**EQUAL YIELD TAX ALTERNATIVES AND
GOVERNMENT DEFICITS**

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ABSTRACT

This paper generalizes the concept of equal yield to accommodate government deficits. This generalization is important from the point of view of actual tax reform. First, the comparison of the several equal yield alternatives developed in this paper provides a measure of the marginal financial crowding-out effects of government deficits. Second, it suggests that the emphasis by policymakers on revenue neutrality is misplaced and should be replaced by a direct emphasis on deficit neutrality. The generalized concept of equal yield is illustrated with a dynamic general equilibrium model of the U.S. economy and the analysis of the effects of integrating the personal and corporate income tax systems.

EQUAL YIELD TAX ALTERNATIVES AND GOVERNMENT DEFICITS

1. Introduction

Most studies on the efficiency effects of taxation, both theoretical and numerical, are based on what was coined by Musgrave (1959) "differential incidence". Differential incidence analysis postulates that comparisons among tax structures should be confined to tax plans with the same yield.

The use of the concept of equal yield can be justified on different grounds. On theoretical grounds, differential tax incidence analysis is designed to evaluate the tax effects of alternative tax regimes in isolation from the yield-related effects. On a more practical vein, most of the actual tax policy changes considered by policymakers are conceived to generate a specific revenue. In many instances the comparison is among revenue neutral alternatives.

In the context of general equilibrium tax analysis, policy evaluations are generally carried out by contrasting a base case equilibrium reflecting the status quo and several counterfactual equilibria reflecting different tax policy scenarios. The link between the base case and the counterfactual simulations is provided by the concept of equal yield. To be comparable, base case and counterfactual equilibria should be such that the size of government is kept constant in a meaningful way. In addition, by concentrating on equal yield alternatives, differential incidence analysis requires the computation of replacement rates, i.e., the computation of the changes in some specific tax rates necessary to neutralize in some way the tax changes under consideration.

Shoven-Whalley (1977) provides a detailed discussion of the concept of equal yield in a general equilibrium context. When government activities include purchases of private goods in addition to taxation and discretionary transfers, equal yield is interpreted to mean the same public utility in both the status quo and the counterfactual experiments. The concept of equal yield as

developed by Shoven-Whalley (1977) has been extensively used by Shoven and Whalley in the context of their model of the U.S. economy - see for example Fullerton-King-Shoven-Whalley (1981), Fullerton-Shoven-Whalley (1983) and Ballard-Fullerton-Shoven-Whalley (1985). This concept has also been used in numerous other papers - see for example Auerbach-Kotlikoff (1983, 1987), Ballard (1987), Ballard-Goulder (1985), Bovenberg (1985, 1986), Fullerton-Gordon (1983), Goulder-Summers (1987), and Piggott-Whalley (1982).

The objective of this paper is to generalize the concept of equal yield to accommodate the presence of government deficits. The optimal level of expenditure for base case public utility can now be financed by either changes in the tax revenues with constant base case deficits or by changes in deficits with constant base case tax revenues, or still by a mix of deficits and tax revenues.

The relevance of government deficits for policy analysis hardly needs any justification. Ever since the early 80's government deficits have become a constant concern for policymakers. In particular, when analyzing the impact of different tax packages their effects on government deficits are of primordial concern. If a tax policy change induces higher government deficits marginal financial crowding effects are generated. Private investment will be crowded-out by higher interest rates induced by higher supply of public bonds.

This generalization of the concept of equal yield is important from the point of view of actual tax reform. First, most of the tax packages actually considered postulate constant tax returns. This revenue neutrality is perceived as a proxy for constant deficits. However, equilibrium prices necessarily will change as a consequence of tax policy changes. Then, the level of expenditures to be incurred to generate equal yield will change and with constant tax revenues so will deficits. The emphasis by policymakers on revenue is misplaced and should be replaced by a direct emphasis on deficit neutrality. Second, some measure of the marginal financial crowding-out effects induced by government deficits can be inferred from the comparison of the several equal yield alternatives.

