International Journal of Multiphysics
Volume 18, No. 4, 2024
ISSN: 1750-9548

Effects of Green Taxes on Total Factor Productivity through Labor Market Demands: Dynamic Systems Approach

Zeinab Mosavari Nezam Abad*, Sayyed AbdolMajid Jalaee Esfandabadi, Mohsen Zayandehroodi

[1]Ph.D. Student, Department of Economics, Faculty of Management and Economics, Islamic Azad University, Kerman Branch, Kerman, Iran.
[2]Professor, Department of Economics, Shahid Bahonar University, Kerman, Iran.

[3]Associate Professor, Department of Economics, Faculty of Management and Economics, Islamic Azad University, Kerman Branch, Kerman, Iran.
*Corresponding author

Abstract

The goal of this article was to investigate the effects of carbon taxes on productivity in Iran using dynamic system frameworks. To this end, time-series data in Iran from 1992 to 2020 were used to investigate the subject using equations. In the dynamic model, two major variables, GDP and carbon dioxide emissions, were selected as so-called *affecting* channels. Scenario results showed that a 3% increase in GDP through the carbon tax channel would boost economic productivity. Also, an 11% increase in carbon dioxide emissions affected green taxes, and finally economic welfare and productivity. The scenario of increasing green taxes on productivity through the economic welfare channel indicated that increasing green taxes affected economic welfare and productivity. It was then concluded that changes in GDP and carbon dioxide emissions could fundamentally affect the extent to which green taxes could affect productivity in Iran. Prediction scenarios demonstrated that public policy-making should concentrate on two GDP and carbon dioxide emission channels to make green taxes affect productivity positively. Since GDP increases greenhouse gas emissions, public tax policies, especially green tax policies, should be in a way that increasing GDP, and consequently, increasing carbon dioxide emissions would boost economic welfare and productivity.

Keywords: Green taxes, labor market demands, productivity, dynamic systems (H23, H21, D62, K23, JEL)

1. Introduction

To improve its economic structure and stability, each country requires permanent sustainable revenue to ensure its successful public planning and policy-making in the long run. As a critical source of revenue for a government, taxes are seen as a permanent and predictable source for government policy-makers. Taxes affect distribution conditions in society by featuring incidence effects, on the one hand, and engendering allocation effects, on the other hand, as resources are shifted from one market to another. Hence, economics always seeks to identify bases of taxes that would produce the highest efficiency in society. Among types of taxes, the only tax base characterized by the above feature is environmental taxes. Levied on different types of environmental pollution, this tax base not only drives efficiency but also increases social utility by reducing pollution costs. This type of tax, mostly cost-based, is referred to as Green Taxes (Jamshid Pajouyan & Narsis Amin Rashti, 2007). As a concept, Green Taxes was first developed in the early 1920s by the economist, Arthur Cecil Pigou, who emphasized levying taxes on factors causing pollution and degrading natural resources. Enacted more than thirty years ago, this tax base was aimed at reforming developed nations' tax systems (Samimi & Alizadeh-Malafeh, 2016). The extent of green taxes depends on the extent of greenhouse gas emissions taking the form of carbon footprints, which are touted as carbon impacts on the environment. This term has also been discussed by both the public and the media (H. Hu, Alen, Kuo, Chien-Hung, H. Huang, Lance, Su, Chao-Chin, 2016).

Greenhouse gas emissions produced by industries have been a critical factor in carbon taxes and are significantly correlated with economic growth. Also, employment is believed to effectively contribute to economic growth, income distribution, and protect human dignity (Mirzaei et al., 2010). Among the four types of economic markets, the labor market is key to regulating workforce supply and demand and balancing macroeconomic variables such as employment. For this, the socioeconomic implications of the labor market equilibrium have captured the attention of economists and policy-makers, alike (Chadha, B. Prasad, E. 1994).

As carbon taxes generally affect the economic total factor productivity, the main objective of this article was to determine if carbon taxes would affect total factor productivity through labor market demand channels established in Iran. Therefore, the main question of the study was: "How have carbon taxes in Iran affected total factor productivity from 1992 to 2020?" This question is answered using dynamic systems and the Vensim software.

In sum, the article's framework is as follows: the Introduction section is first provided which is followed by the Literature Review (the second section), Theoretical Foundations (the third section), Model Estimation (the fourth section), and Conclusion (the fifth section).

