The Effects of Green Tax Implementation on Labor Demand in Iranian Industry Sector

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ABSTRACT

Environmental tax reform can be used in a fundamental transformation towards a green economy. Green tax may reduce the energy consumption and pollution emissions, as well as other benefits. This study mainly focused on the effects of green taxes on labor demand in Iranian industry sector during 1980 – 2015. Regarding the double dividend hypothesis, green taxes may improve the employment by substitution between labor and energy. Using CES production function, the elasticity of substitution between labor and energy is estimated 0.48 percent for industry sector. Then, the effect of green taxes on labor demand is investigated subject to government's fixed budget constraint and labor demand function. The results show that green tax will have positive effects on employment in the industry. During the transfer of the labor tax system to the green tax system, the environment and employment may improve, without additional cost to the government and producer.

1. Introduction

Environmental tax reform can be used in a fundamental transformation towards a green economy. Following environmental degradation, the environmentalists become more concerned about environmental reforms, policies and decision-making goals (Karlygash, 2018). The ecological economists believe that in the growth model, energy is the most important factor for economic growth; so that labor and capital as mediating factors need energy to operate (Stern, 2004). But neoclassical economists believe that energy affects economic growth through its impact on labor and capital indirectly (Stern, 1993). All nations face challenges in using fossil fuels and are striving to improve energy efficiency, energy security, and environmental pressure specially in terms of air pollutions. The pollution effects of fossil fuel consumption include reduction of living quality, reduction of lifetime length due to disease, climate change, and affecting economic activities.

Therefore, many governments provide rules and standards to improve energy efficiency and decrease emission pollutions. Presenting green tax idea by Pigou, the public sector economists found that assuming neutral tax revenues into the greener tax system reduces inefficiency of the tax system as well as environmental quality improvement (Amin Rashti & Siami Araghi, 2012).

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Theoretically, green tax reform is often accompanied with "double dividend" (Bovenberg & Mooij, 1994). The hypothesis is that such reforms create social benefits by reducing pollution, and increase the economic prosperity through the economic efficiency of the tax system (Miguel & Manzano, 2011). Green tax policies are widely used in industrialized countries, but they are less used in transitional and developing countries (Ivanova, 2017).

In implementing environmental taxes, governments should consider achieving environmental goals besides improving economic targets, such as reduction in unemployment rates. However, economic and social consequences may make it politically difficult to implement environmental policies. So, economists have argued that complementary policies such as public spending cuts could be used to reduce the environmental tax burden on private sector income (Kuralbayeva, 2019).

Iran is among the top 10 CO_2 emitting countries and needs to reduce its consumption of fossil fuels and GHG emissions by setting energy and climate policy goals (IEA, 2019). Significant and diverse energy potential is a source of competitive advantage for Iran, particularly in a world where environmental constraints will continue to increase. Iran's overall policy began to encourage improved sustainability in terms of economic and environmental issues. For example, at the UN Climate Change Conference in Paris, Iran stated its commitment to reducing CO2 emissions by 8-12 % against the 2005 level (European Union, 2016). The goal is that Iran makes use of its abundant energy potential through the environmentally responsible development, and efficient use of diverse energy resources in production and consumption sector.

The aim of this study is to assess the effects of the green tax implementation on employment, for the specific case of Iran industry sector. In order to estimate the elasticity of substitution between labor and energy, a CES production function is used. The elasticity of substitution is estimated for Iran's industrial sector during 1980 – 2015.

Therefore, the contributions of this study is that it provides evidence how Iranian economy response to green tax in terms of substitution between energy and employment. The benefits of green tax may guide policymakers toward reforming of energy and environmental policy. The paper is organized as follows. Section 2 provides a review of literature. Section 3 deals with the model and methodology. Section 4 cover estimation results. Finally, section 5 summarizes and concludes.

2. Literature Reviews

Environmental taxes based on the initial theory of Pigou was widely discussed by environmental economists in the 1970s (Kirchgassner et al., 1998). Tullock (1967) introduced "double dividend hypothesis", proposing again Pigou theory and indirect tax for controlling energy consumption and environmental externalities. According to the "double dividend hypothesis", green tax reduces the energy consumption and emissions. Therefore, as the first benefit, it improves the environment by using alternative fuels and affordable technologies (Anger et al., 2006). Furthermore, as the second benefit, green tax creates additional revenues for the government, and leads to the efficiency improvement of the tax system by substituting green tax instead of inefficient tax (Bovenberg & Mooij, 1994; Goldani and Amadeh, 2014; Nicolau, 2010). Based on environmental double dividend, environmental tax reform instead of labor tax system, can reduce unemployment (Kirchgassner et al., 1998; Ziesemer, 2003). In double dividend hypothesis, the superior way for the additional revenue is the payment of subsidies for investing in new technologies that improve the environment and employment (Ziesemer, 1995).

