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Chapter Title: The Theoretical Structure of the Analysis

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The Theoretical Structure of the Analysis

2.1 BASIC THEORETICAL ISSUES

The major difficulty encountered in the assessment of the differential effects of a substitution of one tax (VAT) for another (CIT)¹ is the isolation of the effects of the change in tax structure from the effects of other simultaneous changes. Thus, John Bossons has stated that "one of the most frequent sources of spurious issues [in evaluating tax substitutions] is the confusion of macroeconomic control problems with problems of tax structure" [Bossons, p. 255]. More generally, Carl Shoup has argued that, in a context of multiple goals, the effects of a tax substitution on the achievement of one goal can only be assessed by making simultaneous changes in other fiscal instruments sufficient to maintain presubstitution levels of other goal variables [Shoup, 1970, pp. 12-15].

Of course, the difficulty is that such a multidimensional differential incidence analysis requires both a completely specified general equilibrium approach and a knowledge of the "goals" of the tax substitution, neither of which is available to the analyst concerned with the evaluation of a VAT-CIT substitution. Even the achievement of aggregative neutrality is beyond the confines of the input-output model used in this study. Rather than requiring as a *condition*

1. Throughout this study, the reduction or repeal of the CIT refers to the total CIT in the United States economy, that is, the federal CIT and the CIT of those states that impose this tax. "Government" refers, therefore, to the combined federal-state government. But the VAT is assumed to be imposed only by the federal government (see Chapter 7, section 1).

of the tax substitution that the level of real income and output be unchanged, the input-output model imposes this as an *assumption*, i.e., the final demand vector is assumed to be exogenously given and unaffected by the tax substitution. It should be emphasized that this constraint seriously limits the practical usefulness of the results, especially to the extent that division of the final demand vector between investment and consumption goods is likely to be substantially altered by the tax changes examined.

As a result of these conceptual and empirical limitations, the analysis is confined to the first-round consequences of the tax substitution. However, even though the model is restricted to a rather simple representation of interdependent economic processes, a number of difficult theoretical and conceptual issues arise. In this chapter, we discuss the most important of these issues, their specific representation in an input-output model, and the restrictive assumptions incorporated in the model.

Criteria for a Compensating Tax Substitution. Between the extremes of simple equal monetary yield of the two tax instruments and simultaneous adjustments in a sufficiently large set of instruments to offset any unintentional consequences of the tax substitution, a number of compensatory criteria can be developed. The issue reduces to the identification of a criterion which limits the response as much as possible to the change in tax structure (as opposed, e.g., to implicit changes in stabilization policy) but does not exceed our analytical capabilities.

Alternative Variants of the Value-Added Tax. The VAT can take on a number of different forms, each of which has significantly different economic consequences. Although the empirical analysis is limited to examination of a VAT of the consumption type, it is important to point out the substantive differences between alternative variants.

Price Determination and Tax Shifting. The consequences of the tax substitution ultimately follow from the change in tax rates, the effect of these changes on prices, and the responses of producers and consumers to these tax-rate and price adjustments. Furthermore, unless the responses of prices to tax changes can be identified, criteria for a compensatory tax substitution cannot be concretely specified and realized.

Fiscal Implications of the Tax Substitution. On the basis of the discussion of price determination and tax shifting, it is possible

to specify concretely the elements entering the compensation criterion, thus determining a VAT rate which just compensates, in terms of the government budget balance, for the reduction or repeal of the CIT.

To place this discussion in context the tax substitution used in this analysis must be briefly outlined: a uniform (proportionate) reduction from the initial average CIT rate in each industry is assumed.² The VAT then imposed is to be invoiced on all sales, on the basis of the VAT-exclusive value. The VAT is assumed to be applied on a destination basis, with exports exempted and the VAT applied to imports as a border tax. As the VAT is of the consumption type, a refund is permitted for VAT invoiced on business purchases, including gross investment. The VAT is set at a *rate* that allows the government to purchase the original (presubstitution) bill of goods and services at the new (postsubstitution) prices without incurring a change in its nominal (i.e., money) budget surplus or deficit.

2.2 CRITERIA FOR A COMPENSATING VAT-CIT SUBSTITUTION

A number of considerations entered into our selection of a compensation criterion, as we tried to bridge gaps between what is theoretically desirable and actually feasible:

The goals of the VAT-CIT substitution actually are not clear. Advocates have stressed a range of real or imagined benefits which would flow from this change in tax structure. However, a fundamental uncertainty exists concerning the actual implications of this fiscal change. One purpose of an analysis of this change is to identify these implications; the compensation criterion should then be designed to bring out, rather than disguise, obscure, or define away, the differential impacts of these two taxes.

The compensation criterion should clearly avoid the merging of changes in macroeconomic stabilization policy with changes in tax structure. Expansion or contraction of government budgets could

2. The CIT rate reduction utilized in the analysis is somewhat artificial. First, since state and federal corporate income tax liabilities could not be empirically separated at the level of input-output sectors, it has been necessary to assume that the reduction applies to the total corporate tax liability. More seriously, the reduction is expressed in terms of *effective rates* (actual average tax liabilities, i.e., ratios of CIT to profit), which bear no simple or consistent relationship to statutory corporate tax rates. This will not introduce a bias into the analysis if the simple fact of a reduction in nominal tax rates does not alter the relationship between these and effective rates of tax. In any event, the distortions resulting from this assumption should be of minor importance.

certainly be achieved without reliance on a substitution of a VAT for the CIT. Since our fundamental concern is with the differential consequences of the tax substitution itself, it is necessary to focus the analysis on a specific substitution which does not intermingle these consequences with the consequences of overall changes in government stabilization policy.

The compensation criterion must be consistent with analytical capabilities. On the one hand, to be meaningful compensation must be defined in terms of economic variables whose movements can be captured by the underlying model. For example, a reasonable definition of aggregative neutrality would be unchanged total employment.³ However, to translate tax changes into changes in employment would require a well-developed representation of the labor market, relating employment changes to tax-substitution-induced changes in wages, capital-labor ratios, and output prices. Unfortunately, we do not now have the analytical capabilities to trace out these relationships.

On the other hand, the compensation criterion should include relevant responses which can in fact be projected. Thus, to require only that the monetary yield of the two taxes be equal, under the assumption that, e.g., prices or corporate profits will be unchanged, represents a waste of available information if it is in fact possible to project price and corporate profit changes resulting from the tax substitution, and if these changes will alter tax revenue yields.

Finally, it could be argued that the compensation criterion should be politically and legislatively relevant, since the purpose of studies such as this one is the identification of an open-ended range of uncompensated differential consequences of a potential change in the tax structure.

Of the foregoing, the most important substantive objective in the choice of a compensation criterion is the achievement of aggregative neutrality. However, as noted above this cannot be required as a condition of the tax substitution since it is imposed as an assumption of the input-output model, given the stipulation of a fixed bill of final demands. Thus, the analysis is forced to rely on a more rudimentary criterion which would be *consistent with* (rather than a *reflection of*) a stable macroeconomic control policy.

Specifically, price changes that result from application of the criterion chosen for determining a CIT-compensating VAT rate must be a consequence only of the tax substitution and not of an overall ex-

3. This criterion has been employed in a study of alternatively-compensated reductions in military expenditure [Dresch, 1972b; Dresch and Goldberg].

pansion or contraction of the government budget. Since real government demands for goods and services are assumed to be given, this reduces to a search for a definition of unchanged effective revenue yield. Four possible equal-budgetary-yield criteria can be proposed:

a. *Equal Monetary Yield.* Let C be the CIT revenue loss (either from partial or full repeal of the CIT) and V be the VAT revenue gain, including amounts attributed to purchases by the government.⁴ Equal monetary yield simply requires that $C = V$, a condition that necessitates analysis of "money differential incidence" [Shoup, 1970, p. 13]. Obviously, this condition will entail an unequal real yield of the tax substitution (not to mention of the tax system as a whole, as indicated in b, below) if the prices of government-purchased goods and services rise as a result of the tax substitution. Thus, even if the CIT were the only tax employed initially, a constant bill of goods and services could be maintained only if the government's deficit (surplus) increased (decreased). In the analysis of money differential incidence, then, the effects of two government budget changes are necessarily merged: the tax substitution and an increase or decrease in deficit. In the present case, if P_g is the government price index (in VAT-inclusive terms, compared to a pre-VAT base of unity), it is unlikely that $C = V/P_g$ would also be achieved when the yield criterion is $C = V$.

b. *Equal Real Yield of the Tax Changes.* Here it is required that $C = V/P_g$, i.e., that the VAT revenue be adequate to command the same real resources after the tax substitution as were previously commanded by the CIT revenue forgone through CIT reduction or repeal. But government-purchased goods and services are also financed by tax sources other than the CIT. Consequently, if P_g changes and if the original bill of goods and services is to be purchased by the government, *either* the original net government budget position will change (increase or decrease in deficit or surplus) or rates of other taxes must be simultaneously increased or decreased. Thus, this criterion is consistent with differential incidence analysis only under some further stipulation regarding the nature of concomitant, compensating changes in all other tax rates. One possible condition for simultaneous change in other taxes could be referred

4. Actual or imputed VAT on government purchases is included for logical consistency: since the corporate profits resulting from sales to government are subject to the CIT, parallel treatment suggests that VAT attributable to government also be included.

to as "revenue source neutrality": all other tax rates should be changed enough so that the *proportion* of total governmental revenue derived from each revenue source is the same as before the tax substitution.

