MEASURING THE DEADWEIGHT LOSS FROM TAXATION IN A SMALL OPEN ECONOMY

A general method with an application to Sweden

By
Peter Birch Sørensen
Department of Economics
University of Copenhagen
EPRU and CESifo

DEPARTMENT OF ECONOMICS
UNIVERSITY OF COPENHAGEN

MOTIVATION

- The optimal tax structure minimizes the total deadweight loss from raising the necessary revenue and attaining the desired amount of redistribution

- To solve the optimal tax problem, we need estimates of the marginal deadweight loss from the different tax instruments

- This paper offers a general equilibrium method of estimating marginal deadweight losses in a small open economy

AGENDA

- The general equilibrium approach to the measurement of deadweight loss

- The theoretical general equilibrium framework of the present paper

- General formulae for the marginal deadweight loss from the different tax instruments

- Calibration methods

- Application: The marginal deadweight loss from taxation in Sweden

THE GENERAL EQUILIBRIUM APPROACH TO THE MEASUREMENT OF DEADWEIGHT LOSS

Harberger (1964): The total deadweight loss from imposing a (unit) tax on good *k* is

$$DWL_k = \overbrace{-\frac{1}{2}\tau_k^2 \frac{dX_k}{d\tau_k}}^{\text{Harberger triangle}} - \overbrace{\sum_{i \neq k}\tau_i\tau_k \frac{dX_i}{d\tau_k}}^{\text{Tax interaction effects}}$$

$$\tau_j = \text{unit tax rate on good } j$$

$$X_j = \text{(compensated) demand for good } j$$

MEASURING DEADWEIGHT LOSS: ALTERNATIVE APPROACHES

- Ignore tax interaction effects (Problem: potentially large bias)

- Use large scale CGE models to capture general equilibrium effects (Problem: large models tend to become "black boxes")

- Goulder and Williams (JPE, 2003): Use analytical model that accounts for interaction between commodity markets and the labour market (Problems: Interactions with tax bases for capital income ignored and the DWL from capital taxes cannot be analysed)

APPROACH IN THE PRESENT PAPER

- Simple transparent GE framework accounting for the interaction between all the major tax bases

- Allows decomposition of the marginal deadweight loss into the losses stemming from adjustment of the various tax bases

- New calibration method accounts for cross-restrictions on key elasticities

- Open economy framework allows for the shifting of source-based capital taxes

THEORETICAL FRAMEWORK

- Two-period life cycle model

- Capital perfectly mobile; labour immobile (or imperfectly mobile)

Tax instruments:

- Labour income tax

- Consumption tax

- Residence-based capital income tax on saving

- Source-based business income tax on investment

HOUSEHOLDS

$$U = U\left(C_1, C_2, L\right)$$

$$PC_1 = WL - T - PS, \qquad PC_2 = \left[1 + r\left(1 - t^r\right)\right]PS + B_2$$

$$T = t^w WL - B_1, \qquad 0 < t^w < 1, \qquad B_1 > 0$$

Utility maximization yields the expenditure function

$$E = E\left(P, \frac{1}{1 + r\left(1 - t^r\right)}, W\left(1 - t^w\right), \bar{U}\right)$$

where P includes indirect taxes

FIRMS

$$Y = F(K,L), \qquad \Pi = Y - \rho K - WL, \qquad \rho \equiv r + \delta + t^k$$

Profit maximization implies:

$$F_K(K,L) = \rho, \qquad F_L(K,L) = W$$

$$\frac{dL}{L} = -\varphi \varepsilon_w^L \cdot \left(\frac{dt^k}{\rho}\right), \qquad \frac{dK}{K} = -\left(\overbrace{\varepsilon_\rho^K}^{\text{Direct effect}} + \overbrace{\varphi \varepsilon_w^L}^{\text{Indirect effect}}\right) \cdot \left(\frac{dt^k}{\rho}\right),$$

$\varepsilon_w^L \equiv$ wage elasticity of labour supply

$\varepsilon_\rho^K \equiv$ user cost elasticity of capital demand

$\varphi \equiv \dfrac{\rho K}{WL}$ (business profits relative to labour income)

THE GOVERNMENT

Present value of net taxes paid by a cohort:

$$R = \left[t^w + t^c \left(1 - t^w \right) \right] WL - \left(1 - t^c \right) \left(B_1 + \frac{B_2}{1 + r \left(1 - t^r \right)} \right)$$

$$+ \, t^k K + \frac{t^r r PS - B_2}{1 + r \left(1 - t^r \right)}$$

$t^c = $ consumption tax rate as a fraction of consumer price

THE MARGINAL DEADWEIGHT LOSS FROM TAXATION

$E =$ expenditure function

Marginal deadweight loss:

$$\frac{dDWL}{dt^i} = \frac{dE}{dt^i} - \frac{dR}{dt^i} = \frac{dE}{dt^i} - \underbrace{\frac{dR^s}{dt^i}}_{\substack{\text{"Static"} \\ \text{revenue change}}} - \underbrace{\frac{dR^d}{dt^i}}_{\substack{\text{"Dynamic"} \\ \text{revenue change}}} , \qquad i = c, k, r, w$$

