The Marginal Cost of Public Funds

Theory and Applications

by Bev Dahlby

1 Introduction

There are many fascinating theoretical and empirical issues to be addressed in public finance. But none is more important than measuring the effects of tax rate changes and the costs of incremental tax revenue.
—Feldstein (1997, pp. 211–12)

The marginal cost of public funds measures the loss incurred by society in raising additional revenues to finance government spending. As the quotation by Martin Feldstein indicates, the marginal cost of public funds (MCF) has emerged as one of the most important concepts in the field of public economics. It is the key component in evaluations of tax reforms, public expenditure programs, and other public policies, ranging from tax enforcement to privatization of public enterprises.

Taxes can affect the allocation of resources in an economy by altering taxpayers' consumption, labor supply, and investment decisions. If the "invisible hand" of the market produces an efficient or Pareto optimal allocation of resources, then taxes will result in a less efficient allocation of resources to the extent that they alter households' and firms' decisions. We can think of this efficiency loss as a decline in the size of the "economic pie"—the value of goods and services produced and consumed in the economy, including the value of leisure time and the quality of the environment. The shrinkage of the economic pie is what economists mean by the efficiency cost of the tax system. The MCF is a summary measure of the additional distortion in the allocation of resources that occurs when a government raises additional revenues. However, minimizing the efficiency losses is not the only criteria for evaluating tax measures. Taxes that impose heavy burdens on low income individuals are also "costly" taxes. The MCF concept can be used to combine equity or distributional concerns with efficiency effects in a summary measure of the total cost to a society of raising tax revenues.

Insight is the economist's Holy Grail. The MCF concept is especially valuable because it gives us insight into policies issues, ranging from the desirability of deficit-financing public infrastructure spending to evaluating the bias in fiscal

decision-making caused by tax competition in a federation. It is a very intuitive way of describing fiscal choices, and therefore it can be readily used to convey economists' insights to policy makers and the general public.

While a substantial literature on the MCF has developed over the last twenty years, much of this literature is fragmented because authors have used different measures for the MCF, or its associated concept, the marginal excess burden, MEB. Over the last ten years, my research has focused on the measurement and application of the MCF, especially with regard to the MCFs in federal systems of government. In this book, I bring together the results of my research over the last ten years, providing a unified treatment of the MCF concept and showing how it can be applied in a wide variety of contexts, ranging from computing the MCFs for excise taxes in Thailand to evaluating the fiscal incentive effects of equalization programs in Australia. Hence the title conveys the book's two main contributions—a careful development of the theoretical foundations of the MCF in a variety of contexts and its application to a wide range of public policy issues.

The Marginal Cost of Public Funds: Theory and Application is intended for economists and public policy analysts working for governments, think tanks, and international institutions. While not intended as a textbook, it could be used as a supplementary textbook in advanced undergraduate or first-year graduate courses in economics. I have used drafts of the chapters in my graduate and undergraduate courses on the economics of taxation at the University of Alberta, at the University of Innsbruck, and at the Graduate School of Economics, Getulio Vargas Foundation, in Rio de Janeiro. To enhance its usefulness as a supplementary textbook, I have included exercises and further reading sections at the end of each of the main chapters.

Chapter 2 describes the theoretical foundations of the MCF using the tools of welfare economics. Section 2.1 begins with a review of the concept of the excess burden of taxation—also known as the deadweight loss from taxation—and its measurement using the equivalent variation, compensating variation, and consumer surplus measures of welfare change. This section also introduces a measure of the gain from a tax reform. A point that is emhasized throughout the chapter is that the measurement of the efficiency loss from taxation depends on the prices that are used to evaluate the welfare changes of consumers and producers.

Section 2.2 introduces the concept of the social marginal cost of public funds in a very general context and shows how the conditions defining an optimal tax system and optimal spending on public services are based on this concept. Section 2.3 shows how the MCF concept can be used to calculate the gain, or the loss, from a tax reform, by way of the pre–tax reform and post–tax reform MCFs and a price index that reflects the change in the "value" of a dollar arising from changes in prices caused by the tax reform.

