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 toward a green economy. The green tax may reduce the energy consumption and pollution emissions and may lead to other benefits. This study mainly focused on the effects of the green tax on labor demand in Iran's industry during 1980–2015. Regarding the double dividend hypothesis, the green tax may improve the employment by substitution of labor for energy. Using constant elasticity of substitution (CES) production function, the elasticity of substitution of labor for energy is estimated to be 0.48 percent for Iran's industry sector. Then, the effect of the green tax on labor demand is investigated subject to the government's fixed budget constraint and labor demand function. The results show that the green tax will have positive effects on employment in Iran's 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 producers.

1. Introduction

Environmental tax reform can be used in a fundamental transformation toward 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 in economic growth; thus, labor and capital as the mediating factors need energy to operate (Stern, 2004). However, 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 and energy security and to reduce environmental pressure specially in terms of air pollutions. The pollution effects of fossil fuel consumption include the reduction of living quality, the reduction of lifetime length due to diseases, the climate change, and affecting economic activities.

Therefore, many governments provide rules and standards for enhancing energy efficiency and decreasing the emissions of pollutants. Upon the presentation of the green tax idea by Pigou, the public sector economists found that assuming neutral tax

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revenues into the greener tax system reduces the inefficiency of the tax system and results in environmental quality improvement (Amin Rashti and Siami Araghi, 2012).

Theoretically, the green tax reform is often accompanied by “double dividend” (Bovenberg and Mooij, 1994). The hypothesis is that such reform creates social benefits by reducing pollution and increases the economic prosperity through the economic efficiency of the tax system (Miguel and Manzano, 2011). The 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 in addition to improving economic targets such as the reduction in unemployment rates. However, economic and social consequences may make it politically difficult to implement environmental policies. Therefore, economists have argued that complementary policies such as cutting public spending can be used to reduce the environmental tax burden on the income of the private sector (Kuralbayeva, 2019).

Iran is among the top 10 CO_2 emitting countries and needs to reduce its consumption of fossil fuels and the emissions of greenhouse gases (GHG) 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 CO_2 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 through the efficient use of diverse energy resources in production and consumption sectors.

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

Therefore, the contribution of this study is that it provides evidence how Iran’s economy responses to the green tax in terms of substitution of employment for energy. The benefits of the green tax may guide policymakers toward reforming energy and environmental policies. The paper is organized as follows: Section 2 provides a review of the related literature, and Section 3 deals with the model and methodology. Section 4 covers the estimation results, and finally, Section 5 summarizes the findings and draws the conclusions.

2. Literature Review

Environmental tax 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, the 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, the green tax creates additional revenues for the government and leads to the improvement in the efficiency of the tax system by substituting the green tax instead of inefficient tax (Bovenberg and Mooij, 1994; Goldani and Amadeh, 2014; Nicolau, 2010). Based on environmental double dividend, environmental tax reform instead of the 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 a growing role in the environmental policies of OECD countries (Anger et al., 2006). The green tax can be divided into three types: Pigou tax or tax per unit of emissions and environmental degradation; the indirect environmental tax on production inputs or consumers’ goods associated with environmental pollution; and environmental regulations that have effects similar to indirect environmental taxes (Paytakhti Oskooe and Nahidi, 2008). In Iran, no type of the green tax has been implemented so far, so more subsidies have been paid for energy carriers. Thus, economic and environmental objectives of the green tax can be achieved by the gradual reduction and elimination of energy subsidies and implementation of the green tax as energy price rises.

The increase in energy price encourages the producers to improve the production technology and urge the households to change consumption patterns (Guillaume and Zytek, 2010). Industry demand of energy is the main cause of carbon dioxide emissions which is also associated with the economic growth. Higher energy prices lead to the diversification of energy resources. Substituting the other inputs for the energy in the industry may lead to sustainable economic growth and energy consumption reduction (Kim and 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 inflexible wages; Brik and Michaelis (2002) using theoretical economic equations and endogenous and exogenous models of economic growth; and Kuralbayeva (2013), using a model of an economy with the informal sector in developing countries have investigated the effects of the green tax on employment.

The effect of the green tax implementation on employment and double dividend hypothesis has been studied in several papers (Carraro et al., 1996; Kuper, 1996; Kirchgassner et al., 1998; Holmlund and Kolm, 2000; Bohringer et al., 2001; Kumbaroglu, 2003; Agnolucci, 2009). The results of most studies confirm the positive effects of the green tax on employment in different situations. González (2018) provides a comprehensive review of the related 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 the 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 computable general equilibrium (CGE) model examining 101 industries and commodities in Spain in order to simulate the economic and environmental effects of an environmental fiscal reform. They simulated an increase in the taxes and a reduction in subsidies for these industries and used new revenues to reduce labor, capital, and consumption taxes. Their results suggested that the double dividend hypothesis can be achieved. After three to four years after implementing an environmental fiscal reform (EFR), gross domestic product (GDP) is higher than the base case hydrocarbon consumption and pollutants.