It should be clearly understood that the analysis then concerns the differential incidence of the VAT-CIT substitution *and* the simultaneous changes in other taxes; relative price changes and their effects cannot be viewed as consequences of the tax substitution alone. Nevertheless, equal real VAT-CIT yield and revenue source neutrality appears to be a more interesting combination of budgetary changes than equal monetary yield supplemented by changes in the deficit (criterion a, above).⁵

c. Equal Real Budget Surplus or Deficit. Let R and G refer to government revenue and expenditure; b , before the tax substitution; a , after the substitution. With the relevant postsubstitution price index P , this condition stipulates that $(R_b - G_b) = (R_a - G_a)/P$, meaning that the preexisting real fiscal imbalance is maintained after the tax substitution.⁶

Under one conceivable interpretation, this condition is consistent with differential incidence analysis (as described in condition b, above) on the assumption that the surplus (deficit) will be used to increase (reduce) governmental (private) expenditure in the future, i.e., that the government is *saving* in order to increase, in later years, government expenditure, or, via future lower taxes, private expenditure, or is *dissaving* at the expense of future government or (via future higher taxes) private expenditure. The relevant price index for the evaluation of the real surplus or deficit then depends upon the future use of the surplus or deficit, public or private, and must reflect the impact of the tax substitution on these future prices.

More likely, the government surplus or deficit does not reflect savings or dissavings but instead is the result of overall government

5. Aaron clearly intends to employ the second criterion, although it is not clear what assumptions he makes regarding changes in the real yields of other taxes (rate changes versus increase in deficit). He is also ambiguous about the price index used to evaluate real yields. In referring to government purchasing power of the changed taxes he seems to imply a government price index, but elsewhere he refers to four available alternatives: GNP deflator, government expenditure deflator, wholesale price index, and retail (consumer) price index [Aaron, pp. 165-166.].

6. P , rather than P_g , is used to denote the "price index" because, as will become clear, the appropriate index need not relate to changes in the prices of government-purchased goods and services.

stabilization (macroeconomic control) policy. Under this interpretation, the criterion of equal real surplus implies some concept of aggregative neutrality, i.e., an avoidance of expansion or contraction in the economy. In this case the appropriate "price" index must really be an index of the change in the surplus (deficit) required to maintain the existing level of real aggregate demand. In fact, as has been discussed, our model does not attempt to identify that specific substitution which would be fiscally neutral. In view of the probable effects of the substitution on investment (as discussed in Chapter 5), it would indeed appear that a fiscally neutral substitution would require substantially higher VAT rates than the ones estimated by this model.

d. *Change in Revenue Equal to Change in Expenditure, or Equal Monetary Surplus or Deficit.* Under this criterion $V = C + (P_g G - G) = C + (P_g - 1)G$, where $(P_g - 1)G$ is the change in government expenditure due to the tax-substitution-induced price changes. Equivalently, this criterion implies a constant monetary surplus or deficit, i.e., $(R_b - G_t) = (R_a - G_a)$. This condition could simply be referred to as (narrow) budgetary neutrality, with the VAT compensating for both the nominal CIT revenue loss and the change in government expenditures due to induced price changes. In the present application of this criterion, it is assumed for reasons of tractability that the nominal revenue yield of other tax sources is unaffected by the tax substitution. In principle, the rates of other taxes should be held constant, and the VAT rate should be set sufficiently high to compensate for the tax-substitution-induced changes in the nominal yields of these taxes as well as for the CIT revenue loss and the price-change-induced increase in government expenditure.

Of these four criteria the second (equal real yield) and fourth (equal changes in revenue and expenditure) will be identical if original government expenditure on goods and services equals the amount of CIT revenue which is lost by the reduction in the CIT rate (or by CIT repeal, if the rate is reduced to zero).⁷ The third and fourth (equal real versus equal monetary surplus) will be identical if the original government budget is in balance, but they will be quite different if the government surplus or deficit is large and prices change significantly. Only under the fourth criterion is the VAT

7. This can be easily shown: Criterion d requires that $G(P_g - 1) + C = V$. Criterion b requires that $C = V/P_g$. For criteria d and b to be equivalent, therefore, it is necessary that $G(P_g - 1) + C = CP_g$, i.e., that $G = C$.

treatment of government purchases a matter of indifference: since the VAT on these purchases is simultaneously government revenue and expenditure; whether government purchases are considered subject to or exempt from the VAT will not alter the government surplus or deficit. In all four cases, it is assumed that the tax substitution would have no significant consequences for the nominal yields of other taxes, e.g., ad valorem sales taxes.

For our purposes criterion d seems preferable: It provides a more interesting context than the "money differential incidence" of the simultaneous tax and deficit change implied by the first criterion; it appears to be more in line with legislative realities than the second, which would in principle require simultaneous changes in all tax rates,⁸ and it contrasts with the third, which would require unavailable knowledge regarding fiscal neutrality or the future use of government (dis)savings. Our dominant consideration has simply been to achieve a differential incidence analysis of changes in the tax *structure* consistent with legislative-political realism. For these reasons, we used the fourth criterion, a constant nominal surplus or deficit (or alternatively stated, a net change in revenue equal to the substitution-induced change in expenditure).

2.3 THE CONSUMPTION-TYPE VAT AND ALTERNATIVES

The consequences of a complete or partial replacement of the CIT by a VAT will depend crucially on the precise characteristics of the tax substitution. Identification of the specific CIT change is relatively straightforward: it is assumed that the existing characteristics of the CIT as reflected in observed differentials between nominal and actual (or effective) rates, are unaltered by the tax substitution. Thus, the analysis concerns the complete or partial replacement of the *existing* U.S. CIT (federal and state), rather than an *idealized* CIT, by the VAT.

The same procedure cannot be employed for the VAT, since it is

8. As indicated, it is assumed, for simplicity, that nominal yields of other taxes are unaffected by the tax substitution; a more appropriate assumption would be that other tax *rates* are unaffected. In the initial incidence analysis presented here, the distortion is limited to (a) ad valorem taxes, the yields of which will be sensitive to price changes induced by the VAT-CIT substitution and (b) personal income taxes, the bases of which are altered by changes in after-tax corporate profits. Aaron also assumes constant nominal yields of other ad valorem taxes, an assumption which is particularly inconsistent with the suggested "revenue source neutrality" interpretation of his yield criterion (see note 6). In both our own and Aaron's analyses, however, the effects of these inconsistencies should be of only secondary importance.

not in effect in the United States. Thus, it is necessary to choose the characteristics of the VAT, and we will therefore be substituting an idealized VAT for an actual CIT.

Given this freedom in defining the VAT, we were guided by the following considerations in selecting a specific variant: First, as in the case of the selection of a yield criterion, we sought political and legislative realism. Secondly, and related to the first, we took into account and were guided by the practices of other industrialized nations that impose a VAT. Finally, desirable economic characteristics, relating both to allocative efficiency and to the range of specific objectives advanced by advocates of the VAT, have provided a basic set of criteria for VAT specification.

On the basis of these considerations the *consumption-type VAT* was ultimately selected for analysis. This variant of the VAT has a number of important characteristics which differentiate it from others, particularly in terms of economic effects. In the following discussion, we explain these differences in detail.

The main variants of the VAT are the *consumption*, *income*, and *gross product* types. Under a VAT of the consumption type the tax is invoiced on all sales other than exports. The seller is then credited for VAT invoiced on all business purchases in determining his net VAT liability. Thus, the apparent net base of the VAT consists of final sales to households and government. Since the VAT invoiced on government purchases represents both revenue and expenditure of the government, the ultimate *net* VAT base consists only of final sales to consumers, i.e., private domestic consumption expenditure.

Although the VAT is invoiced on capital goods sales, that tax payment is concurrently recouped by way of an "input tax" credit against the gross VAT liability of the business purchaser of the capital good. A VAT liability arises only at some future date when the capital is transmuted into consumption output. As a result of this immediate tax rebate, the tax funds of users of capital goods are not tied up, as would otherwise occur if the VAT could only be recouped gradually through depreciation of the capital good; in this sense the exemption of investment is equivalent to instantaneous (accelerated) depreciation under a profits tax (full write-off at the time of purchase) [Musgrave, pp. 343-344].⁹

9. Depending on the sophistication of depreciation policy a VAT of the income type may also discriminate against investments of different duration. However, under equivalent depreciation rules an income tax and the income-type VAT would be equally discriminatory [Musgrave, pp. 338-343]. In any event, the degree of discrimination under a VAT of the income type would be small relative to that inherent in the gross-product variant.

It is this instant-rebate feature which differentiates the consumption-type VAT from its alternatives, the income and gross-product types.¹⁰ Under a VAT of the *income type* the tax is "recouped" only through depreciation of the capital good: investment purchases are subject to tax but a credit is allowed only for depreciation. Thus, the net base of the income-type VAT consists of net investment plus consumption. A *gross-product* VAT goes further: it is levied on capital purchases but no credit is permitted for depreciation; the resulting net VAT base consists, therefore, of gross investment plus consumption. Effectively, a VAT on gross investment implies double taxation of capital goods: first at the time when the capital good is purchased, and again when the capital good is transmuted into consumption output and the latter is sold.