In the past decade, the green tax has played as a growing role of environmental policies of OECD countries (Anger et al., 2006). The green tax can be divided into three types: Pigou tax or tax on per unit of emissions and environmental degradation, the indirect environmental tax on production inputs or consumer goods associated with environmental pollution, and environmental regulations that have the same effects of indirect environmental taxes (Paytakhti Oskooe & Nahidi, 2008). In Iran, so far, any type of green tax has not been implemented and instead, much subsidies are paid for energy carriers. So economic and environmental objectives of the green tax can be achieved by gradual reduction and elimination of energy subsidies and implementation of green tax as rising energy prices.

The increase of energy prices encourages the producers to improve the production technology, and households to change consumption patterns (Guillaume & Zytek, 2010). Industry demand of energy is the main cause of carbon dioxide emissions in associated with economic growth. Higher energy prices lead to the diversification of energy resources. Substituting the other inputs instead of the energy in the industry, may lead to sustainable economic growth and energy consumption reduction (Kim & Heo, 2013).

Bye (1996), in a small open economy, Bovenberg and Van der Ploeg (1998), in a small open economy with structural unemployment caused by cost pressure, Albert and Meckl (2001) assuming the inflexible wages, Brik and Michaelis (2002) using theoretical economic equations and endogenous and exogenous models of economic growth, Kuralbayeva (2013), using a model of an economy with the informal sector in developing countries, investigate green tax effects on employment.

The effect of green tax implementation on employment and double dividend hypothesis is studied in several papers (Carraro et al. ,1996; Kuper, 1996; Kirchgassner et al., 1998; Holmlund & Kolm, 2000; Bohringer et al., 2001; Kumbaroglu, 2003; Agnolucci, 2009). The results of most studies, confirm positive effects of green tax on employment in different situations. González (2018) provides a comprehensive review of literature about double dividend hypothesis of environmental tax reform including a statistical and a meta-regression analysis. Different simulations from 40 studies have been analyzed. About 55% of simulations have achieved a double dividend, concluding that although the environmental dividend is almost always achieved, the economic dividend still remains an ambiguous question that needs further research.

González and Ho (2018) have developed a detailed dynamic CGE model examining 101 industries and commodities in Spain, in order to simulate the economic and environmental effects of an environmental fiscal reform. They simulate an increase in taxes and a reduction on subsidies for these industries and at the same time use new revenues to reduce labor, capital and consumption taxes. The results suggest that the "double dividend" hypothesis can be achieved. After three to four years after implementing an EFR, GDP is higher than the base case, hydrocarbons consumption and pollutants.

Maxim et al. (2019) present a meta-regression analysis of simulation studies concerning green tax reform (GTR) across European and non-European countries. The results show that both tax and tax revenue recycle policies play a significant role in determining the employment effect. However, region specific policy design is required for optimal employment effect.

Fan et al. (2019) studied the particular evolution paths of economic growth, pollution intensity, and resource intensity under different environmental tax parameters in China. Results indicate a robust beneficial role of environmental tax on green development.

Kuralbayeva (2019) investigated the consequences of environmental tax reforms for unemployment and welfare, in the case of developing countries. Under the indexation of unemployment benefits and informal-sector income that give rise to a double dividend, a lower level of public spending is associated with a smaller negative impact on the after-tax income of households and a higher increase in employment. The model implies that complementary policy, in terms of lower public spending, is unlikely to be socially acceptable, and does not support the case for a green tax reforms in developing countries.

Some studies examined the theoretical dimensions of environmental taxes in Iran (Paytakhti Oskooe, and Nahidi, 2008; Hasanloo et al., 2012; Paytakhti Oskooe, and Tabaqchi Akbari, 2012; Jamshidi et al., 2012; Goldani and Amadeh, 2014; and Sedehi and Esfahanian, 2019). Pajooyan and Moein nemati (2010), investigate the economic effects of carbon tax with a general equilibrium model for Iran. Amin Rashti and Siami Araghi (2012), studied the relationship between unemployment and green taxes for some OECD countries. Asiae et al. (2012), using a translog cost function showed that the removal of energy subsidies in Iran have a positive effect on employment and the negative effect on economic growth. Mirhosseini et al., (2017) investigated the relationship between green tax reforms and shadow economy using a CGE Model. They concluded that Labor tax and capital tax on the environment will change GDP, welfare, and unemployment.