2. Theoretical Foundations

According to this model, the economy is composed of two models: Urban/rural and agricultural, represented by m and a, respectively. The urban sector is divided into unofficial or registered activities. Throughout the study, the term *unemployed* will be used to describe people who are self-employed in the unofficial sector. Therefore, a number of the urban workforce in the unofficial sector is used as the unemployment rate, as the natural population size of 1 is divided into the following:

(2-1)

$$l_a + (1-u)l_m + ul_m = 1$$

Lobo maintains that production in its primitive form is doomed to failure. In subsistent/self-sufficient agriculture, production is simply or mainly aimed at "self-consumption", characterized by applying simple technologies, small farmlands, lower productivity, risks, and uncertainties (Todaro, 1989). According to this model, the agricultural sector is modeled as a subsistent agriculture, which is assumed to not utilize energy as a production input; rather, it utilizes capital and workforce as the only factors of production. K_a is defined as the capital-to-labor ratio as follows:

(2-2)

$$k_a = \frac{K_a}{L_a}$$

The agricultural sector is fully competitive. This is translated as follows:

(2-3)

$$W_a = g(k_a) - g'(k_a)k_a$$

$g'_k(\,k_a) = r_a$ represents costs of rent and capital in the agricultural sector.

In the official labor market, a constant returns-to-scale matching function (M_t) specified the number of matches between workers searching for a job and job vacancies:

(2-4)

$$M_t = m(suL_m.vL_M.M) = M(susuL_m)^{\gamma}(vL_m)^{1-\gamma}$$

The linear homogenous matching function is used to define the matching rate of companies and workers as a function of the single variable Θ:

(2-5)

$$=\frac{v}{su}\Theta$$

which measures labor market constraints. As a result, the likelihood of a job vacancy being filled is as follows:

(2-6)

$$q=\frac{M_t}{vL_m}=M[\frac{su}{v}]^{\gamma}=M\theta^{-\gamma}$$

$\frac{1}{q}$ is the average period of a job opportunity. Note that q(Θ) is a decreasing function of Θ and the q-to-Θ elasticity is defined as εΘ≡-$q'(\theta)\theta \mid q>0$.

The competition between the worker and the company in the official sector is assumed to end up in failure, as the exogenous Poisson rate (λ) and Bryce's law of motion of the number of unemployed are met as follows:

(2-7)

$$\mathrm{u}L_m=L_m(\lambda(1-u)-su\theta q(\theta))$$

In a steady state, the number of the employed people coming to and leaving the unofficial sector should be balanced as follows:

(2-8)

$$(1\text{-u}) = \text{su}\Theta\text{q}(\Theta)\lambda$$

This study used U and W to represent the value of the worker who is unemployed (searching for an official job) and the employment in an official job.

(2-9)

$$q_i^- =\frac{s_i}{sul_m}m(sul_m\,.\,vl_m)=s_iq\theta=s_iM\theta^{1-\gamma}$$

The optimal level of the worker search intensity i is determined by the worker search marginal cost (σ_{si}) and expected benefits $\frac{dq_i^-}{ds_i(W-U_i)}$ of work search, which is obtained from the following:

(2-10)

$$\sigma_s'(s;z)=\theta q(W-U)$$

The expected utility of unemployment and employment in an official job is defined as follows:

(2-11)

$$\text{rU=z+b-}\sigma\text{+sq}\Theta\text{(W-U)}$$

Each agent company, along with its employees, produces the output $A_mf(k_m.e_m)$, where A_m is a *TFP* parameter.

(2-12)

$rJ=A_m f(k_m.e_m)-(1+\tau_l)w_m-r_m k_m-pE(1+\tau_{e.m})e_m-\lambda(J+P)$

(2-13)

$$rV=-c+(J-V)$$

The first conditions of the labor-to-capital and labor-to-energy ratios are as follows:

(2-14)

$$A_m f_k'(k_m.e_m)=r_m;A_m' f_e(k_m.e_m)=PE(1+\tau_{e.m})$$

Which means:

(2-15)

$$\mathrm{rJ}=\mathrm{y}\,(k_m.e_m)-(1+\tau_l)W_m-\lambda(J+P)$$

Where labor productivity is defined as follows:

(2-16)

$$\mathrm{y}=(k_m.e_m)-r_m k_m-pE(1+\tau_{em})e_m$$

Free arrival at a job vacancy indicated v=0, i.e.,

(2-17)

$$\mathrm{J}=\frac{c}{q}$$

Which suggests that in the equilibrium, the expected profit of a job must make up for the expected cost of a vacancy.

To remove J, the employment cost is assumed to be a constant ratio of the producer's wages in the official sector c=v $(1+\tau_l)W_m$.

(2-18)

$$\mathrm{Y}\,(k_m.e_m)=(1+\tau_l)w_m\left[1+(\lambda+r)\frac{v}{q}\right]+\lambda P$$

The official sector's wage is equal to workers' wage.

