Iran. Econ. Rev. Vol. 19, No. 2, 2015. pp. 211-237

Modeling of Growth and Welfare Effects of Tax Reform in Iran: A Static Computable General Equilibrium Analysis

Hamid Hooshmandi*[1], Majid Sameti[2], Rozita Moayedfar[3]

Received : 2015/10/13 Accepted: 2015/11/21

Abstract

For several decades, the selection of a proper tax base has been among the most serious concerns for the economic policy makers. The computable general equilibrium models analysis provides a comprehensive framework for the investigation of the effects of the adopted policies on the economy of a country. In the present study, using a static computable general equilibrium, the effects of tax reform in Iran have been taken into account. The results of the static comparative analysis show that a reduction in the capital income tax and the wage tax leads to the enhancement of the economic growth and welfare of Iranian households. Besides, the policy of decreasing the consumption tax results in a decrease in the economic growth of the country. Simulation results of the comparative static analysis show that the wage tax has the greatest effect on the economy of the country. The second greatest effects are associated with the capital income tax and the consumption income tax, respectively.

Keywords: Economic Growth, GAMS, Static Computable General Equilibrium, Taxation.
JEL Classification: H21, H24, D58.

1. Introduction

The idea of the multipart general equilibrium growth model was first developed by Johansen (1960) as the first experiment in the application of the general equilibrium model. Dervis et al. suggested that CGE models are more appropriate than the other methods for programming and analysis of the economic policies in the compound markets since independent decisions in these markets are made by different associations and the market mechanisms exert a significant effect on the allocation of the resources.

1. Ph.D. Student of Economics, Economics Department, Isfahan University, Isfahan, Iran (Corresponding Author: hoshmandy_h@yahoo.com).
2. Associate Professor, Economics Department, Isfahan University, Isfahan, Iran (sameti.majid.ui@gmail.com).
3. Assistant Professor, Economics Department, Isfahan University, Isfahan, Iran (r.moayedfar@ase.ui.ac.ir).

CGE models are mostly used in the economics of developing countries in microeconomic scale, where estimation of the effects of the different structures of tax and tariffs or energy policies on the social welfare is in the focus of attention. In developing countries, these models are applied in the medium-term and long-term programs of the different microeconomic and macroeconomic scenarios (Tayyebi, 2006). Robinson (1989) was a pioneer in the application of the CGE models in developing countries. Demelo (1988) also made use of these models for the analysis of commerce policies in developing countries.

In recent years, numerous studies on the implementation of the tax on the consumption and its corresponding merits over the taxation on the capital income and wages have been conducted so that the accumulated capital and saving can be encouraged. In the conduction of tax reform, the main problem is to select an appropriate and correct taxation basis. This choice has important consequences in terms of savings, economic growth, and accumulated capital.

Both public finance and policy makers are willing to know which kind of taxation causes the least damage and shows the maximum efficiency in achieving the target income. One important issue related to the taxation system is to determine whether the taxation helps in the promotion of economic growth or rather hinders the growth. In the economic literature, several questions concerning the relationship between the income tax of the production factors and economic growth may be posed as follows: How does the income tax of the production factors affect the long-term pattern of economic growth? How do modifications in the amounts of the accumulated capital change the results of the incidence of taxation in practice?

The aforementioned questions have been taken into account by Atkinson and Stiglitz (1980) within the framework of the neoclassical balanced growth pattern as well as the life cycle.

The preliminary work on taxation using the general equilibrium model was carried out by Harberger (1962). In his study, Harberger made use of a bipartite equilibrium model with two parameters (i.e., the work force and the capital). Subsequently, Shoven and Whalley (1972) used the computable general equilibrium model of taxation for the USA. These preliminary studies set the ground for further research on computable general equilibrium models (Shoven and Whalley, 1992).

2. Literature Review

2.1 Related Theories

Atkinson and Stiglitz (1980) provided a theoretical analysis of the impacts of capital income tax within the two frameworks of neoclassic growth and life cycle model. Based on their observations, in both cases, tax exerts a negative effect on savings and accumulated capital.

Blanchard and Fisher (1989) analyzed the government in a decentralized economy based on the Ramsey model, where government costs are defined as exogenous. In their study, the effects of variations in government costs– with respect to the financing method– on the equilibrium were also taken into account. In this regard, variations in government costs have been analyzed while the budget is balanced. It has also been assumed that the government consumes the resources and pays the related costs through taxes. If the government imposes lump sum tax per capita, then in the steady state of the government costs, the private sector's consumption dramatically deteriorates while the accumulated capital remains unchanged. If the government applies tax on the capital returns and revenues the taxes to the private sector as lump sum, the said tax causes disturbance and thus affects the resource allocation. In this scenario, the capital tax causes the accumulated capital of the steady state to decrease. Furthermore, the level of consumption in the steady state goes down. By modeling the overlapping generation pattern, they then concluded that if the increases in the government expenses are compensated by parallel increases in the taxes, the accumulated capital and consumption in the steady state decrease.

