_i is production in sector i. a_{kel} and a_{abnd} are parameters of the share for CES, and ρ is an exponent of the CES which can be obtained from the Equation 2:

$$\rho_i^P = \frac{\sigma_i^P - 1}{\sigma_i^P} \Leftrightarrow \sigma_i^P = \frac{1}{1+\rho_i^P} \quad , \quad \sigma_i^P \geq 0 \tag{2}$$

Based on O'Ryan et al. (2001, 2003, 2005) and Beghin et al. (1996), pollution was considered as an input as the effects of pollution costs on health indices can be easily assessed. Furthermore, it is possible that a scenario of the green tax revenue distribution can be considered for producers who use pollution-reducing technologies. The demand and price functions can be assessed through Equation 3:

$$AB_j = \alpha_{AB_j}.\left[\frac{P_{ABND_j}}{P_{AB_j}}\right]^{\sigma^j_{ABND}}.ABND_j$$

$$ND_j = \alpha_{ND_j}.\left[\frac{P_{ABND_j}}{P_{ND_j}}\right]^{\sigma^j_{ABND}}.ABND_j$$

$$P_{ABND_j} = \left[\alpha_{AB_j}.\left(P_{AB_j}\right)^{1-\sigma^j_{ABND}} + \alpha_{ND_j}\left(P_{ND_j}\right)^{1-\sigma^j_{ABND}}\right]^{\frac{1}{1-\sigma^j_{ABND}}} \quad (3)$$

where AB is cost of emission reduction for energy inputs, ND is cost of emission reductions for other non-energy inputs and $ABND_s$ is cost of emission reductions for both energy inputs and non-energy inputs. α_{AB} and α_{ND} are parameters of inputs. α_{ABND} is substitution elasticity for inputs. P_{AB}, P_{ND}, and P_{ABND} represent the prices.

With regards to the main objective of the present study, i.e., assessing the green tax effect on health indicators, the energy sector was considered as the main pattern. Therefore, the nested function of energy including the six main carriers of energy, namely gasoline, kerosene, fuel oil, liquefied petroleum gas (LPG), gasoil and natural gas[1] is defined as follows:

$$E_i = a_i^{ve}\left(\sum_{e=1}^{6}\delta_i^{ve} QFE_{i,e}^{-\rho_i^{ve}}\right)^{\frac{-1}{-\rho_i^{ve}}} \quad (4)$$

where E_i is the aggregate energy input which is specified through considering the six energy inputs of energy as a CES function. $QFE_{i,e}$ refers to the energy carriers and the e-index represents energy products. Therefore,

$$PDE_{i,e} = PEE_i \frac{\delta E_i}{\delta QFE_{i,e}} \quad (5)$$

where $PDE_{i,e}$ stands for energy carrier prices and PEE_i for energy input price. Based on the equation 5, energy input price can be calculated as follows:

$$PEE_i E_i = \sum_{e=1}^{6} PEE_i\, QFE_{i,e} \quad (6)$$

where, change in price of each energy product effects on the input use of energy carriers to the other parts of the production (Eslami Andargoli and Hadian, 2015).

3.2 Household

It is assumed that all revenue from economic activities is distributed between consumers. Total consumer revenue is devoted to consumption, leisure and health (savings has been assumed zero in the present study). Following Mayeres and Van Regemorter (2008), the utility function was established based on the LES utility function:

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[1] Electricity pollution is relatively insignificant.

$$Max \quad U^{\circ} = \alpha_1^{\circ} ln(C - \bar{C}) + \alpha_2^{\circ} ln(l - \bar{l}) + \alpha_3^{\circ} ln(H - \bar{H}) - \sum_{m=1}^{M} \alpha_{H,m}^{\circ} . A_m$$

$$s.t. \quad P_C C + wl + P_{MED} MED \leq I \qquad (7)$$

where U° is the maximum level of the utility function, $(C - \bar{C})$, $(l - \bar{l})$ and $(H - \bar{H})$ are surplus consumption, leisure and health, respectively. $\bar{C}, \bar{l}$ and $\bar{H}$ are the minimum level used in relation to each input.

