Economic Effects of the Corporate Income Tax Reforms: A Computable General Equilibrium Approach

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Recently reform of the corporate income tax (CIT hereafter) is becoming one of the key subjects to raise the national competitiveness in the international economy. In Korea there have been tax reform efforts relating to CIT to meet the international trends several times. The statutory CIT rates have been lowered in many countries. The various reduction and exemptions relating to CIT have been considered. However, Korean CIT system has been evaluated as outdated, in comparison with fast moving international economic environment. The motivation of this paper is to figure out the right direction of the Korean CIT reform.

The discussions on Korean CIT reform have been lop-sided to the qualitative analysis of tax reform appropriateness. There are not many studies explaining how CIT affects the income distribution by classes and production in each industry. Using the Korea Computable General Equilibrium (KOCGE) model, we try to analyze quantitatively the effects of various corporate income tax reduction plans on the GDP, the production in 25 industries respectively as well as on the welfare of the economy. We investigate five measures for CIT reform in Korea. First, we examine the effects of scenario B and C under which the government lowers the CIT rate and increase other tax rates such as the income tax rate for scenario B and the value-added tax rate for scenario C respectively satisfying the government tax revenue constraint. Second, we examine the effects of scenario D and E under which the government lowers the CIT rate and decreases the government expenditures for scenario D or decreases government lump-sum transfers for scenario E satisfying the government budget constraint. Third, we examine the scenario A under which the CIT and the income tax are fully integrated.

According to the simulation results based on the KOCGE model, the scenario E is most desirable tax reform measure for Korean CIT. Under scenario E the government lowers 10% of the CIT rate and decrease government lump-sum transfers, we can improve both efficiency and equity aspect of the economy by increasing the welfare level of the economy as well as improving income distribution by classes. In addition, we found that the full integration of the income tax and the CIT will reduce both labor supply and savings from households resulting lower welfare and aggravate the income distribution.

Keywords: Tax Reform, Corporate Income Tax, Korea CGE Model, Income Distribution
JEL Classification: H2

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I. INTRODUCTION

Recently due to rapid globalization opening of capital market has induced international tax competition with respect to decrease in capital income tax rate. Countries joining international tax competition try to increase capital inflows from foreign countries by reducing the tax rate on capital returns. Especially as the number of multinational firms has increased, the reform of corporate income tax (hereafter CIT) in Korea looks inevitable to secure Korean firms' international competitiveness. The purpose of this paper is to examine various CIT reform proposals to find the optimal scenario for Korea.

The problem of CIT reform is evidently to find an answer to a question of which scenarios among various reform measures for CIT is optimal for Korea. We should have the norms by which we evaluate each CIT reform measure and rank them in order to find the best scenario for CIT reform. The norms are as usual to have efficiency and equity aspects. The efficiency criterion lies in measuring the excess burden of the CIT that is social welfare cost of the CIT, while the equity criterion is to analyze the effect of CIT reform on income distribution of households in the economy. We have to go through an incidence analysis of the CIT for income distribution analysis. Incidence analyses of the CIT are very important since various CIT reform measures affect income distribution as well as social welfare through changes of price mechanism – prices of capital, labor and final goods.

The incidence analysis of CIT may be classified into two sorts, partial equilibrium analysis and general equilibrium analysis. The former focuses on analyzing how taxes on corporate income affect the demands for factors. This approach has a couple of advantages. It is easy to do and also simple to understand the whole process. However, this approach also has shortcomings of being lack of implications for the real world economy since the model is too simple.

On the other hand the general equilibrium approach is to analyze how taxes on corporate income affect the economy as a whole. This approach has advantages of being very realistic and giving us a variety of implications. However, this approach has disadvantages of being too complex and of being hard to interpret the results of analysis. Recently the general equilibrium approach has been used more often than before due to very rapid development of computation devices and soft wares. Harberger (1962) wrote a seminal paper on incidence of the CIT using a two-sector general equilibrium model. Under plausible parameter values depicting the U.S. economy Harberger drew a conclusion that the CIT burden mostly fell on capital. The two-factor, two-sector model postulated by Harberger assumes that economy-wide supplies of the two factors – capital and labor – are perfectly inelastic, but that capital and labor are perfectly mobile between sectors in the closed economy.

Theoretical tax incidence formulae for example derived by Harberger (1962) are appropriate only for small changes around initial no-tax equilibrium. To examine the incidence of large tax changes as well as to consider many more industry sectors and consumers, Shoven and Whalley (1972) suggest a computable general equilibrium model. Their method of computing an equilibrium is based on Scarf's (1967, 1973) algorithm and some other techniques. To analyze large perturbations of the general equilibrium we need to assume specific functional form for production functions of industries and for utility functions of households. The parameter values of those functions are selected such that initial equilibrium values of the model are exactly reproduction of the base year data set. There are several features of the computable general equilibrium models that contribute to the tax incidence studies. Above all, the applied general equilibrium taxation models may use disaggregate data on both production and consumption. We can delineate two levels of disaggregation of production sectors: medium and high. With this specification we may examine the effects of the CIT on each industry outputs directly. Disaggregation of households by income classes in the applied general equilibrium model makes it possible to examine the effect of the CIT on income distribution.

The computable general equilibrium model is very powerful in examining both efficiency and equity effects of various tax reform proposals. Thus, in this paper we use the Korean Computable General Equilibrium (KOCGE) model to examine various CIT reform measures on the welfare as well as income distribution of the Korean economy.

Up to now many of the CIT related studies in Korea, for instance Roh and Kim (1996), Won (1996), Yoo(1993) and Cho (1996), have paid attention to estimation of the effective tax rate for the CIT. Others including Kang (1995), Lee (1999), and Yoo (1997) analyze the CIT reform measures in Korea. An (1996) examined the effect of the CIT rate decrease on investment and savings using the open macro economy model and Kim (1996) estimated the excess burden of the CIT for Korea. Lee (1997) and Lee and Kim (1998) studied the incidence of the CIT in Korea. Kwack (1994) in particular estimated the compliance cost of the CIT in Korea. Park and Lee (2000) set up the CIT revenue forecasting model for Korea.