Using a series of modifications, Barro and Sala-Martin (2004) considered the role of the government in the preliminary model of Ramsey. It has been assumed that the government performs a balanced budget, and also wage income tax τ_w, private asset income tax τ_a, consumption tax τ_c, and firms' earnings tax τ_f, are imposed. It has also been assumed that each household creates a fixed amount of work. In the said model, capital income is effectively doubly taxed: once in the firm level in the rate of τ_f, when the earnings are given to the firm, and the second tax is associated with the household level in the rate of τ_a when this income is received as the rental payments. In their suggested model, the rates of the income tax and wage tax are disregarded from the equilibrium conditions. This problem is due to the assumption that the amount of the work force supply by the

household is fixed. In this case, the lump sum wage tax is presumed to be with no disturbance. If the leisure-work can be selected, then τ_w is no longer considered as a lump sum tax and does not affect the equilibrium. If τ_c is fixed, then the rate of consumption tax does not affect the consumption choice by the passage of time. On the other hand, probable changes in τ_c affect the current and future consumption growth. For instance, if the rate of the consumption tax is expected to increase in the future ($\dot{\tau}_c > 0$), then individuals are inclined to increase their current consumption while they are likely to decrease their future consumption. In this context, as time passes, the consumption rate decreases. Despite the selection of leisure-work, even a fixed τ_c with an impact on the work force supply can affect the equilibrium. In the said model, the imposition of taxes on the income from capital results in a decrease in the level of capital and consumption in the long term. These effects are due to the fact that the said taxes are inclined to decrease the saving.

2.2 Empirical studies

Using computable general equilibrium, Zonoor (2003) conducted a case study of Iran and concluded that the imposition of tax on sale with a rate of 25% results in a decrease in the rate of employment in construction and industrial sectors, while it increases the employment in the service sector. Tax imposition on the wage in the industrial sector results in a decrease in the work force involved, while it increases the employment in other sectors. The imposition of tax (as great as 25%) on the capital income results in a decrease in the capitals and an increase in the employment in the industrial section. However, this generally results in a decrease in the production amount in the industrial section. This taxation has resulted in an increase in the accumulated capital in the construction and service sectors, while it has decreased the accumulated capital in the agricultural sector.

Using a general equilibrium approach, Bhattarai and Okyere (2005) investigated the growth and welfare effects of replacing the taxation on sale with different ratios with the taxation on sale with uniform ratios among all sectors in Ghana. Through the implementation of different scenarios, it has been demonstrated that the replacement of the different tax on sale ratios existing in the basic state with the uniform tax on sale ratios of 1% and 5%– based on the 0.15 and 0.25

elasticity of substitution in production – results in the static profits of 2.2% and 2.5% GDP in Ghana.

According to Myles (2009), taxation produces a negligible effect on economic growth. He made use of both the final price and the average price of the tax. Based on his study, economic growth is affected by numerous factors, and hence the totality of all these factors must be taken into account.

Lumbantobing and Ichihashi (2012) studied the effects of tax structure on economic growth and income distribution. The panel dataset used consisted of 65 countries over the period 1970-2006. Based on their findings, the rates of the income tax of the companies have a significant negative effect on the economic growth and income inequality. However, the rates of the income tax of the individuals produce no effect on economic growth and income inequality.

Using a computable general equilibrium model, Hernandez (2012) investigated the effects of removing the wage income taxes on the work force market of Columbia. Based on his study, removal of the said tax has a negligible effect on the rate of unemployment.

Amir et al. (2013) studied the effects of the latest tax reforms on key macroeconomic variables and distribution of assets and incomes in Indonesia. They found that, under the assumption of the balanced budget, reductions in the income tax of individuals and that of companies might affect economic growth. These modifications in the policies also result in a slight decrease in the tax incidence of the assets. However, the said policies can also increase income inequality since such reductions in taxes are more advantageous for upper class families who have higher incomes.

3. Research Model

In order to achieve the research objectives, the present study has adopted the standard general equilibrium model, developed by Lofgern et al. (2002) and Decaluwé et al. (2013). The suggested model has also been modified in terms of the economic properties of Iran. In what follows, this model will be explained in detail.

3.1 Production sector

It is assumed that firms are active in a competitive environment. Each firm maximizes its profits with respect to the production technology, and accordingly the price of all commodities and services as well as

the production factors are defined. In other words, any given firm is presumed to be price taker. The production technology has a nested structure as follows.

It is assumed that in the high level of production structure, the output of each activity is obtained from the combination of the added value and the intermediate goods with constant shares as complementary. In other words, two classes of input in the high level of production structure are complementary rather than substitutive. This combination is done based on the production function of Leontief as follows.

$$VA_j = \nu_j XST_j \quad (1)$$

$$CI_j = io_j XST_j \quad (2)$$

In these relations, CI_j is the total intermediate goods of the j^{th} industry, VA_j is the added value of the i^{th} industry, XST_j demonstrates the total output of the i^{th} industry, io_j shows the intermediate consumption factor in Leontief function, and ν_j is the coefficient of the added value in Leontief function.

In the next stage of the production structure, the added value consumed by each industry is achieved by the combination of the work force and the capital. In this study, it is assumed that the combination of the work force and the capital has a flexible

substitution property. Besides, they are assumed to be combined based on the production function with constant elasticity substitution. Thus:

$$VA_j = B_j^{VA}\left[\beta_j^{VA} L_j^{-\rho_j^{VA}} + (1-\beta_j^{VA}) K_j^{-\rho_j^{VA}}\right]^{-\frac{1}{\rho_j^{VA}}} \quad (3)$$

where K_j is the demand of the j[th] industry for the capital, L_j is the demand of the j[th] industry for the work force, B_j^{VA} is the scale parameter of the added value, β_j^{VA} is the share parameter for the added value, and finally ρ_j^{VA} shows the elasticity parameter for the added value.