Since tax financed equal yield requires the same deficits in the base case and counterfactual equilibria, the difference between tax-financed and deficit-financed equal yield is generated by optimal changes in government deficits.

The generalized concept of equal yield is implemented in the context of a dynamic applied general equilibrium model of the U.S. economy - the DAGEM model. In this model the intertemporal paths of government expenditure and deficits are optimally determined. The relevance of the different equal yield alternatives for actual tax reform issues is illustrated with the analysis of the effects of integrating the personal and corporate income tax systems in the United States.

This paper is organized as follows. The second section generalizes the concept of equal yield to accommodate government deficits. The third section provides an application of the generalized concepts in the context of the general equilibrium analysis of corporate tax integration. Finally, the fourth section provides some concluding remark.

2. Equal Yield Alternatives and Government Deficits

Shoven-Whalley (1977) provide a detailed discussion of the concept of equal yield in a general equilibrium context. When government is confined to taxation and discretionary transfers, equal yield is interpreted to mean equal tax revenues. On the other hand, when government activities include purchases of private goods in addition to taxation and discretionary transfers, equal yield is interpreted to mean the same public utility in the status quo and in the counterfactual experiments. Now, in a general equilibrium context, changes in the tax structure induce changes in the equilibrium prices. The computation of replacement rates should take into consideration these changes in equilibrium prices. Shoven-Whalley show that "back of the envelope" calculations

of the replacement rates are generally unsatisfactory and that the algorithm for computing equilibrium prices should be augmented to compute also the replacement rates.

2.1 Computing Counterfactual Equilibria for Equal Yield Alternatives

Following Snoven-Whalley (1977), equal yield is assumed to mean equal government public utility in both the base case and counterfactual equilibria. In the base case, government is assumed to maximize a social welfare function in the domain of a public good which is produced using as inputs the commodities in the economy, as well as capital and labor. This maximization is constrained by a recursive set of equations of motion representing the evolution of government debt. Accordingly, the base case equilibrium generates an intertemporal sequence of public utility $(F_{gt}^b, \dots, F_{gT}^b)$. For the counterfactual equilibria equal yield implies that government purchases of commodities will be such that at the new prices the base case sequence of public utilities is attained at minimum cost.

Since government behavior in the counterfactual equilibrium is consistent with compensated demand functions for the base case utility levels, running a counterfactual equilibrium requires changes in the equilibrium conditions and the optimal transitions for the public debt. First, the equilibrium conditions include government compensated demand functions, rather than the ordinary demand functions. Second, the government expenditure function in its budget constraints also reflects the compensated demands. The counterfactual equation of motion for government liabilities can be written as

$$(1) \quad Tt + \Delta B_{gt} = p_L L_{gt}(F_{gt}^b) + \sum_j p_j Y_{gtj}(F_{gt}^b) + p_K K_{gt}(F_{gt}^b) + r_t B_{gt} + Tr_t$$

where TT_t is the endogenous tax revenues; B_{gt} is public debt at t and ΔB_{gt} is the endogenous government deficit; Tr_t is exogenous transfers; and $L_{gt}(\cdot)$, $Y_{gt}(\cdot)$, $I_{gt}(\cdot)$ are compensated government demands for labor, commodity, and investment good and p_{Lt} , p_{jt} and p_{it} the respective prices; and r_t the market interest rate.

In Shoven-Whalley (1977), the concept of equal yield is developed under the assumption that government balances its budget annually. With budgets balanced yearly, the concept of equal yield is unambiguous. The new equilibrium prices and the balanced budget condition will determine the minimal expenditure and taxes needed to maintain base case public utility. Revised case tax revenues just match revised case minimum expenditures. Accordingly, in general, equal yield is inconsistent with equal nominal tax revenue.

