1 Measuring Taxes on Capital and Labor: An Overview of Methods and Issues

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1.1 Introduction

1.1.1 Why Study Effective Tax Rates?

The tax systems of modern economies are highly complicated. They reflect the complex pattern of economic activities, the numerous different forms in which incomes accrue, and the many delicate political compromises underlying the tax laws. When trying to understand and model how taxes affect the economy, economists must inevitably resort to simplified descriptions of the tax system. To be able to see the big picture, policy makers have further a need for summary measures capturing the net effects of the many different provisions of the tax code.

Studies of so-called effective tax rates seek to provide such summary measures. An effective tax rate measures the net amount of tax levied on a certain economic activity, in accord with rules defining the tax base and the statutory tax rate imposed on that base. By estimating effective tax rates, tax economists are trying to answer questions such as: What is the overall burden of taxes on capital and labor, on average and at the margin? How do the net tax burdens vary across different sectors of the economy, across different types of investment, and across different groups of taxpayers? How have the tax burdens on different activities and factors of production evolved over time? And how would net tax burdens change if the tax laws were changed in certain ways?

Equipped with estimates of effective tax rates, analysts may study empirically whether and to what extent taxes affect economic behavior, and policy makers may evaluate whether the net outcome of all the different tax laws accords with their intentions, and how specific changes in the tax code would affect the incentives and net tax burdens faced by taxpayers.

1.1.2 Some Milestones in Effective Tax Rate Analysis

The study of effective tax rates on income from capital received a major stimulus from the work of King and Fullerton (1984), which in turn built on earlier research by Hall and Jorgenson (1967) and King (1974). The many studies initiated by King and Fullerton indicated that the tax systems of most OECD economies were characterized by serious non-neutralities in the early and mid-1980s; this was reflected in large differences in marginal effective tax rates on capital across different asset types, modes of finance, and investor groups. The studies also suggested that the overall marginal effective tax burden on capital was quite high, in part because of the failure to adjust the nominal income tax base for inflation. Thus the King-Fullerton studies left the impression of a highly distortionary system of capital income taxation. Because of their impact on professionals within national and international policy-making bodies, there is hardly any doubt that these studies helped to pave the way for the wave of tax reforms sweeping through the OECD area in the second half of the 1980s and the early 1990s. An important element in most of the reforms was the attempt to achieve greater neutrality of capital income taxation by eliminating tax priviliges for particular types of investment and by bringing depreciation for tax purposes more in line with true economic depreciation. At the same time research from this period also left a puzzle (addressed in chapter 4 of this volume): a study by Gordon and Slemrod (1988) estimated that in 1983 the US tax system collected no net revenue from taxing capital income. How could this be reconciled with the many studies indicating a high marginal tax burden on income from capital?

The original King-Fullerton studies focused on domestic investments financed by domestic savings. But as international capital flows were liberalized during the 1980s, the tax burden on cross-border investment attracted growing attention. Alworth (1988) and Keen (1991) showed how the King-Fullerton methodology could be extended to the study of taxation of multinational companies, and Michael P. Devereux and his collaborators at the Institute for Fiscal Studies in London made a major effort to generalize the King-Fullerton method to allow estimation of marginal effective tax rates on foreign direct investment. This work became an important input into an OECD study on "Taxing Profits in a Global Economy," which provided internationally comparable estimates of marginal effective tax rates on domestic and foreign direct investment in all the OECD countries at the start of the 1990s (OECD 1991).[1]

The same methodology was subsequently used by the Ruding Committee in its study of company taxation in the European Community (European Commission 1992). Some years later Michael Devereux and his IFS colleagues developed a further extension of the King-Fullerton framework, enabling estimation of average as well as marginal effective tax rates on domestic and foreign direct investment.[2] This method was applied in the European Commission's recent report on company tax problems in the European Union (European Commission 2001). A common theme running through these international studies of effective tax rates is that foreign investment tends to be overtaxed relative to domestic investment, due to incomplete alleviation of international double taxation. Hence these studies have helped to keep the removal of tax obstacles to cross-border investment on the policy agenda of international organizations like the OECD and the European Commission. But they have also attracted criticism that the open-economy King-Fullerton framework tends to overestimate the tax burden on international investment because it does not allow for all of the possibilities for tax planning available to multinational companies (see chapter 5 in this volume).

While most studies of effective tax rates have focused on taxes on capital, the recent years have witnessed a growing interest in measuring the tax burden on labor. In part this reflects a suspicion that high and rising taxes on labor have contributed to the stubbornly high rates of unemployment in several European countries. The increased focus on labor taxation may also reflect a perceived need to stimulate labor supply in order to counter the demographic trend toward a growing number of retirees relative to workers. In an influential study, Mendoza, Razin, and Tesar (1994) proposed a simple method for estimating average effective tax rates on labor, capital, and consumption, by combining the Revenue Statistics of OECD Member States with data from the OECD National Income Accounts. This method was applied in a provocative econometric study by Daveri and Tabellini (2000) suggesting that a large part of the rise in unemployment in Continental Europe over the period 1965 to 1995 could be explained by the rising tax burden on labor.

A similar method of estimating average effective tax rates on the basis of aggregate data was used by the European Commission (1997) to argue that international tax competition has caused a shifting of the tax burden away from mobile capital toward less mobile labor. As a supplement to these methodologies based on macro data, the OECD secretariat has developed its "Taxing Wages" approach to measuring average and marginal tax rates on labor, applying the key parameters from current tax rules to hypothetical model households with a specified level and composition of income.

1.2 Measuring Taxes on Capital

In this chapter I provide a summary of the main points made in this volume, within an organizing framework that should help the reader see how the various chapters fit together and complement each other.[3] In section 1.2, I deal with the measurement of effective tax rates on investment in physical capital, and in section 1.3, I focus on the measurement of taxes on labor and on human capital investment.

There are two main approaches to the measurement of effective tax rates on income from capital. One approach uses parameters from current tax laws to calculate the expected future tax burden on hypothetical investment projects, given specific assumptions about asset types, modes of finance, and the tax status of the investor. This may be termed the forward-looking approach. Another methodology uses data on capital taxes collected from firms and their owners and relates these revenue data to estimates of the before-tax income from capital. For reasons which will become clear below, this may be called the backward-looking approach.

1.2.1 Measures Using Parameters of Tax Legislation

The Basic Forward-Looking Measures

The forward-looking measures of effective tax rates on capital are grounded in the neoclassical theory of investment, as set out in detail in the survey by Michael Devereux in chapter 2. This section is a simplified restatement of some of Devereux's main results. To focus on basic methodological issues, we will initially abstract from risk, debt finance, and personal taxes. We will also simplify by abstracting from inflation throughout the analysis.[4]

Consider a corporate firm investing one dollar in some real asset at time zero. If the asset depreciates at the exponential rate δ, and if we treat time as a continuous variable, the *gross* return from the asset at time u will be $(p+\delta)e^{-(\rho+\delta)u}$, where ρ is the firm's discount rate, and p is the *net* rate of return before tax. Hence the net present value of the corporation tax collected over the lifetime of the asset will be

$$NPVT = \int_0^\infty \tau(p+\delta)e^{-(\rho+\delta)u}\,du - A = \frac{\tau(p+\delta)}{\rho+\delta} - A, \tag{1.1}$$

where τ is the statutory corporate income tax rate, and A is the present value of the future reduction in tax due to all deductions from the corporate tax base associated with the investment. For simplicity, let us assume that the only deductions are ordinary depreciation allowances granted at the rate ϕ (which may deviate from δ) on a declining balance basis. We then have

$$A = \int_0^\infty \tau\phi e^{-(\rho+\phi)u}\,du = \frac{\tau\phi}{\rho+\phi}. \tag{1.2}$$

Net of depreciation, the investment will generate a flow of *pre-tax* income with a present value equal to

$$NPV = \int_0^\infty p e^{-(\rho+\delta)u}\,du = \frac{p}{\rho+\delta}. \tag{1.3}$$

The forward-looking measure of the *average effective tax rate* proposed by Michael Devereux in chapter 2 is

$$AETR^f = \frac{NPVT}{NPV} = \frac{(\tau - A)(\rho+\delta) + \tau(p-\rho)}{p}. \tag{1.4}$$

Thus the average effective tax rate measures the proportion of the value of the project which is paid in tax. As the reader may verify from (1.2) and (1.4), we have $AETR^f = \tau$ when $\phi = \delta$. However, when taxable income deviates from true economic income ($\phi \neq \delta$), the average effective tax rate will deviate from the statutory tax rate.

