

Sheshinski, Eytan

**Working Paper**

## Optimum commodity taxation in pooling equilibria

CESifo Working Paper, No. 1815

**Provided in Cooperation with:**

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

*Suggested Citation:* Sheshinski, Eytan (2006) : Optimum commodity taxation in pooling equilibria, CESifo Working Paper, No. 1815, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:

<https://hdl.handle.net/10419/25860>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# OPTIMUM COMMODITY TAXATION IN POOLING EQUILIBRIA

EYTAN SHESHINSKI

CESIFO WORKING PAPER NO. 1815  
CATEGORY 1: PUBLIC FINANCE  
OCTOBER 2006

*An electronic version of the paper may be downloaded*

- *from the SSRN website:* [www.SSRN.com](http://www.SSRN.com)
- *from the RePEc website:* [www.RePEc.org](http://www.RePEc.org)
- *from the CESifo website:* [www.CESifo-group.de](http://www.CESifo-group.de)

# OPTIMUM COMMODITY TAXATION IN POOLING EQUILIBRIA

## Abstract

This paper extends the standard model of optimum commodity taxation (Ramsey (1927) and Diamond-Mirrlees (1971)) to a competitive economy in which some markets are inefficient due to *asymmetric information*. As in most insurance markets, consumers impose varying costs on suppliers but firms cannot associate costs to customers and consequently all are charged equal prices. In a competitive *pooling equilibrium*, the price of each good is equal to average marginal costs weighted by equilibrium quantities. We derive modified *Ramsey-Boiteux Conditions* for optimum taxes in such an economy and show that they include general-equilibrium effects which reflect the initial deviations of producer prices from marginal costs, and the response of equilibrium prices to the taxes levied. It is shown that condition on the monotonicity of demand elasticities enables to sign the deviations from the standard formula. The general analysis is applied to the optimum taxation of annuities and life insurance.

JEL Code: D43, H21.

Keywords: asymmetric information, pooling equilibrium, Ramsey-Boiteux Conditions, annuities.

*Eytan Sheshinski*  
*Department of Economics*  
*The Hebrew University of Jerusalem*  
*Mount Scopus, Jerusalem 91905*  
*Israel*  
*mseytan@mssc.huji.ac.il*

August, 2006

# 1 Introduction

The setting for the standard theory of optimum commodity taxation (Ramsey (1927), Diamond and Mirrlees (1971), Salanie (2003)) is a competitive equilibrium which attains an efficient resource allocation. In the absence of lump-sum taxes, the government wishes to raise revenue by means of distortive commodity taxes and the theory develops the conditions that have to hold for these taxes to minimize the deadweight loss (the '*Ramsey-Boiteux Conditions*'). The analysis was extended in some directions to allow for an initial inefficient allocation of resources. In such circumstances, aside from the need to raise revenue, taxes/subsidies may serve as means to improve welfare due to market inefficiencies. The rules for optimum commodity taxation, therefore, mix considerations of shifting an inefficient market equilibrium in a welfare enhancing direction and the distortive effects of gaps between consumer and producer marginal valuations generated by commodity taxes.

Two major extensions of the standard model have been explored. First, the inclusion of externalities and the need to finance public goods (Sandmo (1975), Stiglitz and Dasgupta (1971), Lau, Sheshinski and Stiglitz (1978)). While specific assumptions about the form of externalities (e.g. 'atmosphere externalities') or about the form of preferences for public goods (e.g. weak separability), as well as the absence of distributional considerations, were needed to obtain sharper results, these contributions are quite general and the results are robust. The second extension is to allow for imperfect competition (Auerbach and Hines (2001), Guesnerie and Laffont (1978), Myles (1987, 1989)). Here, the results seem to depend more crucially on particular assumptions about the definition of the imperfectly competitive equilibrium (monopoly, Cournot, Bertrand or strategic, repeated game-theoretic, equilibria), about the number of firms in oligopoly markets, about the type of taxes (specific or ad-valorem) and about the presence or absence of uncertainty (making the availability or unavailability of insurance critical). Although these papers provide valuable insights about taxation in specific circumstances, no broad rules on optimum taxation under imperfect competition seem to emerge.

This paper goes in a different direction. Markets are assumed to be perfectly competitive but there is *asymmetric information* between firms and consumers

about 'relevant' characteristics which affect the *costs* of firms, as well as consumer preferences. Leading examples are in the field of insurance. Expected costs of medical insurance depend on the health characteristics of the insured. Of course, the value of such insurance to the purchaser depends on the same characteristics. Similarly, the costs of an annuity depend on the expected payout which depends on the individual's survival prospects. Naturally, these prospects also affect the value of an annuity to the individual's expected lifetime utility. Other examples where personal characteristics affect costs are rental contracts (e.g. cars) and fixed-fee contracts for use of certain facilities (clubs).