Also, the concentration of air pollutant is considered as a separate function: $\sum_{m=1}^{M} \alpha_{H,m}^{\circ} . A_m$. Therefore, $\alpha_{H,m}^{\circ}$ is the decrease in marginal utility for the concentration of air from pollutant; m is the concentration of air from pollutant m which includes eight types of pollutants:

$$A_m = A_m(EM_1, \dots, EM_8) \quad \forall m \qquad (8)$$

Consequently, the concentration of the air is a collection of M pollutant. A_m is a function of different pollutants and is considered exogenous. $(EM_{po} \ with \ po = 1, \dots, 8)$.

The utility function is maximized by assuming budget constraint. Taking into account the health indicator equation, the total income (I) should not exceed consumption, leisure and medical care cost.

P_C is the consumer price for C. It is equal to supplier price (q_C) plus the tax for C (t_C). $P_{MED} = q_{MED} + t_{MED}$ represents the medical services price for the consumer. w stands for the wage rate of the labor. Household revenue is derived from Equation 9.

$$I = w(T - \sum_{m=1}^{M} \theta_m A_m) + P \qquad (9)$$

where P refers to non-working revenue, such as wealth, T denotes total time and θ_m refers to reduction of each unit of air pollutant concentration in relation to the reference. H stands for health indicators and is expressed as follows:

where $H = H^* - \sum_m \beta_{1,m} A_m + \beta_2 MED$ (10)

H^* is an exogenous variable which is based on the absence of contamination. In this case, the consumer pays no cost for health problems caused by pollution. $\beta_{1,m}$ and β_2 are health function parameters which indicate the effect of pollution on health and the use of health care, respectively.

Considering Equation 7, demand for consumption, leisure, and health is estimated as:

$$C = \bar{C} + \frac{\alpha_1^{\circ} I^d}{P_C}$$

$$l = \bar{l} + \frac{\alpha_2^{\circ} I^d}{w}$$

$$MED = \frac{\bar{H} - H^* + \sum_m \beta_{1,m} A_m}{\beta_2} + \frac{\alpha_3^{\circ} I^d}{P_{MED}} \qquad (11)$$

$$I^d = w(T - \sum_m \theta_m A_m) + P - P_C \bar{C} - w\bar{l} - P_{MED} \frac{\bar{H} - H^* + \sum_m \beta_{1,m} A_m}{\beta_2} \qquad (12)$$

where I^d is the revenue which can be used for C, l and MED. $\alpha_n^{\circ}(n = 1, 2, 3)$ are parameters for the LES function.

3.3 Government Revenue

Government earns a huge part of its income from taxes. Government subsidies are considered as negative income. In the present study, Equation 13 shows total government revenues, which is represented by $GRev$ in the equation. $MiscRev$, $\sum_h Tax_h^H$, I_{oil} and $\sum_p \tau_{poll} E_p$ refer to miscellaneous government revenues, direct household taxes, oil revenues and green taxes, respectively.

$$GRev = MiscRev + \sum_h Tax_h^H + I_{oil} + \sum_p \tau_{poll} E_p \tag{13}$$

Equations 14 to 16 present a detailed version of Equation 13. (Refer to Beghin et al. ,1996 for more information on the equations in the study).

$$MiscRev = TIndTax - TSubs + YTrade \tag{14}$$

$$TIndTax = PITx + HITx + \sum_f FDITx_f + EITx \tag{15}$$

$$PITx = \sum_i \left(\delta^p \tau_i^p - \varphi_i^p\right) PX_i XP_i$$

$$HITx = \sum_h \sum_i PA_i \tau_{ih}^h XAc_{ih}$$

$$FDITx_f = \sum_h PA_i \tau_i^f XAFD_i^f$$

$$EITx = \sum_r \sum_i PEr_{ir} \tau_{ir}^E ESr_{ir} \tag{16}$$

where $PITx$, $HITx$, $FDITx$, and $EITx$ stand for indirect taxes on production, household consumption taxes, taxes on final demand, and export taxes, respectively. TSubs stands for total subsidies and $YTrade$ is revenue from the import tariff. Distribution of green tax revenue was studied through two scenarios. The first scenario was helping the health sector reduce pollution-related health costs and the second scenario encouraged sectors and polluters to use pollution-reducing technologies.