Some other studies investigate substitution between production inputs. Using the CES production function in the America, Prywes (1986), showed that energy and capital are complementary, and labor, material and energy are substitute for each other. Kemfert (1998), using the multi-stage CES production function in Germany showed that production factors are the substitute factors. Thompson (2010), using the Cobb-Douglas function in America showed that capital, labor and energy are substitute. Aziz (2007), used a two-stage translog cost function in five developing countries and showed that factors of production are substitutes. Also, Ma et al. (2008), showed that labor, capital and energy are substitute each other in China. Haller et al. (2013) show the same results for Ireland. Smyth et al. (2011), and Zha and Ding (2014), using a translog production function in China showed that elasticity of substitution between energy and capital is more than elasticity of substitution between energy and labor.

Koetse et al. (2006), applying a meta-regression model showed that real changes in demand for capital due to the increase in energy prices is applicable in a long-run process. Khodadad kashy and Jani (2011), using a CES production function in the large industries of Iran showed that substitution between labor and energy is quicker than substitution between labor and capital. Eslamloueian and Ostadzad (2014), showed that labor, energy and capital are substitute each other.

According to the literature about labor and energy substitution, as well as macroeconomic effects of green taxation, the effects of green tax on employment are examined in this study. Review literature shows that few studies have investigated the effects of green tax on Iranian economy. Furthermore, different economies may show contradictory findings in terms of economic performance. Thus, this study aimed to examine the impacts of green tax, on employment in industry sector of Iran.

3. Methodology

The driving force of the green tax effect on employment is the technical substitution that cause producer to find motivation for labor substitution instead of energy (Koskela et al. 1999). Therefore, the increasing energy prices as a result of the green tax reform leads to increased demand for the new inputs. Although there are other factors in the production function, but according to the purpose of the research, which considers the impact of labor and energy and their substitution, labor is considered as a factor along with energy. Only these two factors have been examined, because we are seeking to increase labor demand and improve the employment by implementing the policy of increasing energy prices (an environmental policy).

The main concept for the measurement of substitution elasticity developed by Hicks in 1932 (Koetse et al. 2006). Substitution elasticity (σ) measures the relative reaction of production factors $\left(\frac{E}{L}\right)$ to relative changes of the prices $\left(\frac{p_e}{w}\right)$ ratio; assuming fixed production

$$\sigma = \frac{\Delta\left(\frac{E}{L}\right)}{\Delta\left(\frac{p_e}{w}\right)} \cdot \frac{\frac{p_e}{w}}{\frac{E}{L}} = \frac{\%\Delta S_E}{\%\Delta S_L} \tag{1}$$

Despite numerous functional forms for estimating production function, most economic models often use CES production function to describe producer behavior (Kemfert, 1998). In this study for substitution between labor and energy, CES production function is as follows:

$$Y = A\left(aE^{-\beta} + bL^{-\beta}\right)^{-\frac{1}{\beta}} \tag{2}$$

Variables and parameters are as follow. Y; the amount of productions, E; energy consumption, L; the number of labors, A; efficiency parameters, a and b; distribution parameters, β; substitution parameter. also, β > -1, A > 0, parameters a and b > 0 and σ=1/((1+β)) (Kemfert, 1998).

To determine the level of inputs and the elasticity of substitution, cost minimization is considered at a certain level of the production as following:

$$\begin{aligned} &\min\ \widetilde{p_e}E + \widetilde{w}L \\ &\quad \text{S.T} \\ &Y = \left(aE^{-\beta} + bL^{-\beta}\right)^{-\frac{1}{\beta}} \end{aligned} \tag{3}$$

While $\widetilde{p_e}$ *and* $\widetilde{w}$ are price of production factors.

According to the shepherd's theorem, the conditional demand function of inputs is as follow:

$$E^* = a^{\sigma}\widetilde{p_e}^{-\sigma}\left[a^{\sigma}\widetilde{p_e}^{(1-\sigma)} + b^{\sigma}\widetilde{w}^{(1-\sigma)}\right]^{\frac{\sigma}{(1-\sigma)}} Y \tag{4}$$

$$L^* = b^{\sigma}\widetilde{w}^{-\sigma}\left[a^{\sigma}\widetilde{p_e}^{(1-\sigma)} + b^{\sigma}\widetilde{w}^{(1-\sigma)}\right]^{\frac{\sigma}{(1-\sigma)}} \tag{5}$$

Solving first order conditions and considering above equations, the following equations are obtained:

$$\left(\frac{E^*}{L^*}\right) = \left(\frac{a}{b}\right)^{\sigma} \times \left(\frac{\widetilde{w}}{\widetilde{p_e}}\right)^{\sigma} \tag{6}$$

$$\mathrm{Ln}\left(\frac{E^*}{L^*}\right) = \sigma \mathrm{Ln}\left(\frac{a}{b}\right) + \sigma \mathrm{Ln}\left(\frac{\widetilde{w}}{\widetilde{p_e}}\right) \tag{7}$$