When government is allowed to run deficits, the concept of equal yield tax replacement needs to be refined. Equal yield is still assumed to mean equal government public utility in both the base case and counterfactual equilibria. If tax revenues are kept equal to expenditures at the new prices, the government deficits are changed which introduces marginal financial crowding-out effects. Also, by keeping either base case tax revenues or base case deficits constant, there is still one degree-of-freedom since additional expenditures plus discretionary transfers and interest payment on debt, may be financed via tax revenues, bond issuance, or both. Consequently, there are several possible equal yield ways of computing a replacement tax rate in the counterfactual equilibria. The optimal level of expenditure for base case public utility can now be financed by either changes in the tax revenues with constant base case deficits or by changes in deficits with constant base case tax revenues, or still by a mix of deficits and tax revenues.

The following three cases are considered. The superscripts b and c refer to base case and counterfactual case respectively.

1) tax-financed differential incidence

In this alternative, equal yield is defined as the same utility levels and same deficits. The size of the deficits is kept as in the base case. A tax rate is endogenously changed such that tax revenues make up for the expenditure net of deficit financing. Formally, this adds the following constraints to the model:

$$(2) \quad \Delta B_{gt}^C = \Delta B_{gt}^b \text{ or } B_{gt}^b = B_{gt}^C$$

$$(3) \quad TT_t(1T) + \Delta B_g^b = p_{Lt}L_{gt}(\cdot) + \sum_j p_{jt}Y_{gjt}(\cdot) + p_{It}I_{gt}(\cdot) + r_t B_{gt}^b + Tr_t$$

2) deficit-financed differential incidence

This equal yield alternative implies the same government utility and same tax revenues. It should be emphasized that unlike Shoven-Whalley (1977) equal yield is now consistent with equal tax revenue. Tax revenues are kept constant at base case levels. For different equilibrium prices, the same tax revenue implies *endogenous* changes in tax rates. Adjustment to deficits makes up the difference between tax revenue net of transfers, interest payment on the debt, and the minimizing expenditure to achieve base case utilities. Again, unlike Shoven-Whalley (1977) equal yield generates changes in government deficits. Formally, deficit-financed differential incidence adds the following constraints to the model:

$$(4) \quad \Delta B_g = p_{Lt}L_{gt}(\cdot) + \sum_j p_{jt}Y_{gjt}(\cdot) + p_{It}I_{gt}(\cdot) + r_t B_{gt} + Tr_t - TT_t^b$$

$$(5) \quad TT_t^b = TT_t^C(1T)$$

3) mixed-financed differential incidence

This equal yield alternative is an intermediate case in which the same public utility is coupled with the same deficit to tax revenue financing ratio from base case. Formally

$$(6) \quad \Delta E_{gt}^C = [TT_t^b / \Delta B_{gt}^b]^{-1} TT_t^C(IT)$$

$$(7) \quad \{1 + [TT_t^b / \Delta B_{gt}^b]^{-1}\} TT_t^C(IT) = p_{Lt} L_{gt}(\cdot) + \sum_j p_{jt} Y_{gjt}(\cdot) + p_{it} I_{gt}(\cdot) + r_t E_{gt} + Tr_t$$

The comparison among these equal yield schemes is central to tax policy evaluation in the presence of government deficits. Some measure of financial crowding-out effects of government deficits can be inferred from the comparison of the several equal yield alternatives. Tax-financed change blocks marginal financial crowding-out by keeping debt at base case levels. Deficit-financed equal yield emphasizes the marginal financial crowding-out effects by keeping base case tax revenues constant and by allowing deficits to make up the necessary adjustments.

2.2 Computation of the Tax Replacements

The equal yield alternatives discussed above involve endogenous replacement changes in tax rates to be specified. Different tax replacement schemes are considered to assure that enough tax revenue is collected. Tax replacements involve changes, let us say, in the personal income tax rates. The personal income tax collected from individual i at time t is in the counterfactual equilibrium:

$$(8) \quad b_{it} = [aIT_{it} + b](\text{Taxable income}) + LST_{it}$$

where τ is the personal income tax rate; a is a multiplicative change factor; b is an additive change factor; and LST_{it} is a lump sum tax levied on individual i at time t .