According to Beghin et al. (1996), the pollution function is defined as follows:

$$E_P = \sum_i v_i^P . XP_i + \sum_i \pi_i^P \left(\sum_j XA_{P_{ij}} + \sum_h XA_{C_{ih}} + \sum_f XAFD_f^i\right) \tag{17}$$

where i refers to sector index, j to product index, h to the household index, P to production index, XP to product produced, and XA_C to consumption of polluting goods. v_i^P stands for emission of pollutant P for a unit of production in i sector. E_P is sum of all contaminations, i.e. total pollution for each pollutant. Additionally, $\sum_i v_i^P . XP_i$ is the amount of residual contamination of the product, which is not explained by the use of inputs. π_i^P is emission coefficient of contaminant p using energy i. $\sum_j XA_{P_{ij}}$ refers to energy consumption by firms, $\sum_h XA_{C_{ih}}$ to energy consumption by households, and $\sum_f XAFD_f^i$ stands for the final demand.

The pollution tax policy is determined considering a specified amount per unit (tons) of pollutants. Given the difference in emission levels of different energy carriers, different rates of tax from energy products with different levels of pollution were considered.

Green tax revenues were redistributed by two scenarios. In the first scenario, income from taxes was devoted to the health sector to compensate for pollution costs. In the second scenario, income from taxes was devoted to those producers who use pollution-reducing technologies.

3.4 Health Effects

To assess health effects, two methods, namely the physical and the monetary method can be used. Regarding the physical method, introduced by WHO, the health effects are assessed by taking into account the number of years through which someone has become disabled due to their exposure to pollution (DALYs[1]). In the monetary method, HCA[2] or VSL[3] is assessed. HCA is the indirect cost of productivity loss on people's future income, and VSL stands for Willingness To Pay (WTP) to avoid death (See Kirch, 2008).

To assess pollution effects, pollutions should be identified, their concentration should be measured, the number of people at risk should be estimated, and dose-response coefficients should be calculated. Accordingly, in the present study, pollutions were identified first and then, their types were specified. It has been proved that SO_2 and NOx, as well as PM_{10} and $PM_{2.5}$, have very negative effects on health. (Pope et al., 2002). To examine the effects of PM_{10} and $PM_{2.5}$ on death rate, relative risk functions (Ostro, 1994) were used. Because data on $PM_{2.5}$ is not available in Iran, the authors used a coefficient 0.6 to convert $PM_{2.5}$ to PM_{10}.

The following function is used for children:

$$RR = exp[\beta(x - x_o)] \tag{18}$$

where $0.00006 \leq \beta \leq 0.001$, x refers to the yearly average concentration of PM_{10} and x_o to the primal concentration of PM_{10}.

To examine the effects of pollution on adults, the following function (Pope et al., 2002) can be used:

$$RR = [(x + 1)/(x_o + 1)]^{\beta} \tag{19}$$

where $0.0562 \leq \beta \leq 0.2541$, x and x_o stand for the average of yearly and primer concentration of $PM_{2.5}$.

To calculate dose-response coefficients, which show death and illness rates, as a result of exposing to $PM_{2.5}$ and PM_{10}, Table 1 derived from Pope et al. (2002) was used.

[1] disability-adjusted life years

[2] Human Capital Approach

[3] Value of a Statistical Life

Table 1. Coefficients of dose-response for mortality and morbidity

Annual Health Effect	Annual Average Ambient Concentration (per 1 μg/m3)	Dose-response Coefficients
Mortality (percent change in Mortality from heart and lung cancer)	$PM_{2.5}$	0.8%
Persistent bronchitis	PM_{10}	0.9
Admission to the respiratory hospital	PM_{10}	1.2
Visits to the emergency room	PM_{10}	23.5
Days of restricted activity	PM_{10}	5750
Reduce respiration in children	PM_{10}	169
Symptoms of respiratory	PM_{10}	18300

Sources: Pope et al. (2002) and Ostro, (1994)

Finally, to investigate health effects of exposing to air pollution, the physical method, i.e., DALYs, derived from Mayeres and Van Regemorter (2008) was used (Table 2).

