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Measuring the deadweight loss from taxation in a small open economy ☆ A general method with an application to Sweden

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ABSTRACT

The paper develops a simple general equilibrium framework for calculating the marginal deadweight loss from taxation in a small open economy. The framework allows a decomposition of the deadweight loss from each tax instrument into the losses stemming from the contraction of the different tax bases. The paper describes a method of calibrating the model which exploits the links between the various factor supply elasticities implied by the standard life cycle model. It also presents a method of estimating effective tax rates that is consistent with optimising household and firm behaviour. To illustrate how the model works, it is calibrated to a data set for Sweden. The quantitative results indicate that more than half of the marginal deadweight loss from taxes on capital may stem from their negative impact on the tax bases for labour income and consumption.

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1. Introduction

Which tax structure will minimise the efficiency cost of raising the necessary revenue and achieving the desired amount of redistribution? This is a fundamental question for tax economists. To answer it we need to estimate the deadweight loss from the various types of tax. Half a century ago Arnold Harberger (1964) developed a general equilibrium approach to the calculation of deadweight loss. According to his analysis the (approximate) deadweight loss from imposing a tax on a particular good can be decomposed into the well-known "Harberger triangle" measure of the tax-induced distortion to the market for the taxed good itself and a sum of "tax interaction terms" reflecting the reduction or increase in tax distortions to other markets, as the tax on the good considered induces consumers to substitute towards or away from other taxed goods.

Yet over the years numerous studies of deadweight loss have taken a partial equilibrium approach, focusing only on the Harberger triangle, despite the general equilibrium methodology advocated by the master himself.[1] Sometimes the partial approach has been motivated by the scarcity of empirical knowledge of the relevant cross price effects or by the fact that the error caused by ignoring tax interaction effects is likely to be small when the tax rates on other goods are low. But as Goulder and Williams (2003) point out, the bias from ignoring the interaction between commodity markets and the labour market will almost surely be large. The reason is that labour is heavily taxed in all developed countries, so the tax wedge between the marginal product of labour and the marginal disutility of work is big. When a tax on some commodity induces substitution towards leisure, the resulting deadweight loss from reduced labour supply will therefore be relatively large.

This paper is in the spirit of the work by Goulder and Williams. However, whereas they focus on commodity taxes and their interaction with the distortion from the labour income tax, the present analysis incorporates all the main tax instruments such as the labour income tax, consumption taxes, the corporate income tax and taxes on household savings. The paper uses the life cycle model of savings and labour supply to develop empirically implementable formulas for the marginal deadweight losses from these main tax categories, allowing for tax interactions between the markets for goods, labour and capital.

The analysis focuses on a small open economy because most national economies are in fact small and open. With this focus we can highlight the important distinction between residence-based taxes on domestic saving (like the personal capital income tax) and source-based taxes on domestic investment (such as the corporate income tax). We can also illustrate and quantify the different welfare effects of taxing labour directly through the labour income tax and taxing workers indirectly through the source-based corporate income tax that tends to get shifted to wage earners in a small open economy. Thus, after having developed our general formulas

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[1] Hines (1999) surveys the history of the use of Harberger triangles to calculate welfare losses due to distorted prices.

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for the marginal deadweight loss from the main types of taxes, we will show how they can be used empirically by applying them to Swedish data. This exercise will demonstrate the quantitative importance of allowing for interaction effects between taxes on capital and taxes on labour in welfare analysis. Indeed, our analysis suggests that the bulk of the deadweight losses from taxes on capital stems from their negative impact on the tax bases for labour income and consumption.

Numerous studies of the welfare costs of taxation in an open economy have been based on large-scale CGE models (e.g., Jensen et al., 1994), but relatively few studies have derived analytical expressions for deadweight losses in a general equilibrium context. The paper by Diewert (1983) focuses on tax distortions within the production sector of a small open economy without incorporating interactions with the household sector. Apart from the article by Goulder and Williams (2003) already mentioned, the two most direct sources of inspiration for the present work are the papers by Hansson (1984) and Benge (1999). Hansson (1984) sets up a two-sector small open economy model to estimate the marginal cost of public funds associated with different tax instruments, but his modelling of savings behaviour is more rudimentary than here. Like the present paper, the study by Benge (1999) allows an estimate of the additional efficiency loss caused by taxing labour indirectly through the source-based corporation tax rather than through the labour income tax, but his model does not incorporate consumption taxes and taxes on saving.

The rest of the paper proceeds as follows. Section 2 describes the general equilibrium framework underlying our analysis and Section 3 uses that framework to derive formulas for the marginal deadweight loss from the various taxes. Section 4 presents a general method for calibrating the parameters in the formulas. In Section 5 we calibrate the model to Swedish data and present our estimates of the deadweight losses caused by the current Swedish tax system. The concluding Section 6 summarises our main findings.