The average effective tax rate may be calculated for any value of the pre-tax rate of return p. Of particular interest is the amount of tax collected on the *marginal* investment project with a net-of-tax value equal to zero. Gross of tax and depreciation, the present value of the revenue from an extra unit of investment is $PVG = (p+\delta)/(\rho+\delta)$, so a marginal investment project requiring an initial investment outlay of one dollar satisfies $PVG - NPVT - 1 = 0 \Leftrightarrow (1-\tau)(p+\delta)/(\rho+\delta) = 1 - A$, where we have used (1.1). Solving this expression for p, we obtain the required before-tax rate of return on the marginal investment, denoted by $\hat{p}$ and referred to as the *cost of capital*:

$$\hat{p} = \frac{(1-A)(\rho+\delta)}{1-\tau} - \delta. \tag{1.5}$$

Setting $p = \hat{p}$ in (1.4) and inserting (1.5) into the numerator, we obtain a forward-looking measure of the *marginal effective tax rate*:

$$METR^f = \frac{(\tau - A)(\rho+\delta)}{(1-\tau)\hat{p}}. \tag{1.6}$$

A more familiar expression for the marginal effective tax rate is

$$METR^f = \frac{\hat{p} - \rho}{\hat{p}}, \tag{1.7}$$

which says that the $METR^f$ is the difference between the before-tax and the after-tax rate of return, measured relative to the before-tax return. As the reader may check, one arrives at (1.6) by inserting (1.5) into the numerator of (1.7). Hence (1.6) and (1.7) are just alternative ways of expressing the same measure. Note from (1.2) that if the tax code allows immediate expensing of investment ($\phi \to \infty$), we have $A = \tau$. Equation (1.6) then reproduces the well-known result that the marginal effective tax rate is zero under a cash-flow tax with full expensing of investment.

Equations (1.5) and (1.7) summarize the standard King-Fullerton method of estimating the marginal effective tax rate in the absence of personal taxes. The preceding analysis shows that the King-Fullerton marginal effective tax rate is just the borderline measure of the average effective tax rate proposed by Devereux and used in various recent studies such as the one by the European Commission (2001). Indeed, by using (1.6) and (1.7) in (1.4), one can express the average effective tax rate as a weighted average of the $METR^f$ and the statutory tax rate:

$$AETR^f = \left(\frac{\hat{p}}{p}\right) METR^f + \left(1 - \frac{\hat{p}}{p}\right)\tau. \tag{1.8}$$

For the marginal investment project where $p = \hat{p}$ we thus have $AETR^f = METR^f$, but for projects with very high rates of return the average effective tax rate approaches the statutory rate.

When firms earn an above-normal rate of return and must choose between mutually exclusive investment projects, their investment decisions are likely to be influenced by the average as well as by the marginal effective tax rate. For example, suppose that a company can locate production in two different countries. If it faces a high fixed setup cost in each location, it may only be able to make positive profits if it concentrates all activity in one country. In deciding where to locate, a profit-maximizing firm will then start by calculating the optimal scale of investment in each location. This will depend on the *marginal* effective tax rate. The firm will then calculate the total after-tax profit generated by the optimal scale of investment in the two locations. This will be influenced by the *average* effective tax rate. Finally, the firm will locate in the country offering the highest total after-tax profit. Thus both measures of effective taxation are relevant, albeit for different types of investment decision. In particular, there is evidence that the $AETR^f$ has a significant effect on the international location of foreign direct investment, as Devereux explains in chapter 2.

The Role of Debt Finance and Personal Taxes

A main contribution of King and Fullerton (1984) was the extension of the framework of Hall and Jorgenson (1967) to allow for debt finance and personal taxes. These factors may influence the value of an investment project and the cost of capital via their impact on the firm's discount rate.

In the absence of risk and personal taxes, the firm's discount rate under equity finance is simply equal to the risk-free market interest rate, denoted by r. When investment is financed by *debt*, the relevant discount rate is the firm's *after-tax* interest rate, since interest payments are deductible from the corporate tax base:

$$\rho = r(1 - \tau). \tag{1.9}$$

The return to the firm's debt-financed investment will accrue to financial investors in the form of interest income. Suppose now that the marginal investor is subject to personal tax on interest income at the rate m. His after-tax return (s) will then be

$$s = r(1 - m). \tag{1.10}$$

The expression for the marginal effective tax rate in (1.7) must now be modified in the following way to account for taxes collected at the personal as well as at the corporate level:

$$METR^f = \frac{\hat{p} - s}{\hat{p}}. \tag{1.11}$$

Equation (1.10) also gives the net marginal return to saving in the case of equity finance if stock prices adjust to ensure that personal investors obtain the same after-tax return on shares and corporate bonds, that is, if[5]

$$r(1-m)V = (1-m^D)D + (1-z)(\Delta V - N). \tag{1.12}$$

In this arbitrage condition V is the market value of outstanding shares in the firm at the start of the period, ΔV is the increase in the total market value of the firm's shares over the period, D is the dividend paid out at the end of the period, N is new equity injected by shareholders at the end of the period, m^D is the personal tax on dividends net of any dividend tax relief, and z is the effective personal tax rate on accrued capital gains on shares. The left-hand side of (1.12) is the opportunity cost of holding shares rather than bonds, and the right-hand side is the after-tax return on shares, consisting of after-tax dividends and after-tax capital gains (note that $\Delta V - N$ is the capital gain on the shares outstanding at the start of the period).

Equation (1.12) may be used to derive the firm's discount rate under equity finance. Suppose that the firm has already designed an optimal investment plan which has maximized its initial market value V. By definition, a marginal increase in its investment will then leave V unaffected in the current period. If shareholders inject a unit of *new equity* into the firm to finance a unit increase in investment, it then follows from (1.12) that $\Delta V = N = 1$, since $r(1-m)V$ as well as $(1-m^D)D$ will be unchanged. From the start of the next period, the value of V will thus be one unit higher than before, so shareholders will require an increase in their income from shares equal to the opportunity cost $r(1-m)$. If the return to the extra investment is paid out as dividends, equation (1.12) implies that the corporation must be able to generate an extra dividend ρ satisfying

$$\rho(1-m^D) = r(1-m) \Leftrightarrow \rho = r\left(\frac{1-m}{1-m^D}\right). \tag{1.13}$$