Table 2. Assessing health effects of exposing to air pollutions through the physical method

Annual Health Effect	Decrease DALYs per 10,000 cases	All cases	Total DALYs
Mortality due to exposure to PM_{10} (children under 5 years old)	80000	5345	42760
Mortality due to exposure to $PM_{2.5}$ (adults over 30 years old)	80000	8868	70944
Mortality due to exposure of SO_2	80000	220	1760
Mortality due to Other pollutant exposure	80000	364	2912
Total Mortality			118376
Persistent bronchitis	22000	7382	16240
Admission to the respiratory hospital	160	16875	270
Visits to the emergency room	45	331110	1490
Days of restricted activity	3	49020000	14706
Reduce respiration in children	65	944923	6142
Symptoms of respiratory	0.75	155333330	11650
Total morbidity			20498
Non-health effects			22126
Total mortality, morbidity and non-health effects			191000

Sources: Mayeres and Van Regemorter (2008); authors' calculations

Six tax scenarios, i.e., 1, 5, 10, 15, 20, and 30%, were imposed on economic and health indicators.

Parameters in a general equilibrium model are usually estimated through the use of the calibration method. Parameters values can be obtained from econometric estimations or simply from the previous literature. Choosing parameters and specifying their values, however, is of great importance, because it has significant effects on results of the model. Mayeres and Van Regemorter (2008), O'Ryan et al. (2005), Farajzadeh and Bakhshoodeh (2015), Nematollahi et al. (2015), Shahnoushi et al. (2012) and Jafari and Alizadeh (2016) were used to determine parameters of the model and elasticity.

The endogenous variables were measured through the GAMS software and by using MCP technique. The required data was obtained from the SAM and Input-Output table published in 2011, Office of Electricity & Energy Planning in the ministry of Energy of Iran, the World Bank, and the World Health Organization (WHO).

4. Results

Table 3 shows the percentage share of value added, intermediate consumption, and output regarding percentage in relation to different economic sectors. Accordingly, the services, crude oil and natural gas, and manufacturing sectors have had the largest shares of value added, i.e. 40, 16 and 14.4%, respectively. From this perspective, the healthcare sector has had the eighth position. The manufacturing sector has accounted for more than half, about 51%, of intermediate consumption, and the next rank has belonged to the services sector, 18.5%. considering value-added, the services, manufacturing, and crude oil and natural gas sectors have had a share of about 32, 28 and 10.5%, respectively. Because, the value of output is equal to total value added and intermediate consumption that is a logical contribution.

Table 3. The percentage share of value-added, intermediate consumption and output in the economic sectors (percent)

Sectors	Value-added	Intermediate Consumption	Output
Agriculture	8.09	9.86	8.75
Crude oil and natural gas	16.07	1.01	10.40
Other mines	0.82	0.45	0.68
Manufacturing	14.37	50.97	28.14
Electricity	1.52	1.07	1.35
Natural gas distribution	5.19	0.60	3.46
Water	0.27	0.32	0.29
Building	5.18	11.90	7.71
Transportations	5.04	4.05	4.67
Healthcare	3.37	1.24	2.57
Services	40.09	18.54	31.98
Total	100	100	100

Table 4 shows the percentage changes in production of the sectors caused by the implementation of six green tax scenarios. It can be observed that green taxes can reduce production in most sectors. It can also be seen that green tax policy can affect more the manufacturing sector than the other sectors. For

Table 4. Changes in production of the examined sectors in response to different green tax scenarios