The optimization behavior of the firm based on the maximization of profit or minimization of the related costs results in the demand for the work force and the capital. Moreover, if the marginal products of the work force and the capital are considered equivalent to their prices, then the wage rate and the capital rent rate are respectively obtained. Under the assumption of the CES structure, based on the optimum behavior of the firm, the firm's demand from the work force with respect to the capital can be expressed as follows:

$$L_j = \left[\frac{\beta_j^{VA}}{1-\beta_j^{VA}} \frac{R_j}{W_j}\right]^{\sigma_j^{VA}} K_j \quad (4)$$

In the above relation, R_j is the rate of the capital rent by the j[th] industry and W_j the rate of the work force rent by the j[th] industry. Moreover, σ_j^{VA} stands for the transformation elasticity of the added value in CES function, which can be written as follows:

$$\sigma_j^{VA} = \frac{1}{1+\rho_j^{VA}} \quad (5)$$

Besides, it is assumed that the composite input of the intermediate goods used by a typical firm is a combination of different goods and services. Furthermore, the said intermediate goods are assumed to be

obtained from the combination of different goods and services based on the Leontief framework of technology, where no substitutive relations among the related factors exist. Therefore,

$$DI_{i,j} = aij_{i,j} CI_j \quad (6)$$

where $DI_{i,j}$ is the intermediate consumption of the i^{th} goods by the j^{th} firm and $aij_{i,j}$ are the input-output coefficients.

3.2 Institutions

3.2.1 Households

In this model, it is assumed that the household income is received from the sale of the work force, the capital, and the government transfer payments:

$$YH_h = YHL_h + YHK_h + YHTR_h \quad (7)$$

where YH_h is the total income of the *h*th household, YHL_h the work force income of the *h*th household, YHK_h the capital income of the *h*th household, and $YHTR_h$ shows the income transfer to the *h*th household. By subtracting the tax and household transfer to the government, the disposable income of the household can be achieved. Besides, household saving is assumed to be a linear function of its disposable income.

3.2.2 Firms

A firm's income involves its capital income and the transfers received from the other institutions that can be expressed as follows:

$$YF_f = YFK_f + YFTR_f \quad (8)$$

where YF_f is the total income of activity *f*, YFK_f signifies the capital income of activity *f*, and $YFTR_f$ shows the transfer income of activity *f*.

By subtracting the income tax of the firms, the disposable income of the household can be achieved. Besides, from the rest of its disposable income, the firm's savings can be achieved after the subtraction of the firm's transfers to the other institutions. Therefore,

$$YDF_f = YF_f - TDF_f \quad (9)$$

$$SF_f = YDF_f - \sum_{ag} TR_{ag,f} \quad (10)$$

where SF_f is the saving from activity *f*, TDF_f is the income tax of activity *f*, YDF_f shows the disposable income of activity *f*, and $TR_{ag,f}$ represents the income transfers from activity *f* to the institutions.

3.2.3 Government

In the presented model, it is assumed that the government earns its income from the income taxes of both households and firms, goods and services tax, import tax, and other kinds of income. Moreover, the government earns some income from the transfer income and capital income of other institutions. The related equation can be written as follows:

$$YG = YGK + TDHT + TDFT + TPRODN + TPRCTS + YGTR \quad (11)$$

$$YGK = \sum_k \lambda_{gov,k}^{RK} \left(\sum_j R_{k,j} KD_{k,j} \right) \quad (12)$$

$$TDHT = \sum_h TDH_h \quad (13)$$

where *TDFT* shows the total income of the government from the income tax of the firms, *TDHT* represents the total income of the government from the income tax of the households, *TPRCTS* is the total income of the government from the import and production taxes, *TPRODN* stands for the total income of the government from the other production taxes, *YGK* signifies the total capital income of the government, and *YGTR* is the government transfer income.

In this model, it is assumed that the government budget deficit (positive or negative saving of the government) is the difference between the government income and expenditure. Government income subsumes transfers to the institutions and the current costs of goods and services as follows:

$$SG = YG - \sum_{agng} TR_{agng,gvt} - G \quad (16)$$

Here, *SG* is the government saving, *G* the government expenditures on goods and services, and $TR_{agng,gvt}$ is the government transfers to the institutions.

3.2.4 Foreign section

It is hypothesized that the foreign section receives payments for the values of the imports, some part of the capital income, and transfers from the domestic institutions. On the other hand, foreign costs in the domestic economy involve the value of the exports and transfers to the domestic institutions. The difference between the foreign receipts and payments is called the foreign savings, which is equal to the value of the balance of trade:

$$YROW = e\sum_{i} PWM_i\, IM_i + \sum_{k} \lambda^{RK}_{row,k}\left(\sum_{j} R_{k,j}\, KD_{k,j}\right) + \sum_{agd} TR_{row,agd} \tag{15}$$

$$SROW = YROW - \sum_{i} PE_i^{FOB} EXD_i - \sum_{agd} TR_{agd,row} \tag{16}$$

$$SROW = -CAB \tag{17}$$

Here, *CAB* is the balance of the current account, PE_i^{FOB} is the free on board (FOB) price of the export of the *i*th product (per home currency), *SROW* is the foreign savings, and *YROW* and is the foreign income.