Of these studies related to the CIT in Korea, few have examined the effects of the CIT on income distribution, the outputs by industries at higher level of disaggregation of production sector, as well as backward shift of the CIT burden through capital and labor price changes. Therefore in this paper we investigate those effects of various CIT reform proposals using the KOCGE model. The paper is organized as follows. Following Section I we briefly introduce the KOCGE model focusing on modification of the corporate sector in section II. In section III we explain five reform scenarios for the CIT in Korea. In section IV, we analyze the effects of five CIT reform scenarios on the welfare cost of the economy, income distribution, labor supply, savings as well as industry outputs. In section V we explain the policy implications of analyses.

II. KOCGE MODEL

1. Overview of KOCGE Model

The KOCGE (Korean Computable General Equilibrium) model used in this paper basically follow Kim et al. (2003, 2005). The KOCGE model is based on the Ballard-Fullerton-Shoven-Whalley (1985) type model and revised to accommodate Korean situation. Four important factors incorporated in the KOCGE model are resource endowments of the consumers, demand function, production technology, and the equilibrium condition. The model in this paper has three sectors, consumption, production, and government. Households in the consumption sector are divided into 10 income groups with each household category maximizing its utility function subject to a given budget constraint. Business firms in the production sector maximize their profits producing an overall of 26 different manufacturing goods and 10 consumption goods under a CES production function, using labor and capital. The government collects taxes, such as personal income tax, special consumption tax, corporate profit tax, value-added tax and spends within the budget so as to keep the budget balanced.

(1) Production

In the model labor L and capital K are the two basic factors of production employed to produce goods and services. It is assumed that both labor and capital are homogeneous and easily mobile among the sectors. Capital is owned by the ten consumer groups and by government, and we denote endowments by K_j (j = 1, . . . , 10) and K_G, respectively. Capital can be used in any of the 26 producer industries or in the general government sector. These uses of capital are denoted by Ki (i = 1, . . . , 26). Only consumers have endowments Ej (j = 1, . . . , 10) of labor, but because they also consume leisure, their actual supplies are Lj (j = 1, . . . , 10) with leisure denoted Ij (j = 1, . . . , 10). Labor can be used in any of the twenty-six sectors and for each consumer, then, we have $Ej = Lj + Ij$. In total, we have,

$$E = \sum_{j=1}^{10} E_j = \sum_{j=1}^{10} L_j + \sum_{j=1}^{10} I_j = L + I = \sum_{i=1}^{26} L_i + \sum_{j=1}^{10} I_j \qquad (1)$$

Each of these factors is defined in service units per period. When a unit of capital services is rented out for one period, the owner receives a price, P_K, which is net of factor taxes and depreciation. In addition to the rental price, P_L and P_K , which are paid to factor owners, producers are required to pay factor cost including factor income taxes. These taxes differ by sector. Therefore the ith industry producer faces gross of labor income tax P_{Li}^* as follows,

$$P_{Li}^* = P_L(1 + \tau_{Li}) \qquad (2a)$$

When it comes to capital income producer pays the corporate income tax at rate of τ_{Ci} only for corporate sector. The corporate income tax rate τ_{Ci} is the ratio of the corporate income to total taxable capital income. Since the retained earnings are not taxable the after tax capital price becomes

$$P_{Ki}^* = (1 + \frac{\tau_{Ci}}{1 - \tau_{Ci}} \times KENC_i \times (1 - re_i))P_K \qquad (2b)$$

where $KENC_i$ = ratio of corporate sector capital to total ith industry capital, re_i = ratio of retained earnings to total capital income of corporate sector in ith industry.

Capital and labor appear in a constant elasticity substitution (CES) value-added function of the form:

$$VA_i = \Phi_i[\delta_i L_i^{\frac{\sigma i-1}{\sigma i}} + (1-\delta_i)K_i^{\frac{\sigma i-1}{\sigma i}}]^{\frac{\sigma i}{\sigma i-1}} \qquad i = 1, . . . , 26 \qquad (3)$$

where Φ and δ are production parameters, and σ is the elasticity of substitution. For expositional simplicity, we have suppressed the *i* subscripts of all variables and parameters.

This model uses a 26 $\times$26 fixed coefficient input-output matrix, denoted by A, with columns giving the intermediate input requirement per unit of output. The industry outputs are represented as Q_i (i = 1, . . . , 26).

A single output is characterized by cost minimization for each unit of output. Minimization of factor costs ($P_L^* L + P_K^* K$) subject to the constraint that VA =1 in equation (4) yields the labor and capital demand requirement per unit of value-added as shown in equation (5) and (6).

$$\min_{L,K} \quad P_L^* L + P_K^* K$$
$$\text{s.t.} \qquad VA_i = \Phi[\delta L^{\frac{\sigma-1}{\sigma}} + (1-\delta_i) K^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} = 1 \tag{4}$$

$$R_{Li} = \Phi_i^{-1}\left[(1-\delta i)\left(\frac{\delta i P_{Ki}^*}{(1-\delta i) P_{Li}^*}\right)^{(1-\sigma i)} + \delta i\right]^{\frac{\sigma i}{1-\sigma i}} \qquad i=1,\ \ldots,\ 26 \tag{5}$$

$$R_{Ki} = \Phi_i^{-1}\left[\delta i\left(\frac{(1-\delta i) P_{Li}^*}{\delta i P_{Ki}^*}\right)^{(1-\sigma i)} + (1-\delta i)\right]^{\frac{\sigma i}{1-\sigma i}} \qquad i=1,\ \ldots,\ 26 \tag{6}$$

To find out the demand for labor and capital, we denote the value-added contributed by industry i by VA_i and then the contribution ratio to output, var_i, is defined in equation (7) and determined exogenously.