Sectors	Green Tax Scenarios					
	1%	5%	10%	15%	20%	30%
Agriculture	-0.06	-0.11	-0.12	-0.29	-0.63	-0.75
Crude oil and natural gas	-0.11	-0.20	-1.49	-1.78	-2.37	-3.18
Other mines	-0.74	-1.33	-3.28	-5.27	-9.26	-12.56
Manufacturing	-1.32	-2.37	-5.53	-9.09	-16.21	-2.96
Electricity	0.46	0.84	3.34	4.59	7.10	7.47
Natural gas distribution	-0.06	-0.11	-0.27	-0.43	-0.76	-1.02
Water	-0.04	-0.08	-0.18	-0.29	-0.52	-0.67
Building	0.00	0.00	0.01	0.01	0.02	0.04
Transportations	-0.20	-0.37	-0.77	-1.32	-2.42	-3.28
Healthcare	0.03	0.05	0.10	0.18	0.34	0.45
Services	-0.20	-0.36	-0.80	-1.33	-2.40	-3.18

example, by levying a 1% tax rate, there has been a 1.32% decrease in the production of the manufacturing sector. The largest reduction, caused by a 20% tax rate, in the production has belonged to the manufacturing sector. This can be justified by the fact that emission of pollutants from the manufacturing sector has been significantly higher than emission of pollutants from the other sectors. As expected, agriculture, natural gas, water, building, and healthcare sectors have been less affected by the green tax policy. Furthermore, levying taxes has had positive effects on production of electricity, building, and healthcare sectors. For instance, in the 30% tax rate scenario, production of the electricity sector has increased by 7.5%. This could be due to the replacement of fossil fuels with electricity. In this scenario, the largest decline in production has been related to the mining (12.6%) and transportation (3.3%) sectors. This can be justified by high energy costs in these sectors. Changes in production for the agricultural sector has been smaller than that in the mining, manufacturing and transportation sectors. This could be due to the lower level of energy consumption in the agricultural sector than in the other sectors.

Table 5 shows changes in emission of pollutants after implementing green tax policy. As it can be seen, the release of all pollutants has always reduced. This decline is inappreciable in the low tax, i.e. 1% and 5%, scenarios. Therefore, in the 1% green tax scenario, the largest emission reduction, about 1.4%, has been related to SO_2 and CH_4 pollutants and the lowest has been reduction to CO_2, about 1. An increase in tax from 10% to 15% have had more significant effects on emissions reductions. In the tax scenario of 30%, the largest reductions have been in relation to NO_X, $SO_{3,}$ and CH_4, and the smallest reductions have been related to N_2O and CO. These results seem to be rational. Polluting industries simply care more about raising their revenues then protecting the environment. However, imposing heavy penalties on polluting industries through green tax policy can be an adequate incentive to reduce pollutant emissions. In other words, the pollution tax creates clear incentives for polluters to reduce greenhouse gas emissions and seek effective and acceptable alternatives.

Green tax is commonly levied in the developed countries (Andersen, 1994; McKitrick, 1997; Wurzel, 2002; Labandeira et al., 2004; Albrecht, 2006; Robson, 2014). Many European countries have imposed green tax on carbon dioxide, sulfur dioxide and nitrogen oxide emissions. Finland, for instance, was the first country which levied a CO_2 tax on energy carriers through implementing Environmental Tax Reforms (ETR). In 1991, Norway introduced a CO_2 tax and a 10-year plan, from 2001 to 2010, followed the green tax policy. Denmark was also one of the pioneer countries in implementing ETR. In the early stages, in May 1992, tax on energy products used by households was imposed. In January 1993, it was extended to businesses (Speck and Jilkova, 2009). Germany introduced ETR in 1999. A new tax also was imposed on electricity between 1999 and 2003. The Netherlands implemented ETR in the 1990s and levied the Regulatory Energy Tax (RET) in 1996. To persuade companies to reduce their CO_2 emissions, the UK levied a green tax in 2001. Carbon taxes were introduced in the westernmost province of Canada in 2008. Ireland imposed a carbon tax on non-traded sectors in late 2009 (Withana et al., 2013). Australia introduced a carbon tax in July 2012.Consequently, greenhouse gas emissions were reduced after levying the carbon tax on fossil fuels (O'Gorman and Jotzo, 2014).

In India, “green tax” was introduced to fight against pollution in August 2010. In December 2010, targeted subsidies were removed in Iran. This was one of the greatest economic plan of Iran, with the same effective mechanism. For example, Farajzadeh (2018) reported that removal of energy subsidy led to about 6% reduction in CO_2 emissions.