3.3 Demand

The demand for goods and services, which may be either domestic or foreign products, subsumes the intermediate demand, household consumption demand, investment demand, government demand, and transportation demand with margin trading. Households are presumed to have Stone-Geary utility function. These utility functions are characterized by the minimum goods consumption. Besides, they are privileged over the Cobb-Douglass utility functions by the fact that such characterization does not impose the cross price elasticity of zero between two types of commodities and the unit elasticity of income for all commodities on the utility caused by the household consumption. Furthermore, the said characterization provides flexibility towards the possibility of transformation in terms of the

variations in the relative prices of the commodities in the model. The demand of household *h* for each commodity is found based on the maximization of the utility in terms of the budget limit. Therefore, the demand of household *h* for the *i*th commodity can be expressed as follows:

$$PC_i C_{i,h} = PC_i C_{i,h}^{MIN} + \gamma_{i,h}^{LES}\left(CTH_h - \sum_{ij} PC_{ij} C_{ij,h}^{MIN}\right) \quad (18)$$

where $C_{i,h}$ shows the consumption of the *i*th commodity by household *h*, $C_{i,h}^{MIN}$ is the minimum consumption of the *i*th commodity by household *h*, PC_i is the purchase price of the *i*th composite commodity (subsuming all taxes and margin profit), and $\gamma_{i,h}^{LES}$ is the final share of the *i*th commodity in the consumption budget of household *h*.

Investment demand involves the gross fixed capital formation (GFCF) and variations in the inventory. The said two components of the investment demand are separated from each other. It is assumed that the total investment cost is determined by the equilibrium constraint of the investment-savings, where the savings are presumed to be endogenous.

It is also assumed that the gross fixed capital formation is achieved by subtracting the cost of variations in the inventories from the total investment cost. Also, the GFCF is designated for different commodities with fixed parts, which clearly implies that the new capital production function is of the Cobb-Douglas type. Consequently, for a given level of investment costs, the amount of demand for any given *i*th commodity for the investment target is in proportion to its purchase price. The same hypothesis can be used for the current government expenditures on goods and services. With a given value of the current expense budget, it can be suggested that the demand value of each commodity is inversely related to its price.

$$GFCF = IT - \sum_i PC_i VSTK_i \quad (19)$$

$$PC_i INV_i = \gamma_i^{INV} GFCF \quad (20)$$

$$PC_i CG_i = \gamma_i^{GVT} G \quad (21)$$

where *GFCF* is the gross fixed capital formation, INV_i shows the final demand of the *i*th commodity for the investment targets, *IT* is the total investment cost, $VSTK_i$ represents the variations in the inventory of the *i*th commodity, γ_i^{INV} is the part of the *i*th commodity in the total investment cost, *CG* shows the public consumption of the *i*th commodity, and γ_i^{GVT} is the part of the *i*th commodity in the total current public spending of the government on goods and services.
In addition to the final application of the produced goods and services, some parts of the said goods and services are used as intermediate commodities in the production process. The intermediate demand for each goods and services can be defined as the summation of the industry's demands as follows:

$$DIT_i = \sum_j DI_{i,j} \tag{22}$$

Here, is the total intermediate demand for the *i*th commodity.

Finally, some commodities such as transportation and wholesale and retail transactions are used to transport and deliver the commodities in the market. Therefore, the final rates for the volume of the domestic productions and imports are applied to determine the said final services, which are required for the distribution of the commodities among the customers.

$$MRGN_i = \sum_{ij} tmrg_{i,ij} DD_{ij} + \sum_{ij} tmrg_{i,ij} IM_{uj} + \sum_{ij} tmrg_{i,ij}^{X} EXD_{ij} \tag{23}$$

where $MRGN_i$ is the demand of the *i*th commodity as the margin of transportation or transaction.

3.4 Supply of producers and foreign trade

This section investigates the trade relations between the domestic and foreign economies. These relations involve supply for exports and demands for imports. These two relations are found based on the specification of the customers' behaviors towards different supply resources and the supply behavior of domestic manufacturers. In this model, a small-sized country is hypothesized, and thus the prices of

the transacted commodities are global and fixed (i.e., prices of imports and exports are assumed to be exogenous).

It is hypothesized that the products of each industry are supplied to both domestic and foreign markets. The basis for the amount of supply in each of these two markets is also determined based on the income maximization behavior of the firm. The products supplied to a market are presumed to be slightly different from the products supplied to another market. In other words, it is assumed that an imperfect substitution exists between the products produced for the domestic market and those intended for the export. This assumption is used in the suggested model through the application of the aggregation function with constant elasticity transformation (CET).

$$XS_{j,i} = B_{j,i}^{X}\left[\beta_{j,i}^{X} EX_{j,i}^{\rho_{j,i}^{X}} + (1-\beta_{j,i}^{X}) DS_{j,i}^{\rho_{j,i}^{X}}\right]^{-\frac{1}{\rho_{j,i}^{X}}} \quad (24)$$

where $XS_{j,i}$ is the production of the *i*th commodity by the *j*th industry, shows the supply of the *i*th commodity by the *j*th industry for domestic market, $B_{j,i}^{X}$ is the scale parameter, $\beta_{j,i}^{X}$ points to the share parameter, and $\rho_{j,i}^{X}$ shows the elasticity parameter.

Relative supply functions are achieved from the first condition of the income maximization with respect to the aggregation function of CET:

$$EX_{j,i} = \left[\frac{1-\beta_{j,i}^{X}}{\beta_{j,i}^{X}} \frac{PE_i}{PL_i}\right]^{\sigma_{j,i}^{X}} DS_{j,i} \quad (25)$$

In this relation, $\sigma_{j,i}^{X}$ is the transformation elasticity in CET function, which can be written as follows:

$$\sigma_{j,i}^{X} = \frac{1}{1-\rho_{j,i}^{X}} \quad (26)$$

In brief, the producer's behavior, defined in terms of the nested CET functions, is in a way that at the higher level, the total products are assigned to the products of different firms in the industry, while at

the lower level, the supply of each product is distributed between the domestic market and export.