Alternatively, the firm may decide to finance the unit increase in investment by *retained profits*, that is, by reducing its dividends D by one unit in the current period. Since the *initial* market value V is still unaffected (given that investment had already been optimized), this unit reduction in dividends must generate a capital gain equal to $(1 - m^D)/(1 - z)$ to maintain the financial market equilibrium condition (1.12). In the subsequent periods shareholders will require a rate of return $r(1 - m)$ on this increase in their wealth. Assuming again that the return to the marginal corporate investment is paid out as dividends, the additional dividend ρ must therefore be sufficient to ensure that

$$\rho(1 - m^D) = r(1 - m)\left(\frac{1 - m^D}{1 - z}\right) \Leftrightarrow \rho = r\left(\frac{1 - m}{1 - z}\right). \tag{1.14}$$

The discount rates in (1.9), (1.13), and (1.14) are derived on the assumption that any differences in the after-tax returns to debt and equity instruments will be eliminated by the arbitrage behavior of financial investors. But it seems equally plausible that the attempts of corporations to minimize their cost of finance would eliminate any differences in discount rates across the different modes of finance. Given the asymmetric tax rules prevailing in most countries, these two equilibrium conditions cannot be met simultaneously. King and Fullerton (1984) sidestepped this difficulty by considering two alternative scenarios. One scenario (the so-called fixed-r case) assumed that the arbitrage behavior of financial investors was dominant, enforcing the discount rates in (1.9), (1.13), and (1.14). In this case the after-tax return to saving is given by (1.10) regardless of the form of corporate finance, but the cost of corporate capital differs across modes of finance. In the alternative scenario (the fixed-p case) King and Fullerton assumed that the financial arbitrage of corporations will equalize the cost of the different types of finance, implying identical discount rates for debt, retained earnings, and new equity. In this case the cost of capital will be the same across all modes of finance, but savers will end up with different after-tax returns to debt and equity.

Thus, because it assumes perfect substitutability between debt and equity instruments combined with asymmetric tax rules, the King-Fullerton framework cannot explain why corporations would want to use both types of financing instruments at the same time as financial investors would want to hold both asset types. As a consequence studies in the King-Fullerton tradition take financing and portfolio decisions to be exogenous and typically calculate effective tax rates for each single mode of finance. To estimate an average value for the effective tax rate, it is normally assumed that the marginal debt–equity mix corresponds to the average proportions of debt, new equity and retained earnings observed in the data. As is pointed out by Devereux in chapter 2, one problem with this approach is that the firm's marginal source of finance may change over the lifetime of the investment project considered.

Accounting for Risk

An alternative way of dealing with personal taxes is to introduce a risk premium in the firm's borrowing rate of interest, which depends on its debt-to-asset ratio, and to allow for a risk premium on shares that depends on the firm's dividend payout ratio. It is customary to assume that the firm's cost of credit is rising in the debt–asset ratio, reflecting an increased risk of bankruptcy as leverage goes up. Moreover it is sometimes assumed that the risk premium on shares is decreasing in the dividend payout ratio, as shareholders have a (non-tax) preference for dividends over capital gains. This may be because shareholders attach a positive "signaling" value to dividends, or because they have difficulties monitoring whether managers make efficient use of the firm's internal funds.

In these circumstances the weighted average cost of corporate finance ($WACF$) would be given as

$$WACF = d[r + a(d)] + (1 - d)\rho, \qquad 0 \leq d \leq 1, \tag{1.15}$$

and the cost of equity finance ρ would be given by the arbitrage condition

$$r(1 - m) + b(\omega) = \rho[\omega(1 - m^D) + (1 - \omega)(1 - z)], \qquad 0 \leq \omega \leq 1. \tag{1.16}$$

The variable d is the debt–asset ratio, a is the risk premium on the firm's debt, b is the risk premium on its shares, and ω is the fraction of the return on shares taking the form of dividends, with the remaining fraction $1 - \omega$ accruing as capital gains. Via its dividend policy the corporation can control ω. A value-maximizing corporation will choose d and ω so as to minimize its weighted average cost of finance, subject to (1.15) and (1.16). In such an optimum debt and equity will be equally costly *at the margin*, due to the endogenous adjustment of the risk premia, and the split between new equity and retained profits will be determined by the optimal value of ω. Once the optimal financial policy has been identified, the resulting value of $WACF$ (the overall discount rate) can be used to determine a unique cost of corporate capital, and the optimal values of d and ω can be used to calculate the overall after-tax return to the savers who finance corporate investment.

This approach to corporate finance and investment is in the spirit of Boadway, Bruce, and Mintz (1984). In principle, it allows for optimizing financial behavior of corporations as well as the arbitrage behavior of financial investors. For purposes of calculating the effective tax rate, the researcher may assume that the empirically observed values of d, ω, ρ, and $r + a$ reflect this optimizing behavior. These are attractive features of a methodology for estimating effective tax rates. But the modelling of risk embodied in equations (1.15) and (1.16) is somewhat rudimentary and ad hoc. A more satisfactory theory must relate the risk premium in the cost of capital to the risk characteristics of the firm's real assets.

Such a theory is outlined by Devereux in chapter 2. His analysis implies that the risk premium varies positively with the covariance between the stochastic asset return and the investor's future income from other sources. An important issue is how taxes affect the risk premium in the required before-tax rate of return. Devereux shows that this question can only be answered by specifying the entire probability distribution of the before-tax return to the real asset considered. Depending on the specific assumptions made, the risk premium may or may not be affected by the tax system. Since complete knowledge of the distribution of before-tax asset returns is rarely available, it is difficult to estimate the impact of taxes on the cost of capital in the presence of risk. This would seem to favor an approach where the analyst simply calculates the effective tax rate for alternative exogenous levels of the before-tax return, in line with the method for calculating the forward-looking average effective tax rate given in (1.4).

Should Measures of Effective Tax Rates Allow for Personal Taxes?

The formulas presented above (equations 1.9 to 1.13) assume that the marginal financial investor is subject to domestic personal income tax. However, the marginal investor could also be a tax-exempt or tax-privileged institution such as a pension fund acting on behalf of household savers, or a foreign household or institutional investor. Uncertainty regarding the identity and tax status of the marginal investor makes it hard to estimate the marginal tax bill collected at the investor level, as Devereux points out in chapter 2.

The high international mobility of capital also makes it questionable whether it is meaningful to add up corporate and personal taxes to get an overall measure of the effective tax rate. To see the problem, note that equation (1.11) may be rewritten as

$$METR^f = \frac{\hat{p} - s}{\hat{p}} = \frac{\overbrace{(\hat{p} - r)}^{\substack{\text{Tax on}\\ \text{investment}}} + \overbrace{(r - s)}^{\substack{\text{Tax on}\\ \text{saving}}}}{\hat{p}}. \tag{1.17}$$

In a small open economy with perfect capital mobility and residence-based personal income taxation, the before-tax interest rate r will be exogenously given from the world capital market. In the absence of taxation and risk, this interest rate would also represent the cost of capital. Thus the "investment tax wedge" $(\hat{p} - r)$ in (1.17) reflects the extent to which the tax system distorts domestic investment, while the "savings tax wedge" $(r - s)$ measures the degree to which the personal tax system distorts domestic savings. By reducing domestic investment, a rise in the investment tax wedge will tend to *reduce* capital imports, whereas a rise in the savings tax wedge will tend to *increase* the inflow of capital by discouraging domestic saving. Hence the two tax wedges should not be added together in a single measure of the marginal effective tax rate if one wants to study how the tax system affects international capital flows, as Sinn (1988) pointed out several years ago. Moreover, if the purpose is to investigate how taxes affect domestic investment, one should focus entirely on the investment tax wedge and leave out the personal tax wedge $(r - s)$ from the measure of the marginal effective tax burden. On the other hand, if one wants to study the impact of taxation on domestic saving, one may neglect the corporation tax reflected in the investment tax wedge, as was in fact done in the report by the OECD (1994) on taxation and saving.