The three replacement schemes are obtained as follows.

- 1) multiplicative replacement - set $b=LST=0$ and let a be endogenously determined;
- 2) additive replacement - set $a=1$, $LST=0$, and let b be endogenously determined;
- 3) lump sum replacement - set $a=1$, $b=0$, and let LST_{it} be endogenously determined.

In general, not all possible replacement schemes are feasible. The tax base that provides the additional revenues to match the tax revenues foregone by the policy changes has got to be important enough to generate the necessary revenues. Otherwise, counterfactual equilibrium may fail to exist (see Shoven-Whalley (1977) on this issue).

3. Some Results from an Application of the Equal Yield Techniques

To illustrate the application of the different equal yield alternatives a practical tax reform issue - the integration of the personal and corporate income tax systems - is considered in the context of the DAGEM model of the U.S. economy. This section starts with a brief description of the DAGEM model (see Pereira [1988a] for a full description of this model) and concludes with the presentation of the simulation results (see Pereira [1988a] for a detailed presentation of the simulation results on the corporate tax integration issue).

3.1 Brief Description of the DAGEM Model

In the DAGEM model the U.S. economy is characterized by an incomplete, sequential market structure in a finite horizon and discrete time frame. All current markets are open, but there are no future markets at any time. At any time, several markets are open for the different consumption goods, and for physical capital, labor and financial assets. In this economy there are three types of agents: consumer groups, industries, and government. Agents face a dynamic environment. Economic behavior of every agent in this economy is derived from an intertemporal specification of the agent's objectives and constraints.

The model considers four industrial sectors: sector one includes agriculture mining and energy, sector two includes food, textiles, paper, chemicals, lumber and metals; sector three includes trade, finance, real estate, and services, and sector four includes capital goods like construction, transportation and machinery. Industries maximize the present value of the net cash flow in a technology with adjustment costs to determine endogenously optimal supplies and optimal demands for the different production inputs. In particular, investment decisions are forward looking. Real investment is financed by retained earnings and issuance of new debt and equity according to exogenously defined rules.

Government engages in several economic activities. First, it collects taxes - on the use of labor by the different industries, on both corporate and personal income including capital gains, and on sales - according to an exogenously given tax regime. The taxation system in the model reflects the situation in the United States after the Tax Reform Act of 1986. Second, it transfers discretionary lump-sum amounts to the private sector. Finally, it purchases consumption goods and primary inputs to accomplish general government activities through the production of a public good. Government intertemporal behavior is obtained from the maximization of a social welfare

function defined over the domain of the public good. General government activities are constrained by a recursive set of budget constraints so that government is allowed to run yearly deficits. Government engages in the sale of public bonds to finance such imbalances.

The model considers three income classes: lower class with yearly income below six thousand of 1973 dollars; middle class with income between six and fifteen thousand, and upper class with income above fifteen thousand of 1973 dollars. Optimal household behavior follows a life-cycle type of model generating endogenous savings and labor-leisure decisions. Household savings are invested in financial assets - public bonds and private bonds and equity. In the absence of uncertainty, the composition of the asset portfolio is a matter of indifference for the households.

Portfolio decisions merely accommodate the composition of the demand for the funds households are supplying:

To make their real and financial decisions at each t , the economic agents use several types of information. They observe current prices at t . However, economic decisions are formulated in a context of imperfect information about future prices and interest rates. Intertemporal consistency is not imposed in the model. Agents are allowed to commit mistakes due to incorrect expectations. By generally assuming imperfect foresight, decisions will be taken that could have been improved upon, should the agents have accurately foreseen the future. Thus, plans about the future will, in general, be revised.