$$\text{var}_i = \frac{VA_i}{Q_i} \tag{7}$$

Once var_i is determined, the demand for labor and capital follows

$$L_i = VA_i R_{Li} = VA_i \Phi_i^{-1}\left[(1-\delta i)\left(\frac{\delta i P_{Ki}^*}{(1-\delta i) P_{Li}^*}\right)^{(1-\sigma i)} + \delta i\right]^{\frac{\sigma i}{1-\sigma i}} \tag{8}$$

$$K_i = VA_i R_{Ki} = VA_i \Phi_i^{-1}\left[\delta i\left(\frac{(1-\delta i) P_{Li}^*}{\delta i P_{Ki}^*}\right)^{(1-\sigma i)} + (1-\delta i)\right]^{\frac{\sigma i}{1-\sigma i}} \tag{9}$$

Given parameters δ, Φ and σ for each industry, we use the net of tax factor prices together with the tax rate to calculate each producer's gross-of-tax price for each factor. Thus the tax system distorts factor input decisions. We assume perfect competition in both the factor and good markets. Therefore there is no economic profit left after the producer pays for factor costs and taxes. The price of a producer's good is P_i (i = 1, . . . , 26) must be set such that zero economic profit condition is satisfied. The before tax price of one unit of the ith good is the cost-covering price of producer goods, that is, the price being paid to value-added (V_i) in equation (10) and intermediate good (a_{ij}) which is inputted in one unit of the producer's good. This is shown by equation (11).

$$V_i = P^*_{Li} R_{Li} + P^*_{Ki} R_{Ki} \qquad i = 1, \ldots, 26 \tag{10}$$

$$P = (I - A^T)^{-1} V$$

$$P(26 \times 1) = \begin{bmatrix} P_1 \\ . \\ . \\ P_{26} \end{bmatrix} \qquad V(26 \times 1) = \begin{bmatrix} V_1 \\ . \\ . \\ V_{26} \end{bmatrix} \tag{11}$$

where A^T is the transpose matrix of the input-output matrix A.

We impose different value added tax rates on each industry's intermediate purchases from each other industry. Each industry is supposed to share its tax burden at the same level, the effective value added tax rate of each industry is different from each other, due to the economic policies of the government. We impose different tax rate on each industry. To analyze the performances of tax administration, we add tax avoidance rate in this model, as follows.

$$P^*_i = P_i[1 + \tau_{vi}\{(1 - a_{vi}) enc_i + ec_i\}] \tag{12}$$

Here τ_{vi} is the value added tax rate, a_{vi} is the avoidance rate on value added tax. ec_i and enc_i are respectively the ratio of corporate sector to whole industry and that of non-corporate sector within each industry, $enc_i + ec_i = 1$. The tax avoidance rate is defined as follows.

$$a_{vi} = \frac{total\ amount\ of\ value\ added\ tax\ in\ economy - value\ added\ tax\ actually\ paid}{total\ amont\ of\ value\ added\ tax\ in\ economy} \tag{13}$$

$$i = 1, \ldots, 26$$

Consumer goods X_m (m = 1, . . . , 10) are produced as producer goods Q_i through a fixed coefficient Z matrix as shown in (14). Each of the coefficient Z_{im} in the Z matrix gives the amount of producer goods *i*, needed to produce one unit of consumer good *m*. Since perfect competition is assumed, producers make zero profits after payments for factors, factor taxes, and output taxes. The zero profit condition also applies to the production of consumer goods. The costs covered in consumer good prices are given by P_m in equation (14).

$$P_m = \sum_{i=1}^{26} z_{im} P_i^* \qquad m = 1, \ \ldots, \ 9 \tag{14}$$

When consumers purchase good X_m, they must pay additional value added taxes. We model sales taxes on the purchase of each good at rates τ_m (m = 1, . . . , 9). Gross-of-tax prices paid by consumers are shown in (15). Sales tax τ_m include all the taxes that the consumers face, for example, special consumption tax, telephone tax, liquor tax, stamp tax, security trading tax.

$$P_m^* = P_m(1 + \tau_m) \tag{15}$$

(2) Households

We assume that the households in this model own all the goods and factor of payments. The market demand functions for goods are non-negative and continuous in prices. Individuals make saving decisions based on expectations about the resulting increment in future consumption. We assume that expectations are myopic in the sense that individuals expect all current prices, including the return to capital, to remain constant through all future periods.

The household chooses the demand for consumer goods based on three-stage maximization of the nested utility function. In the first stage, consumers choose present consumption *H* and future consumption C_F, to maximize their CES utility function. Equation (16) shows the first stage consumers' maximization problem. Each consumer group has its own set of parameters and values, which is a CES utility function; we suppress indexes for expositional simplicity.

$$\max_{H,\, C_F} \quad U(H, C_F) = [\alpha^{\frac{1}{\sigma_2}} H^{\frac{\sigma_2 - 1}{\sigma_2}} + (1-\alpha)^{\frac{1}{\sigma_2}} C_F^{\frac{\sigma_2 - 1}{\sigma_2}}]^{\frac{\sigma_2}{\sigma_2 - 1}}$$

$$\text{s.t.} \qquad I = P_H H + \frac{P_s \overline{P}}{P_K \gamma} C_F \tag{16}$$

Here *I* is current expanded income after taxes and transfers, α is a weighting parameter and σ_2 is the elasticity of substitution between *H* and C_F. γ is the physical service flow per unit of capital goods purchased, which is assumed exogenous.

In the second stage, consumers distribute their present consumption H, after saving. They choose their composite good $\overline{X}$ and leisure ℓ maximizing a CES Utility function U($\overline{X}$, ℓ) . The 2nd stage maximization problem is written in equation (17).

$$\max_{\overline{X},\, l} \ H = [(1-\beta)^{\frac{1}{\sigma_1}} \overline{X}^{\frac{\sigma_1 - 1}{\sigma_1}} + \beta^{\frac{1}{\sigma_1}} l^{\frac{\sigma_1 - 1}{\sigma_1}}]^{\frac{\sigma_1}{\sigma_1 - 1}} \qquad (17)$$
$$\text{s.t.} \quad I - P_s S = \overline{P}\,\overline{X} + P_l l$$

where β is a weighting parameter, and σ_1 is the elasticity of substitution between $\overline{X}$ and l. The price of leisure, P_l is taken to be the after-tax return to labor of each group. Since a unit of labor earns P_L after factor taxes, $P_l = P_L$ (1- τ_j), where τ_j id the jth consumer's personal marginal tax rates.