The prevalence of institutional and foreign shareholders and a predominant focus on investment incentives explain why many recent studies of effective tax rates have abstracted from personal taxes. However, even if one only wants to estimate the investment tax wedge $(\hat{p} - r)$, it may not be appropriate to neglect personal taxes altogether. The reason is that the cost of capital $\hat{p}$ depends on the firm's discount rate ρ, which is affected by personal taxes if the controlling shareholder is subject to personal income tax. Thus there is no easy way out of the problem of allowing for personal taxes in the estimation of effective tax rates.

Measuring Taxes on Foreign Direct Investment

The forward-looking King-Fullerton framework for effective tax rate analysis allows the researcher to specify all the institutional details that are relevant for the hypothetical investment project considered. In particular, although cross-border direct investment may involve more complicated patterns of finance and greater complexity of tax rules, the King-Fullerton framework can in principle be amended to allow for these complications, as pointed out by Devereux in chapter 2.

However, in practice, analysts have rarely tried to account for all of the intricate tax planning practices used by multinational companies to reduce their tax burden. These practices include the financing of foreign investment via finance subsidiaries located in tax havens, the shifting of debt from low-tax to high-tax jurisdictions, the shifting of taxable profits through transfer pricing, the exploitation of special tax rules applying to royalties, and the exploitation of special tax regimes offered by host governments to attract particularly mobile or valuable activities.

In chapter 5, Harry Grubert analyzes the implications of such practices for the measurement of effective tax rates on foreign direct investment. In the first part of the chapter he sets up a simple simulation model of a multinational company to illustrate how the effective tax rate on FDI may be affected by the most important forms of tax planning. This simulation analysis highlights the importance of how royalties are taxed and whether companies can use tax haven finance subsidiaries. It also shows that shifting debt to high-tax foreign locations can have a notable effect on the effective tax rate.

In the second part of chapter 5, Grubert supplements these hypothetical calculations by using tax return and survey data to analyze the determinants of the actual average effective tax rate on overall US manufacturing investment abroad. Among the most important determinants are the shifting of real assets and debt to low-tax jurisdictions, other forms of income shifting, the share of royalties in total foreign source income, and home country repatriation taxes. This part of Grubert's analysis indicates that compared to the average local company, the US subsidiaries operating abroad face a 5 percentage point lower average effective tax rate as a result of the tax benefits they enjoy by being part of a multinational enterprise. This finding clearly goes against the perception that cross-border direct investment tends to be overtaxed due to incomplete relief of international double taxation.

In the final part of chapter 5, Grubert presents an econometric analysis to suggest that host governments tailor their tax rules for inward FDI so as to increase their national welfare. Specifically host governments offer tax concessions to highly mobile foreign companies in the electronics and computer industry, and to foreign companies that sell a large share of their output offshore (presumably because offshore sales tend to improve the terms of trade of the host country). In contrast, subsidiaries of other R&D-intensive companies face relatively high effective tax rates, apparently because they tend to earn high local rents that can be appropriated by the host government.

Grubert's thought-provoking analysis raises some fundamental methodological questions. For example, if income can be shifted from a low-tax to a high-tax subsidiary, to which one should the tax benefit be attributed when estimating the average effective tax rates in each location? Clearly, the reduction in the global tax burden can only be obtained if the company operates in both jurisdictions simultaneously. More generally, given that many tax-planning strategies are fundamentally multilateral in nature, the assignment of the resulting tax benefits to the individual entities in a multinational group may require more or less arbitrary assumptions. Grubert's analysis also shows that the tax burden on a subsidiary in a multinational group of companies will generally depend on the activities and location of other entities in the group. This means that the effective tax rate on foreign direct investment will tend to be *company-specific*. Hence one cannot estimate the incentive for FDI by only looking at the parameters of tax legislation in the host and home countries, as previous studies have assumed. While these observations may seem somewhat pessimistic, Grubert's contribution also offers some constructive suggestions on alternative ways of estimating the tax burden on foreign direct investment.

1.2.2 Measures Using Data on Taxes Collected

The Basic Backward-Looking Measures

The use of tax return data in section 5.2 of Grubert's chapter is an example of the second main approach to effective tax rate analysis. This method uses data on capital income taxes paid and relates the observed tax bill to some estimate of the before-tax income from capital. By definition, the total income from capital before tax is pK, where K is the total capital stock, and where we recall that p is the average before-tax rate of return. If the total capital income tax bill in period t is T_t, the so-called backward-looking definition of the *average* effective tax rate on capital income in period t is

$$AETR^b = \frac{T_t}{p_t K_t}. \tag{1.18}$$

To focus on the basic methodology, we will once again simplify by abstracting from debt and personal taxes. If the tax savings from depreciation allowances in year t amount to D_t, the corporate income tax bill (representing the entire capital income tax bill) will then be

$$T_t = \tau_t(p_t + \delta)K_t - D_t. \tag{1.19}$$

When the rate of depreciation for tax purposes (ϕ) differs from the true depreciation rate (δ), the book value of assets in the firms' tax accounts (K^T) will deviate from the true replacement value of the capital stock. If the firms' gross investment in the past period $t-u$ was I_{t-u} and the rate of depreciation for tax purposes has varied over time, we have

$$K_t^T = \int_0^{\infty} I_{t-u} \cdot e^{-\int_u^t \phi_{t-s}\, ds}\, du \tag{1.20}$$

and

$$D_t = \tau_t \phi_t K_t^T. \tag{1.21}$$

Equations (1.18) through (1.21) make clear that the average effective tax rate estimated for the current period t will generally depend on the history of investment as well as on historical tax rules. Indeed, we might have subtracted an additional term from the right-hand side of (1.19) to allow for the current tax savings stemming from deductions for losses carried over from the past. These observations explain why the measure in (1.18) is referred to as a "backward-looking" effective tax rate.

However, under certain stylized assumptions the average effective tax rate in (1.18) will coincide with the forward-looking measure of the average effective tax rate given in (1.4). Specifically, suppose that the economy has followed a golden rule path where the capital stock has grown at a constant rate equal to the real interest rate r so that

$$I_{t-u} = (r + \delta)K_{t-u}. \tag{1.22}$$

Suppose further that the rate of depreciation for tax purposes has been constant in the past. Since (1.22) implies that $I_{t-u} = I_t e^{-ru}$, equation (1.20) then simplifies to

$$K_t^T = \int_0^{\infty} I_t \cdot e^{-(r+\phi)u}\, du = \frac{I_t}{r + \phi}. \tag{1.23}$$

From (1.2), (1.21), and (1.23) we get $D_t = A_t I_t$, which may be inserted into (1.19) along with (1.22) to give

$$T_t = [(\tau_t - A_t)(r + \delta) + \tau(p_t - r)]K_t. \tag{1.24}$$

Substituting (1.24) into (1.18), we get $AETR^b = [(\tau_t - A_t)(r + \delta) + \tau(p_t - r)]/p_t$. Comparing this to (1.4), and remembering that $\rho = r$ in the absence of personal taxes, we see that $AETR^b = AETR^f$ under the assumptions made. In other words, with an unchanging tax law and steady golden rule growth, the backward-looking and the forward-looking measures of the average effective tax rate are identical. Moreover, if we add the assumption of constant returns to scale so that $p_t = \hat{p}_t$, the result $AETR^b = AETR^f$ implies $AETR^b = METR^f$, since we have seen previously that $AETR^f = METR^f$ when $p = \hat{p}$. Thus the *backward-looking average* effective tax rate will also equal the *forward-looking marginal* effective tax rate under stable tax laws, golden rule growth and constant returns, as Roger Gordon, Laura Kalambokidis, and Joel Slemrod point out in chapter 4.