2. A simple general equilibrium framework for calculating deadweight loss in a small open economy

Our theoretical framework describes a long-run equilibrium in a small open economy where capital is perfectly mobile across borders whereas labour is immobile.[2] With perfect capital mobility the domestic equilibrium real interest rate is exogenously given from the world capital market, assuming that uncovered interest parity and relative purchasing power parity prevail in the long run. Firms maximise profits using inputs of capital and labour, taking product and factor prices as given. Household behaviour follows the standard two-period life cycle model where consumers work during the first period of life and save part of their income for the second period in which they are retired. The government levies a source-based business income tax on the return to domestic investment, a residence-based capital income tax on the return to domestic household saving, a labour income tax and an indirect tax on consumption. Part of the revenue from these taxes is used to finance transfers to workers and pensioners. The following subsections describe the model economy in more detail.

2.1. Households

The representative consumer's lifetime utility is given by the well-behaved utility function

$$U = U(C_1, C_2, L), \tag{1}$$

where L is the labour supply during young age, and C_1 and C_2 are the total consumption during young and old age, respectively. When specifying the consumer's budget constraint, we choose the world market producer price of goods as our numeraire. We assume that, after some initial policy change, all tax rates remain constant over the life course of the cohort considered. With the producer price index serving as the numeraire, the consumer price index P (which includes indirect taxes) will therefore also be constant over the consumer's life cycle. The consumer's lifetime budget constraint may then be written as

$$PC_1 + pPC_2 = W(1-t^w)L + B_1 + pB_2, \qquad p \equiv \frac{1}{1+r(1-t^r)}, \tag{2}$$

where W is the wage rate, t^w is the effective marginal tax rate on labour income, B_1 and B_2 are the (after-tax) government lump-sum transfers to people of working age and to retirees, respectively, r is the pre-tax real interest rate, t^r is the effective marginal capital income tax rate on the real return to saving, and p is the relative price of future consumption. By maximising Eq. (1) subject to Eq. (2), one may derive the consumer's optimal levels of saving and labour supply both of which will depend on the real after-tax wage rate, the real after-tax interest rate and the lump-sum transfers.

2.2. Firms

The net profit Π of the representative domestic firm is

$$\Pi = Y - \rho K - WL, \qquad \rho \equiv r + \delta + t^k, \tag{3}$$

where Y is the domestic output, K is the domestic capital stock, and ρ is the user cost of capital consisting of the sum of the net rate of return required by the international capital market (r), the rate of depreciation (δ), and the source-based tax on business capital (t^k), measured per unit of capital. In the following, we shall also refer to t^k as the investment tax wedge. The competitive firm maximises Eq. (3) subject to the following constant-returns production function (where subscripts denote partial derivatives):

$$Y = F(K, L), \quad F_K > 0, \quad F_L > 0, \quad F_{KK} < 0, \quad F_{LL} < 0, \quad F_{KL} = F_{LK} > 0. \tag{4}$$

This yields standard first-order conditions of the form $F_K(K, L) = \rho$ and $F_L(K, L) = W$. To calculate marginal deadweight losses, we will need to know how the direct and indirect tax rates (with the latter working through P) affect the variables K, L, and W. Exploiting the homogeneity properties of the production function, and defining the real after-tax consumer wage rate as $w \equiv W(1 - t^w)/P$, one can derive the following results:

$$\text{Effects of a change in } t^w: \quad \frac{dL}{L} = \frac{dK}{K} = -\varepsilon_w^L \cdot \left(\frac{dt^w}{1-t^w}\right), \qquad \varepsilon_w^L \equiv \frac{\partial L}{\partial w}\frac{w}{L}. \tag{5}$$

$$\text{Effects of a change in } P: \quad \frac{dL}{L} = \frac{dK}{K} = -\varepsilon_w^L \cdot \left(\frac{dP}{P}\right). \tag{6}$$

$$\text{Effects of a change in } t^r: \quad \frac{dL}{L} = \frac{dK}{K} = -\varepsilon_r^L \cdot \left(\frac{dt^r}{1-t^r}\right), \tag{7}$$

$$\varepsilon_r^L \equiv \frac{\partial L}{\partial r(1-t^r)} \frac{r(1-t^r)}{L}.$$

$$\text{Effects of a change in } \rho: \quad \frac{dL}{L} = -\varphi \varepsilon_w^L \cdot \left(\frac{d\rho}{\rho}\right), \qquad \varphi \equiv \frac{\rho K}{WL}, \tag{8}$$

$$\frac{dK}{K} = -\left(\varepsilon_\rho^K + \varphi \varepsilon_w^L\right)\left(\frac{d\rho}{\rho}\right), \qquad \varepsilon_\rho^K \equiv -\frac{\partial K}{\partial \rho}\frac{\rho}{K} = -\frac{1}{F_{KK}}\frac{\rho}{K}. \tag{9}$$

[2] Actually our framework can accommodate some international labour mobility since this can be modelled pragmatically as an increase in the wage elasticity of labour supply. The critical assumption is that labour is imperfectly mobile whereas capital mobility is perfect. This difference in the degree of mobility seems realistic, given the observed rough equality of real interest rates across countries combined with large disparities in real wage rates.

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