After spending P_l ℓ on leisure, consumer has $I - P_s S = \overline{P}\,\overline{X} + P_l l$ available to spend on the consumption components on $\overline{X}$ **,** in the third stage. They choose X_m (m=1, , , 9) to maximize a Cobb-Douglas form of the subutility function in (18),

$$\max \quad \overline{X} = \prod_{m=1}^{9} X_m^{\lambda_m} \qquad (18)$$
$$\text{s.t.} \ I - P_s S - P_l l = \sum_{m=1}^{9} X_m P_m^* I$$

The λ_m weighting parameters are the Cobb-Douglas expenditure shares. Constrained maximization of the subutility function, $\overline{X}$, provides the demand functions as follows

$$X_{mj} = \frac{\lambda_{mj}(I_j - P_S S_j - P_{l_j}^* l_j)}{P_m^*} \qquad m = 1, \ \ldots, \ 9, \ j = 1, \ \ldots, \ 10 \qquad (19)$$

With the important property of the nested Cobb-Douglas and CES utility function, we derive the following price functions in (20), (21), and (22)

$$\overline{P} = \prod_{m=1}^{15} \left(\frac{P_m^*}{\lambda_m}\right)^{\lambda_m} \qquad (20)$$

$$P_H = [(1-\beta)\overline{P}(1-\sigma_1) + \beta P_l^{(1-\sigma_1)}]^{\frac{1}{(1-\sigma_1)}} \quad (21)$$

$$P_U = [\alpha P_H^{(1-\sigma_2)} + (1-\alpha)[\frac{P_S \overline{P}}{P_K \gamma}]^{(1-\sigma_2)}]^{\frac{1}{(1-\sigma_2)}} \quad (22)$$

(3) Government

The government collects personal income tax, value-added tax, sales tax, and factor payment tax as tax revenues and maintains a balanced budget. The personal income tax follows marginal rates that differ among income groups. It also includes special features that discriminate by industry. For example, industry with more corporate sector will have a higher tax burden. Within the corporate sector, the industry with higher residual earnings will pay more taxes than the industry with higher dividends and interest payments. We assume that there is a tax evasion rate a_{vi} assigned to each industry *i* in the non-corporate sector, which includes mostly self-owned firms. This is shown in equation (12).

The sum of each industry's capital income net of corporate income is the same as the capital income received by the ten consumer classes. The right hand side of equation (23) is the sum of capital income received by the ten consumer groups and the left hand side is the sum of capital expenditure paid by twenty-six industries.

$$\sum_{i=1}^{26} CAI_i = \sum_{j=1}^{10} CAI_j \quad (23)$$

Each of the 10 consumer groups has a marginal tax rate on all capital and labor income, denoted by τ_j (j = 1, . . ,10). Many transfer payments are not subject to income tax. In our model we assume that all transfers are tax-exempt, while labor income is fully taxable. This is expressed by the following formula for income taxes paid by group j.

$$T_j^I = B_j + \tau_j P_L L_j + \tau_j (1-a_{ij}) P_K K_j \quad (24)$$

The intercept of each linear tax function, B_j may be interpreted as a kind of social security tax: it is negative reflecting the fact that marginal tax rates exceed average tax rates. While marginal changes in income are taxed at the appropriate marginal rate for each group, this marginal rate does not change as income changes. Expanded income, I_j, equals transfers plus labor and capital income, plus the value of leisure, minus income taxes. Therefore, for each group j (j = 1,⋯, 10), we have

$$I_j = (R - G)d_j - B_j + E_j P_L (1 - \tau_j) + K_j P_K [1 - \tau_j (1 - a_{ij})] \tag{25}$$

Here, G is government expenditures, which is the sum of government's fixed capital formation (Q^{FIG}) and government's consumption expenditures (Q^{FG}), that is $G = Q^{FIG} + Q^{FG}$, and is exogenously determined. We divide government expenditures into two categories. Some publicly supplied goods and services are offered free of charge, while other expenditure for goods and services and investment are subject to a user's charge. The government distributes the residual after paying expenditures (G) from tax revenues (R) to each group of consumers as a transfer. The distribution for j^{th} consumer group is d_j (R-G) which can be interpreted as a kind of social securities. Since the government transfers to the consumers all residuals, the government budget is always balanced as shown in (26).

$$\begin{aligned}
&\sum_{j=1}^{10} [B_j + \tau_j P_L L_j + \tau_j (1 - a_{ij}) P_K K_j] + \sum_{m=1}^{9} (\sum_{j=1}^{10} \tau_m P_m X_{mj}) \\
&+ \sum_{m=1}^{9} [(\sum_{i=1}^{26} Z_{im} P_i \tau_{vi}^{*})(\sum_{j=1}^{10} X_{mj})] + \sum_{i=1}^{26} (\tau_{Li} P_L L_i + \tau_{Ki} P_K K_i) \\
&- (G + \sum_{j=1}^{10} d_j (R - G)) = 0
\end{aligned} \tag{26}$$

2. Equilibrium of Model

The equilibrium of the model is defined under given governmental policy variables {G, d_j} and parameter values (enc_i, ec_i, a_{vi}, a_{ij}), distribution variables {H_j, C_{Fj}, S_j, $\overline{X}$, l, X_{mj}, R_{Li}, R_{Ki}, Q_i, L_i, K_i} and price variables {P_H, P_S, P_L, P_K, P_i, P_m, $\overline{P}$, P_l} (i=1,.. 26, j=1,...10) satisfying the following conditions:

A. Optimization condition

A-1. Producer's optimization condition: equation (4)

A-2 consumer's optimization condition

A-1-1. 1st step optimization condition: equation (16)

A-1-2. 2nd step optimization condition: equation (17)

A-1-3. 3rd step optimization condition: equation (18)

B. Government's budget balanced condition: equation (26)

C. Feasibility Condition

D. Market equilibrium condition

D-1. Goods market equilibrium condition

D-2. Factor market equilibrium condition

(1) Goods Market Equilibrium

In the goods market, the demands for final producer goods are divided into consumption demand (Q^{FC}), investment demand (Q^{FI}), government consumption demand (Q^{FG}), and foreign demand (Q^{FX}). We assume that foreign demand is balanced. The equilibrium condition for the goods market is determined where total demands for final producer goods equal total supplies in production sector.