It is assumed that in the case of changing the ratio of prices, the factors ratio does not change simultaneously and this adjustment occurs within one year (Khodadad Kashi and Jani, 1390):

$$\left[\frac{\left(\frac{E}{L}\right)}{\left(\frac{E}{L}\right)_{-1}}\right] = \left[\frac{\left(\frac{E}{L}\right)^*}{\left(\frac{E}{L}\right)_{-1}}\right]^{\theta} \tag{8}$$

Therefore, the following equation is obtained based on growth rate of variables and the above assumption:

$$\begin{aligned} \mathrm{Ln}\left(\frac{E}{L}\right) &= \sigma\theta \mathrm{Ln}\left(\frac{a}{b}\right) + \sigma\theta \mathrm{Ln}\left(\frac{\widetilde{w}}{\widetilde{p_e}}\right) \\ &\quad + (1-\theta)\mathrm{Ln}\left(\frac{E}{L}\right)_{-1} \end{aligned} \tag{9}$$

where θ, is the adjustment factor.

To examine the green tax effects on employment, two different tax system is considered. If labor tax system is considered as the initial one, in this case $t_w > t_{p_e}$ (where t_{p_e} is the tax rate on energy prices and t_w is the tax rate on labor wage). Considering taxes on energy prices and taxes on labor wage, another tax system is created. Where the level of production and the tax revenues in both tax systems are the same, the level of employment will be different. In the new system, the rate of energy tax is higher than tax rates on labor; $t_{p_e} > t_w$.

For changing of labor tax system to the green tax system, several conditions must be fulfilled. Level of primary production (Y_0) based on initial tax rates is considered to be the same in both systems and it will move along the isoquant production curves to increase the employment. For maximizing the profit, the total cost and also the government budget constraint is assumed fixed (Koskela et al. 1998). According to the diagram (1) point A shows the labor tax system ($t_{p_e} < t_w$), and point B shows the green tax system ($t_{p_e} > t_w$) for the given Y_0 level (Koskela et al. 1998). Moving from point A to B, and transfer of the labor tax system to the green tax system, at no extra cost for the government or the company. So employment will rise, energy consumption will decrease and environmental quality will improve.

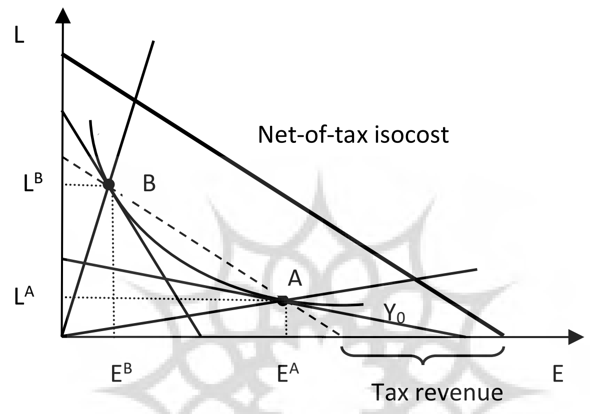

Figure 1. Labor tax system and green tax system.

Tax reform including energy tax system, will increase the government budget (assuming $t_w < t_{p_e}$). First, the government budget reaches to the zero by reducing tax rate on wages and it leads to reduction of production cost, and increase of production and employment level. Then, by increasing rate of energy tax over the rate of labor wage tax, employment will increase and energy demand and production levels will decrease to the initial production level (Koskela et al. 1998). The impact of tax reform on government budget with constant production constraint depends on tax rates:

$$\left.\frac{dG}{dt_{p_e}}\right|_{dY=0} \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} 0 \Leftrightarrow t_w \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} t_{p_e} \qquad (10)$$

Demand for production inputs is related to the factors such as the price of inputs. The gross price of labor $\tilde{w} = w(1 + t_w)$ and the gross price of energy $\tilde{p_e} = p_e(1 + t_{p_e})$ are effective on the labor demand as follows (Koskela et al. 1998):

$$\begin{aligned} dL = {} & \left[L_{\tilde{w}}(1 + t_w)w_{t_w} + L_{\tilde{w}}w\right]dt_w \\ & + \left[L_{\tilde{w}}(1 + t_w)w_{t_{p_e}} \right. \\ & \left. + L_{\tilde{p_e}}p_e\right] dt_{p_e} \end{aligned} \qquad (11)$$

where $L_{\tilde{w}}$ is the change of labor demand relative to gross wages, $L_{\tilde{p_e}}$ is the change of labor demand relative to gross energy prices, w_{t_w} is the change of net wage relative to the tax rate on wages, $w_{t_{p_e}}$ is the change of net wage relative to the tax rate on energy prices.