(2-19)

$$w_m+\lambda P=z+b-\sigma$$

The wage rate:

(2-20)

$$\frac{W_m-(Z+B-\sigma)}{W_m}+\frac{\lambda P}{w_m}=\frac{\beta}{1-\beta}v[\frac{r+\lambda}{q}+s\theta]$$

The equation that calculates the utility of the search intensity can be written as follows:

(2-21)

$$\sigma' = \frac{\beta}{1-\beta}\theta v w_m$$

Migration equilibrium conditions are defined as follows:

(2-22)

$$w_a + X_a + r\phi_f = rU$$

The steady state is characterized by zero migration flows f=0, with workers being indifferent to staying in the agricultural and urban sectors.

(2-23)

$$w_a + X_a = z + b + \sigma[\varepsilon_\sigma - 1]$$

One of the main obligations of a government is to procure public goods G and transfer them to the unemployed:

(2-24)

$$\text{G+u}L_m b = \tau_L w_m(1-u)L_M\left[1 + v\frac{r+\lambda}{q}\right] + \tau_{e.m}PEe_m(1-u)L_m$$

The assumptions are that goods produced in official and unofficial sectors are fully replaceable, the government limits its consumption to these goods, its revenue comes from energy taxes in the official sector, value-added taxes $\tau_{e.m}PEe_m(1-u)L_m$, and costs of capital employment taxes $\frac{\tau_L W_m(1-u)L_m v(r+\lambda)}{q}$. Meanwhile, green tax policy implications for labor market results can be examined by solving a parametric model and policy-making discussions in two areas. In one area, there are various cases of tax laws. In the second area, there are various modeling hypotheses that may concern government expenses.

Previous analyses have shown that green tax reforms will have different impacts on the employment and production of urban sector employees (Zare'ei et al., 2019).

Concerning the interplay between government expenditure and other sectors of the economy, government expenditure for a certain amount of household income I is defined as follows as it affects household welfare.

(2-25)

$$\text{U(I)}=c_A^{\alpha A} c_M^{\alpha M} G^\theta$$

The social welfare measure is defined as the weighted sum of the utility of all households (the official, unofficial, and rural sectors):

(2-26)

W=(1-u) lmU (wm+λP)+uLmU(z+b)+LaU(wa)

Where U represents the household welfare function. The weighted utilities given represent social welfare, listed in previous research. Moreover, the social welfare measure is stated as the utility of each economic factor.

3. Literature Review

Numerous research articles have investigated the significance of carbon footprints and green taxes. The most important of these are as follows:

In the study, "Effects of Green Taxes on Unemployment (Case study: Member States of the Organization for Economic Co-operation and Development)", Amin Rashti and Siami Araghi (2011) concluded that this type of taxes could successfully increase the quality of the environment. However, the study hypothesizes whether or not these taxes have replaced other taxes, which should be examined under *added dividends*. This study tested the above hypothesis through cross-sectional-time series data for some OECD countries where green taxes are employed, using two models. The study found that in the first model, greenhouse gas emissions had affected green taxes and in the second model, green taxes had served as an independent variable affecting unemployment.

In the study "Estimation of Labor Demand Function in the Industry Sector in the Iranian Economy", Mowlaei and Ashtiani (2012) investigated the important factors affecting this function using two static and dynamic models. They concluded that in the short and long run, labor demand will be inversely related to labor wages and directly related to value added, capital stock, and labor productivity.

In the study, "Green Taxes: a Factor Which Has Been Neglected in Industrial Planning of Iran", Feizpour, Shahmoradi, and Asayesh divided industrial outputs by the amount of pollution they produced and measured their profitability. Findings suggested that in all cases, the profitability of polluting industrial outputs was significantly higher than that in clean industries.

In the study "Simulation of Green Tax on Economic Growth in Iran: Application of Computable General Equilibrium (CGE) Approach", Jafari Samimi and Alizadeh (2016) simulated green taxes on the Iranian economic growth by applying the CGE approach, concluding that indirect taxes could boost economic growth in all scenarios.

In the study "The Estimation of Optimum Green Tax on Emission of CO_2 by Cement Industry in Iran", Hassanloo, Khalilian, and Amirnejad (2015) estimated relevant green taxes on carbon dioxide emissions in the cement industry. The estimation of the model parameters indicated the significance of all variables except for the variable of the interplay between personnel costs and equipment maintenance and repair costs. Findings also showed that the rate of green taxes on the cement industry's carbon dioxide emissions amounted to 15% per ton of output.

Forootan, Pajouyan, Ghaffari, and Khodadad Kashi (2021) investigated the effects of levying green taxes on energy consumption in Iran, concluding that signs of internal price elasticity could be confirmed based on theoretical expectations. They also demonstrated that the two groups, i.e., household energy and transportation fuel experienced almost elastic prices for all three income groups; it was also noted that the commodity group of transportation fuel was deemed a luxury commodity for the poor and middle groups of society, while as a necessary commodity for the wealthy; meanwhile, the household energy group was thought of as a necessary commodity for all households.