Note: In general we have $\dfrac{dE}{dt^i} = \dfrac{dR^s}{dt^i} \implies \dfrac{dDWL}{dt^i} = -\dfrac{dR^d}{dt^i}$

THE DEGREE OF SELF-FINANCING

DSF = the fraction of the initial revenue gain which is lost due to behavioural responses

$$DSF_{t^i} \equiv -\frac{dR^d / dt^i}{dR^s / dt^i} = \frac{dDWL / dt^i}{dR^s / dt^i}$$

THE MARGINAL DEADWEIGHT LOSS FROM THE LABOUR INCOME TAX

$$DSF_{t^w} = \overbrace{\left(\frac{t^w \varepsilon_w^L}{1-t^w}\right)}^{\substack{\text{loss of labour} \\ \text{income tax revenue}}} + \overbrace{\left(\frac{t^c\left(1-t^w\right)\varepsilon_w^L}{1-t^w}\right)}^{\substack{\text{loss of consumption} \\ \text{tax revenue}}} + \overbrace{\left(\frac{m^k \theta^k \varepsilon_w^L}{1-t^w}\right)}^{\substack{\text{loss of business} \\ \text{income tax revenue}}} + \overbrace{\left(\frac{t^r \theta^s \varepsilon_w^S}{1-t^w}\right)}^{\substack{\text{loss of savings} \\ \text{tax revenue}}}$$

$\varepsilon_w^L \equiv$ compensated net wage elasticity of labour supply

$\varepsilon_w^S \equiv$ compensated net wage elasticity of saving

$m^k \equiv \dfrac{t^k}{\rho - \delta} =$ marginal effective tax rate on business income

$\theta^k \equiv \dfrac{(\rho - \delta)K}{WL}, \qquad \theta^s \equiv \dfrac{rPS/WL}{1 + r\left(1 - t^r\right)}$

THE MARGINAL DEADWEIGHT LOSS FROM THE GENERAL CONSUMPTION TAX

$$DSF_{t^c} = \left(\frac{1-t^w}{1-t^w + b_1 + pb_2} \right) \frac{dDWL/dt^w}{dR^s/dt^w}$$

$$b_1 \equiv \frac{B_1}{WL}, \qquad b_2 \equiv \frac{B_2}{WL}, \qquad p \equiv \frac{1}{1+r(1-t^r)}$$

THE MARGINAL DEADWEIGHT LOSS FROM THE BUSINESS INCOME TAX

$$
DSF_{t^k} = \overbrace{\left(\frac{t^w \varepsilon_w^L}{1-t^w}\right)}^{\substack{\text{loss of labour} \\ \text{income tax revenue}}} + \overbrace{\left(\frac{t^c\left(1-t^w\right)\varepsilon_w^L}{1-t^w}\right)}^{\substack{\text{loss of consumption} \\ \text{tax revenue}}} + \overbrace{\left(\frac{m^k\left(\varepsilon_\rho^K\left(\frac{\rho-\delta}{\rho}\right)+\theta^k \varepsilon_w^L\right)}{1-t^w}\right)}^{\substack{\text{loss of business} \\ \text{income tax revenue}}} + \overbrace{\left(\frac{t^r \theta^s \varepsilon_w^S}{1-t^w}\right)}^{\substack{\text{loss of savings} \\ \text{tax revenue}}}
$$

$$
= \frac{m^k\left(\frac{\rho-\delta}{\rho}\right)\varepsilon_\rho^K}{1-t^w} + \frac{dDWL\,/\,dt^w}{dR^s\,/\,dt^w}
$$

THE MARGINAL DEADWEIGHT LOSS FROM THE SAVINGS INCOME TAX

$$DSF_{t^r} = \overbrace{\left(\frac{t^w \varepsilon_r^L}{(1-t^r)\theta^s}\right)}^{\substack{\text{loss of labour}\\\text{income tax revenue}}} + \overbrace{\left(\frac{t^c(1-t^w)\varepsilon_r^L}{(1-t^r)\theta^s}\right)}^{\substack{\text{loss of consumption}\\\text{tax revenue}}} + \overbrace{\left(\frac{m^k\theta^k\varepsilon_r^L}{(1-t^r)\theta^s}\right)}^{\substack{\text{loss of business}\\\text{income tax revenue}}} + \overbrace{\left(\frac{t^r\varepsilon_r^S}{1-t^r}\right)}^{\substack{\text{loss of savings}\\\text{tax revenue}}}$$