Using price elasticities of labor demand, the equation (12) is obtained:

$$\begin{aligned} dL = {} & \frac{L}{(1 + t_w)}\varepsilon_{L.\tilde{w}}(1 + \omega_{t_w})dt_w \\ & + \frac{L}{(1 + t_{p_e})}\left[\varepsilon_{L.\tilde{w}}\omega_{t_{p_e}} \right. \\ & \left. + \varepsilon_{L.\tilde{p_e}}\right] dt_{p_e} \end{aligned} \qquad (12)$$

In the above equation $\varepsilon_{L.\tilde{w}}$ is the elasticity of labor demand relative to the gross wages, ω_{t_w} is the elasticity of net wage relative to the tax rate on wages, $\omega_{t_{Pe}}$ is the elasticity of net wage relative to the tax rate on energy, $\varepsilon_{L.\widetilde{Pe}}$ is the price elasticity of labor demand with respect to the energy prices

According to the necessary conditions in moving from the labor tax system to green tax system, the government fixed budget constraint is considered as follows:

$$\left.\frac{dL}{dt_{p_e}}\right|_{dG=0} \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} 0 \Leftrightarrow \frac{\tau_{t_{p_e}}}{\tau_{t_w}} \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} \frac{\varepsilon_{L.\widetilde{w}}\omega_{t_{p_e}} + \varepsilon_{L.\widetilde{p_e}}}{\varepsilon_{L.\widetilde{w}}\left(1+\omega_{t_w}\right)} \quad (13)$$

In the above equation, $\tau_{t_{p_e}}$ is the elasticity of tax revenue relative to the tax rate on energy, and τ_{t_w} is the elasticity of tax revenue relative to the tax rate on labor wage. This equation is used for investigation of the energy tax rate effects on labor demand (Koskela et al. 1998).

Assuming zero budget changes and primary production level, the government fixed budget constraint is as follows:

$$dG = G^*_{t_w} dt_w + G^*_{t_{p_e}} dt_{p_e} = 0 \quad (14)$$

Therefore, surplus revenue of government as a result of higher taxes on energy should be used to reduce the tax rate on labor wages, so that the amount of government budget remains constant. $G^*_{t_w}$ and $G^*_{t_{p_e}}$ in the above equation are:

$$G^*_{t_w} = \frac{wL}{(1+t_w)}\left[1 + \left(t_w(1+\varepsilon_{L.\widetilde{w}}) + t_{p_e}\frac{p_e E}{wL}\varepsilon_{E.\widetilde{w}}\right)\right] \quad (15)$$

$$G^*_{t_{p_e}} = \frac{p_e E}{(1+t_{p_e})}\left[1 + \left(t_{p_e}(1+\varepsilon_{E.\widetilde{p_e}}) + t_w\frac{wL}{p_e E}\varepsilon_{L.\widetilde{p_e}}\right)\right] \quad (16)$$

Where, $\varepsilon_{L.\widetilde{w}}$, $\varepsilon_{E.\widetilde{w}}$, $\varepsilon_{E.\widetilde{p_e}}$ and $\varepsilon_{L.\widetilde{p_e}}$ are price elasticity of labor demand relative to wages, price elasticity of energy demand with respect to wages, price elasticity of energy demand with respect to energy prices and price elasticity of labor demand with respect to price of energy, respectively. In this study W, is net wage of labor taxes and L is the number of labors in year 2015.

4. Data and Estimation Results

In this study, energy consumption of the industrial sector contains majors oil products (kerosene, gas oil, LPG, gasoline and fuel oil and ovens), gas, electricity and coal, based on million barrels of oil equivalent. The price of energy is the weighted average of energy carriers price based on the share in total energy consumption. Data for employment is obtained from Plan and Budget Organization and the Statistical Center of Iran. For determining rate of wages, annual per capita service compensation data of employees in industrial workshops with more than ten workers is used. The real wage rate is obtained by consumer goods and services price index (CPI) available in Central Bank of Iran. In this study, due to low power of labors in Iran, the net wage is considered exogenous. For calculating the price elasticity of labor and energy, real value added (billion Rials) of the industrial sector is used.