In the study "Estimation of Disequilibrium Aggregate Labor Market", Rosen and Quant (1997) investigated the U.S. labor market. They used annual figures from 1930 to 1973 to examine four equations of labor demand, real wage adjustment, and the observed supply of workforce. They found that labor demand was a function of the private sector's wages at the fixed price of 1958, gross national product at fixed prices, and the time trend variable.

In the study "Green Taxes and Double Dividends in a Dynamic Economy", Glom & Kawaguchi (2008) employed a general equilibrium model for the American economy, arguing that increasing gasoline taxes and reducing capital taxes would entail two types of welfare effects: increasing good consumption (efficiency utility) and increasing the quality of the environment (green utility). Findings revealed how many people were ready to pay for the quality of the environment; other findings showed that the size of green utility was smaller than efficiency utility.

Anthony (2013) investigated the effects of environmental taxes from diesel and electricity carriers on workforce revenue using the computable general equilibrium (CGE) method. Findings showed that when tax bases were reduced, welfare costs of controlling emissions in the U.S., China, and India declined by 28, 89, and 97%, respectively.

Varquez-Rowe et al. (2014) investigated the use of energy and greenhouse gas emissions in fishing. This study applied the Life Cycle Assessment (LCA) method and the Environmental Data Analysis (EDA). Data were collected from six Spanish fishing fleets from 2007 to 2011. It was found that around 1.25 of global greenhouse gas emissions were caused by fishery.

Shigeru Matsumoto (2022) investigated the effects of carbon taxes on household energy mix, suggesting that households take into account relative prices of various sources when selecting ideal energy sources. Carbon taxes were found to affect the selection of household energy by relatively changing prices of various energy sources. It was demonstrated that increasing carbon tax rates could reduce the advantage of cheap energy source prices against expensive energy sources. Thus, households are expected to shift from cheap energy sources to expensive energy sources.

The literature has shown that none of the studies has employed dynamic models to determine if taxes affect economic productivity. Meanwhile, carbon tax implications require the model's structure to be specified in a way that 1: it represents the course of time (time trend), and 2: it determines the direct channels that can represent the effects of carbon taxes. While the effects of carbon taxes on economic productivity are not direct, the study's modeling takes into account the economic implications of carbon taxes through relational channels.

4. Model Estimation

Dynamic systems can model complicated socioeconomic systems based on causal loops quantitatively, rather than qualitatively, using mathematical equations and computer programs. Featuring greater flexibility in modeling large and complicated systems, dynamic systems are capable of large-scale modeling, including strategic, security, social, medical, and international problems at different time intervals and time steps (Sapiri, Zulkepli, Ahmad, Zainal Abidin & Hawari, 2017).

Dynamic systems are highly flexible frameworks characterized by modeling large and complicated systems that provide strategic, security, social, medical, and international modeling at different time intervals and time steps (Sterman, 2000).

In the dynamic system modeling process, a problem is defined by the following stages:

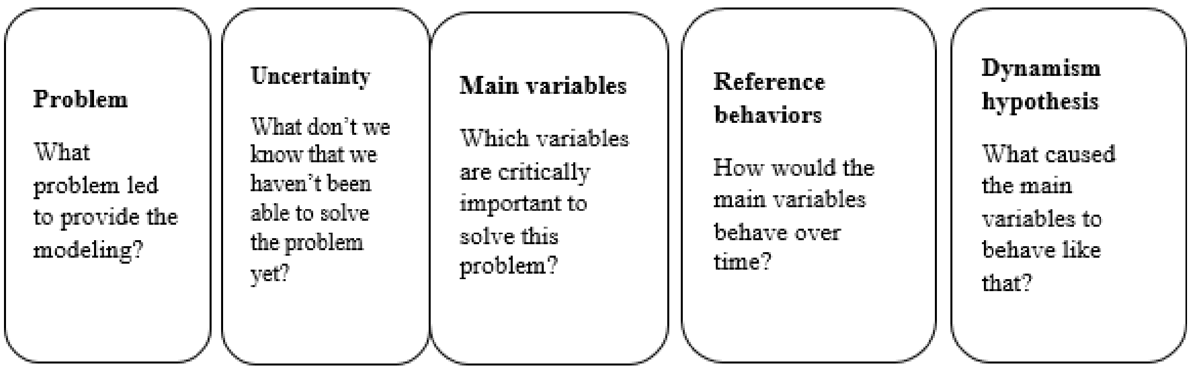

Figure 1. Dynamic Systems Modeling Process (Source: Sterman 2000)

In 1978, Alinaghi Mashayekhi presented a dynamic system model to demonstrate the crisis-hit Iranian economic situation in a transition from an oil-dependent economy to an oil-independent economy. In the article "A Dynamic Systems Model to Analyze Iran's Energy-Economic System", Mirma'soumi et al. (2011) provided a dynamic energy-economic system based on Mashayekhi's 2019 dynamic model to investigate Iran's socioeconomic system. Mohaghar et al. (2013) also investigated the dynamic behavior of domestic industries following custom tariff fluctuations using dynamic systems. Faghfouri Azar et al. (2019) also designed a dynamic model to analyze social capital using the dynamic systems approach.