$\varepsilon_r^L \equiv$ compensated net interest elasticity of labour supply

$\varepsilon_r^S \equiv$ compensated net interest elasticity of saving

$\theta^s \equiv \dfrac{prPS}{WL} = \dfrac{\text{present value of capital income}}{\text{present value of labour income}}$

CALIBRATION METHODS: ELASTICITIES

Using the Slutsky equations and the budget constraints, we derive the links between factor supply elasticities implied by the life cycle model. For example:

$$\varepsilon_w^S = \left(\frac{1-t^w}{1-t^w + b_1 - \left(\frac{b_2}{1+g^c} \right)} \right) \varepsilon_w^L, \qquad g^c \equiv \frac{C_2}{C_1} - 1$$

$$\varepsilon_r^L = \left(\frac{r\left(1-t^r\right)}{1+r\left(1-t^r\right)} \right) \left(1-c\right) \varepsilon_w^L, \qquad c \equiv \frac{1}{1 + p\left(1+g^c\right)}$$

We also derive the link between the compensated and the uncompensated interest elasticities of saving. The parameter θ^s is calibrated from a multi-period theoretical life cycle model.

CALIBRATION METHODS: EFFECTIVE TAX RATES

- The effective overall tax rate on consumption is estimated from VAT and excise tax rates, using disaggregated consumption data and assuming consumers optimise the allocation of consumption

- The effective overall tax rate on saving is estimated from tax rates on different forms of saving, assuming consumers optimise their portfolio composition

- The effective marginal tax rate on business income is estimated by the King-Fullerton method as a weighted average of the tax rates on debt-financed and equity-financed investment

- The effective marginal tax rate on labour income includes social security taxes and is a weighted average across income groups

CALIBRATION TO SWEDISH DATA, 2008

Elasticities of factor supply and demand	Elasticities of substitution	Initial effective tax and transfer rates	Income and consumption shares etc.	Other parameters (annual basis)
$\varepsilon_w^L = 0.264$	$1/\gamma = 1$	$t^w = 0.476$	$\theta^s = 0.145$	$r = 0.05$
$\varepsilon_r^L = 0.055$	$\phi = 1.0$	$t^c = 0.249$	$\theta^k = 0.15$	$\pi = 0.02$
$\hat{\varepsilon}_r^S = 0.0$	$\sigma = 1.0$	$t^r = 0.315^3$	$P_H C_H / PC = 0.2$	$g^w = 0.02$
$\varepsilon_r^S = 0.559$	$\sigma_h = 1.5^1$	$m^k = 0.079^4$	$S^F / S^I = 0.931$	$g^c = 0.01$
$\varepsilon_w^S = 0.201$	$\sigma_o = 1.0^2$	$b_1 = 0.227$		$\delta = 0.09$
$\varepsilon_\rho^K = 1.0$	$1/\eta = 1/3$	$b_2 = 0.086$		$T = 60$
				$n = 45$

DEGREES OF SELF-FINANCING: BASELINE SCENARIOS

Cut in effective marginal tax rate on	*Contribution to DSF from higher revenue from taxes on*				*Total DSF*
	Labour income	Consumption	Business income	Savings income	
Labour income	23.9	6.6	0.6	1.7	32.8
Consumption	16.0	4.4	0.4	1.2	22.0
Business income	23.9	6.6	6.2	1.7	38.5
Savings income	26.5	7.3	0.6	25.7	60.1

SENSITIVITY ANALYSIS:
TOTAL DEGREES OF SELF-FINANCING (%)

Change in effective marginal tax rate on	*Base line[1]*	$1/\eta = 0.2$ $(\varepsilon_w^L = 0.17)$	$1/\eta = 0.5$ $(\varepsilon_w^L = 0.36)$	$\hat{\varepsilon}_r^S = -0.3$ $(\varepsilon_r^S = 0.26)$	$\hat{\varepsilon}_r^S = 0.3$ $(\varepsilon_r^S = 0.86)$	$g^c = 0.005$ $(\theta^s = 0.098)$	$g^c = 0.015$ $(\theta^s = 0.191)$
Labour income	33	21	45	33	33	32	33
Consumption	22	14	30	22	22	21	22
Business income	38	27	50	38	38	38	39
Savings income	60	47	73	46	74	73	53

CONCLUSIONS

- In a high-tax country like Sweden, the deadweight loss from an across-the-board increase in the marginal labour income tax rate could be around 1/3, and the deadweight loss from an increase in the marginal savings tax rate could be more than ½

- Robust result: DWL(investment tax on normal return) > DWL(labour tax) > DWL(consumption tax): Case for an ACE

- Ignoring tax interaction effects when analysing the deadweight loss from direct and indirect taxes on labour does not lead to major errors, but ignoring such effects when analysing taxes on capital leads to serious underestimation of the DWL

- The DWL from the savings income tax appears to be quite high, so there may be a good case for the Nordic dual income tax with a low capital income tax rate