In addition, the base of a gross-product VAT is highly sensitive to the definition of the accounting period (differentiating intermediate from capital purchases) while that of the income and consumption types is not. Thus, the gross-product type strongly discriminates against lengthy investments.¹¹ On the other hand, the relation of the consumption type to the life of a capital investment is completely neutral, but only at the expense of a total exemption of capital goods from the tax (Shoup, pp. 251-252; Musgrave, pp. 336-346). Similarly, it is neutral to the degree of capital-intensiveness of production techniques.

As in the case of instantaneous depreciation under an income or profits tax, the exemption of investment under a consumption-type VAT logically requires that the investor receive an immediate refund if he enjoys a *net* credit (excess of credits on intermediate and capital goods purchases over liability on sales). Simply providing for a carryover of net credits to future periods is not adequate, since the value of a credit of a given dollar amount is reduced the longer the refund is delayed. This consideration could be quite significant in the case of newly formed or rapidly expanding firms, for which the value of the credit would be greatly eroded if the credit were not realized until years later. It is now the practice in all European countries to refund net VAT credits without delay.

10. In addition to the gross-product, income and consumption types of VAT, Shoup [1970, pp. 352-354] identifies the wages, or investment-income-exclusion, variant, the base of which will be equal to consumption in any period only if net investment is equal to profits (more generally, to nonwage income).

11. The invoice method of administering the collection of the VAT, described in the text, breaks down if either an income or gross-product, rather than consumption VAT, is applied. For a discussion of alternative methods of administration, see Shoup [1970, pp. 257-261].

For goods in international trade, it is assumed that the VAT is imposed on the destination principle, i.e., export sales are exempt from the VAT while it is imposed as a border tax on imports.¹² Value added at all stages in the course of production for export is ultimately VAT-free since a full tax credit is enjoyed at the final stage on all export-embodied inputs while export sales are exempted from tax. Thus, the relation of the VAT itself to the terms of trade is neutral: the imposition of the tax should leave export prices unchanged and alter import and import-competing prices equivalently.

Finally, in contrast to (broadly based or partial) income taxes or to an income or gross product VAT the consumption VAT is neutral in its relation to consumption versus savings. In brief, the present value of all future consumption is unaffected by the timing of consumption, since the consumption-type VAT does not create a gap between the gross- and net-of-tax rate of return to capital. Because of this characteristic, a consumption-type VAT, by diverting resources from consumption to investment, would stimulate growth if it were substituted for a CIT or other income tax. This would be in addition to any stimulus due to strengthened demand which might result from the substitution of the VAT for the CIT on the basis of a balanced budget criterion.

Primarily as a result of these allocatively neutral efficiency characteristics the consumption-type VAT has commanded wider attention than its alternatives, and has been advanced as an alternative to other types of taxes, particularly the CIT. For these reasons, our analysis is restricted to the consumption type.

A final issue concerns the treatment of other taxes in determining the base of the VAT, and vice versa. In our analysis the VAT is excluded from the bases of other taxes, e.g., the CIT, while all components of value added, including other taxes, are included in the VAT base. The reason for this treatment can be indicated using indirect business taxes (IBT) as an example. Under our assumptions the VAT is invoiced at a uniform rate on VAT-exclusive but IBT-inclusive value. Employing the invoice method, with each firm invoicing VAT on sales (other than exports) and receiving a credit for VAT invoiced on purchases, the ultimate ratio of aggregate net VAT liabilities (excluding VAT on government purchases) to aggregate consumption expenditures will equal the VAT rate. This equal-

12. A destination-based VAT is somewhat difficult to contemplate in the case of the United States. Invoicing the tax on export sales might raise questions of an unconstitutional tax on exports. Exemption of imports would require that some kind of credit for a hypothetical tax on imports be allowed, since imports as intermediate goods cannot be distinguished in final transactions.

ity would break down if the VAT were imposed on IBT-exclusive value *unless* all elements of IBT imposed at all previous stages (e.g., real property, excise, sales, motor vehicle and fuel taxes) could be separately identified and excluded, at the stage in question, from all purchases by the firm, which is obviously impossible.¹³ The invoice method would result in an indeterminate relationship between VAT liabilities and consumption expenditures if each firm simply excluded from sales its own IBT in determining its net VAT liability, because IBT imposed at earlier stages of production would still bear the VAT at later stages. Thus, the ratio of total VAT yield to aggregate consumption (exclusive of IBT) would diverge from the VAT rate uniformly invoiced on IBT-exclusive sales, since the IBT would have been only partially excluded.¹⁴ In fact, the effective VAT rate would necessarily be greater than the invoiced rate since a portion of the IBT (from earlier stages of production) could not be identified and excluded from the invoice sales basis. This inconsistency between the nominal and effective VAT rate disappears if the IBT is uniformly *included* in the VAT invoiced sales base.

2.4 TAX SHIFTING AND TAX-SUBSTITUTION-INDUCED PRICE ADJUSTMENTS

2.4.1 The Translation of Tax Changes into Price Changes

As noted previously, the crucial first-round response to a change in tax structure is the effect of the tax change on commodity and factor markets. In the analysis of the price effects of the tax substitution, macroeconomic effects have simply been ignored. Thus, at this stage, we are interested only in those extremely short-run impacts which will occur before any significant macroeconomic reactions have manifested themselves. For even an intermediate-term policy it will be necessary to take these reactions into account,

13. Indirect business taxes in the national income accounts include federal excise taxes, customs duties, and "nontaxes" (user charges and fees), state and local sales taxes, motor vehicle licenses, property taxes, and nontaxes. In 1969, indirect business tax revenue amounted to about \$85 billion. Excise taxes and sales tax accounted for 48.12 percent and property taxes for 36.25 percent of this total.

14. This can easily be shown by a simple numerical example. Assume that the economy consists of two firms, *A* and *B*, and a consumer, *C*. Before any taxes are imposed, *A* has a sale of \$100 to *B*, and *B* resells to *C* at \$200. Suppose that a 5 percent sales tax is imposed. *A* sells to *B* for \$105. *B* adds value, as above, of \$100, and so he pays 5 percent tax on \$205, or \$10.25, and sells to *C* for \$205 + \$10.25 = \$215.25. Total IBT is \$5 + \$10.25 = \$15.25. A 2 percent VAT is now imposed. Sales inclusive of taxes now are: *A* to *B*, \$107,

and as discussed in the latter chapters of this book, these effects are likely to be so substantial as to overwhelm the first-round consequences. This will be true whether macroeconomic balance is restored through a higher VAT rate than presented here, together with a budget surplus or diminished deficit, or whether the balance is restored through monetary stringency and higher interest and net profit rates.

In principle, even the microeconomic consequences of the substitution should be traced through by means of a fully articulated general equilibrium representation of interrelated commodity and factor markets. Since this is beyond current capabilities, our analysis is focused on the narrower issue of the probable *initial* effects of the tax substitution on commodity prices, rather than moving directly to economic effects, e.g., changes in the allocation of resources. A completely fixed (price-inelastic) bill of final demands is assumed as well as unchanged factor earnings (other than corporate profits). The "price effects" we project actually represent "tax allocation effects." Instead of observing the translation of tax changes into price changes, a range of assumptions is employed concerning the characteristics of this tax change-price adjustment relationship. In this context, the term "tax shifting" is simply a shorthand reference to these assumed tax allocation relationships. Thus, our concern with the shifting of a particular tax in fact reflects our inability to identify the ultimate effects of the tax change on relevant economic magnitudes.

The alternative "tax shifting" assumptions employed in the analysis should, then, be viewed simply as alternative characterizations of the initial effects of a change in tax instruments on prices.¹⁵

2.4.2 CIT Shifting

With reference to first-round price adjustments, the issue of CIT shifting is concerned with the degree to which a reduction (increase) in the CIT is translated into reductions (increases) in prices. This

B to *C*, \$215.25 plus VAT imposed on a basis exclusive of VAT plus *B*'s indirect tax only (i.e., on $\$215.25 - \$10.25 = \$205$). This VAT, at 2 percent, is \$4.10. *B* therefore sells to *C* for $\$215.25 + \$4.10 = \$219.35$. Consumption expenditures exclusive of all taxes are \$200. Dividing this into total VAT revenue (\$4.10), we get 2.05 percent, which is greater than the nominal VAT rate of 2 percent. This is so because elements of the sales tax in the earlier stages of production cannot be excluded from sales in the later stages on which the VAT is invoiced.

15. Discussions with Wassily Leontief have served to clarify both our understanding and exposition of this issue.

differs somewhat from previous discussions which have questioned the effect of such a tax change on gross- or net-of-tax profits or rates of return [Krzyzaniak and Musgrave]. However, under the assumption of unchanged factor (except capital) earnings and final demands, the effects of a change in the CIT on profits (gross or net) and on prices will be directly related. Thus, in the following discussion profit can be conceived of either as an aggregate or per unit of output. Similarly, tax revenues may be interpreted interchangeably as either aggregate or per unit. The objective is to devise a flexible and internally consistent relationship between changes in CIT rates and changes in per unit CIT liabilities (and hence, under current assumptions, prices).