It is noteworthy that figures of investment, inflation, population, taxes, minimum wages, productivity, bank interest rates, and interest rates on long-term deposits, which are the key variables of the study, were based on the time-series statistics of the Iranian economy from 1992 to 2020 and were collected from the Iranian Central Bank and its Statistical Center. Other variables are defined in Equations 4-1, 4-2, 4-3, 4-4, 4-5, and 4-6. These equations are calculated in a dynamic system using the Vensim software.

4-1: GDP- Population- Minimum wage- Interest Rate on Long-term Deposits = Labor Market Demand

4-2: (Government budget) F=Liquidity

4-3: GDP- Inflation + Green Taxes - Bank Interest Rate= Economic Welfare

4-4: F (Economic Welfare) = Productivity

4-5: Population + Taxes = Government Budget

4-6: Gross Fixed Capital (Time) - Bank Interest Rate + Liquidity = Gross Fixed Capital

Using descriptive statistics and the variables affecting green taxes in the past years, this study investigated the two key variables of GDP and carbon emissions to examine the effects of taxes on productivity. The key point is that the two variables, i.e., GDP and carbon emissions will not have a direct effect on productivity due to the system's structure, as increasing carbon emissions will change green taxes and consequently, economic welfare, which will affect productivity in itself. This is because workforce welfare will have a positive and significant effect on its motives and productivity, and employees' welfare will indirectly affect their productivity through their motives. The variable of GDP is a key variable affecting all economic sectors; for this, in this study, [GDP] had a direct effect on green taxes, which will also affect productivity through the economic welfare channel. Figure 2 below demonstrates the above materials.

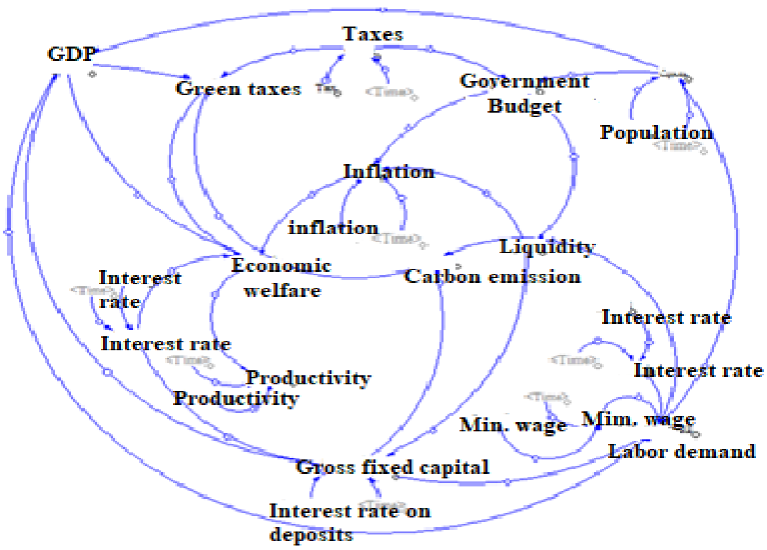

Figure 2: Dynamic carbon tax and economic welfare systems (Source: Study findings)

Figure 2 is plotted using the Vensim software and shows a causal relationship between carbon taxes and productivity. According to this figure, GDP and carbon emissions affect economic welfare through green taxes, and economic welfare affects productivity. Using the changing trend of model variables in the past and also citing some future predictions, six scenarios related to the two main model variables and model prediction were developed.

First Scenario (a 3% increase in GDP):

Since GDP has been one of the major variables affecting taxes in general and carbon taxes in specific, and the average Iranian economic growth over the last 20 years has been around 3%, this scenario exhibits the effect of a 3% rise in the GDP on the main study indexes, as given in Figure 3. Considering dynamic model structures and the systematic relationship between the variables and equations in each section, it is analytically important to understand how a variable serving the relational channel between the independent variable and the dependent variable will be affected and how it will react. Therefore, dynamic models generally show the variable's reaction over time. As shown in Fig. 3, green taxes and economic welfare, under the influence of the 3% GDP increase, see an upward trend from 1992 to 2020.