Section 2.4 uses the concepts of consumer and producer surplus to provide an intuitive derivation of a formula for the MCF for an excise tax in a competitive market. This formula allows one to calculate the MCF based on the elasticities of demand and supply and the tax rate.

Section 2.5 explores the relationship between the MCF and the MEB, which is the additional excess burden generated in raising an additional dollar of tax revenue. This section shows that the $MCF = (1 + MEB_{EV})P$, where MEB_{EV} is the equivalent variation-based MEB and P is a price index that converts the equivalent variation of welfare changes, which are measured at before-tax prices, into a dollar measure of the welfare change at the after-tax prices, the MCF.

Section 2.6 applies the conceptual framework developed in the preceding sections to a standard economic problem—measuring the gain from tariff reductions. A simple partial equilibrium model is used to illustrate why tariffs have high MCFs and how the gains from tariff reductions can be computed using the MCFs for tariffs and their replacement taxes. Some illustrative calculations show that there are potentially large efficiency gains if a tariff is replaced by a broad consumption tax in a country that is highly dependent on tariff revenues.

Section 2.7 shows how distributional concerns can be incorporated in the definition and measurement of the MCF. The social marginal cost of public funds, the SMCF is shown to be the product of two factors—Ω, which is the distributionally weighted cost of all of the consumer and producer prices changes resulting from an increase in the tax rate on commodity i, and the MCF, which is the aggregate efficiency loss caused in raising an additional dollar of tax revenue. Section 2.8 provides a brief review of a few key studies that have contributed to the development of the concept and the interpretation of the MCF. Other studies that have made specific contributions to the calculation of the MCFs for commodity, labor and capital taxes are discussed in sections 3.8, 5.6, and 7.5.

Chapter 3 focuses on the MCFs for commodity taxes. The model developed in chapter 2 is extended by measuring the MCF when there are other distortions in the economy. These distortions include taxes on other commodities, positive and negative externalities in the production and consumption of commodities, imperfect competition, smuggling and tax evasion, and addiction. Thus a major theme of chapter 3 is how market distortions can be incorporated in the measurement of the MCF. The final section of the chapter contains a summary of studies of the marginal distortionary costs of commodity taxes. These studies are divided into those that focus on the MCFs for taxes on specific commodities, those that calculate the MCFs for general sales taxes, and those that calculate the MCFs for taxes on imports and exports.

Chapter 4 contains studies of the MCFs for excise taxes in Thailand and the United Kingdom. In Thailand commodity taxes represent 59.1 percent of total tax revenues, with excise taxes contributing 25.6 percent of tax revenues. Given its heavy

reliance on excise taxes, the equity and efficiency effects of excise taxes are important aspects of tax policy in Thailand. Estimates of the own- and cross-price elasticities of demand are used in this chapter for ten categories of goods and services in Thailand to capture the interdependence of the various commodity tax bases in Thailand in computing the MCFs. In section 4.1 the nontax distortions created by (1) environmental externalities, (2) public expenditure externalities, (3) addiction, (4) market power, and (5) smuggling are incorporated in the computation of the MCFs. The analysis indicates that the MCF for the fuel excise tax is relatively low while the MCFs for the tobacco and alcohol excise taxes exceed 2.00. Also calculated are distributionally weighted MCFs, which do not change the ranking of the social marginal cost of the excise taxes. Finally, this section shows that a revenue-neutral marginal tax reform—reducing the excise tax rates on alcohol and tobacco by one percentage point and increasing the fuel excise tax—will result in a net efficiency gain equal to 1.72 Baht for every additional Baht of fuel tax revenue.