Consider a corporation with after-tax net profits of π_N (total or per unit), resulting from gross profits of π taxed at a rate t , i.e.,

$$\pi_N = (1 - t)\pi.$$

A tax change is then introduced which reduces the corporate tax rate from t to γt , i.e., tax rates are reduced by a percentage $S = 100(1 - \gamma)$, where $0 \leq \gamma < 1$. If it is assumed that the benefit of the corporate tax reduction is entirely shifted to consumers, then with unchanged unit sales *net* profits will not change as a result of the rate reduction, i.e.,

$$\pi_N = (1 - \gamma t)\pi',$$

where π' denotes gross profits after the tax reduction. Then,

$$(1 - \gamma t)\pi' = (1 - t)\pi,$$

and

$$\pi' = \frac{(1 - t)}{(1 - \gamma t)}\pi.$$

Corporate income tax revenue before the rate reduction was simply $t\pi$. If gross profits had not changed as a result of the tax change, revenue would have been reduced to $\gamma t\pi$, implying a revenue loss of $(1 - \gamma)t\pi$. However, because of the shifting of the tax benefit, corporate tax revenues are reduced by a larger amount, i.e., by

$$\begin{aligned} \Delta T &= t\pi - \gamma t\pi' \\ &= t\pi - \gamma t \frac{(1 - t)}{(1 - \gamma t)}\pi \\ &= \frac{(1 - \gamma)}{(1 - \gamma t)} t\pi > (1 - \gamma)t\pi \end{aligned}$$

since $(1 - \gamma t)$ is less than unity. If, for example, pretax profits were \$100 and the original tax rate were 50 percent, the presubstitution revenue would be \$50. The tax rate is then reduced to 25 percent ($\gamma = 0.5$). With no shifting, revenue would be reduced to \$25 and net profits would rise to \$75. However, if the full benefit of the tax reduction is shifted forward, pretax profits fall to \$66.67, tax revenue falls to \$16.67, and net-of-tax profits remain constant at \$50. Thus, forward shifting of the corporate tax savings (*unshifting* in Aaron's terminology) results in greater corporate tax revenue losses and price reductions than might be superficially anticipated [Shoup, 1959, pp. 323-324].

Most generally, the true shifting parameter for the CIT, α , can be defined as the ratio of the change in gross profits to the change in tax liabilities, itself a consequence of a change in CIT rates, i.e.,

$$\alpha = \frac{\pi - \pi'}{t\pi - t'\pi'}, \quad (2-4-1)$$

where $t' = \gamma t$. If gross profits are expressed per unit of output, then the numerator of this expression is simply the price-reduction benefit to purchasers of a tax reduction of the *amount* specified in the denominator, assuming that other components of price are unaffected by the tax change.¹⁶

16. The CIT shifting parameter as defined here differs from that employed by Aaron [p. 164], whose specification is correct only under the assumption that the CIT is completely removed. That is, Aaron mistakenly assumes that the reduction in CIT liability (per unit output) is predetermined, independently of the value of the shifting parameter. In effect, he makes the reduction in CIT liability a function only of the original level of gross profit (or CIT liability) and of the change in the tax rate. The change in CIT liability under Aaron's formulation is simply

$$\Delta T^A = (t - t')\pi,$$

the change in the tax rate multiplied by the original level of gross profit. The purchaser price reduction is then $a\Delta T^A = a(t - t')\pi$, where a is the Aaron shifting parameter. In fact, of course, that price reduction implies a further reduction in profits and tax liabilities, a reduction which again must be assumed to be shifted, ad infinitum (an infinite series that converges toward a limit). Most importantly, these further reductions depend upon the value of the shifting parameter. In consequence, it is necessary to express ΔT as a *function* of the true shifting parameter, α . Thus, $\Delta T = t\pi - t'\pi'$; and from the definition of α (above),

$$\pi' = \frac{(1 - \alpha t)}{(1 - \alpha t')} \pi$$

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From equation (2-4-1) the absolute change in (per unit) gross profit (price) can be determined as a function of the degree of CIT reduction, the shifting parameter, and the level of gross profit prior to the CIT reduction:

$$\begin{aligned}\pi - \pi' &= \frac{\alpha(t - t')}{(1 - \alpha t')} \pi \\ &= \frac{(1 - \gamma)}{(1 - \alpha \gamma t)} \alpha t \pi\end{aligned}\quad (2-4-2)$$

since $t' = \gamma t$. (For π ; see the preceding footnote.)

This change in gross profit or price takes into account the fact that if the benefits of the CIT reduction are shifted forward, a corresponding initial price and gross profit reduction implies a further reduction in tax liability, a reduction which in turn must be shifted through further reduction in price and gross profit, ad infinitum.

In summary, the effect on price of a given reduction in effective corporate income tax rates will necessarily depend on the degree of CIT shifting. If any part of the CIT savings are shifted forward, gross-of-tax corporate profits will decline, implying an equivalent reduc-

so that

$$\begin{aligned}\Delta T &= t\pi - t' \frac{(1 - \alpha t)}{(1 - \alpha t')} \pi \\ &= \frac{(t - t')}{(1 - \alpha t')} \pi\end{aligned}$$

and the resultant price reduction is

$$\pi - \pi' = \alpha \Delta T = \frac{\alpha}{(1 - \alpha t')} (t - t') \pi = \frac{\alpha}{(1 - \alpha t')} \Delta T^A$$

Thus, if the true shifting parameter is α , Aaron's parameter "a" is given by

$$a = \frac{\alpha}{(1 - \alpha t')},$$

and only when $t' = 0$ does $a = \alpha$, i.e., only when the CIT is fully removed is Aaron's parameter "a" equal to the true shifting parameter α . The most serious consequence of this misspecification is that in cases of partial CIT reduction the true shifting parameter will be a function of the effective tax rate. Since the present analysis examines partial replacement of the CIT by the VAT, it is necessary to employ the correct, although mathematically more complex, shifting parameter α .

tion in price. Only if the tax savings are completely retained by producers, i.e., if gross profits remain constant and net profits increase by the amount of the tax savings, will the CIT reduction have no effect on prices.

Thus, it is necessary to specify CIT shifting parameters for all industries. Unfortunately, there exists no consensus concerning the degree to which the corporate income tax has been shifted in the short run; empirical estimates range from no shifting to shifting in excess of the increase in tax liabilities [Gordon; Krzyzaniak and Musgrage]. Classical price theory suggests no short-run shifting. However, the diversity of empirical shifting estimates and the plausibility of market structure hypotheses which would give rise to some degree of shifting dictate that alternative CIT shifting assumptions be examined. In the empirical analysis, CIT shifting parameters ranging between the logical extremes of zero (no shifting) and one (full shifting) are employed. As has been discussed, these shifting parameters are defined as the ratios of the change in gross profit to the change in tax liability, where the latter reflects the full effects of both (a) the initial change in tax rates, and (b) the change in tax liability due to the change in gross (taxable) profit resulting from shifting. Under full forward shifting of the CIT reduction *net-of-tax* profit is unchanged, while under zero shifting *gross* profit remains constant.

In principle, it is necessary to specify a CIT shifting parameter for each industry. While there is no basis for assuming that shifting parameters will be equal for all industries, except under the classical assumption of zero short-run shifting, the lack of any reasonable basis for determining differential CIT shifting parameters dictates the provisional assumption that all industries shift equal proportions of their reduced CIT liabilities. CIT shifting parameters that vary by industry are not employed.

In summary, if any part of a given CIT reduction is shifted, the result is a price reduction to the consumer. The reduction in price is then a function of the degree of CIT reduction, of the value of the shifting parameter (assumed equal for all industries), and of the initial CIT liability per original dollar of sales (*not* equal for all industries). The higher the initial CIT liability, the greater the resultant reduction in price. Thus, a very capital-intensive industry or an industry with a very high profit rate or one which is highly incorporated will experience above-average reductions in price due to the shifted CIT reduction: the *initial* tax rate per dollar of sales will be higher, and the consequent reduction in gross profit will be greater [Shoup, 1959], implying greater reductions in price on both counts.

2.4.3 Effects of the VAT on Prices

Shifting of the VAT, i.e., the relationship between the VAT rate and prices (inclusive or exclusive of VAT itself) is also more complex than might at first appear. Let P denote price prior to the introduction of the VAT; P' , the VAT-exclusive price after VAT imposition; P^* , the VAT-inclusive price; and Z , the VAT rate. Then the VAT-inclusive price will simply be $(1 + Z)P'$. As in the case of the CIT, the VAT shifting parameter, β , can be defined as the ratio of the change in price to the change in tax liability, the comparison in each case being to the situation prior to VAT introduction:

$$\beta = \frac{(1 + Z)P' - P}{ZP'} \quad (2-4-3)$$

In the analysis of the VAT-CIT substitution the pre-VAT (but post-CIT reduction) price is adjusted by the effect of the VAT, i.e., P' is expressed as a function of β , Z , and P :

$$P' = \left(\frac{1}{1 + Z - \beta Z} \right) P \quad (2-4-4)$$

Thus, in terms of VAT-inclusive prices

$$\begin{aligned} P^* &= (1 + Z)P' = \left(\frac{1 + Z}{1 + Z - \beta Z} \right) P \\ &= \left[1 + Z \left(\frac{\beta}{1 + Z - \beta Z} \right) \right] P. \end{aligned} \quad (2-4-5)$$

In this formulation, the effect of any failure fully to shift the VAT (i.e., $P > P'$) will be to reduce the VAT-exclusive value added, which will in turn reduce the VAT liability, again ad infinitum.¹⁷ As a result, the ultimate VAT-exclusive price will lie between the pre-VAT

¹⁷ The formulation here again contrasts with Aaron's [p. 164], which is simply

$$(1 + Z)P' = P[1 + Zb]$$

where b is Aaron's misspecification of the VAT shifting parameter. By inspection, it can be seen that Aaron's b is given by

$$b = \frac{\beta}{(1 + Z - \beta Z)}$$

which is independent of the VAT rate, Z , only if $\beta = 0$ or $\beta = 1$, i.e., if the VAT is fully absorbed by profits or is fully shifted forward. Thus, the effective degree of VAT shifting assumed by Aaron differs from that nominally indicated.

price P (unitary shifting) and $[1/(1 + Z)]P$ (zero shifting), depending on the degree of VAT shifting (β).