But to the extent that these restrictive assumptions are violated, the three measures of effective tax rates will deviate from each other. In particular, the existence of pure profits ($p > \hat{p}$) means that the backward-looking average effective tax rate will deviate from the forward-looking marginal effective tax rate governing the incentive to invest. In chapter 4, Gordon, Kalambokidis, and Slemrod (henceforth GKS) therefore propose an alternative measure of the marginal effective tax rate which may be estimated from data on tax revenue and income. The backward-looking marginal effective tax rate measure suggested by GKS is

$$METR^b = \frac{(T - E)/K}{(T - E)/K + r(1 - \tau)}, \tag{1.25}$$

where T is still the actual capital income tax revenue observed, while E is the estimated revenue which would be collected under a so-called R-base cash flow tax that excludes financial income and replaces depreciation allowances by expensing for new investment (all variables in equation 1.25 refer to time t, but for convenience we drop the time subscripts). To understand the rationale for (1.25), recall that $A = \tau$ under full expensing. According to (1.24) the tax revenue accruing under a cash-flow tax would therefore be

$$E = \tau(p - r)K, \tag{1.26}$$

so from (1.24) and (1.26) we have

$$\frac{T-E}{K} = (\tau - A)(r+\delta), \tag{1.27}$$

where A now indicates the present value of the tax savings from depreciation allowances under current tax laws. In the absence of personal taxes we have $\rho = r$. It then follows from (1.5) that

$$\hat{p} - r = \frac{(\tau - A)(r+\delta)}{1-\tau}, \tag{1.28}$$

so from (1.7), (1.27), and (1.28) we get

$$METR^f \equiv \frac{\hat{p} - r}{\hat{p}} = \frac{(\tau - A)(r+\delta)}{\hat{p}(1-\tau)} = \frac{(T-E)/K}{(T-E)/K + r(1-\tau)}. \tag{1.29}$$

The result in (1.29) shows that the backward-looking GKS measure of the marginal effective tax rate is indeed equal to the forward-looking marginal effective tax rate, given the assumptions of constant tax laws and golden rule growth underlying equation (1.24) (which was used in deriving this equation).

Note the intuitive appeal of the GKS measure: we know from theory that a cash flow tax does not impose any tax burden on investment at the margin. Hence it is tempting to estimate the marginal effective tax burden on capital income by calculating the additional revenue generated by the current income tax compared to a cash-flow tax. As indicated in (1.29), which abstracts from personal taxes, this additional revenue stems from the fact that the income tax only allows depreciation (implying $A < \tau$) rather than full expensing (which would imply $A = \tau$).

Backward-Looking versus Forward-Looking Measures

Since investment decisions depend on current and expected future tax rules, a measure of the effective tax rate should in principle be forward-looking if it is meant to capture the effects of taxation on the incentive to invest. However, in practice, it is very difficult to incorporate the effects of all the complex details of the tax code in a forward-looking model of the effective tax rate. The main advantage of backward-looking measures is that the impact of all the special provisions in the tax law will tend to be reflected in the revenue data used to construct these measures. If the tax laws are relatively stable over time and the economy does not deviate too much from its golden rule growth path, a backward-looking effective tax rate may therefore be a good proxy for the ideal forward-looking measure. But the greater the historical instability of tax laws and of investment and profits, the less one should rely on a backward-looking effective tax rate as an indicator of incentives for future investment. In particular, a backward-looking measure cannot be used to evaluate the effects of tax reform proposals on the incentives for capital formation and on the distribution of income.

Gordon, Kalambokidis, and Slemrod analyze in chapter 4 the extent to which different effective tax rate measures will provide a biased indicator of the "true" marginal effective tax rate on investment, once various complicating factors are taken into account. They compare the forward-looking King-Fullerton marginal effective tax rate ($METR^f$) to the backward-looking average effective tax rate ($AETR^b$) and to their own GKS measure ($METR^b$). As we have seen above, all of these measures will generate the correct marginal effective tax rate in a simple setting with golden rule growth, constant tax laws, and constant returns. Maintaining the assumptions of golden rule growth and constant tax laws, the authors consider a number of complications such as risk, pure profits, debt finance, and resale of assets with the purpose of stepping up the basis for (accelerated) depreciation. They find that their own GKS measure is the only indicator that consistently equals the theoretically correct marginal effective tax rate even if the researcher does not have explicit knowledge of the amount of risk, pure profit, use of debt finance, and frequency of asset resales. Gordon, Kalambokidis, and Slemrod then proceed to show that all of the three measures yield biased estimates of the marginal effective tax rate in the presence of tax-motivated choice of organizational form and tax-motivated debt arbitrage. Nevertheless, they conclude that in many cases where the $METR^f$ and the $AETR^b$ will overestimate the true marginal effective tax rate, the GKS measure will yield a lower and more realistic estimate of the marginal tax burden. In this way the analysis in chapter 4 helps to resolve the puzzle that conventional measures such as $METR^f$ often imply very high effective tax rates whereas the actual net revenue from capital income taxes seems to be very low in many countries.

Gordon, Kalambokidis, and Slemrod are concerned with finding the best possible indicator of the tax distortion to investment decisions. Sometimes analysts and policy makers may also be concerned with the impact of tax on the current distribution of factor income between capital and labor. In that case it seems most appropriate to use a backward-looking average effective tax rate to measure the tax burden on capital income, since such a measure records the actual taxes collected from intramarginal as well as marginal investment projects. Backward-looking average tax rates, measured using actual revenue figures, take into account the effects of tax planning, tax relief provided by lax or discretionary administrative practice, as well as noncompliance. If we only want to study the effect on today's income distribution, it is no problem that the backward-looking average tax rate may partly reflect past tax laws and the historical behavior of investment and profits.

However, a problem with backward-looking as well as forward-looking measures is that taxes formally levied on capital income may not represent a true burden on capital owners if taxes are shifted via changes in relative prices induced by a change in investment behavior. In particular, it may be misleading to add up the revenue from source-based and residence-based capital income taxes in an open economy, since the incidence of the two types of taxes will be very different. With high capital mobility, a source-based capital income tax will tend to be shifted onto workers in the form of lower real wages because it generates a capital outflow. By contrast, a residence-based capital income tax will tend to be fully reflected in a lower net return to the capital owner because it cannot be avoided by moving capital abroad (on the optimistic assumption that tax enforcement is effective). This suggests that the revenues from source-based and residence-based capital income taxes should not be lumped together in a single measure of the overall effective tax rate if the purpose is to study the effect of taxation on the distribution of after-tax incomes.

Estimating Backward-Looking Average Effective Tax Rates: Macro Data versus Micro Data

Backward-looking average effective tax rates can be estimated either from macro data or from micro data. The most well-known measure of the average effective tax rate on capital income derived from *macro data* is the one proposed by Mendoza, Razin, and Tesar (1994). These authors combine the OECD tax revenue statistics with statistics on aggregate before-tax factor incomes taken from the OECD National Income Accounts. According to their method (henceforth referred to as the MRT method), the average effective tax rate on capital income is calculated as the total reveneue from taxes deemed to fall on capital, divided by the economy's net operating surplus (which is the national accounts measure of aggregate pre-tax capital income net of depreciation).