Purchasers' behavior coincides with the producer's behavior. Presumably, the local products are imperfect substitutions for the imports. In other words, the commodities are heterogeneous in terms of their production origin. Therefore, the commodities that are demanded in the domestic market are composite commodities, which are provided through the combination of the local (i.e., domestic) and the imported products. Imperfect substitution between these two groups of commodities can be defined based on the aggregation function with constant elasticity transformation as follows:

$$Q_i = B_i^M \left[\beta_i^M IM_i^{-\rho_i^M} + (1-\beta_i^M) DD_i^{-\rho_i^M}\right]^{\frac{-1}{\rho_i^M}} \quad (27)$$

Here, Q_i is the amount of demand for the *i*th composite commodity, B_i^M is the scale parameter, β_i^M is the share parameter, and ρ_i^M is the elasticity parameter.

Unlike the sellers, the purchasers minimize their expenses with respect to the CES aggregation function. The relative demand functions derived from the first-order optimization conditions can be expressed as follows:

$$IM_i = \left[\frac{\beta_i^M}{1-\beta_i^M}\frac{PD_i}{PM_i}\right]^{\sigma_i^M} DD_i \quad (28)$$

Here, PD_i stands for the price of the domestic product *i* in the domestic market, PM_i represents the price of the import product *i* in the domestic market, and σ_i^M refers to the elasticity transformation.

3.5 Prices

Different prices and price indexes naturally depend on the assumptions and the subordinated figures used. In the aggregation states, the price of an aggregation is the weighted sum of the prices of all its constituent parts. Different prices have been considered in our suggested model as follows:

3.5.1 Cost of each Production Unit in the Industry

The cost of each production unit in the industry is equal to the weighted sum of the prices of the added value and aggregated intermediate consumption; thus,

$$PP_j = \frac{PVA_j VA_j + PCI_j CI_j}{XST_j} \quad (29)$$

In this relation, VA_j / XST_j and CI_j / XST_j are weights. By multiplying the two sides of the above equation by XST_j, we have:

$$PP_j XST_j = PVA_j VA_j + PCI_j CI_j \quad (30)$$

The aggregated intermediate consumption price is a combination of the prices of the intermediate input commodities of the industry. Besides, the added value price is a combination of the capital and work force prices. Thus:

$$PT_j = (1 + ttip_j) PP_j \quad (31)$$

$$PCI_j = \frac{\sum_i PC_i DI_{i,j}}{CI_j} \quad (32)$$

$$PVA_j = \frac{WC_j LDC_j + RC_j KDC_j}{VA_j} \quad (33)$$

where PT_j is the basic price of the production of the *j*th firm and PCI_j is the intermediate consumption price index of the *j*th industry.

3.5.2 International Transactions Price

The exporting industries are permitted to sell their products in international and domestic markets. Consequently, their aggregated production equals the weighted sum of the obtained price in each market, which follows the aggregate price rule. Weights of each market are indeed the ratio of the sold products to the total amount of products. These weights change in response to the changes in relative prices, which depend on the transformation elasticity in CET. The basic price obtained by the *j*th industry is a weighted sum of the basic

prices in the domestic and export markets. The FOB price, which is paid by the purchasers in the export market, is different from what the producers receive in the said market. This difference is due to the price margin and export taxes, which are to be considered in the model.

$$PT_j = \frac{\sum_i P_{j,i} XS_{j,i}}{XST_j} \tag{34}$$

$$P_{j,i} = \frac{PE_i EX_{j,i} + PL_i DS_{j,i}}{XS_{j,i}} \tag{35}$$

$$PE_i^{FOB} = \left(PE_i + \sum_{ij} PC_{ij} tmrg_{ij,i}^{X} \right) (1 + ttix_i) \tag{36}$$

The price of the composite commodity is a weighted sum of the paid prices for the domestic and import products. The price paid for the domestic products is equal to the sum of the prices considered by the producers, the price margins, and indirect taxes. Similarly, the price paid for the imported product is a global price, which is written in terms of the home currency and is added to the import tax, price margins, and indirect tax.

3.5.3 Price indexes

Four price indexes have been defined in the model: GDP deflator index, consumer price index, investment price index, and public expenses price index.

The GDP deflator index is determined based on Fisher's index, while the consumer price index is defined based on Laspeyre's price index. On the other hand, the investment price and the public expense price indexes are determined based on the price indexes.

3.6 Equilibrium in model

In order to solve the model, it is essential to balance the supply and demand in the goods and service market with those in the factor market. Furthermore, the investment cost is supposed to be equal to the summation of the savings of the institutions. Finally, supply of the goods intended for export is to be kept in balance with the demand for the said commodities.

$$Q_i = \sum_h C_{i,h} + CG_i + INV_i + VSTK_i + DIT_i + MRGN_i \quad (37)$$

$$LS = \sum_j LD_j \quad (38)$$

$$KS = \sum_j KD_j \quad (39)$$

$$IT = \sum_h SH_h + \sum_f SF_f + SG + SROW \quad (40)$$

$$DD_i = \sum_j DS_{j,i} \quad (41)$$

$$EXD_i = \sum_j EX_{j,i} \quad (42)$$

where *LS* is the work force supply and *KS* is the capital supply.