4-7: Carbon Emissions + Taxes + GDP* (3% + 1) = Green Taxes

4-8: Green Taxes + Bank Interest Rate - Inflation - GDP* (3% + 1) = Economic welfare

4-9: Productivity1 (Time) + Economic Welfare= Productivity

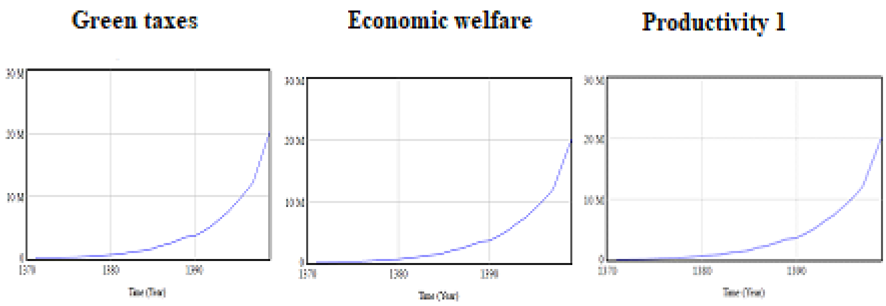

Figure 3: Productivity changes from a 3% increase in GDP (Source: Study findings)

Since the scenario is defined to determine the effects of carbon taxes on productivity, the defined chain to determine the effect indicated that taxes on greenhouse gas emissions had been affected by the variable of GDP. It is clear that the production of greenhouse gas emissions affected economic welfare and productivity.

Second Scenario (an 11% increase in greenhouse gas emissions):

According to the changing greenhouse gas emissions trend with an average of 11% over the past 20 years, the second scenario was aimed at determining the effects of carbon taxes on productivity by considering an 11% increase in greenhouse gas emissions.

4-10: Carbon emissions (11%+1) + GDP + Taxes = Green Tax

4-11: GDP - Inflation + Green Tax - Bank Interest Rate= Economic Welfare

4-12: Economic Welfare + Productivity 1 (Time)= Productivity

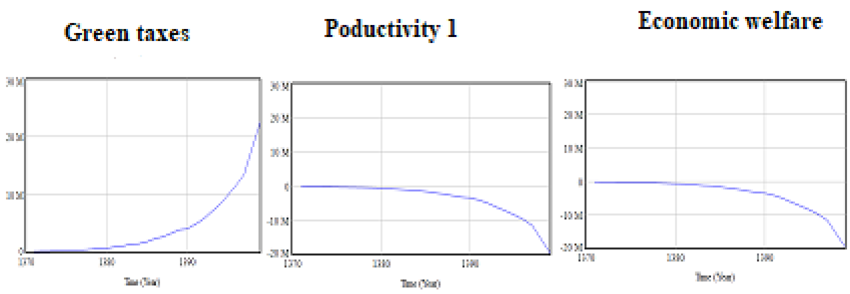

Figure 4: Changes in green taxes, economic welfare, and productivity from an 11% increase in greenhouse gas emissions (Source: Study findings)

As the model shows, an 11% rise in greenhouse gas emissions through the green taxes channel increased economic welfare and productivity. Also, to examine the direct effects of carbon dioxide emissions on economic welfare, shown in Figure 4, if carbon emissions are not increased from the green taxes channel, they will decrease economic welfare and productivity.

Third scenario (a 2.5% increase in green taxes):

Since one of the effective variables on productivity has been carbon taxes in general and economic welfare in specific and the average green taxes in the Iranian economy has been 2.5% over the past 20 years, Figure 5 exhibits the effects of a 2.5% increase in green taxes on economic welfare and productivity. As shown, economic welfare and productivity were affected by changing green taxes. As green taxes increased, the consumption of fossil fuels and consequently, pollution decreased, which led to an increase in the economic welfare of society.

4-13: Inflation - GDP + Bank Interest Rate - Green Taxes (2.5%+1) = Economic Welfare

4-14: Economic Welfare + Productivity 1 (Time)= Productivity

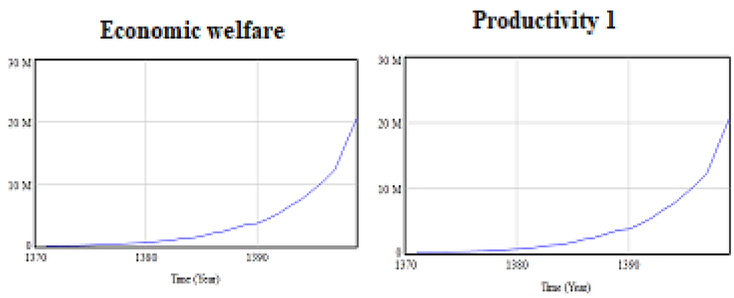

Figure 5: Changes in economic welfare and productivity from a 2.5% increase in green taxes (Source: Study findings)

Fourth scenario (a 3% increase in GDP; predicting the time interval from 2021 to 2027)

This scenario takes into account the effects of a 3% increase in GDP for a 6-year time interval (from 2021 to 2027), predicting a 2.7% increase in GDP for the interval. The results are exhibited in Figure 6 below. As given by the figure, GDP helps increase greenhouse gas emissions and consequently, increase green taxes, boosting productivity and economic welfare to experience an upward trend.