In chapter 7, David Carey and Josette Rabesona provide a detailed discussion of the MRT method and propose a number of modifications to it. The advantage of the method is that it is relatively simple and allows a comparison of effective tax rates across countries and over time, based on readily available OECD data. However, as Carey and Rabesona point out, the MRT method relies on some very restrictive assumptions. For example, to estimate the capital income tax component in total personal income tax revenue, MRT assume that the effective *personal* tax rates on labor income and capital income are identical. This neglects the tax favors granted to many important forms of capital income such as the imputed return to owner-occupied housing, the return to pension saving, and dividends. It also neglects the fact that several countries operate a dual income tax system that systematically taxes capital income at a lower rate than labor income. Ceteris paribus, the neglect of these factors means that the MRT method tends to overestimate the effective tax rate on capital, but some other features of the method work in the opposite direction. First, the MRT method excludes certain taxes on movable property from the estimated capital income tax revenue. Second, the method assumes that all of the income of the self-employed represents capital income, even though it partly reflects the reward to the labor input of the selfemployed. Third, by categorizing all of the personal income tax revenue either as labor taxes or capital income taxes, the method neglects the fact that part of personal tax revenue may stem from taxes on government transfers.

Via successive modifications of the basic MRT measure, Carey and Rabesona try to account for these and other complications. They find that more realistic estimates of the average effective tax rate on capital income often deviate substantially from the crude meausures implied by the MRT method. In particular, whereas the simple MRT measures suggest that the rising overall tax burden in Europe in recent decades has been concentrated on labor income, the modified effective tax rate measures offered by Carey and Rabesona do not support this conclusion. On this basis they conclude that macro-based measures of average effective tax rates must be used with great care and should be supplemented by other tax indicators that can corroborate the story they tell.

Such alternative tax indicators could be average effective tax rate measures based on *micro-level data* drawn from tax returns. In chapter 10 Steven Clark discusses and illustrates the use of micro-based estimates of average effective tax rates. One theme running through this chapter is that micro-based measures can account for differences in tax treatment across (groups of) taxpayers and can be used to construct more precise estimates of average economywide tax rates, compared to measures based only on aggregate revenue data. In the area of capital income taxation, Clark's paper highlights the critical importance of adjusting for cyclical effects and business losses in measuring an economywide average effective corporate tax rate. He reviews various ways of adjusting for business losses by means of micro data, and certain issues encountered with each technique. He also uses micro data to document significant variations in effective tax rates by firm size and across industries, thereby underscoring the relevance of going beyond aggregate summary measures of the effective tax rate on corporate income.

1.2.3 Using Alternative Measures of Taxes on Capital: What Difference Does It Make?

Do the various measures of the effective capital income tax rate yield very different quantitative estimates in practice? The previous sections have already touched upon this important issue. In chapter 3 it is considered more systematically by Michael Devereux and Alexander Klemm. They calculate six different measures of the effective capital income tax rate for the United Kingdom over the last thirty years. Besides considering the forward-looking average and marginal effective tax rates ($AETR^f$ and $METR^f$) and the backward-looking GKS measure of the marginal effective corporate tax rate ($METR^b$), they also construct a time series for the backward-looking MRT measure of the overall average effective capital income tax rate, and two backward-looking series for the average effective corporate tax rate; one based on aggregate data for the corporate sector, and another based on individual company accounts.

Devereux and Klemm show how forward-looking effective tax rate measures depend crucially on assumptions regarding personal taxes, the source of finance, and whether underlying economic parameters such as the rate of inflation and the market rate of interest are allowed to vary over time. They also demonstrate how use of alternative definitions of taxation from company accounts can give a markedly different impression of the evolution of effective tax rates over time. Further they show how macro-based backward-looking measures of taxes on capital depend crucially on what taxes are included in capital income tax revenue.

Overall, Devereux and Klemm find that the different measures give a very different picture of the level and evolution of the effective tax rate on capital. They conclude that appropriate choice of methodology and careful use of data are vital in the construction and use of effective tax rates. Empirical researchers cannot simply pick the most convenient measure and assume that alternative measures would yield more or less the same results. Correspondence with theory as well as correspondence with real-world institutional details are criteria that may be used in choosing between alternative measures.

1.3 Measuring Taxes on Labor

We now turn to the measurement of effective tax rates on labor income. Again, we may distinguish between average and marginal effective tax rates, and between measures based on the parameters of tax legislation versus measures using data on taxes paid. In addition a distinction can be made between direct taxes collected from employers and employees and indirect taxes on consumption that drive a further wedge between the labor cost of the employer and the real disposable wage of the employee. In the following section we will specify these measures and indicate how they are likely to affect behavior in the labor market.

1.3.1 Basic Measures of Effective Tax Rates on Labor Income

One main approach to the estimation of effective tax rates on labor income is to specify the labor income and other relevant characteristics of a hypothetical representative taxpayer (individual or household) and calculate the average or marginal tax burden implied by current tax laws.

To give a stylized example of this fairly straightforward methodology, let w be the wage paid to the worker *after* deduction for taxes levied on the employer but *before* deduction for taxes levied on the employee. In many countries the payroll tax and social security tax levied on the employer (T^{se}) and the social security tax collected from the employee (T^{sw}) both depend on w, that is, $T^{se} = T^{se}(w)$ and $T^{sw} = T^{sw}(w)$ (quite often the tax schedules $T^{se}(w)$ and $T^{sw}(w)$ are purely proportional, but sometimes they include an absolute maximum and/or a tax-exempt minimum value of w). The personal tax on labor income is usually levied on $\hat{w} \equiv w - T^{sw}(w)$, representing the worker's income after deduction for social security taxes. The personal labor income tax schedule $T^p(\hat{w})$ captures the progressivity of the personal income tax and may depend on the taxpayer's family status. To the extent that the taxation of labor income is integrated with the taxation of nonlabor income y, the labor income tax bill must be specified as $T^p = T^p(\hat{w}, y)$, and the analyst must make some assumption on y. In simple applications y is usually set equal to zero, so below we will just abstract from nonlabor income.

The *average effective direct tax rate on labor income* (τ^{ad}) is defined as the total direct labor tax bill relative to the employer's total labor cost $w + T^{se}(w)$:

$$\tau^{ad} = \frac{T^{se}(w) + T^{sw}(w) + T^p(w - T^{sw}(w))}{w + T^{se}(w)}. \tag{1.30}$$

The numerator on the right-hand side of equation (1.30) measures the total direct tax wedge between the employer's labor cost and the net wage received by the employee. The *marginal effective direct tax rate on labor income* (τ^{md}) measures the increase in this tax wedge induced by a unit increase in the employer's labor cost:

$$\tau^{md} = \frac{\dfrac{dT^{se}}{dw} + \dfrac{dT^{sw}}{dw} + \dfrac{dT^p}{d\hat{w}}\left(1 - \dfrac{dT^{sw}}{dw}\right)}{1 + \dfrac{dT^{se}}{dw}}. \tag{1.31}$$

With knowledge of w and of the current tax schedules $T^{se}(w)$, $T^{sw}(w)$, and $T^p(\hat{w})$, the analyst can calculate the effective direct tax rates in (1.30) and (1.31).

An alternative approach that has been widely used to estimate the *average* effective direct tax rate on labor income is to use *macro data* on aggregate labor income tax revenues and aggregate labor income. According to this method, pioneered by Mendoza, Razin, and Tesar (1994), the average effective direct tax rate on labor income is calculated as

$$\tau^{ad} = \frac{S^e + S^w + \alpha^{se} S^{se} + \alpha^w R^p}{W + S^e + S^w + \alpha^e Y^e}, \tag{1.32}$$

where S^e are aggregate payroll taxes and social security taxes paid by employers, S^w and S^{se} are aggregate social security taxes paid by employees and by the self-employed, respectively, R^p is the total personal income tax revenue, α^w is the fraction of personal taxes estimated to fall on labor income, α^{se} is the share of S^{se} estimated to represent a tax on the labor income of the self-employed, W is the total compensation of employees net of payroll taxes and social security contributions, Y^e is total income from self-employment, and α^e is the estimated labor income share of Y^e. Thus the numerator of (1.32) is a measure of the aggregate taxes on labor, and the denominator is a measure of the aggregate before-tax labor income earned by wage earners and by the self-employed.