4. Experimental Results

4.1 Required data

In order to solve our designed general equilibrium model, the data from the social accounting matrix (SAM), issued in the year 2010, has been used. Due to the model's characteristics, the SAM matrix has been modified and its extracted data have been used to solve the suggested model. In this study, four different economic sectors (i.e., agriculture, mining and industry, oil and gas, and service sectors) have been considered and aggregated. Furthermore, different economic deciles of the rural and urban households have been aggregated and used in our suggested model in the form of two institutions as rural and urban households. Besides, the required data for such parameters as part of the production factors and scale parameters have been obtained based on the economic optimization relations. Moreover, in this study, with respect to the general equilibrium model characteristics, some of the model parameters have been assumed as exogenous and have thus been investigated based on the previous national and international studies while considering the economic conditions of Iran.

Using GAMS software programming, the proposed model in the previous section has first been solved for the basic state. Then, using different scenarios for the considered taxes, the model has been solved again and the results of the variations in the target variables have been

found. Finally, the basic values have been compared with the values obtained after the application of decreased taxes and the results have been presented. With regard to each tax, the designed scenarios are 5%, 10%, 15%, 20%, 25%, and 30% reduction in the considered tax rate.

4.2 Static analysis of growth and welfare effects of wage tax reform

Decreased tax on the wage income through the increased capability for saving from the work force income results an increase in the volume of investment. As shown in Table 1, a reduction in the wage tax rate as large as 30% results in a 2.8% increase in the investment (changes of the accumulated capital) and a 0.15% increase in the gross domestic production (GDP). Reduction in the wage tax leads to an increase in the work force supply and a decrease in the production cost, and thus it results in increased investment and GDP. Decrease in the rate of wage tax affects the structure of production in the country with respect to the economic sectors. A decrease in the said tax by increasing the returns (wage) after the work force tax results in an increase in the work force supply in different sectors. In the agricultural sector, a 30% reduction in the wage tax rate leads to a 0.22% increase in the added value of the said sector. Besides, a 30% reduction in the rate of the said tax results in an approximately 0.1% increase in the added value of the industrial sector. Therefore, it can be suggested that reduced wage tax affects the agricultural sector more than the industrial sector, which is indicative of the fact that the agricultural sector is more labor-intensive than the industrial sector. Reduced wage tax rate increases the added value of the services sector much greater than that of the other considered sectors, to the effect that a 30% reduction in the said tax leads to an increase in the added value of the said sector as large as 2.7%. This finding demonstrates that the services sector is the most labor-intensive of all economic sectors, and hence it enjoys a big increase in its related added value.

Table 1. Effects of wage tax reform (%)

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Goods consumption by the urban and the rural households	0.65 0.85	1.3 1.72	1.98 2.6	2.65 3.49	3.33 4.4	4.02 5.3
Investment (changes in accumulated capital)	0.86	1.17	1.7	2.12	2.45	2.8
Gross domestic production	0.023	0.048	0.073	0.098	0.124	0.15
Added value sector	0.036	0.072	0.11	0.147	0.186	0.224
Agricultural	0.014	0.03	0.044	0.059	0.074	0.09
Industrial	0.43	0.87	1.32	1.77	2.23	2.7
services	-0.28	-0.65	-1.32	-1.84	-2.25	-2.67
Oil and gas						
Government tax income	0.098	0.2	0.3	0.41	0.5	0.62
Government consumption	-0.72	-1.02	-1.45	-1.84	-2.14	-2.67

Source: research findings

Compared to the other sectors, in the oil and gas sector, reduction in the income tax has produced a different effect and has thus resulted in a decrease in the added value of the said sector under different scenarios. Decision making on investment in the oil and gas sector is not as much affected by the market signs and signals as it is increasingly affected by the government policies, foreign exchange resources from the export of oil and gas, and foreign resource adsorption state. Two main and salient features of the said sector are its capital intensiveness and technology intensiveness. Due to the nature of its plans and projects, this industry requires considerable investments through the adsorption of different investors. In Iran, the private sector cannot generally afford to finance oil and gas projects. In the present time, parts of the financial resources required for oil and gas projects in Iran are provided with Buy Back and finance, while some parts of these projects are financed through the domestic (generally governmental) resources. It can be expressed that a decrease in government income due to the decreased rate of the wage tax leads to a decrease in the governmental capability to invest in oil and gas projects, whereas the added value in this sector goes up.

At first, the decreased rate of the wage tax reduces the tax income of the government, which in turn results in a decrease in the government expenditures. A 30% decrease in the rate of the said tax leads to an approximately 2.7% decrease in the government expenditures. On the other hand, after a delay, reduction in the rate of the wage tax increases the investment and gross national production, which in turn results in a increase in the government tax income. For example, a 30% decrease in the rate of the wage tax leads to a 0.6% increase in the government income. As represented by Table 1, the decrease in the amount of the said tax generally develops and produces a positive effect on the budget of the country.

Different criteria exist for the measurement of household welfare. In this work, household welfare has been measured based on the consumption of goods by households. Reduction in the rate of the wage tax has resulted in a greater increase in the household welfare of the rural families than that of the urban ones. Under scenarios 1 to 6, consumption of the urban households has risen from 0.65 to 4.02%, whereas the rural households have increased their consumption from 0.85 to 5.3%.

4.3 Static analysis of the growth and welfare effects of capital income tax reform

Decreased rate of the capital tax leads to the relative cheapness of the production factor of the capital with respect to the work force, and consequently the investment volume increases due to the decrease in the production cost. The results of Table 2 demonstrate that a decrease in the rate of the capital income tax under scenarios 1 to 6 results in an increase in the investment rate (changes in the accumulated capital) from 0.06% to 0.37%. A decrease in the rate of the capital income tax increases the amount of production in the more capital-intensive sections, and consequently the economic growth improves. According to Table 2, a 30% decrease in the rate of the capital tax results in a 0.012% increase in the gross domestic production. A comparison of the results in Tables 1 and 2 shows that a decrease in the rate of the wage tax results in a further increase in the investment and gross domestic production of the country, which generally shows the labor-intensiveness of the Iranian economy. Reduction in the capital income tax by increasing the returns after the capital tax results in an increase in the accumulated capital, and thus it obliges the firms to substitute

this production factor for the work force. For instance, a 30% decrease in the capital income tax rate results in an approximately 0.01% increase in the added value of the agricultural sector. Implementation of this policy in the industrial sector results in an approximately 0.3% increase in its related added value.