Maxim et al. (2019) presented a meta-regression analysis of the simulation studies concerning the green tax reform (GTR) across European and non-European countries. Their results showed 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 applying different environmental tax parameters in China. Their results indicated the robust beneficial role of environmental tax in 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 a complementary policy, in terms of lower public spending, is unlikely to be socially acceptable and does not support the case of a green tax reform in developing countries.

Some studies have 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; Sedehi and Esfahanian, 2019). Pajooyan and Moein Nemati (2010) investigated 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 the green tax for some OECD countries. Asiae et al. (2012), using a translog cost function, showed that the removal of energy subsidies in Iran has a positive effect on employment and a negative effect on economic growth. Mirhosseini et al. (2017) investigated the relationship between the 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 have investigated substitution of production inputs. Using the CES production function in the United States, Prywes (1986) showed that energy and capital are complementary, and labor, material, and energy are a 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 the United States, demonstrated that capital, labor, and energy are a substitute for each other. Aziz (2007) used a two-stage translog cost function in five developing countries and reported that factors of production are a substitute for each other. Also, Ma et al. (2008) showed that labor, capital, and energy are a substitute for each other in China. Haller et al. (2013) reported the same results for Ireland. Smyth et al. (2011) and Zha and Ding (2014), using a translog production function in China, showed that the elasticity of substitution of energy for capital is more than that of substitution of labor for energy.

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

According to the literature on the substitution of labor for energy, as well as the macroeconomic effects of the green taxation, the effects of the green tax on employment are examined in this study. The review of the related literature shows that few studies have investigated the effects of the 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 the green tax on employment in the industrial sector of Iran.

3. Methodology

The driving force behind the effect of the green tax on employment is the technical substitution that causes producers to find motivation for the substitution of labor for energy (Koskela et al. 1999). Therefore, the increasing energy price 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, 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 seek to increase labor demand and improve the employment by implementing the policy of increasing energy price (an environmental policy).

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

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

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 the substitution of labor for energy, CES production function is defined as:

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

where Y is the amount of productions, E represents energy consumption, L stands for the number of labors, and A is the efficiency parameter; a and b indicate the distribution parameters, and β is the substitution parameter. Also, $\beta > -1$, $A > 0$, a and $b > 0$, and $\sigma = 1/(1+\beta)$ (Kemfert, 1998).

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

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

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

According to the shepherd's theorem, the conditional demand function of inputs is given by:

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

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

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

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

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

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, 2011):

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

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

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

where θ is the adjustment factor.

To examine the effects of the green tax on employment, two different tax systems are considered. If the labor tax system is considered as the initial one, in this case $t_w > t_{p_e}$, where t_{p_e} is the rate of the tax on energy price and t_w is the rate of the tax on labor wage. Considering taxes on energy price and taxes on labor wage, another tax system is created. When 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 the tax on energy is higher than that of the tax on labor, that is $t_{p_e} > t_w$.

To change the labor tax system to the green tax system, several conditions must be fulfilled. The level of primary production (Y_0) based on the 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 Figure 1, point A shows the labor tax system ($t_{p_e} < t_w$), and point B indicates the green tax system ($t_{p_e} > t_w$) for the given level of Y_0 (Koskela et al., 1998). Moving from point A to point B indicates the transfer of the labor tax system to the green tax system at no extra cost for the government or the company. Hence, employment will rise, and environmental quality will improve, while energy consumption will decrease.

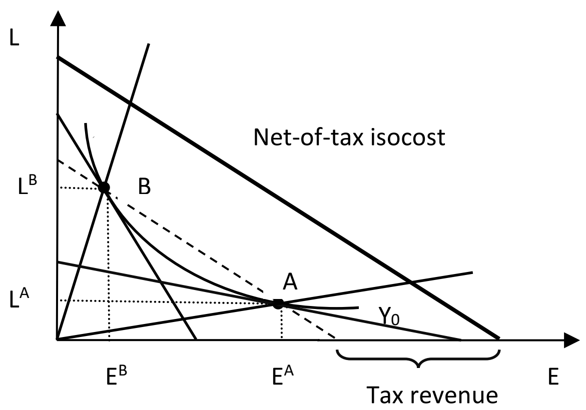

Figure 1. The labor tax system and the green tax system.