The macro-based effective tax rate in (1.32) is sometimes referred to as an *implicit tax rate on labor* or as a *labor tax ratio*. While data for S^e, S^w, S^{se}, and R^p can be obtained directly from the revenue statistics of the OECD, existing studies of labor tax ratios differ from each other in the particular method or data source used to estimate the variables α^{se}, α^w, W, α^e, and Y^e. The difficulties involved are discussed by Carey and Rabesona in chapter 7 and by de Haan, Sturm, and Volkerink in chapter 9.

Macro data have also been used by Mendoza, Razin, and Tesar (1994) and others to estimate an average effective indirect tax rate on consumption (c). By reducing the net reward to work, indirect consumption taxes are part of the overall tax burden on labor. Based on aggregate revenue data and national income accounts, the average effective indirect tax rate on consumption can be calculated as follows:

$$c = \frac{\text{Revenue from indirect consumption taxes}}{\text{Private consumption} + \text{Government nonwage consumption}}. \tag{1.33}$$

The measure of aggregate consumption in the denominator of (1.33) is somewhat broader than the actual consumption tax base in OECD countries. The motivation for including government nonwage consumption in the denominator is that part of the VAT and excise taxes included in the numerator end up being paid by the government itself via higher prices of privately produced inputs used in the production of government services. Again, empirical studies differ in the exact way in which they define and measure the magnitudes in the numerator and the denominator in (1.33). In chapter 7, Carey and Rabesona discuss the issues involved.

For the individual worker the effective tax rate on consumption will depend on his particular consumption pattern, given that commodity taxation is nonuniform across commodities. In principle, micro data may provide information on individual consumption patterns, but quite often the analyst may have to resort to a macro-based average measure of c like the one given in (1.33), even if he uses the parameters of tax legislation to estimate the *direct* effective tax rate on labour.

Armed with an estimate of the effective indirect tax rate on consumption, one can calculate a *total* averate effective tax rate on labor income that includes direct as well as indirect taxes. Suppose that the consumption expenditure in the denominator of (1.33) is measured in producer prices (i.e., excluding indirect taxes), and suppose we normalize the producer price level at unity. With the notation in (1.30), the worker's after-tax real wage rate measured in producer prices may then be written as $[w - T^{sw}(w) - T^{p}(w - T^{sw}(w))]/(1+c)$, whereas the employer's total real labor cost is $w + T^{se}(w)$. The total direct and indirect tax wedge on labor income is the difference between these two magnitudes. Using (1.30), we may therefore express the *total average effective tax rate on labor income* (τ^{a}) as

$$\tau^{a} = \frac{w + T^{se}(w) - [w - T^{sw}(w) - T^{p}(w - T^{sw}(w))](1+c)^{-1}}{w + T^{se}(w)} = \frac{\tau^{ad} + c}{1+c}. \tag{1.34}$$

The *total marginal effective tax rate on labor income* (τ^{m}) is the increase in the total direct and indirect tax wedge induced by a unit increase in the employer's total labor cost. Differentiating in the numerator and denominator of (1.34) and using (1.31), we thus have

$$\tau^{m} = \frac{1 + \dfrac{dT^{se}}{dw} - \left[1 - \dfrac{dT^{sw}}{dw} - \dfrac{dT^{p}}{d\hat{w}}\left(1 - \dfrac{dT^{sw}}{dw}\right)\right](1+c)^{-1}}{1 + \dfrac{dT^{se}}{dw}} = \frac{\tau^{md} + c}{1+c}. \tag{1.35}$$

In analyzing the effects of taxation on labor market behavior, one should in principle focus on total effective tax rates. The total *average* effective tax rate is likely to influence decisions on participation in the formal labor market, and it also has an income effect on the number of working hours supplied by labor market participants. In addition a higher total average effective tax rate may have a tax-push effect on wage setting in imperfect labour markets, such as by provoking more aggressive union wage claims. Furthermore the total average tax rates for workers in different income groups provide information on the way the tax system affects the after-tax distribution of labor incomes. The total *marginal* effective tax rate will have a substitution effect on the number of hours worked, and for a given average tax rate, a higher marginal tax rate may dampen wage claims in imperfect labor markets.[6] Thus both measures of the effective tax rate are needed for a complete analysis of the impact of tax on labor market performance.

1.3.2 Measures Based on Tax Legislation: The "Taxing Wages" Approach

The leading example of a labor tax measure derived from the parameters of tax legislation is the Taxing Wages approach applied by the OCED. In chapter 8, Christopher Heady describes and discusses this approach, which is used to calculate the average and marginal direct tax burden on the labor income of eight "typical" taxpayer types in each OECD country. The method assumes that each taxpayer's annual income from employment equals some fraction of the average gross wage earnings of a full-time worker in the manufacturing sector of each OECD economy (the so-called average production worker, APW). Additional assumptions are made regarding other relevant personal circumstances such as family status and number of dependent children. The taxes considered are personal income tax, social security taxes by employers and employees, and payroll taxes. Universal family benefits paid in respect of dependent children are also taken into account, to facilitate comparison between countries that provide family support through deductions from the tax base and countries that support families via cash benefits. Apart from this, taxpayers are assumed to have no other nonlabor income.

Given these assumptions plus information on current labor income tax rules, the total and marginal direct tax wedges can be calculated for the eight household types, using the procedure summarized in equations (1.30) and (1.31) above. The strength of the Taxing Wages methodology is that it allows international comparisons of labor tax burdens for workers of similar types. In contrast to macro-based measures, the Taxing Wages approach allows estimation of marginal tax burdens, and its measures are not affected by cross-country differences in population structures and income distributions. Heady also points out the limitations of the approach. For example, it only considers workers within a fairly narrow income range, and so does not capture the entire tax burden on labor. In chapter 10, Steven Clark illustrates how micro data collected from tax returns can provide a more complete picture of the level and distribution of labor income taxes across the entire population of taxpayers.

The most important methodological limitation of the Taxing Wages approach is the exclusion of indirect taxes on the goods that workers consume. As Heady explains, this reflects that OECD member states have not yet agreed on a common framework for estimating the effective indirect tax rate on consumption.

The final part of Heady's chapter investigates the extent to which the taxing wages measure of the average effective direct tax rate on the average production worker correlates with the macro-based estimate of the average effective direct labour income tax rate offered by Carey and Rabesona in chapter 7. A cross-country analysis for the year 2000 shows a high correlation coefficient of 0.85, but time series correlations for individual countries give a very mixed picture, with a weak or even a negative correlation between the two tax rate measures for some countries. Thus the choice between a macro-based measure and the popular Taxing Wages measure seems to matter and must be made with a view to the purpose of the study and the questions being asked.