Section 4.2 calculates the MCFs for the 1999 excise taxes on petroleum, alcoholic beverages, and cigarettes in the United Kingdom, taking as a starting point a study by Parry (2003). Like Parry, the analysis shows that petroleum taxes are the most distortionary and that cigarette taxes are the least distortionary, but the analysis extends Parry's findings in three ways. First, the section's calculations reveal that it is potentially important to distinguish between direct consumption externalities and public expenditure externalities, whereas Parry treated all externalities as direct consumption externalities. Second, from the tax shifting and conjectural variations parameter estimates for the cigarette industry by Delipalla and O'Donnell (2001), the calculations reveal that it is important to incorporate the market power distortion in measuring the MCF for excise taxes on cigarettes. Third, the calulations reveal that it is important to distinguish between the MCFs for the ad valorem and per unit excise levied on cigarettes.

Chapter 5 focuses on the MCF from taxing labor income because taxes on labor income—either levied directly through income, payroll, and social security contributions or indirectly through broadly based sales taxes—represent the most important source of tax revenues in most countries. Indeed much of the literature on the MCF deals with taxes on labor income. The chapter begins by deriving the MCF for a proportional wage tax in a perfectly competitive labor market where magnitude of the MCF depends on the elasticities of supply and demand of labor, and it briefly reviews some of the empirical evidence concerning labor supply elasticities. Section 5.2 uses the framework developed in Dahlby (1998) to consider the marginal cost of funds from imposing a progressive income tax with increasing marginal tax rates. The section develops a generic measure of the SMCF that can be used to evaluate any arbitrary increase in one or more of the marginal tax rates that are imposed under a progressive personal income tax. The section also reviews the calculation of the

SMCFs for three alternative progressivity-preserving tax rate increases from a study of the Japanese income tax system by Bessho and Hayahi (2005).

Section 5.3 uses a model developed by Kleven and and Kreiner (2006) to show how the labor force participation effects from tax rate changes can be incorporated in the MCF. Computations of the MCFs for five European countries by Kleven and Kreiner show that incorporating the participation or "extensive margin" responses can significantly increase estimates of the MCFs for some countries.

Most of this chapter uses the conventional labor supply model to analyze the MCF from taxes on earnings. However, in recent years, the most important research concerning the disincentive effects of taxation has tried to measure the wide range of adjustments that individuals can make to their reported incomes in response to a tax rate increase. Section 5.4 shows how the estimates of the elasticity of taxable income can be used to calculate the MCF. Section 5.5 shows that the MCF concept is at the heart of three standard models of political economy—the median voter model, the probabilistic voting model, and the Leviathan model. These models show that the MCF is important for predicting how a government will tax, not just for guiding prescriptions for how it should tax.

There have been many studies of the MCF from taxing labor income that have used frameworks similar to the one adopted in this book, but there are also many other empirical studies have used a wide variety of concepts—marginal welfare cost, marginal excess burden, marginal efficiency cost, and marginal deadweight loss—and other frameworks to calculate the marginal distortionary cost of taxes on labor income. Section 5.6 provides a brief survey of the wide range of empirical studies of the marginal distortionary cost of taxing labor income.

Chapter 6 contains three applications of the MCF concept to the taxation of labor income. Section 6.1 incorporates one of the most important labor market distortions in the measurement of the MCF: involuntary unemployment. The section uses the Shapiro and Stiglitz (1982) efficiency wage model to explain the existence of involuntary unemployment. The analysis, based on numerical values of the Canadian labor market, shows that incorporating involuntary unemployment significantly increases the MCF for an employer payroll tax.

Section 6.2 uses the MCF concept to evaluate a tax enforcement program in Thailand, based on a case study in Thailand by Poapangsakorn et al. (2000). The section develops a measure of the marginal social cost of raising revenue from increased tax enforcement activity, the $SMCF_p$, and shows that more resources should be devoted to tax enforcement if (and only if) the $SMCF_p$, is lower than the social marginal cost of raising revenue by increasing tax rates, the $SMCF_t$. The Poapangsakorn et al. (2000) study found that the $SMCF_p$ was high for the Thai tax enforcement program, indicating that it was a high-cost source of additional tax revenue for the government of Thailand.