Table 5. Change in emission levels of pollutants in Iran in response to different green tax scenarios (percentage)

Pollutants	Green Tax Scenarios					
	1%	5%	10%	15%	20%	30%
NO_X	-1.32	-3.25	-5.28	-12.85	-17.5	-32.25
SO_2	-1.25	-3.05	-7.37	-11.45	-16.72	-24.55
SO_3	-1.43	-3.54	-8.56	-13.24	-18.25	-26.78
CO	-1.23	-3.03	-7.32	-10.8	-14.62	-21.45
SPM	-1.27	-3.12	-7.49	-11.62	-15.6	-21.83
CO_2	-1.05	-2.65	-6.4	-10.5	-15.23	-22.56
CH_4	-1.4	-3.44	-8.32	-12.92	-17.35	-24.85
N_2O	-1.12	-2.71	-6.55	-10.16	-13.56	-20.35

The approaches taken by Sarraf et al. (2005) and Mayeres and Van Regemorter (2008) were used in order to estimate the cost of damage by reduction of air pollutant emissions after levying green tax. In the aforementioned studies, the relationship between total air pollution damage and mortality, morbidity and non-health effects, e.g., reduced visibility and limited aesthetic value of landscapes, were examined. In the present study, the health effects of PM_{10}, $PM_{2.5}$ and SO_2 were studied. The effects of other pollutants were also considered. The results showed that $PM_{2.5}$, PM_{10}, other pollutants and SO_2 are the main pollutants with a 55.2, 33.5, 10.4 and 0.9 percentage share, respectively. Samek (2016) also observed that PM_{10} and $PM_{2.5}$ concentrations, as well as NO_2, had a significant impact on human mortality and morbidity, especially in cases of cardiovascular and respiratory diseases.

The results concerning the effects of contaminations on health indicators are shown in Table 6. Accordingly, mortality, morbidity and non-health effects of air pollution, have been 62%, 26.4%, and 11.6%, respectively. Overall, these results indicate that air pollution can have a significant effect on human health. Apart from positive impacts of the green tax on health indices (see Table 7), some acceptable solutions have been offered, too. For instance, forests produce some social and environmental benefits, e.g., reducing air pollution, linked to mortality and morbidity, aside from marketable timber outputs (Powe and Willis, 2004). That means policy makers should have a more serious look at planting trees.

It should be noted here that the monetary value has been assessed based on Iran's minimum wage in 2016.

Table 6. Estimating health effects based on monetary evaluation

Annual Health Effect	Total DALYs	Value (Billion Rials)	Share of GDP
Mortality	118376	32.047	0.51
Morbidity	50498	13.671	0.22
Non health effects	22126	5.99	0.1
Total mortality, morbidity and non-health effects	191000	51.708	0.83

Table 7 shows the variation in average annual health costs, including mortality, morbidity and non-health costs, caused by the application of different green tax scenarios. Accordingly, there has always been a positive correlation between green tax and health costs.

Table 7. Estimating the impact of annual health costs caused by the application of different green tax scenarios

Annual Health Effect	Green Tax Scenarios					
	1%	5%	10%	15%	20%	30%
Health Costs (mortality, morbidity and non-health effects)	-1.26	-3.10	-7.16	-11.70	-16.10	-24.33

Various studies show that diffusion of various air pollutants can cause such harmful health effects as respiratory problems, asthma exacerbations, allergies, cardiovascular effects, and lung cancer (WHO, 2006; Modig et al., 2006;

Forsberg et al., 1997; Nyberg et al., 2000). Therefore, green tax policy can be an effective way to reduce negative impacts.

Here, EV is used to determine welfare effects of tax policy on society. In the first scenario, income from taxes is devoted to the health sector to compensate for costs of pollutions. In the second scenario, income from taxes is devoted to those producers who use pollution-reducing technologies. As shown in table 8, there have been beneficial changes in welfare have been effective in both scenarios. In the first scenario, the largest welfare change, 0.65%, has been related to the 15% tax rate. At the higher rates, despite its effective changes, is the change rate has been decreasing. In other words, imposing a higher tax rate cannot increase the overall welfare. This might be due to a sharp decline in output of the sectors. In the second scenario, a positive correlation has been found between tax rates and welfare changes. The application of pollution-reducing technologies by pollutant sectors as well as setting different levels of production might justify this.