1.3.3 Alternative Measures of Labor Tax Burdens: What Difference Do They Make?

In chapter 9, Jakob de Haan, Jan-Egbert Sturm, and Bjørn Volkerink provide a systematic analysis of the implications of choosing different measures of the average effective tax rate on labor income. They start by surveying the alternative ways in which effective labor tax rates have been measured in recent cross-country macroeconomic studies of the effects of taxation on unemployment and growth. Almost all of these studies have used average effective tax rates; the great majority has been based on macro data, and only few have included indirect taxes. De Haan, Sturm, and Volkerink find that although the different tax indicators imply significant differences in the estimated *level* of taxation, the various measures are generally quite highly correlated over time. The authors then run a number of regressions to test whether the statistical significance of the labor tax rate in some well-known empirical models of unemployment and investment is affected by the choice between the different tax rate measures. They find that this is generally not the case, which is in line with the reported high correlations for most tax rate indicators. Thus de Haan, Sturm, and Volkerink arrive at a more optimistic conclusion than Chris Heady: for the purpose of macroeconomic time series analysis, the choice of indicator for the average effective labor income tax rate does not seem to matter too much, although the levels of these indicators differ a lot across countries.

This finding is consistent with the analysis of Carey and Rabesona in chapter 7. Carey and Rabesona propose a number of reasonable modifications to the macro-based measure of the average effective direct tax rate on labor income introduced by Mendoza, Razin, and Tesar (1994). They show that the estimated level of the effective tax rate can be significantly affected by these modifications, but they also find that their own preferred measure of the labor income tax rate is in most cases highly correlated over time with the measure of Mendoza, Razin, and Tesar.

Coupled with the findings of Devereux and Klemm in chapter 3, this suggests that the estimation of effective tax rates on capital income involves greater uncertainties than the estimation of effective tax rates on income from labor. This seems plausible, given that capital income tends to be harder to measure and to be subject to more complex tax rules.

1.3.4 Measuring Taxes on Human Capital

While studies of effective tax rates on investment in physical and financial capital abound, there have been very few attempts to estimate effective tax rates on the return to investment in *human* capital. Both forms of investment involve the sacrifice of present for future consumption, but whereas the net return to investment in nonhuman capital depends on the rules for taxing capital income, the net return on human capital investment is governed by the taxation of labor income and by public subsidies for education.

Giving the growing importance of education and training in the knowledge-based "new" economy, it seems increasingly important to develop a method for estimating the effective tax burden on the return to human capital investment. In chapter 6, Kirk Collins and Jim Davies offer such a methodology. This section outlines the main features of their approach, which is based on a forward-looking effective tax rate measure using parameters from current laws on taxation and education subsidies.

Collins and Davies define the effective tax rate on the return to a specified education program (the effective tax rate on human capital, ETR^h) as

$$ETR^h = \frac{r_g - r_n}{r_g}, \tag{1.36}$$

where r_g is the internal rate of return to the education program in the absence of tax, and r_n is the internal rate of return in the presence of tax. The taxpayer is assumed to enroll in the education program in period t and to retire from the labor market in the later period T. If he did not enroll in the program, he could expect to earn the amount of before-tax labor income E_t^* in period t; if he completes the program, he will actually earn the before-tax income E_t in that period. His direct (before-tax) cost of education in year t is denoted C_t while his opportunity cost is the forgone labor income E_t^*. Hence the internal before-tax return to the education program is given by the equation

$$\sum_{t=1}^{T} \frac{E_t - E_t^* - C_t}{(1 + r_g)^{t-1}} = 0. \tag{1.37}$$

Replacing the before-tax variables in (1.37) by the corresponding after-tax variables E_t^a, E_t^{a*} and C_t^a, the after-tax return to education can be found from

$$\sum_{t=1}^{T} \frac{E_t^a - E_t^{a*} - C_t^a}{(1 + r_n)^{t-1}} = 0. \tag{1.38}$$

The earnings variables E_t and E_t^* can be estimated from cross-sectional micro data for individuals with different ages and education levels, and E_t^a and E_t^{a*} can be calculated from current tax laws, given data for E_t and E_t^*. The variables C_t and C_t^a can be estimated from data on tuition fees plus current rules regarding public education grants, subsidized student loans, and so on.

Note that if the labor income tax were levied at a flat constant rate τ and allowed deduction for the direct cost of education C_t, we would have $(E_t^a - E_t^{a*} - C_t^a) = (1 - \tau)(E_t - E_t^* - C_t)$, and r_n would be equal to r_g, implying a zero effective tax rate on human capital investment. In other words, a purely proportional labor income tax with full deduction for all private costs of education is neutral toward investment in human capital, so a positive effective tax rate on such investment derives from the progressivity of the labor income tax and/or from nondeductibility of the direct costs of education.

Notice also that since most meaningful education programs are "lumpy" investments involving a substantial amount of forgone current earnings, it is difficult in practice to distinguish between the marginal and the average effective tax rate on human capital investment. For this reason Collins and Davies only refer to the effective tax rate on the return to particular education programs.

To measure how the fiscal system affects the overall incentive for human capital investment, one must also account for the fact that the government bears a substantial part of the direct costs of education by paying salaries to teachers and professors, by maintaining the buildings of schools and universities, and so on. These costs are part of the direct *social* costs of education (C_t^p), so the social (or public) return to human capital investment (r_p) should be calculated as[7]

$$\sum_{t=1}^{T} \frac{E_t - E_t^* - C_t^p}{(1 + r_p)^{t-1}} = 0. \tag{1.39}$$

Given this estimate of r_p, Collins and Davies define the *effective subsidy rate on human capital* (ESR^h) as

$$ESR^h = \frac{r_g - r_p}{r_g}, \tag{1.40}$$

and they define the *net effective tax rate on human capital* as $ETR^h - ESR^h$.

Collins and Davies apply this methodology to a study of effective tax and subsidy rates on human capital investment in Canada. For individuals with median earnings, they find that effective tax rates on human capital formed in first-degree university study are sizable, although not as high as for physical capital. When the expenditure side and its direct subsidies are taken into account, the net effective tax rate on human capital becomes negative. The authors also find that the taxation of human capital is far from uniform. Effective tax rates depend on income level, gender, part-time versus full-time study, whether students have loans, number of dependants, and use of tax-sheltered savings plans. Workers at higher levels of the lifetime earnings distribution may face substantially higher effective tax rates than low-income workers, as a result of progressive labor income taxation.

This case study of Canada illustrates how the framework proposed by Collins and Davies can be used to quantify the impacts of a wide range of tax and subsidy provisions on the incentive to invest in human capital. Their innovative analysis should stimulate further studies in this somewhat neglected area of effective tax rate analysis.

1.4 Concluding Remarks

Economic behavior is constrained by the intricate web of institutions shaped by the private and public sectors. The tax system is one such important and complex institution. In trying to understand how taxes affect economic incentives—which is arguably the most important purpose of effective tax rate analysis—the analyst must therefore pay attention to institutional detail. At the same time there is a need for summary measures capturing the main effects of the complex tax laws, to help analysts and policy makers from getting lost in the jungle of special provisions. The art of effective tax rate analysis is to provide such summary measures without obscuring important details that are seriously at odds with the generalizations and simplifications needed to derive them.

The present introduction cannot do justice to the many insights contained in the following chapters. I nevertheless hope that it has provided a useful roadmap that will encourage the reader to study the contributions of this volume to the state of the art of effective tax rate analysis.

Notes

1. One of the scholarly articles emerging from this work was Devereux and Pearson (1995).

2. Examples of this line of research are Chennels and Griffith (1997), Devereux and Griffith (1998), and Devereux, Griffith, and Klemm (2002).

3. For a complementary overview of the methods and problems of effective tax rate analysis, see OECD (2000).

4. In chapter 2 Devereux shows explicitly how effective tax rates are influenced by inflation.

5. For a moment it will be convenient to treat time as being divided into discrete periods.

6. The effects of taxation on wage formation in alternative models of imperfect labor markets are analyzed in detail in Sørensen (1999).

7. Equation (1.39) abstracts from positive externalities from education. Alternatively, these could be deducted from the estimate of C_t^p.

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