Table 2. Effects of capital income tax reform (%)

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Goods consumption by the urban and the rural households	0.005 0.012	0.011 0.026	0.017 0.039	0.024 0.03	0.028 0.065	0.034 0.078
Investment (changes in accumulated capital)	0.06	0.12	0.183	0. 24	0.29	0.37
Gross domestic production	0.002	0.004	0.005	0.008	0.009	0.012
Added value sector	0.014	0.028	0.043	0.54	0.071	0.086
Agricultural	0.048	0.096	0.14	0.192	0.24	0.288
Industrial	-0.011	-0.023	-0.034	-0.045	-0.057	-0.068
services	-0.11	-0.21	-0.327	-0.44	-0.55	-0.654
Oil and gas						
Government tax income	0.036	0.073	0.11	0.147	0.185	0.22
Government consumption	-0.11	-0.22	-0.31	-0.44	-0.54	-0.67

Source: research findings

Due to the wide application of capital in the industrial sector, the added value of the said sector is increased more by the policy of reduced capital tax than the policy of decreased wage tax. This indicates the capital-intensiveness of the industrial sector in Iran. Reduced rate of the capital income tax in the services results in the increased production in the said sector. However, this increase is not enough to compensate for the decreased production due to the loss of the work force in this sector, and subsequently the added value of the services decreases. Therefore, a 30% decrease in the rate of the capital income tax results in an approximately 0.07% decrease in the added value of services. Based on the results in Table 2, the implementation of this policy also results in a decrease in the added value in the oil and gas sector.

Reduced rate of the capital income tax first reduces the government expenditures and then increases its income tax, and thus the government budget improves. However, the policy of decreasing the said tax has less effect on the government budget than the policy of decreasing the wage tax. A 30% decrease in the rate of the capital income tax results in an approximately 0.7% decrease in the government expenditure, while it leads to a 0.2% increase in the rate of the government tax income.

According to our results, a decrease in the rate of the capital income tax in our considered scenarios has generally increased the Iranian households' welfare. However, the Iranian rural families have enjoyed more household welfare than the urban families. In this context, the reduced rate of the capital tax has caused the rural households to increase their consumption from 0.012 to 0.078%.

4.4 Static analysis of growth and welfare effects of consumption tax reform

In this section, the static computable general equilibrium model is analyzed in light of the consumption tax. It is expected that a decrease in the rate of the consumption tax increase the consumption demands of the individuals and decrease their savings, which in turn results in the reduced volume of investment in the economy. A 30% decrease in the rate of the consumption tax results in a 0.12% decrease in the investment as well as a 0.0022% decrease in the gross domestic production (Table 3). It can be observed that, compared to the other two said taxes, this tax has a minimal effect on the investment and production in the country. This finding is in complete agreement with our theoretical expectations.

Table 3. Effects of consumption tax reform (%)

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Goods consumption by the urban and the rural households	0.03 0.004	0.025 0.007	0.038 0.011	0.051 0.014	0.064 0.018	0.08 0.021
Investment (changes in accumulated capital)	-0.019	-0.039	-0.059	-0. 079	-0.099	-0.12
Gross domestic	-0.0003	-0.0007	-0.001	-0.0015	-0.0019	-0.0022

production						
Added value sector	0.01	0.02	0.031	0.041	0.051	0.062
Agricultural	0.03	0.065	0.098	0.13	0.16	0.2
Industrial	00	-0.001	-0.002	-0.003	-0.003	0.004
services	-0.22	-0.44	-0.67	-0.89	-1.11	-1.31
Oil and gas						
Government tax income	0.017	0.033	0.05	0.067	0.084	0.1
Government consumption	-0.22	-0.44	-0.65	-0.89	-1.11	-1.32

Source: research findings

A 30% decrease in the rate of the consumption tax in industrial, agricultural, and services sectors results in 0.2%, 0.062%, and 0.004% increases in the added value of the said sectors, respectively. Based on the observations, the greatest increase is related to the added value of the industrial sector. This can be explained by the fact that in the industrial sector, larger volume of commodities pass through the market channel. Similar to the abovementioned policies, this policy also has a negative effect on the added value of the oil and gas sector.
Based on the results of Table 3, the decreased rate of the consumption tax under our considered scenarios increases the government tax income and decreases its related costs, and consequently it generally improves the government budget. A 30% decrease in the rate of consumption tax results in a 0.1% increase in the government tax income and a 1.3% decrease in the government expenditures.

According to Table 3, the decreased consumption tax effect on the household welfare for the urban households is greater than the said effect for the rural households. This can be due to the more dependency of the urban families on the market commodities. The results show that, based on the defined scenarios, the urban household consumption has increased from 0.03 to 0.08%.