It should be noted that under a VAT of the consumption-type only consumption purchases are ultimately subject to the tax. Since credit is granted the buyer for VAT invoiced on business purchases, investment and exports are effectively exempt from tax, while the VAT on government purchases is simultaneously government revenue and expenditure. However, this does not imply that effectively exempt transactions will be unaffected by the imposition of the VAT. Specifically, if producers fail to fully shift the VAT, then VAT-exclusive prices will decline. Thus, imposition of the VAT would reduce the *effective price* of VAT-exempt purchases. This result will be further examined in the later discussion of interindustry changes in tax liabilities.

In summary, the introduction of the VAT will increase VAT-inclusive prices in each industry unless the VAT liability is fully absorbed by profits or other factor earnings. Again, it is necessary to specify a tax-shifting parameter. Unlike CIT shifting, for which various alternative parameter values are examined, the VAT in our model is assumed to be fully shifted forward by all industries. The difference in treatment rests on three considerations. First, if it is assumed that the VAT is not fully shifted forward, difficult issues are raised concerning the actual incidence of the VAT and the consequent changes in the yields of other taxes, e.g., the remaining CIT (as will be discussed below). Secondly, full shifting of the VAT is at least consistent with classical price theory, given that final demand is completely price-inelastic, a condition implicit in our assumption of an unchanged final demand vector. Finally, we have argued that nonclassical assumptions concerning the shifting of the CIT necessarily relate to *net* rates of return. Similar market considerations must underlie a short-run failure to fully shift the VAT. However, the "net rate of return" constraints have already been incorporated through CIT shifting. It therefore seems redundant to impose them a second time through less than full shifting of the VAT since the two tax changes are simultaneous. As a result, full forward shifting of the VAT is assumed throughout.

Thus, it is assumed that, in response to the VAT introduction, producers mark-up their pre-VAT prices by the full amount of the VAT liability. Furthermore, it is assumed that *VAT-exclusive* prices for each industry are uniform for all purchasers. For investment goods purchases and exports, the effective price is VAT-exclusive, since a full VAT credit is allowed. Since government incurs no net VAT liability, only domestic consumers, having no tax credit, pay at VAT-inclusive prices.

2.4.4 Price Formation and the Rate of Depreciation

Because in the short run the *gross earnings* of existing capital goods are necessarily a kind of quasi-rent, short-run changes in capital goods prices and the replacement cost of depreciated capital should not influence output price under the usual profit maximization assumptions. However, the assessment of the VAT-CIT substitution under a range of assumptions concerning the degree of forward CIT shifting logically necessitates the inclusion in the base of the VAT of depreciation at post-tax-substitution prices.

Specifically, classical price theory, positing profit-maximizing behavior on the part of producers, implies that a corporate profits tax will not be shifted in the short run; any output-price configuration which maximized profits prior to the introduction (removal) of the CIT will also maximize profit after the CIT change. Short-run capital earnings are indeed purely a quasi-rent. With unchanged final demands (shifts in demand functions in which all final outputs are held constant), the reduction of the CIT and introduction of the VAT will simply increase prices by the amount of the VAT.

However, in this "classical case," whether depreciation is evaluated at replacement cost or not, is a matter of indifference *as far as the price effects of the substitution are concerned*. VAT-exclusive prices will be unchanged, and VAT-inclusive prices will be increased by the VAT rate applied to total value added originally embodied in a unit of final output. Since gross investment is effectively VAT-exempt the replacement cost of depreciated capital is unaltered by the tax substitution. Thus, the inclusion of depreciation at replacement cost is consistent with the classical treatment of *gross capital earnings* as a quasi-rent *as long as classical assumptions regarding tax shifting are also employed*.

Any other short-run shifting assumptions necessarily violate the classical model. To justify, e.g., forward shifting of a CIT, it is necessary to introduce nonclassical theories of price determination, oligopolistic theories relating to recognized interdependence between producers, "administrative" and "entry-restricting" pricing, etc. A thorough exposition of these issues is beyond the scope of the present study, but a central observation can be made: whatever the underlying price determination process, in any case involving forward shifting of a CIT or nonshifting of a VAT, the price determination must operate on the basis of net profits; i.e., net capital earnings and rates of return must underlie price formation. Thus, short-run shifting of CIT increases or of the benefits of CIT reductions must result from (imperfectly competitive) market pressures, or potential pressures, on net earnings. In consequence, when

the classical assumptions are given up, i.e., when forward shifting of a CIT or less-than-full shifting of a VAT are introduced, net earnings are logically implied as the determinants of prices. And for true net earnings to determine price, changes in the replacement cost of capital must be translated into equivalent changes in output price.¹⁸

In an input-output model, the translation of changes in capital goods prices into changes in output prices requires that depreciation be removed from gross value added and included in interindustry transactions. Depreciation is thus treated as having been contributed by capital-goods-producing industries rather than by capital-goods-using industries. Consistent with nonclassical shifting assumptions, price will then be determined by net rather than gross value added.

It should be clearly understood that the issue of the appropriate treatment of depreciation concerns criteria for price determination and is not unique to the analysis of the consumption-type VAT. In fact, the initial price effects of the tax substitution will be unaffected by the inclusion of depreciation in value added or in interindustry transactions regardless of the type of VAT (consumption, income, or gross-product) examined, as long as the classical shifting assumptions are maintained. Under nonclassical shifting assumptions, determination of prices by *net* earnings of capital (value added net of depreciation) requires that depreciation *not* be included unchanged in value added. For the consumption and income types of VAT, prices will be determined by net capital (and other) earnings only if depreciation is included at replacement cost, i.e., in interindustry transactions.

For a gross-product VAT, the necessary treatment in nonclassical cases is even more complex, because gross investment (net investment plus depreciation) is included in the VAT base, and depreciation is taxed twice, first as a component of value added of final output and second as a component of final output itself. Unlike a consumption or income VAT, a gross-product type permits no credit against final VAT liabilities of VAT on gross investment (consumption type) or on depreciation (income type). To achieve a given level of net earnings it is necessary to alter prices to reflect both changes in replacement cost and the additional taxation of depreciation.

The treatment of depreciation under a gross-product VAT is in-

18. As a result, Aaron's inclusion of depreciation in value added is acceptable only under classical shifting assumptions, i.e., zero shifting of the CIT and full shifting of the VAT. When, however, the Aaron model is used to experiment with nonclassical shifting assumptions, it incorrectly includes depreciation in value added, i.e., at original rather than replacement prices, and prices are incorrectly determined by gross rather than net value added.

deed complex, regardless of the shifting assumptions employed. Even under classical shifting assumptions, interpretation of depreciation and price formation depends on whether depreciation is allocated to intermediate transactions or to value added. If to value added, the *net* earnings of capital can be demonstrated to decline by the amount of the VAT liability on depreciation, even though VAT-exclusive capital goods prices and gross value added are unchanged. This is simply because VAT on depreciation cannot be credited against final VAT liabilities. However, if depreciation is instead allocated to intermediate transactions, this will not imply, as it does in the cases of VATs of the consumption and income types, that net earnings will be unaffected: the VAT on depreciation as an intermediate good, i.e., as a component of final value added, is not the only tax on depreciation. The capital-using industry will itself be forced to pay the VAT on depreciation, and true net earnings will decline by this amount.

In consequence, it is not sufficient to include depreciation in inter-industry transactions for the analysis of nonclassical cases in which prices are to be determined by net capital earnings. To achieve any given level of *net earnings* it is necessary to adjust depreciation for both changes in capital goods prices and the noncredibility of VAT on depreciation. If depreciation for some industry is D at original capital goods prices, and if P_K is an index of VAT-exclusive capital goods prices after the tax substitution, then the value of depreciation which must enter final prices, if a predetermined level of net earnings is to be attained, is $P_K D(1 + Z)^2$, where Z is the VAT rate. Simply including D as an intermediate transaction would result in a contribution to final output price of $P_K D(1 + Z)$, and net earnings would fall short of the predetermined level by $Z P_K D$, the net VAT liability of the capital-using industry on account of depreciation. The "true" replacement cost of capital now includes the noncreditable VAT, i.e., becomes $P_K D(1 + Z)$. To obtain a given level of net earnings this amount must be included in total value added embodied in final output. The depreciation contribution to final output price is then $[P_K D(1 + Z)](1 + Z) = P_K D(1 + Z)^2$. The VAT liability on sales attributed to depreciation is simply $P_K D(1 + Z)Z$; deducting this amount from the depreciation component of final (VAT-inclusive) sales price, we are left with the VAT-inclusive replacement cost of capital, i.e.,

$$\begin{aligned} P_K D(1 + Z)^2 - P_K D(1 + Z)Z &= P_K D(1 + 2Z + Z^2 - Z - Z^2) \\ &= P_K D(1 + Z). \end{aligned}$$

Thus, it is necessary (a) to include depreciation at VAT-exclusive replacement capital prices, i.e., as an intermediate good, and (b) to augment this amount by the VAT liability on depreciation $(1 + Z)$, if a given level of net earnings is to be achieved under a gross-product VAT.