Section 6.3 uses the MCF concept to derive the optimal "flat tax." The flat tax is a progressive tax that can be made more progressive, for a given tax yield, by increasing the basic exemption and the marginal tax rate on earnings above the exemption. The section uses the model to compute the optimal flat tax for a government that needs to raise the same revenues as a 20 percent proportional tax on earnings. The computations indicate that the optimal exemption level can be relatively high (43 percent of earners would not pay the tax) and the optimal marginal tax rate can be over 40 percent even with relatively modest distributional objectives.

Chapter 7 investigates the optimal taxation treatment of the return to capital in a small open economy using the marginal cost of public funds concept. The chapter starts with a simple two-period life cycle model, which is used to examine one of the most hotly contested tax policy issues: whether governments should levy income taxes or consumption taxes. The optimal tax rule from the Corlett and Hague model—tax at a higher rate the good that is most complementary with leisure—implies that there should be a tax on the return on savings if future consumption is more complementary with leisure than current consumption. This insight, stemming from the work of Feldstein (1978) and Atkinson and Sandmo (1980), provides an alternative intuitive explanation of the optimal tax treatment of savings. Section 7.1 presents some calculations of the optimal tax or subsidy on the return on savings and the gain or loss in moving from a proportional income tax to an equal yield (in present value terms) consumption tax system. These calculations indicate that shifting to a consumption tax may entail either a large gain or a large loss depending on the value of the compensated cross-price elasticity of demand between future consumption and leisure, the elasticity of the supply of savings, and the labor supply elasticity.

Section 7.2 turns the attention from a residence-based tax on the return to savings to a source-based tax on the return to capital. The section begins by deriving expressions for the MCFs for capital and labor taxes in a small open economy where there are pure profits because of a fixed supply of a third input (interpreted as land or natural resources). The section derives a closed form expression for the optimal tax rate on capital, and shows that the optimal tax depends on the own- and cross-price elasticities of demand for labor and capital, the labor supply elasticity, the tax rates on labor income and pure profits, and on distributional preferences. It shows that if the government only cares about the tax burden on labor and the production function is Cobb-Douglas, then the optimal tax rate on capital is the after-tax share of profits in total income.

Section 7.3 analyzes the MCF for a corporate income tax (CIT) levied by a small capital-importing economy when the home country adopts (1) a foreign tax credit system, (2) an exemption system, or (3) a deduction system. The expressions for the MCFs are used to calculate the optimal CIT rate and wage tax rate under the three international tax regimes. The overall conclusion is that although capital mobility

puts downward pressure on CIT rates, especially if capital-exporting countries adopt exemption or deduction systems, relatively high rates can be chosen by a small capital-importing country if pure profits are a relatively large share of domestic income and low distributional weights are applied to profits. Chapter 7 concludes with a brief survey of the results of previous studies of the marginal distortionary cost of taxing the return on capital.

Chapter 8 focuses on the MCF from public sector borrowing. Section 8.1 begins with a brief overview of the postwar literature on the burden of the public debt. This historical background helps put into context the models of the public debt that are considered in this chapter. The postwar debates over the burden of the public debt identified two main mechanisms by which the public debt can impose a burden on the economy—through a wealth effect and through a distortionary tax effect. Section 8.2 uses the Diamond (1965) overlapping generations model to analyze the wealth effect of the public debt and to derive a measure of the marginal cost of funds from public sector borrowing.

Section 8.3 uses a simple model, originally developed by Elmendorf and Mankiw (1999), to analyze the MCF from public sector debt when interest payments on the debt are financed by a distortionary tax on total output. This framework is used in section 8.4 to derive a rule for the optimal financing of lumpy expenditure projects—use debt financing to equalize over time the marginal cost of public funds through taxes. A numerical example shows that there can be significant welfare gains from debt-financing lumpy expenditures. Finally, section 8.5 uses a simple endogenous growth model, which incorporates the Ricardian equivalence effect and the distortionary tax effect, to derive a measure of the marginal cost of funds from public sector borrowing and to explore the connection between the level of public debt and the rate of economic growth. This model is used to compute the marginal cost of public funds from public sector borrowing in the Canada and the United States and to consider the effect of higher public debt on the optimal level of public expenditures.