$$Q = (I - A)^{-1}(Q^{FC} + Q^{FI} + Q^{FG} + Q^{FX}) \tag{27}$$

Here the consumption demand for final producer good, Q_i^{FC}, is defined as follows

$$Q_i^{FC} = (\sum_{m=1}^{9} Z_{im} X_m) P_i \qquad i = 1, \cdots, 26 \tag{28}$$

$$Q^{FC} = \sum_{i=1}^{26} Q_i^{FC} \tag{29}$$

In this model, the investment demand for final producer goods, Q^{FI}, is the sum of the household sector's savings (Q^{FIH}), the corporate sector's savings (Q^{FIC}), the government's savings (Q^{FIG}) and depreciation (D), and changes in inventories (IV) as shown in (30). We assume that government and corporate sector savings and inventory changes are given exogenously.

$$Q^{FI} = Q^{FIH} + Q^{FIC} + Q^{FIG} + D + IV \tag{30}$$

Here, household's savings equals investment demand for final producer goods, as shown in (31).

$$Q_k^{FIH} = Z_{i10} S_H \,, \qquad i = 1, \cdots, 26 \tag{31}$$

(2) Factor Market Equilibrium

Capital market equilibrium is as follows

$$\sum_{i=1}^{26} (K_i - D_i) - \sum_{i=1}^{26} Q_i^{FIC} - \sum_{j=1}^{10} K_j = 0 \tag{32}$$

Labor market equilibrium is as follows

$$\sum_{i=1}^{26} L_i - \sum_{j=1}^{10} L_j = 0 \tag{33}$$

3. Derivation of Model Equilibrium

The equilibrium in this model is summarized by 565 equations with 565 variables. To solve this system of equations, we replace the variables in equations reducing this system of equation into 3 equations with 3 variables, P_L, P_K, R, as follows:

$$\begin{aligned} F^1 &\equiv \sum_{i=1}^{26} L_i - \sum_{j=1}^{10} L_j \\ &= \sum_{k=1}^{26} [\sum_{j=1}^{10} T_{ij} (\sum_{m=1}^{10} Z_{im} (\sum_{j=1}^{10} \frac{\lambda_{mj} (I_j - P_S S_j - P_l l_j)}{P_m^*}))] R_{Li} - \sum_{j=1}^{10} L_j \\ &= 0 \end{aligned} \tag{33}$$

$$F^2 \equiv \sum_{i=1}^{26} K_i - \sum_{j=1}^{10} K_j$$
$$= \sum_{k=1}^{26} [\sum_{j=1}^{10} T_{ij} (\sum_{m=1}^{10} Z_{im} (\sum_{j=1}^{10} \frac{\lambda_{mj} (I_j - P_S S_j - P_l l_j)}{P_m^*}))] R_{Ki} - \sum_{j=1}^{10} K_j \qquad (34)$$
$$= 0$$

$$F^3 \equiv \sum_{j=1}^{10} [B_j + \tau_j P_L L_j + \tau_j (1 - a_{ij}) P_K K_j] + \sum_{m=1}^{9} (\sum_{j=1}^{10} \tau_m P_m X_{mj})$$
$$\sum_{m=1}^{9} [(\sum_{i=1}^{26} Z_{im} P_i \tau_{vi}^*)(\sum_{j=1}^{10} X_{mj})] + \sum_{i=1}^{26} (\tau_{Li} P_L L_i + \tau_{Ki} P_K K_i) - R \qquad (35)$$
$$= 0$$

III. SIMULATION FOR THE CORPORATE INCOME TAX REFORM PROPOSALS IN KOREA

1. Corporate Income Tax Reform Proposals

(1) Full Integration of Individual Income Tax and Corporate Income tax: Scenario A

This scenario is to abolish the CIT and increase the individual income tax rate for satisfying the real tax revenue constraint. Thus the following condition must be satisfied.

$$R(1) = R(0) Q_L \quad \text{where } Q_L = \frac{\sum_{m=1}^{9} P_m^*(1) x_m^D(0)}{\sum_{m-1}^{9} P_m^*(0) x_m^D(0)} \qquad (36)$$

Here number 0 in the bracket represents the benchmark equilibrium, while number 0 represents the counter-factual equilibrium. Hence $R(0)$ represents the tax revenue in benchmark equilibrium while $R(1)$ represents the tax revenue in counterfactual equilibrium. Q_L is the Laspeyres price index, and $P_m^*(1)$ and $P_m^*(0)$ represent the new equilibrium and the benchmark equilibrium price vector respectively. $x_m^D(0)$ denotes the consumption level of good m in benchmark equilibrium.

(2) The CIT rate cut with other Tax rate Increase : Scenario B and C

These proposals may be considered since the other tax rate must be increased to keep real tax revenue constant when the CIT rate is cut. Here we consider two scenarios.

Scenario B is to increase the individual income tax rate when the CIT rate is cut.

Scenario C is to increase the value-added tax rate when the CIT rate is cut. For both tax reform proposals the magnitude of the CIT rate decrease is 10%, 20%, 30%, 40%, and 50% of current rate for simulation.

(3) The CIT rate cut with Government Expenditure Decrease : Scenario D and E

If the government increases other taxes to keep its revenue constant when it decreases the CIT rate, it should meet the resistance from tax payers who will bear more tax burdens after tax reform. Thus, more realistic tax reform proposal for the CIT is to decrease government expenditures in accord with the CIT revenue reduction. There are two sorts of government expenditures – government consumption expenditures and transfer payments. Therefore, there are two kinds of tax reform proposals.

Scenario D is to cut the CIT rate and decrease government consumption expenditures accordingly,

Scenario E is to cut the CIT rate and decrease government transfer payments accordingly.