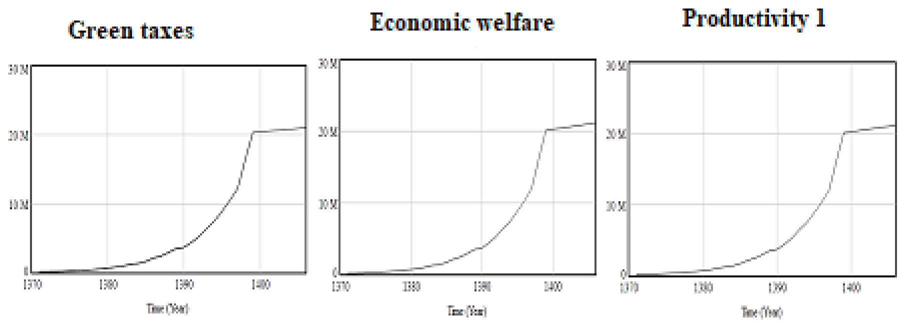

Figure 6: Predicting changes in green taxes and economic welfare and productivity from a 3% increase in GDP (Source: Study findings)

Fifth scenario (an 11% increase in greenhouse gas emissions; predicting the time interval from 2021 to 2027)

Since greenhouse gas emissions can affect green taxes (the inhibitor factor), this section considers an 11% increase in greenhouse gas emissions based on its past trend. Also, a 2% increase in greenhouse gas emissions was projected for the time interval from 2021 to 2027. As noted in Figure 7, increasing greenhouse gas emissions has had no significant effect on green taxes and consequently, economic welfare and productivity. This scenario only considered the effects of an 11% increase in greenhouse gas emissions, assuming that the GDP rate is constant. Because carbon emission changes are smaller than GDP changes, increased carbon emissions will not fundamentally have a significant effect on green taxes, economic welfare, and consequently, productivity.

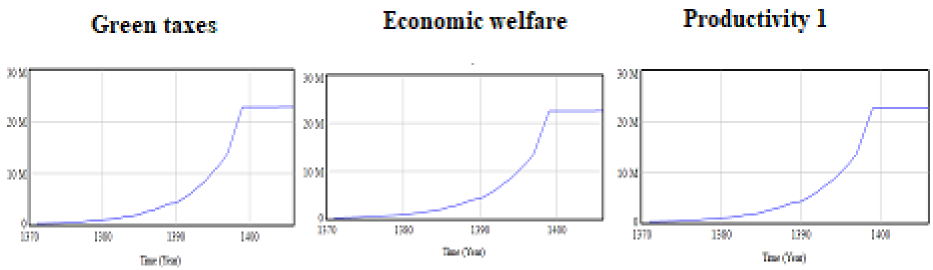

Figure 7: Predicting changes in green taxes and economic welfare and productivity from an 11% increase in carbon dioxide emissions (Source: Study findings)

Sixth scenario (a 2.5% increase in green taxes; predicting the time interval from 2021 to 2027)

This scenario considered the effect of a 2.5% increase in green taxes for a 6-year time interval from 2021 to 2027, projecting a 1% increase in green taxes from 2021 to 2027. The results of this are exhibited in Figure 8. As noted, as green taxes increase, so will economic welfare. Meanwhile, since economic welfare and productivity are positively and directly correlated, productivity will increase, also.

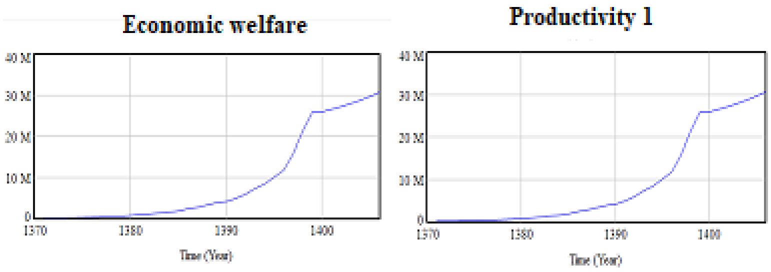

Figure 8: Predicted changes in economic welfare and productivity from a 2.5% increase in green tax (Source: Study findings)