5. Results and Discussion

Financial policies can affect the level of economic activities by changing the returns after the application of the tax. The idea of transferring from the income tax into the consumption tax is a challenging issue in economics. In the present study, a static general equilibrium analysis of the effects of the tax reform on the investment, gross domestic production, household welfare, structure of production, and government budget variables has been provided. Based on the

analysis of the effect of reduction in the wage tax, it has been observed that the said policy brings about some positive effects on the accumulated capital and gross domestic production. This policy differently affects the structure of product in various economic sectors. Reduction in the wage tax rate has the greatest effect on the services, which indicates that the said sector is the most labor-intensive sector in the economy of the country. Using this policy, the welfare of the rural households increases more than that of the urban ones. This result shows that, in order to consume goods, the rural households are more dependent on the income from their work force than the urban households. In other words, the rural households' marginal propensity to consume based on the income from the work force is greater than that of the urban households. Therefore, the reduction in the wage income tax rate increases the consumption of the rural households more than that of the urban families.

According to our obtained results on the decreased capital income tax, the application of this policy increases the investment and gross domestic production. The implementation of this policy affects the structure of production in various sectors. Apart from the oil and gas sector, the most affected sector by this policy is the industrial sector, which indicates the capital-intensiveness of the said sector, compared to the other considered economic sectors. This policy has also increased the household welfare of both rural and urban families.

The results of Table 3 demonstrate that the reduction in the rate of the consumption tax results in a decrease in the investment volume and gross domestic production. Reduction in the rate of the consumption tax through the reduction in the prices of consumable goods leads to an increase in the households' demands for the said commodities, and hence it enhances the household welfare.

Reductions in all three kinds of taxes negatively affect the added value of the oil and gas sector. In Iran, domestic investment in oil and gas sector is generally performed by the government, and reduction in the government tax income decreases the added value created in the said sector. Our results also show that reduction in the rates of the wage tax, capital income tax, and consumption tax improves the government budget state. In this context, the greatest effect is related to the wage tax.

The analytic results of the static general equilibrium tax model show that, in Iran, wage tax reform exerts the greatest effects on the state

economy – followed by the capital income tax and consumption tax. Therefore, a taxation ranking can be defined in the order of magnitude as wage tax, capital income tax, and consumption tax. Based on the obtained results, our policy recommendation is that, in order to reform the tax structure in Iran, the government should follow the policy of transferring the taxes from the wage tax through the capital income tax into the consumption tax. Furthermore, the results of the research show that taxation on wages and capital income negatively and taxation on consumption positively affect the economic growth. In general, our obtained results demonstrate that the conduction of tax reforms through a decrease in the wage tax and capital income tax and through an increase in the consumption tax paves the way for further economic growth and household welfare so that the government can adopt the policy of transferring the tax base from the tax on the production factors (i.e., work force and capital) to the tax on the consumption.

References

Amir, H., Asafu-Adjaye, J., & Ducpham, T. (2013). The Impact of the Indonesian Income Tax Reform: A CGE Analysis. *Economic Modeling, 31*, 492–501.

Atkinson, A. B., & Stiglitz, J. E. (1980). *Lectures on Public Economics*. McGraw-Hill.

Barro, R. J., & Sala-i-Martin, X. (2004). *Economic Growth*. McGraw-Hill.

Bhattari, K. R., & Okyere, A. (2005). Welfare and Growth Impacts of Tax: Applied General Equilibrium Models of Ghana. *Research Memorandum, 53.*

Blanchard, O. J., & Fisher, S. (1989). *Lectures on Macroeconomics*. The MIT Press.

Dcaluwé, B., André, L., & Véronique, R. (2013). The PEP Standard, Single- Country, Static CGE Model. Department of Economic, University of Laval, Quebec.

De Melo, J. (1988). Estimating the Cost of Protection: General Equilibrium Approach. *Quarterly Journal of Economics, 92*(2).

Dervis, K., DE Melo, J., & Robinson, Sh. (1981). A General Equilibrium Analysis of Foreign Exchange Shortages in a Developing Economy. *The Economic Journal, 91*, 891-906.

Harberger, A. C. (1962). The Incidence of Corporation Income Tax. *Journal of Political Economy, 70*, 215-240.

Hernandez, G. (2012). Payroll Taxes and the Labor Market: A Computable General Equilibrium Analysis. *Latin American Journal of Economics, 59*, 123-99.

Johansen, L. (1960). *A Multi-Sectoral Study of Economic Growth*. Amsterdam: North- Holland Publishing Co.

Lofgren, H., Harris, R. L., & Robinson, Sh. (2002). A Standard Computable General Equilibrium (CGE). International Food Policy Research Institute.

Lumbantobing, I. A., & Ichihashi, M. (2012). The Effects of Tax Structure on Economic Growth and Income Inequality. *IdEC Discussion Paper*. Hiroshima University.

Myles, G. D. (2009). Economic Growth and the Role of Taxation: Aggregate Data. OECD Economics Department. ECO/WKP55.

Robinson, Sh. (1989). *Multi-sectoral Models. In Handbook of Development Economics*, Vol.2. Elsevier Science Publisher. B.V.

Shoven, J. B., & Whalley, J. (1992). *Applying General Equilibrium*. Cambridge Surveys of Economic Literature.

---------- (1972). A General Equilibrium Calculation of the Effects of Differential Taxation of Income from Capital in the US. *Journal of Public Economics, 1*, 281-321.

Tayyebi, K, Mesrinejad, S. (2006). Methodology of Computable General Equilibrium (CGE): Theory and Application. *Quarterly of Economic Studies, 1*, 103-132.

Zonoor, H. (2003). *Pattern of Applied General Equilibrium for Analysis of the Effect of Tax Imposition in Iran*. Tehran: Economic Affairs Deputy Publications, Ministry of Finance and Economy.