These two scenarios must satisfy the government balanced budget constraint, while scenario B and C must satisfy the equal tax revenue constraint. The magnitudes of the CIT rate are 10%, 20%, 30%, 40%, and 50% for scenario D and E

2. Economic Effects of Corporate Income Tax Reform Measures

(1) Welfare Effects

The impact of specific tax reform on the efficiency of the economy can be calculated by either by the ‘Equivalence Variation (*EV*)’ or the ‘Compensating Variation (*CV*)’ measures. In this paper, we use the Hicks’ Compensating Variation depicted as follows

$$CV = E(u^N, p^N) - E(u^0, p^0) \qquad (37)$$

Here, the function E(·) represents the expenditure function. u^0 and p^0 are the utility level and price vector respectively under the initial benchmark equilibrium. u^N and p^N

are the utility level and price vector respectively under a new counter-factual equilibrium after changing the policy variables. $E(u^N, p^N)$ is the expenditure level needed to keep the utility level u^N under the new price vector p^N. The Compensating variation represents the income compensation needed to keep the consumer at the initial utility level as the price vector changes. When consumer's preference are assumed homothetic, Compensating Variation CV can be expressed as follows

$$CV = \frac{u^N - u^0}{u^N} \cdot I^N \tag{38}$$

Here I^N is the income level in the counter-factual equilibrium. The total Compensating Variation is the sum of Compensating Variation of each income class. That is

$$CV = \sum_{j=1}^{H} CV_j$$

where CV_j is Compensating Variation for income class j, and H is total number of the class in this model and H=10.

(2) Income Distribution Effects

The impact of specific corporate income tax reform on the equity of the economy can be estimated either by the 'Gini Index' or the 'Deciles Distribution Ratio'. The latter is measured by the ratio of total income of the lower 20% income class to total income of upper 20% class. The higher the Deciles Distribution Ratio is, the fairer the income distribution. The lower the Gini Index the fairer the distribution of income.

(3) Effects on Labor Supply and Saving

Depending on whether corporate tax reform either encourages or discourages each income group's will to work and will to save, income distribution and welfare of the economy change. So, it is important to measure how corporate tax reform affects labor supply of each income group (L_j, j=1, …, 10) and total labor supply($\sum_{j=1}^{10} L_j = L$) in the economy. Furthermore, it is also important to measure how corporate tax reform affects savings of each income group (S_j, j=1, …, 10) and total savings($\sum_{j=1}^{10} S_j = S$).

(4) Effects on industrial production and factor income

To analyze the corporate tax incidence, the effect of corporate tax reform on production by each industry (Q_i, i=1, …,26) and on factor income need to be analyzed. By comparing initial factor prices ($P_L(0)$, $P_K(0)$) with factor prices after tax reforms ($P_L(1)$, $P_K(1)$), we analyze the split of corporate tax burden either to the labor income or to the capital income. The corporate tax reform effect on tax revenue can also be measured.

IV. SIMULATION RESULTS

Simulation results of five Korean corporate reform scenarios are summarized as <Table 1>

<Table 1> Simulation Results

	A Integrate CIT[a]&PIT	B CIT[a]↓& ↑PIT	C CIT[a]↓& VAT↑	D CIT[a]↓& Govt Exp↓	E CIT[a]↓& Tansfers↓
Efficiency CV	↓	10%↓→↑ 20 ~ 50%↓→↓	All CIT↓→ proportionally↓	All CIT↓→↑ 40%↓→max	10%↓→↑ 20 ~ 50%↓→↓
Income distribution	Improved	Improved	Worsened	Worsened	Improved
Revenue	Unchanged	Unchanged	Unchanged	↓	10%↓→1.7%↓ 50%↓→7.8%↓
Production	↓	↓ (c)	↓ (c)	↓ (c)	↑ (c)
Tax Incidence[b]	P_L ↑ (1.046%) P_K ↑ (7.977%)	P_L ↑ (0.570%) P_K ↑ (4.494%)	P_L ↑ (0.502%) P_K ↑ (4.500%)	P_L ↓ (1.346%) P_K ↑ (2.501%)	P_L ↑ (0.184%) P_K ↑ (5.327%)
Labor Supply	↓	↓ (c)	↓ (c)	↓ (c)	↑ (c)
Savings	↓	↓ (c)	↑ (c)	↑(c)	↑ (c)

Note: (a) Corporate Income Tax rates are reduced by 10%, 20%, 30%, 40%, 50% for each scenario.

(b) Changes in P_L and P_K are for the case of 50% CIT rate reduction.

(c) Size of decrease (increase) in industrial production is proportional to size of CIT rate reduction

1. Welfare Effects

For five different corporate income tax reform scenarios, the welfare effects are analyzed. The results are summarized as <Table 2>. First, in cases (scenario B and C) of reducing corporate income tax rate by 10%, 20%, 30%, 40%, 50% respectively and increasing other tax rates for the equal revenue constraint, total welfare of the economy is decreased. Meanwhile, in case (scenario D) of reducing the government consumption expenditures to compensate tax revenue reduction, total welfare of the economy is increased generally.

Second, the case (scenario D) of reducing the government consumption expenditures increases the welfare of the economy more than case (scenario E) of reducing the transfers. Increasing the economic welfare is measured as about 5.4 trillion Won (2.02% of GDP), in case (scenario D) of reducing the government consumption expenditures to compensate 40% of CIT tax rate reduction.

Third, Integration of corporate and personal income tax (scenario A) decreases total welfare of the economy by about 1.3 trillion Won (0.47% of GDP).

Fourth, only the case (scenario B) of reducing corporate income tax rates and increasing personal income tax rates by 10% increases total welfare of the economy. In all other case of increasing tax rate, especially increasing value-added tax rate, total welfare decreases. So, it should need to be careful to decrease the CIT rate and to increase the other tax rates, considering welfare reducing effect as well as the tax resistance effect.