Chapter 9 focuses on the potential biases in the perceived MCFs of subnational governments in a federation. These biases can arise because of vertical and horizontal fiscal externalities among the governments in federation. Section 9.1 begins with a brief discussion of the nature of the tax externalities that arise in a federation and the associated problem of fiscal imbalance—misallocations of the tax burden and the provision of public services among subnational governments and between the levels of government. The conventional definition of fiscal imbalance is not very useful for policy purposes. Defining fiscal imbalances in terms of differences in the marginal cost of public funds provides valuable insights concerning this issue.

Section 9.2 develops a simple model of horizontal tax externalities in which subnational governments levy taxes on a mobile tax base. Each government's perceived

MCF is biased upward because it does not take into account the positive fiscal externality that its taxes create for other subnational governments. Section 9.3 considers how intergovernmental grants can be structured to correct the fiscal distortions caused by horizontal tax and expenditure externalities and to address horizontal fiscal imbalances. In the latter case equalization grants can help achieve an optimal allocation of the tax burden across the federation by equalizing the MCFs across subnational governments. The section shows that the optimal equalization grants will depend on the relative sizes of the tax bases of the subnational governments as well as on the relative tax sensitivity of their tax bases.

Section 9.4 examines the vertical fiscal externalities that can occur in a federal state because of the interdependence of the central and subnational governments' tax bases. The framework developed in Dahlby and Wilson (2003), where both central and subnational governments levy taxes on labor income and profits, is used to show that the subnational governments' MCFs may be biased either up or down because of the vertical tax externality.

Section 9.5 uses a model developed by Keen and Kotsogiannis (2002) to describe the conditions under which either the vertical or the horizontal tax externalities dominate and whether subnational governments' spending is too low or too high. This framework is also used to illustrate situations where there is a vertical fiscal imbalance in the sense that the MCFs of the federal and state governments are not equal, and either too little or too much state spending results relative to federal spending.

Chapter 10 analyzes three policy issues that arise in a federations. Section 10.1 uses the marginal cost of funds concept to analyze the provision of investment incentives by subnational governments. In particular, this framework is used to evaluate the provision of R&D tax subsidies by provincial governments in Canada. Almost all previous studies of R&D tax policies have focused either on the tax sensitivity of R&D or on external rate of return from R&D. The main contribution of this section is to show how the tax sensitivity of R&D, its external rate of return, and the marginal cost of public funds can be combined in evaluating tax subsidies for R&D.

In most federations the federal and subnational governments have different "fiscal capacities" because either the sizes of their tax bases differ or the tax sensitivity of their tax bases differ. These differences in fiscal capacities can give rise to horizontal and vertical fiscal imbalances within a federation. Intergovernmental grants are part of the fiscal architecture of most federations in order to address these imbalances, but the intergovernmental grants can have unintended effects on the tax and expenditure decisions of national and subnational governments. Section 10.2, which is based on Dahlby and Warren (2003), shows how fiscal equalization grants may have affected the perceived MCFs of the state governments in Australia.

Section 10.3 applies a modified version of the Kanbur and Keen (1993) cross-border shopping model to the effects of an equalization grant system on the

horizontal and vertical fiscal imbalances in a federation. The section explores how the financing of equalization grants—either funding by the federal government out of general tax revenues or direct contributions by the state governments—affects the ability of equalization grants to address vertical and horizontal fiscal imbalances. A simulation model is used to show that the efficient allocation of the tax burden in a federation may require higher tax rates in regions with the less sensitive tax bases. These simulations show how regionally differented tax rates would implement the equivalent of the Ramsey rule for optimal taxation by shrinking the regional tax bases in the same proportion. The simulations also show that an equalization grant system can improve welfare, as measured by a utilitarian social welfare function, if states vary in the size of their tax bases or the tax sensitivity of their tax bases.