Table 8. Changes in welfare as due to enactment of different green tax scenarios

Income Redistribution Scenarios	Green Tax Scenarios					
	1%	5%	10%	15%	20%	30%
Aiding the health sector	0.07	0.12	0.35	0.65	0.2	0.15
Aiding pollution-reducing technologies	0.8	2.4	4.7	9.2	14.8	17.3

5. Conclusions and Recommendations

The main objective of the present study was to examine the effects of green tax on the health sector. In line with this, a standard general equilibrium framework was used and Iran's economy was divided into 11 sectors. Factors of production were assumed to be labor, capital and energy.

Overall, the results show that production of most sectors reduce after levying a green tax. In all tax scenarios, health costs, i. e. mortality, morbidity and non-health costs, significantly reduced. Therefore, the quality of environment can be improved by reduced the health sector's costs through abolishing the tax on environmentally-friendly products, the tax on wage and business income who act in such a way that the environment is preserved and also the taxes on buildings which are designed in a way that they help protect the environment. In addition, fossil fuels and mining taxes and also tariff on imports of high energy products should be increased.

Our findings are in line with the findings of Shahnoushi et al. (2012) who observed that levying a green tax reduced pollutions and increased welfare. Farajzadeh and Bakhshoodeh (2015) also found that a rise in price of energy products reduced pollutions and increased social welfare. Concerning the effects of reducing pollutions on heath indices, our findings were also in line with the findings of Ghorani-Azam et al. (2016). Keshavarz et al. (2017) reported that eliminating subsidies would have a negative effect on the health sector and household costs and would increase the health prices index. Similarly, O'Ryan et al. (2005) observed that pollution tax led to a better environmental situation.

Income from environmental taxes may be used to finance reduction of the existing pollutions. The recycling fund process significantly reduces welfare costs associated with the general plan of taxation. At the moment, green taxes are still in an early stage of development in Iran so that they only cover a small fraction of large firms' income. Article 38 of the Value Added Tax (VAT) act specifies that, apart from the VAT, large polluting industries should also pay one percentage of their income as green taxes. Though, these taxes are subject to a range of financial structural reforms that can be called as "environmental reforms of the financial system". Furthermore, 6% of GDP and 5 to 10% of government expenditures in the developing countries are allocated to the healthcare sector (Basu et al., 2012). In this regard, according to Statistical Center of Iran, 6.8 % of Iran's GDP has been devoted to the health sector, which means the health costs would be significantly reduced.

In recent years, some achievements have been observed in developing services and healthcare facilities of Iran. The recent agreement among EPA[1], the Economic Commission of Iran, and Iran's Ministry of Economy and Finance is one of these achievements. This agreement has caused the value added tax to be amended. Furthermore, Iran's government has developed a tax system similar to the green tax. Depending on intensity, duration, type, and location of pollution, producers who do not comply with the environmental standards are subject to green taxes on sales or service income by rates of 0.5, 1 and 1.5%. According to principles 3, 29 and 43 of the constitution, the government is obliged to make use of all its facilities for improving public health. One example is a 2% increase in the VAT to alleviate the health sector's problems and to provide the facilities and service in a way that 1% percent of its income can be allocated to the development and planning of the health system (Ferdosi et al., 2017). Nevertheless, the aforementioned reforms have not yet adequately implemented in Iran's tax structure.

Extending the green tax system through increased green tax revenues can reduce the healthcare cost. Given its positive social and economic effects, not only does green tax have a positive effect on the country's economic policies, but also it can have massive direct and indirect impacts on economic activities. Additionally, its deterrent effect leads to an increase in revenue sources in the healthcare and environmental fields. As a result of adopting the law on environmental protection in large industrial and refinery projects, health expenditure is expected to significantly fall.

[1] Environmental Protection Agency

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