<Table 2> Welfare Effects of CIT Reform Scenarios by Measuring Changes in CV

(Unit: Billion Won)

A Integration of CIT & PIT	CIT Rate Reduction	B CIT↓& ↑PIT	C CIT↓& VAT↑	D CIT↓& Govt Exp↓	E CIT↓& Tansfers↓
-1,258.6	10% ↓	108.2	-211.4	1,108.9	10%↓→↑ 20 ~ 50%↓→↓
	20% ↓	-75.2	-705.4	1,687.2	-53.0
	30% ↓	-249.9	-1,183.5	2,231.9	-217.2
	40% ↓	-416.3	-1,646.4	5,374.1	-373.2
	50% ↓	-574.6	-2.095.0	3,238.9	-521.4

2. Income Distribution Effects

The simulation results of corporate income tax reform on the Income distribution of the economy are summarized as <Table 3>. If Gini Index after tax reform is decreased compared to the benchmark equilibrium index level, 0.27858, then the distribution of income is improved.

Corporate income tax burden splits to labor and capital income. In cases (scenario B) of reducing CIT rate and increasing PIT, income distribution is worsened, due to progressive Korean income tax scheme. Meanwhile, in case (scenario C) of increasing VAT rate, income distribution is improved, due to regressivity of VAT tax scheme. What is interesting is the case (scenario D and E) of reducing the government expenditures. Reducing the government consumption expenditures makes worse the income distribution, meanwhile, reducing the government transfers improves the income distribution. The benefit of government expenditures is equal to all income groups, due to its non-exclusiveness. This makes income distribution worse. Government transfer is proportional to income level of each income group. So the burden of reducing transfers is progressive and the income distribution is improved[1]. If transfers are distributed differently, income distribution results of transfers change as well.

<Table 3> Income Distribution Effects of CIT Reform Scenarios by Measuring Changes in Gini Index

A Integration of CIT & PIT	CIT Rate Reduction	B CIT↓& ↑PIT	C CIT↓& VAT↑	D CIT↓& Govt Exp↓	E CIT↓& Tansfers↓
0.27340	10% ↓	0.27795	0.27899	0.27885	0.27834
	20% ↓	0.27736	0.27938	0.27901	0.27811
	30% ↓	0.27679	0.27975	0.27916	0.27789
	40% ↓	0.27625	0.28010	0.27931	0.27768
	50% ↓	0.27573	0.28042	0.27944	0.27747
improved	Income Distribution	improved	worsened	worsened	improved

[1] In KOCGE model, government transfer is defined as social security benefit from government. According to 『Annual Report on the Family Income and Expenditure Survey』, social security benefit for each income group is progressive.

Table 4a and Table 4b show the effect on labor supply and savings of five different policy changes for the corporate income tax. Let us begin to discuss the effect of the corporate income tax change on labor supply. Labor supply appeared to decrease in both the policy scenarios A and B whereas scenario A involves the integration of corporate income tax into the individual income tax system and scenario B indicates an increase in income tax burden. Such the decrease in the labor supply in overall economy resulted from the work incentive decreases due to the after tax labor income decrease caused by the rise of the income tax rate. The fundamental cause of the labor supply decrease due to the income tax rate rise is that the wage elasticity of leisure demand is -0.2.

<Table 4a> The Effect of the Corporate Income Tax change on Labor Supply

(base equilibrium labor supply=150,075, ten billion Wons)

Scenario A integration of corporate income tax and individual income tax	% of the reduction of corporate income tax rates	Scenario B corporate income tax rate decrease & individual income tax increase	Scenario C corporate income tax rate decrease & VAT increase	Scenario D corporate income tax rate decrease & government expenditure decrease	Scenario E corporate income tax rate decrease & transfer expenditure decrease
149,085 (-0.660)	10% fall	149,954(-0.081)	149,973(-0.068)	149,914(-0.108)	150,227(0.101)
	20% fall	149,840(-0.157)	149,878(-0.132)	149,820(-0.170)	150,371(0.197)
	30% fall	149,732(-0.229)	149,788(-0.191)	149,731(-0.228)	150,509(0.289)
	40% fall	149,628(-0.298)	149,705(-0.247)	149,648(-0.285)	150,639(0.376)
	50% fall	149,529(-0.304)	149,625(-0.300)	149,569(-0.337)	150,765(0.459)
labor supply decrease		labor supply decrease	labor supply decrease	labor supply decrease	labor supply decrease

Note: 1) Per unit labor supply is computed as 1 Won.
2) The number in parenthesis represents the percentage rate of change. The rate of change indicates the ratio of increase or decrease to the base equilibrium.

The scenario C of the decrease in the corporate income tax rate and the increase in the value added tax rate also turned out to decrease labor supply. The decrease in the labor supply shown in scenario B is greater than that in scenario C. This is because the rise of the value added tax rate indirectly decreases the after tax labor income through the price rise of consumption goods followed by the decrease in the real income, while the rise of the income tax rate decreases the after tax labor income directly

The policy scenario D representing the decrease in both the corporate income tax and the government expenditure decreases labor supply, while the scenario E decreasing the transfer income increases labor supply. The reason why the scenario D decreases labor supply eventually is that diminishing work incentive is due to the fact that the decrease in the government consumption expenditure from the corporate income tax decrease induces both the aggregate demand and wage to decrease.

Table 4b summarizes the effects of the corporate income tax change on the household savings. Both A and B appear to decrease savings. The reason why the household savings decrease due to the income tax increase followed by the corporate income tax decrease is that the elasticity of savings to the interest rate is 0.4%. Therefore the income tax increase lowers the after tax interest rates followed by the reduction of the household savings

<Table 4b> The Effect of the Corporate Income Tax change on Savings

(base equilibrium labor supply=14,219, ten billion Wons)

Scenario A integration of corporate income tax and individual income tax	% of the reduction of corporate income tax rates	Scenario B corporate income tax rate decrease & individual income tax increase	Scenario C corporate income tax rate decrease & VAT increase	Scenario D corporate income tax rate decrease & government expenditure decrease	Scenario E corporate income tax rate decrease & transfer expenditure decrease
14,116(-0.725)	10% fall	14,207(-0.091)	14,305(0.598)	14,317(0.682)	14,263(0.303)
	20% fall	14,195(-0.173)	14,386(1.167)	14,399(1.261)	14,304(0.591)
	30% fall	14,183(-0.256)	14,463(1.710)	14,477(1.313)	14,343(0.864)
	40% fall	14,173(-0.331)	14,537(2.229)	14,553(2.341)	14,380(1.125)
	50% fall	14,162(-0.404)	14,607(2.728)	14,625(2.848)	14,415(1.375)
decrease in savings		decrease in savings	decrease in savings	decrease in savings	decrease in savings

Note: The number in parenthesis represents the percentage rate of change.