Atomistic competition in each and every market is assumed. Even though the number of agents on each side of the market is finite, it is assumed that enough agents are involved to render their actions negligible in terms of the overall equilibrium outcomes. The concept of Temporary Walrasian Equilibrium, (TWE), is adopted to capture the incomplete and sequential aspects of real world trading and the limitations of foresight into the future which we want to capture in this model. All current markets are assumed to clear, hence the Walrasian nature of equilibrium

Also, equilibrium in the short run is parametric on the expectations of future prices held by the different agents as well as future taxation parameters, hence the temporary nature of equilibrium. The link between adjacent periods is endogenously provided by the recursive transitions of the stock variables in the economy.

The DAGEM model departs from most of the numerical GE literature for tax policy evaluation, in several fundamental directions directly relevant for policy-oriented analysis (see Shoven-Whalley (1984) and Pereira-Shoven (1988) for detailed surveys of this literature). First, it provides a comprehensive modeling of dynamic economic behavior. In particular, government deficits are optimally determined and investment decisions are forward looking and are the result of optimizing behavior. Secondly, it encompasses an endogenous sequential equilibrium structure founded on dynamic economic behavior with flexible expectations. Thirdly, the model provides a detailed consideration of financial assets, public and private.

In the context of the DAGEM, policy evaluations are carried out by contrasting a base case reflecting the status quo and several counterfactual equilibria reflecting different policy scenarios. The information contained in the different equilibria is synthesized in a scalar efficiency indicator which is the dynamic generalization of the Hicksian compensation test. This efficiency indicator was designed to accommodate intertemporal comparisons when perfect foresight is not assumed and future markets are not open.

Given the temporary equilibrium structure of the DAGEM, the computation of a t -dimensional intertemporal equilibrium path involves the computation of a sequence of t , one-shot, short-run equilibria parametrically on price expectations. The optimal transitions of the stock variables between adjacent short-run equilibria are determined endogenously given the equilibrium prices and net demands. For the simulation reported in this paper the DAGEM is run to produce a twenty-year equilibrium sequence in a decision time frame of one hundred years under

myopic expectations.

3.2 The Issue of Corporate Tax Integration

The corporate income tax has long been criticized for its effects on the economy. First, the corporate income tax introduces a wedge between the rates of return on capital in the corporate and in the non-corporate industries. Thus, the allocation of investment in the economy is distorted in favor of the non-corporate sectors. Second, the existence of differentiated investment tax credits and depreciation allowances creates a wide variety of marginal corporate taxes across industries. Consequently, allocations within the corporate sector are distorted. Third, the special treatment of capital gains distorts the financing of investment by inducing more retained earnings. Fourth, the tax treatment of interest payments distorts the financing of investment by inducing more debt financing. Finally, the corporate income tax represents a 'double' taxation of income at both the personal and corporate levels; corporate earnings are subject to the corporate tax, and the after-tax earnings are either distributed as dividends and taxed at the personal level or retained and potentially taxed as capital gains.

The public finance literature often proposes to eliminate or reduce the distortions created by the taxation of corporate income by fully or partially integrating the corporate and the personal income tax systems. Full integration, the complete elimination of the corporate income tax, is the only way to completely eliminate all the distortions generated by the corporate income tax.

The policy experiment reported here consists of eliminating the corporate income tax at the cost of increasing marginal tax rate on personal income under multiplicative replacement. The replacement scheme is plausible on a priori grounds. Using the personal income tax as the base for the tax replacement in the context of corporate tax integration is conceptually appropriate in the

light of the concept of "double taxation." Also, personal income tax as the base for the tax replacement in the context of corporate tax integration, seems to minimize the likelihood of non-existence of equilibrium, in that corporate tax revenues were about 8% of total tax revenues in 1985, while personal income tax revenues accounted for 46%.

Table 1 indicates the different results obtained under the different equal yield alternatives. Simulation results suggest that the efficiency gains from such a radical measure as the elimination of the corporate income tax are modest. Under the best scenario, the elimination of the corporate income tax has long-run welfare effects which range from .06884% to .07459% of the present discounted value of consumption and leisure.