Tax reform, including energy tax system will increase the government budget (assuming $t_w < t_{p_e}$). First, the government budget reaches zero by reducing the rate of the tax on wages, which leads to a reduction in the production cost and an increase in the level of production and employment. Then, by increasing the rate of the tax on energy with respect to the rate of the tax on labor wage, employment will increase, but the 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 the rate of the taxes:

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

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

$$dL = [L_{\widetilde{w}}(1+t_w)w_{t_w} + L_{\widetilde{w}}w]dt_w + \left[L_{\widetilde{w}}(1+t_w)w_{t_{pe}} + L_{\widetilde{p_e}}p_e\right]dt_{p_e} \quad (11)$$

where $L_{\widetilde{w}}$ is the change of labor demand relative to the gross wages, $L_{\widetilde{p_e}}$ indicates the change of labor demand relative to the gross energy price, w_{t_w} represents the change of net wage relative to the rate of the tax on wages, and $w_{t_{pe}}$ is the change of net wage relative to the rate of the tax on energy price.

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

$$dL = \frac{L}{(1+t_w)}\varepsilon_{L.\widetilde{w}}(1+\omega_{t_w})dt_w + \frac{L}{(1+t_{p_e})}\left[\varepsilon_{L.\widetilde{w}}\omega_{t_{pe}} + \varepsilon_{L.\widetilde{p_e}}\right]dt_{p_e} \quad (12)$$

where $\varepsilon_{L.\widetilde{w}}$ is the elasticity of labor demand relative to the gross wages, ω_{t_w} indicates the elasticity of the net wage relative to the rate of the tax on wages, $\omega_{t_{Pe}}$ stands for the elasticity of the net wage relative to the rate of the tax on energy, and $\varepsilon_{L.\widetilde{Pe}}$ is the price elasticity of the labor demand with respect to the energy price.

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

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

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

Assuming zero budget changes and a primary production level, the government fixed budget constraint is expressed by:

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

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

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

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

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

4. Data and Estimation Results

In this work, the energy consumption of the industrial sector contains major oil products (kerosene, gas oil, liquefied petroleum gas (LPG), gasoline, and fuel oil), gas, electricity, and coal based on million barrels of oil equivalent. The price of energy is the weighted average price of the energy carriers based on the share in total energy consumption. Data on the employment are obtained from Plan and Budget Organization and the Statistical Center of Iran. For determining the rate of wages, the data on the annual per capita service compensation of the employees in industrial workshops with more than 10 workers are used. The real wage rate is obtained by consumer goods and service price index (CPI) available in the Central Bank of Iran. In this study, due to low power of labors in Iran, the net wage is considered to be exogenous. For calculating the price elasticity of labor and energy, the real value added (billion Rials) of the industrial sector is used.

The rate of the tax on labor wage is determined through the calculation of tax exemption and the available rates of Tax Organization of Iran. In Iran, energy subsidies are paid by the government, so it is used as a negative rate of the tax on energy. To calculate the subsidy of petroleum products, the difference between the price of their consumption in the industrial sector and the 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 taken into account. The subsidy of coal is determined by the difference between the consumer price and the average price of the exported and imported coal in the industrial sector in 2015. The electricity subsidy is obtained from 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 the investigation of the stability of the variables are presented in Table 1.

Table 1. Results of ADF and PP tests for the research variables at critical levels.

Variables	Amount of Dickey-Fuller Statistics	Amount of Phillips-Perron Statistics	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 in this work

According to Table 1, all the variables are nonstationary at various levels. Thus, the difference of variables has been used to make the data stationary. The results of Dickey-Fuller and Phillips-Perron test after one difference of the variables are presented in Table 2.

According to the results of the above table, all the 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 the variables. Based on the test results of the residual stationary test, there is no cointegration between the model variables.

The elasticity of the substitution of labor for energy in Iran's industrial sector from 1980 to 2015 has been estimated using the ordinary least squares method (OLS) as presented in Table 3.