Savings are shown to increase in all the scenarios such as scenario C (corporate income tax reduction and the VAT increases, scenario D (decrease in the government consumption expenditure) and scenario E (the decrease in both corporate income tax and the transfer expenditure).

When we consider the effects on labor supply and savings, the decrease in both the corporate income tax and the government expenditure is more effective than the corporate income tax reduction together with other tax increases.

3. The Effect on Production Across Industries

<Table 5> The Effect of the Corporate Income Tax Change on the Industry Production

(Base Equilibrium Industry Production = 580,432 unit Billion Wons)

Scenario A integration of corporate income tax and individual income tax	% of the reduction of corporate income tax rates	Scenario B corporate income tax rate decrease & individual income tax increase	Scenario C corporate income tax rate decrease & VAT increase	Scenario D corporate income tax rate decrease & government expenditure decrease	Scenario E corporate income tax rate decrease & transfer expenditure decrease
149,085(-0.660)	10% fall	149,954(-0.081)	149,973(-0.068)	149,914(-0.108)	150,227(0.101)
	20% fall	149,840(-0.157)	149,878(-0.132)	149,820(-0.170)	150,371(0.197)
	30% fall	149,732(-0.229)	149,788(-0.191)	149,731(-0.228)	150,509(0.289)
	40% fall	149,628(-0.298)	149,705(-0.247)	149,648(-0.285)	150,639(0.376)
	50% fall	149,529(-0.304)	149,625(-0.300)	149,569(-0.337)	150,765(0.459)
Total production decrease		Total production decrease	Total production decrease	Total production decrease	Total production decrease

Note: 1) Per unit labor supply is computed as 1 Won.
2) The number in parenthesis represents the percentage rate of change. The rate of change indicates the ratio of increase or decrease to the base equilibrium.

In Table 5, the scenarios B and C both are shown to decrease the total industrial productions, indicating that the degree of decrease in the total industrial production is proportional to the corporate income tax rate decrease. But production levels appeared to increase in such industries as general machine, precision machine, construction industry, real estate and business service. The scenario D appeared to decrease the total industrial production, while the scenario E decreased it. This also indicates that the changes in the industrial total production become greater in the proportion of the level of fall in the corporate income tax rates.

In the case of the scenario D, production levels are shown to increase in all the industries except the industries of ceramic, the first metal, metal product, general machine, electricity and electronic meter, precision meter and construction. Those industries appear to obtain the benefits from the corporate income tax rate reduction regardless of scenarios. In the case of scenario E, on the other hand, production levels are shown to increase in all the industries except the industries of textile and leather, wholesale and retail, telecommunication, social and service.

4. The Effect on Tax Revenue

In principle, tax revenue should be unchanged in the scenario of the increase in other tax system along with the abolishment of the corporate income tax. Thus, the changes in tax revenue are found only in the corporate income tax decrease and the government expenditure decrease. When the corporate income tax rates fall by 10%, 20%, 30%, 40%, 50% and the government expenditure decrease, tax revenues appear to decrease by 2.1%, 3.9%, 5.7%, 7.3%, and 8.9% respectively. The level of the tax revenue decrease is shown to be smaller in scenario E than in scenario D.

V. POLICY IMPLICATIONS

1. Policy Implication from the Simulation of the Corporate Income Tax Changes

The simulation results of the corporate income tax change using our computational general equilibrium model give rise to the following policy implications. Firstly, in order to compensate for the decrease in tax revenue due to the reduction of the corporate income tax rates, the reduction of the government expenditure appeared to be superior, in terms of welfare aspect, to the increase in income tax or consumption tax. This implies that the distortion of resource allocation from tax increase is greater than that from the decrease in the government expenditure. It also implies that the reduction of the corporate income tax rate in 2001 can be justified and result in a desirable outcome if it comes with the decrease in the expenditure. Unfortunately, Korea experienced lack of efforts of reducing government expenditure for the 2002 budget.

The second implication is that in the case of reducing corporate income tax rate, the decrease in the government expenditure increases national savings, while income tax increase ends up with reducing national savings. This also implies that the decrease in the personal savings resulted from the income tax increase outweighs the increase in the corporate savings. As a result, we can learn that the distortion effect of tax also appears to be large in Korea.

The third implication involves the comparative advantage of the income tax raise over the VAT raise in terms of equity in the case of tax raise to compensate for revenue decrease due to the corporate income tax rate reduction. This is because both progressivity of income tax and the regressivity of VAT induce the superiority of income tax raise.

The fourth and final implication is that the integration of corporate income tax into income tax (abolition of corporate income tax in other word) gives rise to negative effects on savings, labor supply and efficiency all together within context of our model. This indicates that abolishing corporate income tax on the purpose of efficiency gain cannot show any increase in efficiency in our simulation.

2. Issues involved in changing the corporate income tax law

Four policy implications derived from simulation using our KOCGE model can be different if we apply some other assumptions and parameter values. However, our sensitivity analysis results indicate that major lessons from the conclusions and policy implications would be unchanged. Our conclusions and implications can provide a momentum for the more detailed and rigorous discussion about the tax policy change. In particular, further discussion of the corporate income tax change requires a full consideration of circumstance and tax environment faced by Korean companies.

An important policy suggestion based on the simulation results gives rise to the efforts of reestablishment and reduction of various tax reductions or exemptions and quasi taxes for the revision of the corporate income tax system. Broadening the tax base of the corporate income tax from the efforts enable the tax rate reduction to play a more important role in activate the economy and enhance the international competitiveness. More specifically, as meeting the open economy and internationalization, such efforts can construct a base for introducing foreign capital and activating investment through the tax rate reduction. In addition, more efforts should be given to the simplification of procedures and forms for the tax exemptions used by the small and medium enterprises, through which more efficient assistance for those enterprises can be guaranteed.

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