The efficiency benefits from integration are inversely related to the size of change in the personal income tax rates. With full integration, deficit-financed equal yield requires the lowest increase in personal tax rates and yields the highest efficiency results. In turn, tax-financed equal yield requires the largest increase in personal tax rates and yields the lowest efficiency results. This fact emphasizes the importance of the tax replacement inherent to the differential incidence analysis. The elimination of the distortions generated by the corporate income tax is accomplished by increasing the marginal tax rates at the personal income level. This increase of personal tax rates introduces itself additional distortions in the labor-leisure decisions. The gains from integration under equal yield are the net efficiency effects of simultaneously eliminating some distortions at the cost of creating others.

In the experiments under deficit-financed equal yield, in which tax revenues are held constant, government deficits are actually increased vis-a-vis the tax-financed case. This illustrates the importance of considering the effects on equilibrium prices of the tax changes in consideration. Also, it illustrates the loss that when government is allowed to run deficits, comparing tax packages that yield the same tax revenue is not deficit neutral due to changes in

equilibrium prices. Therefore, policymakers should be well advised to focus directly on deficit neutral policies instead of on tax revenue neutrality as a proxy for constant deficits if their concern is to avoid increasing government deficits.

The simulation results in Table 2 neatly illustrate the marginal crowding-out effects generated by changes in government deficits. In fact, tax-financed equal yield blocks additional changes in deficits and "a fortiori" blocks marginal financial crowding out. In turn, deficit-financed and mixed-financed equal yield are accompanied by increased deficits and corresponding marginal financial crowding-out effects, .113% and .091% respectively. Higher deficits are associated with higher after-tax interest rates. In turn, higher after-tax interest rates generate lower private investment and lower total income.

Finally, in the case of these corporate income tax integration experiments, marginal financial crowding-out effects induced by changes in government deficits seem to be of second-order importance vis-a-vis the additional distortions in the intertemporal labor-leisure decisions. In fact, the increases in government indebtedness are negatively associated with the efficiency gains. Higher deficits are expected to generate unfavorable marginal financial crowding-out effects. However, these remain unnoticeable in the simulation results. In fact, efficiency gains with deficit-financed equal yield are higher than with tax-financed and mixed-financed equal yield despite the fact that the latter two generate lower government debt.

4. Summary and Concluding Remarks

This paper generalizes the concept of equal yield in a general equilibrium context to accommodate government deficits. This generalization is important from the point of view of actual tax reform.

First, most of the tax packages actually considered postulate constant tax returns. This revenue neutrality is perceived as a proxy for constant deficits. Given that equilibrium prices necessarily will change as a consequence of policy changes, the level of expenditures to be incurred to generate equal yield will change, and with constant tax revenues so will deficits. The emphasis on revenue is misplaced and should be replaced by deficit neutrality. Second, some measure of marginal financial crowding-out effects of government deficits can be inferred from the comparison of the several equal yield alternatives. Since tax-financed equal yield requires the same deficits in the base case and counterfactual equilibria, the difference between tax-financed and deficit-financed is generated by optimal changes in government deficits. Finally, this generalization is still a further step in establishing the general equilibrium approach as the most satisfactory way of analyzing large tax policy changes.

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Table 1.

EFFICIENCY EFFECTS OF CORPORATE TAX INTEGRATION

	<u>Equivalent Variations</u>	<u>Tax Replacement Factor</u>
	(billions of 1973 dollars)	
Deficit-Financed E.Y	25.470	1.21762
Tax-Financed E.Y	23.505	1.22471
Mixed-Financed E.Y	25.055	1.21895

Table 2.

OTHER EFFECTS OF CORPORATE TAX INTEGRATION

	<u>Deficits</u>	<u>Interest Rat.</u>	<u>Investment</u>	<u>GNP</u>
	counterfactual/base case values			
Deficit-Financed E.Y	1.00113	1.00160	.99686	.99872
Tax-Financed E.Y	1.00000	1.00056	.99763	.99874
Mixed-Financed E.Y	1.00091	1.00138	.99749	.99872