To reiterate, under our assumptions, price is determined by value added *net* of true economic depreciation (capital consumption evaluated at replacement cost). This is equivalent to treating capital earnings as quasi-rents *if the corresponding classical shifting assumptions are employed* (zero CIT and full VAT shifting), since in this case consumption prices would rise just by the amount of the VAT and capital goods prices would be unchanged. It is also consistent with nonclassical cases in which prices change through the influence of tax shifting on *net* earnings, and thus on value added net of true depreciation.

2.5 FISCAL IMPLICATIONS OF THE TAX SUBSTITUTION

2.5.1 Revenue and Expenditure Effects

The VAT-CIT substitution will have both direct and indirect effects for all levels of government. Directly, the tax involves a loss in CIT revenue and a more-or-less compensatory increase in revenues from the VAT. Indirectly, any changes induced in prices of governmental-purchased goods and services by the tax substitution will alter either government expenditure or real levels of government demand, while changes in consumer prices may lead to adjustments of public employees' wages. Also, changes in prices and wages in the rest of the economy will lead to secondary changes in the revenue yields of other taxes, and in each of these cases the effects may be quite different at different levels of government.

For a first-round analysis of the change in tax structure, the following effects are considered: Direct changes in VAT and CIT revenue yields due to increases or decreases in the rates of these taxes; indirect changes in VAT and CIT revenues due to changes in value added or in corporate profits resulting from the tax substitution, a consequence of the direction and degree of tax shifting; and finally, changes in the level of nominal government expenditure, due to price changes, assuming a fixed bill of real final demands of government.

It is specifically, if unrealistically, assumed that the nominal yields of taxes other than the VAT and the CIT are unaffected by the tax substitution. A more complete analysis would incorporate changes

in other revenues following from effects on factor earnings and prices, requiring that the VAT be sufficient to compensate for these as well as changes in the CIT and in government prices. Adjustments of actual government demands and of public employees' wages are considered second-round responses to the change in tax structure and are ignored in the formal analysis. Differential inter-governmental fiscal consequences are briefly considered at a later stage. For present purposes government is viewed in integrated, national income accounts terms.

2.5.2 CIT Revenue Loss

Although the tax substitution involves a simultaneous reduction or elimination of the CIT and compensating imposition of the VAT, it is useful heuristically to view the change in tax structure as a series of individual tax changes. Thus, the revenue loss resulting from a reduction in effective CIT rates can first be considered independently of later changes in VAT rates.

The CIT revenue loss is straightforward if either (a) the CIT is completely repealed or (b) the benefits of the CIT reduction are not shifted forward in the form of lower prices (and profits). If the CIT is repealed, the nominal revenue loss is simply the prior yield of this tax. Regardless of any resultant changes in profits, the revenue loss is unchanged. If the CIT is only partially eliminated, then the revenue loss will simply equal the change in yield at the original level of profits only if the benefits of CIT reduction are not shifted forward, reducing gross-of-tax profits.

Shifting of the CIT will, however, reduce taxable profits, resulting in a revenue loss greater than would be implied by the change in rates at original profit levels. Recall that CIT shifting was defined as the ratio of the change in profits to the change in tax liabilities:

$$\alpha = \frac{\pi - \pi'}{t\pi - t'\pi'}$$

where as before α represents the shifting parameter, π the level of gross profits (aggregate or per unit output), t the tax rate, and primes (') indicate post-tax-substitution values.

The change in CIT revenues, ΔT_C , is then simply

$$\begin{aligned} \Delta T_C &= t\pi - t'\pi' \\ &= t\pi - t' \frac{(1 - \alpha t)}{(1 - \alpha t')} \pi \\ &= \frac{(t - t')}{(1 - \alpha t')} \pi \end{aligned} \tag{2-5-1}$$

Because of the shifting-induced decline in taxable profits, the ultimate CIT revenue loss is a multiple $[1/(1 - \alpha t'')]$ of the loss due to the rate reduction alone $[(t - t')\pi]$.

2.5.3 VAT Revenue and Interdependence in Tax Yields

The revenue gained by imposition of the VAT is similarly dependent on the degree to which the VAT itself is shifted. If the VAT is fully shifted forward through higher prices, then value added (price) exclusive of the VAT is unaffected by the imposition of the tax. Thus, VAT revenue would be given by the VAT rate multiplied by taxable (consumption) expenditure (accumulated value added). However, if the VAT is not fully shifted, then value added exclusive of the VAT will decline, resulting in a concomitant decline in VAT revenue.

Thus, if the value of taxable sales, prior to imposition of the VAT but after CIT reduction, is denoted by P' (previously denoting price), the VAT rate by Z , and the degree of VAT shifting by β , then the VAT-exclusive value of taxable sales after introduction of the VAT, P'' , is

$$P'' = \left(\frac{1}{1 + Z - \beta Z} \right) P' \quad (2-5-2)$$

implying VAT revenue of

$$\Delta T_V = ZP'' = \frac{Z}{(1 + Z - \beta Z)} P' \quad (2-5-3)$$

However, the ultimate change in tax revenue resulting from the imposition of the VAT is still more complex, unless the VAT is fully shifted forward. First, it is necessary to identify the component of price (the factor return) that bears the unshifted part of the VAT. Provisionally, assume that the failure fully to shift the VAT is reflected by a reduction in profit (aggregate and per unit of output). Then, as a result of the shifting of part of the VAT burden to profits, profits will decline by $P' - P''$, which will result in a decline in corporate income tax revenues. With the given (post-CIT-reduction) CIT rate, t' , the change (positive or negative) in CIT revenue will be $t'(P'' - P')$, i.e.,

$$\begin{aligned} \Delta T_{CV} &= t'(P'' - P') \\ &= t' \left[\left(\frac{1}{1 + Z - \beta Z} \right) P' - P' \right] \\ &= t' P' \frac{-Z + \beta}{1 + Z - \beta Z} \end{aligned} \quad (2-5-4)$$

where ΔT_{CV} is the change in CIT revenue resulting from the proportion of the VAT liability borne by profits. ΔT_{CV} will be zero only if $\beta = 1$, i.e., if the VAT is fully shifted, or if $t' = 0$, i.e., the CIT is totally repealed. The full change in revenue following the imposition of the VAT is, then,

$$\begin{aligned}\Delta T &= \Delta T_V + \Delta T_{CV} \\ &= \left(\frac{Z}{1 + Z - \beta Z} \right) P' + \left(\frac{-Z + \beta Z}{1 + Z - \beta Z} \right) t' P' \\ &= \left[\frac{(1 - t' + \beta t')}{1 + Z - \beta Z} \right] P'\end{aligned}\tag{2-5-5}$$

Of course, this would not be the end of the tax revenue effects of incomplete forward shifting of the VAT, e.g., personal income tax liabilities would be altered through reductions in dividends or capital gains. Furthermore, any shifting of the CIT savings would generate additional reductions in profits and prices, and hence in VAT and CIT revenues. Most generally, any backward shifting of the VAT will simultaneously affect federal and state CIT, other income tax, and possibly non-income-tax revenues. Similarly, changes in prices, through either the forward shifting of the CIT reduction or backward shifting of the VAT, will reduce government revenues from existing ad valorem excises, even if final demands are unaffected by the price and disposable income changes. Thus, unless the rates of these taxes are simultaneously altered, their revenue yields will also be affected.

In brief, revenue yields of different taxes are interdependent, and this interdependence, not to mention the identification of economic effects, would require that a tax substitution be examined in a general equilibrium context. The model used here to assess the effects of a VAT-CIT substitution goes only partially in this direction. A number of artificial assumptions have had to be made to render the problem tractable; one of the most important of these is the assumption that the nominal yields of other taxes will be unaffected by the VAT-CIT changes.

2.5.4 Change in Government Expenditure

Since government final demands are assumed to be constant and changes in public employee wages and in transfer payments (e.g., relief to needy) induced by the VAT-CIT substitution are relegated to later-round adjustments, government expenditure will be altered

only by changes in the prices of government-purchased goods and services. Since the VAT invoiced on government purchases in the aggregate represents both revenue and expenditure, it makes no difference whether VAT is charged on government purchases and the amount entered as additional VAT revenue, or whether government purchases are exempt and government prices are VAT-exclusive.

The reduction or repeal of the CIT will benefit government to the degree to which CIT savings are translated into lower prices. Employing the yield criterion that the government surplus or deficit be unchanged by the tax substitution, CIT shifting reduces the total VAT revenue required to compensate for the CIT.