The tax rate on labor wage is obtained through the calculations of tax exemption and available rates of Tax Organization of Iran. In Iran, energy subsidies paid by the government, thus it is used as negative tax rate on energy. To calculate the subsidy of petroleum products, the difference between the price of their consumption in the industrial sector and Persian Gulf FOB prices in 2015 is considered (available at energy balance sheet). To calculate the subsidy of natural gas, the difference between the price of its consumption in the industrial sector and the average global price of natural gas according to information from BP statistical review of 2015 is considered. The subsidy of coal is obtained by the difference between the consumer price and the average price of exported and imported in the industrial sector in 2015. The electricity subsidy is obtained by the difference between the average cost price of electricity and its consumer price in the industry sector.

The Augmented Dickey-Fuller unit root test (ADF) and Philips-Perron unit root test (PP) for investigation of variables stability is presented in table 1.

Table 1. Results of ADF and PP test for the research variables in level.

variables	The amount of Dickey-Fuller statistic	The amount of Phillips-Perron statistic	The critical level values		
			10%	5%	1%
$\left(\frac{E}{L}\right)$	-1.77	-1.76	-2.61	-2.95	-3.63
$\left(\frac{\tilde{w}}{\tilde{p}_e}\right)$	-2.87	-2.33	-2.61	-2.95	-3.64
E	0.14	0.142	-2.61	-2.95	-3.63
L	0.48	0.30	-2.61	-2.95	-3.63
$\tilde{w}$	-1.68	-2.30	-2.62	-2.95	-3.65
$\tilde{p_e}$	-2.07	-2.26	-2.61	-2.95	-3.63
Y	-0.74	-0.79	-2.61	-2.95	-3.63

Source: Research calculations

According to the table (1), all variables are unstationary in level. So, the difference of variables has been used to make data stationary. The results of Dickey-Fuller and Phillips-Perron test after one difference of variables are presented in Table (2).

Table 2. Results of ADF and PP test for difference of research variables.

variables	The amount of Dickey-Fuller statistic	The amount of Phillips-Perron statistic	The critical level values		
			10%	5%	1%
$d\left(\frac{E}{L}\right)$	-6.15	-6.14	-2.61	-2.95	-3.63
$d\left(\frac{\tilde{w}}{\tilde{p}_e}\right)$	-4.58	-4.7	-2.61	-2.95	-3.64
dE	-5.69	-5.69	-2.61	-2.95	-3.63
dL	-4.09	-4.04	-2.61	-2.95	-3.63
$d\tilde{w}$	-4.02	-3.11	-2.62	-2.95	-3.65
$d\tilde{p_e}$	-4.64	-4.56	-2.61	-2.95	-3.63
dY	-3.73	-3.7	-2.61	-2.95	-3.63

Source: Research calculations

According to the results of the above table, all variables are stationary in the first-order difference. Therefore, according to the Engel-granger test (EG) method, after estimating each model, the residuals are tested for possible cointegration between variables. Based on the test results of residual stationary test there is no cointegration between model variables.

The elasticity of substitution between energy and labor in Iran's industrial sector (during 1980 -2015) have been estimated using the ordinary least squares method (OLS) (table 3).

$$Ln\left(\frac{E}{L}\right) = -1.06 + 0.086\, Ln\left(\frac{\tilde{w}}{\tilde{p}_e}\right) + 0.83\, Ln\left(\frac{E}{L}\right)_{-1} \quad (17)$$

Table 3. Estimation results of the CES production function in the industrial sector.

Parameter	$\alpha = \sigma\theta Ln\left(\frac{a}{b}\right)$	$\alpha_1 = \sigma\theta$	$\alpha_2 = (1-\theta)$
Quantity (probability level)	-1.055856 (0.1172)	0.085664 (0.0593)	0.834165 (0.0000)
R^2= 0.87	F= 113.3	D-W= 2.26	
Test results of residuals reliability The critical level values:	Dickey-Fuller statistic= -6.55 1%= -3.63 5%= -2.95 10%= -2.61		

Source: Research calculations

According to equation (14), the estimated parameters are σ, θ, a, b:

1-θ ≘ 0.83 ⟹ θ ≘ 0.17

σθ= 0.086 ⟹ σ ≘ 0.51

σθLn(a/b)= -1.06 ⟹ a ≘ 0.000004 b ≘ 0.999996

The elasticity of substitution between energy and labor is estimated 0.48. It means that one percent increase (or decrease) of labor demand (or energy), leads to the 0.48 percent decrease (or increase) in energy demand (or labor).

To calculate price elasticities, labor and energy demand has been estimated by conditional demand functions of two inputs. Labor demand of the industrial sector is estimated using the equation (7). To solve positive correlation between the error components, AR (1), AR (2) and MA (1) are imported in the demand function and the result is as follows:

$$L = 2448453 - 12431.75\,\tilde{w} + 2.98\,\tilde{p}_e + 4.11\,Y + 268972.4\,D + 1.24\,AR(1) - 0.82\,AR(2) + 0.93\,MA(1) \quad (18)$$

In the above equation variables are defined as follows; L, the number of labors in the industry; W, the gross wages in the industry sector; P_e, the gross price of energy; Y, the total value added of industry. The result of estimation after autocorrelation removal is shown in table (4).