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

According to Equation (14), estimated parameters σ, θ, a, and b are expressed in:

$1-\theta \doteq 0.83 \quad \Rightarrow \quad \theta \doteq 0.17$

$\sigma\theta = 0.086 \quad \Rightarrow \quad \sigma \doteq 0.51$

$\sigma\theta Ln(a/b) = -1.06 \quad \Rightarrow$

$a \doteq 0.000004 \; b \doteq 0.999996$

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

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

Variables	Amount of Dickey-Fuller Statistics	Amount of Phillips-Perron Statistics	Critical Level Values		
			10%	5%	1%
$d\left(\frac{E}{L}\right)$	–6.15	–6.14	–2.61	–2.95	–3.63
$d\left(\frac{\widetilde{w}}{\widetilde{p_e}}\right)$	–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
$d\widetilde{w}$	–4.02	–3.11	–2.62	–2.95	–3.65
$d\widetilde{p_e}$	–4.64	–4.56	–2.61	–2.95	–3.63
dY	–3.73	–3.7	–2.61	–2.95	–3.63

Source: Research calculations in this work

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 Dickey-Fuller statistic= –6.55 The critical level values at 1%, 5%, and 10% are –3.63, –2.95, and –2.61 respectively.			

Source: Research calculations in this work

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

$$L = 2448453 - 12431.75\,\widetilde{w} + 2.98\,\widetilde{p_e} + 4.11\,Y + 268972.4\,D + 1.24\,AR(1) - 0.82\,AR(2) + 0.93\,MA(1) \tag{18}$$

where L is the number of labors in the industry; W indicates the gross wages in the industry sector; P_e represents the gross price of energy; and Y is the total value added of industry. The result of the estimation after autocorrelation removal is presented 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: Dickey-Fuller statistic= –6.31 The critical level values at 15, 5%, and 10% are –3.63, –2.95, and –2.61 respectively.								

Source: Research calculations in this work

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

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

where E is the energy consumption of the 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 (see Table 5). The results show that the value added of the industry sector and the increase in the energy price have a positive impact on labor demand, but the price of labor (wages) has a negative effect on labor demand in the industry sector. Furthermore, the value added of the industry sector has a positive impact, but the energy price 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 Dickey-Fuller statistic = –5.57 The critical level values at 1%, 5%, and 10% are –3.63, –2.95, and –2.61 respectively.								

Source: Research calculations in this work

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

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

Price Elasticity of Demand $\varepsilon_{ij} = \frac{\partial x_i}{\partial p_j} \cdot \frac{p_j}{x_i}$	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 in this work

Then, whether higher taxes on energy will increase the government budget or not is investigated; in this condition, it is possible to reduce the rate of the tax 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 rate of the income tax, the average rate of the tax on wage is calculated at 15%. Also, the average rate of energy subsidies (as the negative rate of the tax on energy) is calculated at about –73%. Thus, according to Equation (16), the rate of the tax on labor wages is higher than that of the tax on energy price (energy subsidies).

Therefore, Iran is in the labor tax system, and increasing the rate of the tax on energy price and decreasing the rate of the tax on wages lead to the same initial level of production while the government budget is fixed. Furthermore, it may be supposed that energy and labor are a substitute for each other in the industrial sector, and the labor demand is affected by the price of labor and the price of energy.

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

$$G^*_{t_w} = 738953527.14 \quad (21)$$

$$G^*_{t_{p_e}} = 403426376.66 \quad (22)$$

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

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

Then, the change of the labor demand relative to the rate of the energy tax is calculated as follow:

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

Considering the government fixed budget constraint, the changes in the labor demand due to the rates of the energy tax can be calculated by:

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

By combining the calculated equations, the result is expressed in Equation (26):

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

Therefore, the change in the labor demand due to the change in the rate of the energy tax is positive. In other words, by increasing the rate of the tax on energy price and considering the government fixed budget constraint, the labor demand increases. In the transfer of the 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, producers do not change the price of products (P). After increasing the rate of the tax on energy, the government budget increases, but it reaches the initial amount by reducing rate of the tax on the labor wage.

5. Conclusions

The green tax is expected to lead to the reduction in the energy consumption, environmental protection, and other related benefits. Regarding the double dividend hypothesis, the green tax may improve the employment by substituting labor for energy. The aim of this study is to assess the effects of the green tax implementation on employment, for the specific case of Iran's industrial sector.

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

The estimates of the labor demand function show that gross wages and gross energy price will affect the labor demand. Gross prices are also influenced by the tax rates. The results demonstrate that, under a taxation scheme that gives rise to a double dividend, the labor demand increases due to the increase in the rate of the energy tax 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 the green tax on employment. It is recommended that due to the low price of energy and the importance of natural resources in Iran, environmental policies such as the green tax should 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 effects of the labor market of the environmental tax reform in developing countries is likely to be unsuccessful. In this study, the entire industry sector has been studied, but it is better to examine all the subsections of different activities. The green reform, however, may lead to a change in social welfare in terms of income or life quality.

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