If the VAT is fully shifted, government prices after the imposition of the VAT will be determined only by the reduction or repeal and the degree of shifting of the CIT. However, if the VAT is not fully shifted, but is partially or completely absorbed by profits or other factor earnings, then government prices, *exclusive of VAT*, will decline, on the reasonable assumption that VAT-exclusive prices are identical for all purchasers. In brief, a firm cannot easily distinguish between ultimately taxable and nontaxable sales, and the failure to shift the VAT fully will result in price reductions in the case of sales entitled to a VAT credit. Even if the firm could distinguish between taxable and nontaxable transactions, the maintenance of VAT-exclusive prices on nontaxable sales, when VAT-exclusive prices of taxable sales declined, would necessitate an inherently unstable dual price system.

In fact, it is assumed throughout that the VAT is fully shifted forward. Thus, government expenditures will be affected only by the possible shifting of the CIT reduction.

2.6 THE INPUT-OUTPUT MODEL ANALYTICAL SYNTHESIS

2.6.1 Overview of the Model

All the foregoing elements, including (a) the criteria for a compensating tax substitution, (b) the special characteristics of the consumption-type VAT, (c) price formation, tax shifting, and the appropriate treatment of depreciation under nonclassical pricing assumptions, and (d) direct and indirect fiscal implications of the tax substitution are structurally integrated in the context of an input-output model. Essentially, the input-output model provides a framework for a static general equilibrium price determination within which the first-round economic effects of a compensated tax substitution can be identified.

In input-output analysis, price for each industry's output is defined as the total value of primary resources directly and indirectly used in the production of a unit of final output. Ultimately, this price consists of *imports* and *value added*, with value added defined to include all primary factor income, including employee compensation, profits, and all other factor payments. If output is measured in constant dollars, i.e., as the *value* of output prior to the tax substitution, then the unit price of each industry's output is initially unity by definition. Any change in this "price per dollar of final output" will then measure the change in value added (including imports) per original dollar of final output resulting from the tax substitution.

Defined in this way, output price for *any* industry is related to value added of *all* industries by a set of technical input coefficients which specify total inputs (direct and indirect) from each industry required to produce a dollar of final output of the given industry. Thus, given the total input coefficients, value added per unit of output for all industries can be transformed into output price for any particular industry. A change in any price is then necessarily the consequence of a change in the value added of some industry or industries. As a result, the input-output relationships between industries imply that a change in the value added of any industry will be passed forward automatically as a price change of other industries.

In input-output practice, depreciation, or capital consumption can be treated either as a component of gross value added or as an intermediate input. Depreciation is conventionally included in value added simply because of the empirical difficulty of allocating it over capital-goods-producing industries. However, by use of a capital flow table, supplemented by a number of assumptions concerning the relationships between investment and output, it is possible to distribute depreciation over capital-goods-producer industries. Because net value added is logically implied as the determinant of price in cases of short-run shifting of the CIT, depreciation allowances by industry have been subtracted from both gross investment and gross value added and have been added to interindustry transactions.¹⁹

19. Specifically, two basic assumptions are required to estimate capital consumption on an interindustry basis. First, depreciation of capital goods supplied by industry *i* to industry *j* is assumed to be proportionate to the stock of *i*th industry capital goods in industry *j* in the previous period, i.e.,

$$D_{ij,t} = d_{ij}K_{ij,t-1}$$

where $D_{ij,t}$ is depreciation of the *i*th good in the *j*th industry in period *t*, $K_{ij,t-1}$ is the stock in the preceding period, and d_{ij} is the depreciation rate as approx-

As a result of the depreciation adjustment, the price effects of the VAT-CIT substitution incorporate the tax-substitution-induced changes in the prices of capital good inputs: capital consumption per unit of output is evaluated at postsubstitution replacement cost rather than at original cost. Value added will then include only *net* earnings of capital, in addition to other factor incomes. However, because only final consumption sales constitute the base of the consumption-type VAT after allowances and credits, only value added directly or indirectly entering consumption is ultimately subject to tax.

It must be reiterated that this treatment of depreciation, entering it into prices at replacement cost, is equivalent to treating capital earnings as quasi-rents *if the corresponding classical tax shifting assumptions are employed* (zero CIT and unitary VAT shifting). In this case consumption prices rise just by the amount of the VAT, capital goods prices are unchanged, and the treatment of depreciation, whether as an interindustry transaction or as a component of gross value added, is a matter of indifference. However, only the former treatment of depreciation (as an interindustry transaction, i.e., at replacement cost) is consistent with nonclassical shifting assumptions, under which prices respond to the effects of tax changes on net earnings of capital.

imated by the reciprocal of the average useful life of the i^{th} capital good in the j^{th} industry. Secondly, the growth rates of all types of capital goods stocks in an industry are assumed to be uniform, equal to the normal (average) growth rate of real output of the industry, g_j , i.e.,

$$\frac{K_{ij,t} - K_{ij,t-1}}{K_{ij,t-1}} = g_j$$

Thus, the unobserved stock in the preceding period, $K_{ij,t-1}$, can be determined on the basis of gross investment, $I_{ij,t}$, given by the capital flow table, and the rates of growth and depreciation, g_j and d_{ij} :

$$K_{ij,t-1} = \frac{I_{ij,t}}{g_j + d_{ij}}$$

Depreciation, by user and supplier industry, is then

$$D_{ij} = d_{ij} \frac{I_{ij}}{g_j + d_{ij}}$$

The details of the conversion of depreciation into interindustry transactions are contained in Appendix A, section 4.

In the analysis of the first-round effects of the tax substitution, it is assumed that the constant-dollar bill of final demands (by industry) and the input-output coefficients (inclusive of depreciation) are unaffected by the tax changes. Demand and input-substitution responses to the tax-induced changes in relative prices are relegated to later-round reactions. Thus, the initial (first-round) price effects of the tax substitution must be interpreted primarily as indices of potential demand and production-process responses to the tax substitution, rather than as price changes which would actually be observed.

The substance of the foregoing model can be outlined conceptually in terms of its application to the VAT-CIT substitution. The effects of the tax substitution on prices can be most conveniently broken into two independent phases: First, the reduction in the CIT, and second, the imposition of the VAT. In each phase, the effect on prices results from tax-substitution-induced changes in value added (defined inclusive of CIT and VAT liabilities).

A reduction in effective CIT rates will have no effect on prices if reduced CIT liabilities are simply converted into higher net profits. However, if the CIT savings are shifted to purchasers, then to that degree gross-of-tax profits, value added, and hence price, will decline. Note that a decline in the value added of any one industry will be reflected in the prices of all industries that use the product of that industry as an intermediate good.

Thus, the effect of the CIT reduction on prices is a function of the degree of CIT reduction, of the magnitude of the CIT shifting parameter (assumed to be equal for all industries), and of the initial *direct and indirect* CIT liability per original dollar of output.

In the second phase, introduction of the VAT will increase value added in each industry (inclusive of VAT) if the VAT is fully shifted forward in higher prices. However, if the VAT is of the consumption type and is fully absorbed by profits or other factor earnings, then under the assumption of equal VAT-exclusive prices for all purchasers aggregate value added (inclusive of net VAT) will decline, i.e., consumption prices will be unchanged by the VAT, while effective prices for nonconsumption purchasers will *decline* by the (rebated) VAT liability. At intermediate degrees of VAT shifting, value added may increase or decrease, but in any event will increase by less than the nominal VAT liability.

If the VAT is fully shifted forward, VAT-exclusive prices will be determined only by the reduction in and shifting of the CIT, i.e., prices after the CIT reduction but before the VAT introduction are equal to VAT-exclusive prices after inauguration of the VAT. Thus,

VAT-inclusive prices will be known as soon as the VAT rate is determined.

In addition, the CIT-compensating VAT rate is dependent only on the previously determined VAT-exclusive prices. The selected criterion for VAT yield is simply that net change in government revenue equal net change in government expenditure, i.e., that the net change in the government surplus be zero. The *net* change in government surplus *after the CIT reduction* but before the VAT is given by the algebraic sum of the decrease in CIT revenue (direct decrease due to rate reduction, and indirect decrease due to shifting) and the decrease in government expenditure (due to reductions in the prices of governmentally purchased goods and services, resulting from CIT shifting). In addition, government expenditure will be increased by the amount of the VAT invoiced on government purchases; however, since the VAT on government purchases is government revenue as well as expenditure, these items cancel out and can be ignored, i.e., government can be assumed to pay at VAT-exclusive prices. Thus, *with full VAT shifting* the required VAT revenue is known as soon as the CIT is reduced.²⁰ The base of the VAT, private domestic consumption at VAT-exclusive prices, is also known if the VAT is fully shifted. Therefore, the required VAT rate is simply the ratio of the pre-VAT net change in government surplus to the VAT base, both computed *after* reduction of the CIT. The resultant VAT rate will be just sufficient to produce a net change in government revenue equal to the net change in expenditure, i.e., an unchanged monetary surplus or deficit. Given the VAT rate and VAT-exclusive prices, VAT-inclusive consumption prices can then be determined.

In the more general case of incomplete VAT shifting, VAT-exclusive prices would not be known until the VAT rate was determined. That is, *VAT-exclusive* prices would depend on the shifted VAT rate. In this case, not examined here, the VAT rate and prices (both inclusive and exclusive of VAT) would have to be determined simultaneously.