5. Conclusion

Two GDP and carbon dioxide emissions indexes as the channels through which carbon taxes affect productivity were used to answer the question *How do carbon taxes affect productivity factors through the labor market demand channel?* Under the effects of a 3% increase in GDP, green taxes, economic welfare, and productivity followed an increasing trend from 1992 to 2020. On the other hand, the second scenario showed that increasing carbon emissions, if not made through the green taxes channel, will reduce economic welfare and productivity, resulting in carbon dioxide emission changes affecting the extent to which green taxes can affect productivity in Iran. The third scenario showed that considering the 2.5% growth rate over the past 20 years, as demonstrated by the figure, increasing green taxes would reduce fossil fuels and consequently, pollution, which would help strengthen the society's economic welfare. It is thus recommended that policy-making should focus on two GDP and carbon dioxide emission channels to make green taxes affect productivity positively. According to dynamic system features and related scenarios defined for the model estimation, GDP growth was projected to increase greenhouse gas emissions, driving productivity and economic welfare toward an upward trend. However, according to the economic welfare scenario, increasing carbon emissions did not have a considerable effect on economic welfare and productivity because the extent to which increasing carbon emissions affect green taxes and economic welfare would be highly insignificant compared to GDP. As known, because an immense part of government spending is set aside for civil and capital expenditure and this factor is correlated with CO_2 production, findings suggest that public policies to increase green taxes should be tailored to the increase in carbon dioxide emissions to help boost economic welfare and productivity.

Reference

1. Chadha, B, Prasad, E, (1994). "Are prices countercyclical? Evidence from the G-7", *Journal of Monetary Economics, No 34, pp 239–257.*
2. Faghfouri Azar, A., Bakouie, F., Mahdavi Adeli, M. H., Radfar, R., & Afshar Kazemi, M. A. (2019). Designing a Dynamic Model to Analyze Social Capital with System Dynamics Approach. *Social Capital Management*, *6*(4), 445-473. doi: 10.22059/jscm.2019.282916.1866
3. Feizpour, M. A., Shahmohamadi Mehrjardi, A., & Asayesh, F. (2014). Green Tax: a Factor which Has Been Neglected in Industrial Planning of Iran. *Journal of Environmental Studies*, *40*(2), 401-413. doi: 10.22059/jes.2014.51208
4. Forootan, F., Pajouyan, J., & Ghaffari, F. (2019). The Evaluation of the Impact of Price Regulation on Energy Demand: Quantile Regression Approach. *Industrial economic reserchs*, *3*(9), 19-38. doi: 10.30473/indeco.2019.7013.
5. Glomma, Gerhad; Daiji Kawaguchi. (2008). Green taxes and double dividends. *Journal of Policy Modeling, 30,19–2. 8)*
6. Hassanloo, S., Khalilian, S., & Amirnejad, H. (2016). The Estimation of Optimum Green Tax on Emission of CO_2 by Cement Industry in Iran. *Environmental Researches*, *6*(12), 39-50.

7. H. Hu, Alen., Kuo, Chien-Hung., H. Huang, Lance., Su, Chao-Chin. (2016). Carbon footprint assessment of recycling technologies for rare earth elements: A case study of recycling yttrium and europium from phosphor. *Waste manage, Volume 60, February 2017, Pages 765-774.*
8. Jafari Samimi, A., & Alizadeh Malafeh, E. (2016). Simulation of Green Tax on Economic Growth in Iran: Application of Computable General Equilibrium (CGE) Approach. *Economic Growth and Development Research, 6(22), 70-57.*
9. Moller, N. F. (2017). Energy Demand, Substitution and Environmental Taxation: An Econometric Analysis of Eight Subsectors of the Danish Economy. *Energy Economics, 61, 97-109.*
10. Mowlaei, M., & Ashtiani, M. (2012). Estimation of Labour Demand Function of Industry Sector in Iranian Economy during 1353-1387 *Economics Research, 12(45), 227-242.*
11. Nong, Duy, Simshauser, Paul., Nguyen, Duong Binh. (2021). Greenhouse gas emissions vs CO_2 emissions: Comparative analysis of a global carbon tax. *Applied Energy Volume 298, 15 September 2021, 117223.*
12. Rashti, N.A., Araghi, E.S., & Shayeste, M. (2014). Relationship between financial development and economic growth, evidence from financial crisis. *Asian Economic and Financial Review, 4*, 930-940.
13. Rosen, H. Quant R. (1997). "Estimation of Disequilibrium Aggregate Labour Market", *The Review of Economics Statistic, No. 6, pp. 998-1020*
14. Sapiri, H., Zulkepli, J., Ahmad, N., Abidin, N. Z., & Hawari, N. N. (2017). *Introduction to system dynamic modelling and Vensim software*: UUM Press: UUM Press
15. Shigeru Matsumoto. (2022). “How will a carbon tax affect household energy source combination?”. *Energy Strategy Reviews 40 (2022) 100823*
16. Zarei, P., Jalaei, S.A., & Sadeghi, Z. (2019). Simulation and prediction of the green tax effect on energy consumption and intensity in Iran using a genetic algorithm. *Journal of Tax Research*.