Table 4. Estimation results of the labor demand in the industry sector.

Parameter	β_0	β_1	β_2	β_3	D	AR (1)	AR (2)	MA (1)
Quantity (probability level)	2448453 (0.0000)	-12431.75 (0.0048)	2.98020 (0.0001)	4.10582 (0.0000)	268972.4 (0.0762)	1.23797 (0.0000)	-0.82176 (0.0001)	0.93294 (0.0000)
R^2= 0.98	F= 200.5413	D-W= 2.12						
Test results of residuals reliability: The critical level value	Dickey-Fuller statistic= -6.31 1%= -3.63 5%= -2.95 10%= -2.61							

Source: Research calculations

Then, using equation (6), the energy demand has been estimated as follows:

$$E = 77.5 - 0.000221\,\widetilde{p_e} - 0.065\,\widetilde{w} + 0.00017\,Y + 32.21\,D + 1.83\,AR(1) - 0.95\,AR(2) - 0.95\,MA(1) \quad (19)$$

In the above equation, E is energy consumption of industry sector in terms of million barrels oil equivalent. To avoid the positive correlation between the error components, AR (1), AR (2) and MA (1) are imported in the demand function (table 5). The results show that value added of the industry sector and energy prices increase has a positive impact, and the price of labor (wages) has a negative on labor demand in the industry sector. Furthermore, value added of the industry sector has a positive impact and energy prices has a negative impact on energy demand.

Table 5. Estimation results of the energy demand in the industry sector.

Parameter	γ_0	γ_1	γ_2	γ_3	D	AR (1)	AR (2)	MA (1)
Quantity (probability level)	77.5223 (0.0223)	-0.00022 (0.0373)	-0.06541 (0.8461)	0.00017 (0.0000)	32.2144 (0.0758)	1.82887 (0.0000)	-0.95087 (0.0000)	-0.95506 (0.0000)
R^2= 0.973			F= 1433.92			D-W= 2.079		
Test results of residuals reliability The critical level values:					Dickey-Fuller statistic= -5.57 1%= -3.63 5%= -2.95 10%= -2.61			

Source: Research calculations

To calculate the price elasticity, the results of energy and labor demand estimates are used. In table (6) term $\frac{\partial x_i}{\partial p_j}$ is extracted from the demand for inputs. The amount of the price (P_j) and inputs (X_i) is considered once for 2015 and once again based on the average variables.

Table 6. The price elasticities of labor and energy in industrial sector.

Price elasticity of demand $\varepsilon_{ij} = \frac{\partial x_i}{\partial p_j} \cdot \frac{p_j}{x_i}$	The average price elasticities (1980-2015)	price elasticities (2015)
$\varepsilon_{L.\widetilde{w}} = \frac{\partial L}{\partial \widetilde{w}} \cdot \frac{\widetilde{w}}{L}$	$\varepsilon_{L.\widetilde{w}}$ = -0.25	$\varepsilon_{L.\widetilde{w}}$ = -0.21
$\varepsilon_{L.\widetilde{p_e}} = \frac{\partial L}{\partial \widetilde{p_e}} \cdot \frac{\widetilde{p_e}}{L}$	$\varepsilon_{L.\widetilde{p_e}}$ = 0.11	$\varepsilon_{L.\widetilde{p_e}}$ = 0.08
$\varepsilon_{E.\widetilde{p_e}} = \frac{\partial E}{\partial \widetilde{p_e}} \cdot \frac{\widetilde{p_e}}{E}$	$\varepsilon_{E.\widetilde{p_e}}$ = -0.24	$\varepsilon_{E.\widetilde{p_e}}$ = -0.13

Source: Research calculations

Then, it is investigated that whether higher taxes on energy will increase the government budget or not; In this condition it is possible to reduce the tax rate on wages (Koskela et al. 1998).

$$\left.\frac{dG}{dt_{p_e}}\right|_{dY=0} \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} 0 \Leftrightarrow t_w \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} t_{p_e} \quad (20)$$

Considering the annual deductible and the income tax rates, the average tax rate on wage is calculated 15%. Also, the average rate of energy subsidies (as the negative tax rate on energy) is calculated about -73%. So, according to the equation (16) tax rate on labor wages is higher than the tax rate on energy prices (energy subsidies).