2.6.2 The Analytics of the Model

The mathematical representation of the foregoing model is straightforward. Consider a depreciation-adjusted input-output system, in which estimates of depreciation (use of capital services) are added to

20. If the VAT were not fully shifted, then VAT-exclusive prices of government purchases would decline further with the introduction of the VAT, as noted previously.

interindustry flows and correspondingly subtracted from gross value added and from gross investment for each industry. Final demand (y) is disaggregated into private domestic consumption (c), government purchases (g), net private domestic investment (i), and exports (e).²¹ Net value added per dollar of output (v) is divided into gross corporate profits (π) and other elements (o), including imports.²² The input-output model is thus given by

$$x = (I - A)^{-1}y = (I - A)^{-1}(c + g + i + e) \quad (2-6-1)$$

$$p' = v'(I - A)^{-1} = (\pi + o)'(I - A)^{-1} \quad (2-6-2)$$

where I is an n by n identity matrix, A is an n by n matrix of direct requirements coefficients, x is a vector of total output, p is a vector of prices, and primes indicate transposes.

Equations (2-6-1) and (2-6-2) represent two views of an input-output system. Equation (2-6-1) relates total outputs of all industries to final demands from all industries. Equation (2-6-2) relates final output prices of all industries to primary factor costs of all industries and reveals the cost structure of producing a dollar of final output in terms of the primary resources eventually used. These two equations indicate the dual aspects of the input-output system.

Equation (2-6-2) is appropriate for answering the question: What would be the relative price consequences if all or part of the corporate income tax were replaced by a consumption-type value-added tax, assuming that the bills of real final demand, c , g , i , and e and the input-output structure, A , are unchanged by the tax substitution?

Let $S/100 = s$ be the uniform proportionate reduction in initial effective CIT rates. The pre- and postsubstitution CIT rates for industry j are denoted by t_j and t_j' [$= t_j(1 - s)$], respectively. The CIT shifting parameter for industry j , α_j , is defined as the ratio of the change in gross profit to the change in tax liability, i.e.,

$$\alpha_j = \frac{\pi_j - \pi_j^*}{t_j\pi_j - t_j^*\pi_j^*}, j = 1, 2, \dots, n, \quad (2-6-3)$$

where asterisks (*) represent post-CIT-reduction values. As a consequence of the CIT reduction and shifting, per unit value added for industry j , v_j , is reduced by $\Delta\pi_j$,

21. Each of these final demands represents a vector by industry.

22. Value added and its components are again vectors by industry.

$$\Delta \pi_j = \pi_j - \pi_j^* = \frac{\alpha_j}{1 - \alpha_j (1-s)t_j} (st_j \pi_j), j = 1, 2, \dots, n, \quad (2-6-4)$$

assuming that other value-added elements remain unchanged. Thus, the per unit value added for industry j after the CIT reduction but before the VAT introduction is simply

$$v_j^* = v_j - \Delta \pi_j = v_j - \alpha_j st_j \pi_j \quad (2-6-5)$$

with

$$a_j = \frac{\alpha_j}{1 - \alpha_j (1 - s) t_j} \quad (2-6-6)$$

for $j = 1, 2, \dots, n$. For the reasons indicated in section 2.4.2, it is assumed that α is uniform across the industries.

Therefore, value added for all industries after CIT reduction is

$$v^{*'} = v' - s\pi'tb, \quad (2-6-7)$$

where π' is a $1 \times n$ row vector containing initial gross profits, t is an $n \times n$ diagonal matrix containing initial CIT rates, and b is an $n \times n$ diagonal matrix containing the elements a_j . From equation (2-6-2), the price vector of final output after the CIT reduction, in terms of value added, is

$$p_2' = v^{*'} (I - A)^{-1}, \quad (2-6-8)$$

with the price reduction equal to $s\pi'tb(I - A)^{-1}$. Since it is assumed that the VAT is fully shifted forward, the VAT-inclusive price vector after the VAT introduction is simply the price vector p_2 multiplied by 1 plus the VAT rate, i.e.

$$p_3' = (1 + Z) p_2' = (1 + Z) v^{*'} (I - A)^{-1}, \quad (2-6-9)$$

where Z is VAT rate. With the introduction of the VAT, p_2 can be interpreted as a vector of VAT-exclusive prices.

The VAT rate is still not determined. To solve for the VAT rate, individual gross changes in government revenue and expenditure resulting from the CIT-VAT substitution must be calculated. To

satisfy the yield criterion, an unchanged monetary surplus (or deficit), net changes in revenue and expenditure must be equal. On the revenue side, the reductions in CIT rates cause original government revenue to decrease by an amount $s\pi'tx$ plus an additional amount $s(1-s)\pi'tbtx$ if the tax saving is shifted forward. CIT revenue will not be further reduced since the VAT is assumed to be fully shifted forward. Second, the introduction of VAT increases government revenue by an amount equal to $Zp_2(c+g)$, with c and g standing for private domestic consumption expenditures and government purchases at their original values. It can be assumed that, since the government is not itself a VAT-payer, it will not enjoy a credit for the VAT invoiced to it on its purchases from the tax-paying sector. It therefore pays the VAT-inclusive price on all purchases, including its purchases of capital goods, but correspondingly it is the recipient of these invoiced tax revenues.²³ The net change in the government revenue is thus

$$\Delta R = Zp_2(c+g) - s\pi'tx - s(1-s)\pi'tbtx. \quad (2-6-10)$$

On the expenditure side, the change in the government expenditure is simply the difference between the post-tax substitution and the original expenditure, i.e.,

$$\Delta G = (1+Z)p_2'g - p'g. \quad (2-6-11)$$

Setting $\Delta G = \Delta R$ to satisfy the equal yield condition and utilizing equations (2-6-2), (2-6-7), and (2-6-8), a quadratic equation in Z , the VAT rate, can be derived:

$$k_1Z^2 + (k_1 - k_2)Z - k_2 = 0, \quad (2-6-12)$$

where k_1 and k_2 are scalars with

$$k_1 = v'(I-A)^{-1}c - s\pi'tb(I-A)^{-1}c,$$

and

$$k_2 = s\pi'tx + s(1-s)\pi'tbtx - s\pi'tb(I-A)^{-1}g.$$

23. As has been noted repeatedly, under the constant surplus condition the VAT treatment of government purchases is, in the aggregate, a matter of indifference.

Examining the elements of these expressions:

1. $s\pi'tx$ = primary loss in CIT revenue, an increasing function of the degree of CIT reduction.

2. $s(1 - s)\pi'tbtx$ = secondary loss in CIT revenue resulting from any partial or full shifting of the CIT reduction. The loss increases and then, when the CIT reduction approximates 50 percent, decreases at a diminishing rate. Also, it increases at an increasing rate with increases in the shifting parameter.

3. $s\pi'tb(I - A)^{-1}g$ = reduction in government expenditure resulting from lower VAT-exclusive prices due to CIT shifting. It increases at a diminishing rate with increases in the degree of CIT reduction. It also increases, but at an increasing rate, as the CIT shifting parameter increases.

4. $v'(I - A)^{-1}c$ = total private domestic consumption expenditure before the tax substitution.

5. $s\pi'tb(I - A)^{-1}c$ = reduction in private domestic consumption expenditure due to CIT shifting, increasing at a diminishing rate with increases in the degree of CIT reduction and at an increasing rate with increases in the CIT shifting parameter.

Thus, k_1 and k_2 can be easily interpreted: k_1 is total private domestic consumption expenditure after the CIT reduction but before the VAT introduction; k_2 is change in the government surplus or deficit after the CIT reduction but before the VAT introduction. Since the VAT invoiced to the government on its purchases represents equal amounts of increases in government expenditure and revenue, the invoiced VAT does not appear in k_2 , nor does government expenditure appear in k_1 . Therefore, k_1 is the VAT base and k_2 , the VAT revenue required to preserve the government budget position before the tax change. Thus the solution of equation (2-6-12) for the VAT rate, Z , is

$$Z = \frac{k_2}{k_1} = \frac{s\pi'tx + s(1 - s)\pi'tbtx - s\pi'tb(I - A)^{-1}g}{v'(I - A)^{-1}c - s\pi'tb(I - A)^{-1}c} \quad (2-6-13)$$

That is, the required VAT rate is equal to the ratio of the required compensatory VAT revenue to the VAT base. With the VAT rate determined, the price equations (2-6-8) and (2-6-9) provide, respectively, VAT-exclusive and -inclusive prices after the tax substitution.²⁴

24. Since prices were initially unity by definition, postsubstitution prices can be interpreted as ratios to presubstitution prices.

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Aggregate price indices are obtained from these indices of individual prices. For domestic private consumption the index is computed by dividing consumption expenditures at VAT-inclusive prices by the consumption expenditures prior to the tax substitution, i.e.,

$$P_c = 100(p'_3c/p'c). \quad (2-6-14)$$

Similarly, the VAT-exclusive price indices for government purchases, net investment, and exports are respectively:

$$P_G = 100(p'_2g/p'g) \quad (2-6-15)$$

$$P_I = 100(p'_2i/p'i) \quad (2-6-16)$$

$$P_E = 100(p'_2e/p'e). \quad (2-6-17)$$