Therefore, Iran is in the labor tax system; and increasing the tax rate of energy prices and decreasing the tax rate of wage leads to the same initial level of production, while government budget is fixed. Furthermore, it may be supposed that energy and labor are substitutes in the industry sector, and labor demand is affected by the price of labor and prices of energy.

Based on the results, the tax rate on labor wages (t_w) equal to 0.15 and energy subsidy rates (t_{p_e}) (as a negative tax rate) equal to 0.73. P_e is net price of energy tax (Realized with Energy price index) and E is the amount of energy consumption in terms of million barrels' oil equivalents in 2015. The estimation results of equation (20) and (21) are as follows:

$$G^*_{t_w} = 738953527.14 \tag{21}$$

$$G^*_{t_{p_e}} = 403426376.66 \tag{22}$$

Ratio of tax income elasticity considering the tax rate on energy($\tau_{t_{p_e}}$) with respect to ratio of tax income elasticity considering the tax rate on wage(τ_{t_w}) is:

$$\frac{\tau_{t_{p_e}}}{\tau_{t_w}} = \frac{G^*_{t_{p_e}}(1+t_{p_e})}{G} \Big/ \frac{G^*_{t_w}(1+t_w)}{G} = 0.128 \tag{23}$$

Then, labor demand change relative to energy tax rates is investigated as follow:

$$\frac{dL}{dt_{p_e}} = \frac{L}{(1+t_w)}\varepsilon_{L.\tilde{w}}\frac{dt_w}{dt_{p_e}} + \frac{L}{(1+t_{p_e})}\varepsilon_{L.\widetilde{p_e}} \tag{24}$$

Considering the government fixed budget constraint, labor demand changes due to energy tax rates can be calculated as follows:

$$\left.\frac{dL}{dt_{p_e}}\right|_{dG=0} \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} 0 \Leftrightarrow \frac{\tau_{t_{p_e}}}{\tau_{t_w}} \begin{Bmatrix} > \\ = \\ < \end{Bmatrix} \frac{\varepsilon_{L.\widetilde{p_e}}}{\varepsilon_{L.\tilde{w}}} \tag{25}$$

By combining the calculated equations, the result of equation (27) is expressed as follows:

$$\left(\frac{\tau_{t_{p_e}}}{\tau_{t_w}}\right) = 0.128 \quad > \quad -0.44 \quad = \left(\frac{\varepsilon_{L.\widetilde{p_e}}}{\varepsilon_{L.\tilde{w}}}\right) \Rightarrow \left.\frac{dL}{dt_{p_e}}\right|_{dG=0} > 0 \tag{26}$$

Therefore, changes in labor demand due to changes in energy tax rates is positive. In other words, by increasing the tax rate on energy prices and considering the government fixed budget constraint, labor demand increases. In the transfer of labor tax system to the green tax system, the first condition is that the production must be constant. According to the constant production and the total fixed cost, producer does not change price of products (P). After increasing the tax rate on energy, the government budget increases; but it reaches the initial amount by reducing tax rates on labor wage.

5. Conclusions

Green taxes are expected to lead to energy consumption reduction, environmental protection and other related benefits. Regarding the double dividend hypothesis, green taxes may improve the employment by substitution between labor and energy. The aim of this study is to assess the effects of the green tax implementation on employment, for the specific case of Iranian industry sector.

In this study, using the CES production function the elasticity of substitution between energy and labor is investigated. Based on data of Iran's industries during 1980 to 2015, the results show that the substitution between these two inputs is confirmed. Therefore, by an increase of energy prices in the industry sector and replacing the labor with energy, energy consumption will decrease and employment will increase. But in the current situation and the recession crisis, it may lead to production reduction and the closure of industries and the more recession. Therefore, constant production and spending the government budget surplus for increasing employment is entered as a condition in the estimation. Then, initial production can be reached by substituting tax rates.

The estimates of labor demand function show that gross wages and gross energy prices will affect the labor demand. Gross prices are also influenced by the tax rates. The results show that, under a taxation scheme that gives rise to a double dividend labor demand increases due to the increase of energy tax rate and the government fixed budget.

Focusing on environmental problems caused by the indiscriminate use of energy and considering the issue of unemployment, the results of this study indicate positive effects of green tax on employment. It is recommended that due to low prices of energy and the importance of natural resources in Iran, environmental policies such as green tax to be implemented. For this purpose, the government should reduce energy subsidies and remove it gradually. It should be noted that based on Kuralbayeva (2019) lower public spending as a complementary policy to improve the labor market effects of environmental tax reforms in developing countries are likely to be unsuccessful. In this study, the entire industry sector has been studied, but it is better that all subsections of different activities to be examined.

These green reforms, however, may lead to a change in social welfare in terms of income or life quality.

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