When firms are able to identify customers' relevant characteristics (in insurance parlance, 'risk class'), competitive pressures equate prices to marginal costs for each customer type, and the competitive equilibrium is efficient. Such identification, however, may not be possible or is imperfect and costly because it requires monitoring of activities, such as quantities purchased (Rothschild-Stiglitz (1976)), and the collection of information available at a multitude of firms. In these circumstances, commodities are sold at the same prices to different types of consumers, mostly to all consumers without distinction. This is called a *pooling-equilibrium*. Zero profits in a competitive pooling equilibrium imply that the price of each good is equal to average marginal costs weighted by the equilibrium quantities purchased by all consumers.

This paper analyses the conditions for optimum commodity taxes in the presence of pooling markets. The modeling of preferences and of costs is general, allowing for any finite number of markets. We focus, though, only on efficiency aspects, disregarding distributional ('equity') considerations<sup>1</sup>. We obtain surprisingly simple modified Ramsey-Boiteux conditions and explain the deviations from the standard model. Broadly, the additional terms that emerge reflect the fact that the initial producer price of each commodity deviates from each consumer's marginal costs, being equal to these costs only on average. Each levied specific tax affects all prices (termed, a '*general-equilibrium effect*'), and, consequently, a small increase in a tax level affects the quantity-weighted gap between producer prices

---

<sup>1</sup>We have a good idea how exogenous income heterogeneity can be incorporated in the analysis (e.g. Salanie (2003)).

and individual marginal costs, the direction depending on the relation between demand elasticities and costs.

After developing general formulas (Section 3), we analyze (Section 4) an example of a three-good economy with pooling equilibrium in the annuity market.

## 2 Equilibrium With Asymmetric Information

Individuals consume  $n$  goods,  $X_i$ ,  $i = 1, 2, \dots, n$  and a numeraire,  $Y$ . There are  $H$  individuals whose preferences are characterized by a linearly separable utility function,  $U$

$$U = u^h(\mathbf{x}^h, \alpha) + y^h, \quad h = 1, 2, \dots, H \quad (1)$$

where  $\mathbf{x}^h = (x_1^h, x_2^h, \dots, x_n^h)$ ,  $x_i^h$  is the quantity of good  $i$  and  $y^h$  is the quantity of the numeraire consumed by individual  $h$ . The utility function,  $u^h$ , is assumed to be strictly concave and differentiable in  $\mathbf{x}^h$ . Linear separability is assumed to eliminate distributional considerations, focusing on the efficiency aspects of optimum taxation. It is well-known how to incorporate equity issues in the analysis of commodity taxation (e.g. Salanie (2003)).

The parameter  $\alpha$  is a personal attribute which is singled out because it has *cost effects*. Specifically, it is assumed that the unit costs of good  $i$  consumed by individuals with a given  $\alpha$  ('type  $\alpha$ ') is  $c_i(\alpha)$ . Leading examples are health and longevity insurance. The health status of an individual affects both his consumption preferences and the costs to the medical insurance provider. Similarly, the payout of annuities (e.g. retirement benefits) is contingent on survival and hence depends on the individual's relevant mortality function. Other examples are car rentals and car insurance, whose costs and value to consumers depend on driving patterns and other personal characteristics<sup>2</sup>.

It is assumed that  $\alpha$  is continuously distributed in the population, with a distribution function,  $F(\alpha)$ , over a finite interval,  $\underline{\alpha} \leq \alpha \leq \bar{\alpha}$ .

The economy has given total resources,  $R > 0$ . With unit costs of 1 for the

---

<sup>2</sup>Representation of these characteristics by a single parameter is, of course, a simplification.

numeraire,  $Y$ , the aggregate resource constraint is written

$$\int_{\underline{\alpha}}^{\bar{\alpha}} [\mathbf{c}(\alpha)\mathbf{x}(\alpha) + y(\alpha)]dF(\alpha) = R \quad (2)$$

where  $\mathbf{c}(\alpha) = (c_1(\alpha), c_2(\alpha), \dots, c_n(\alpha))$ ,  $\mathbf{x}(\alpha) = (x_1(\alpha), x_2(\alpha), \dots, x_n(\alpha))$ ,  $x_i(\alpha)$  being the aggregate quantity of  $X_i$  consumed by all type  $\alpha$  individuals:  $x_i(\alpha) = \sum_{h=1}^H x_i^h(\alpha)$  and, correspondingly,  $y(\alpha) = \sum_{h=1}^H y^h(\alpha)$ .

The First-Best allocation is obtained by maximization of a utilitarian welfare function,  $W$ ,

$$W = \int_{\underline{\alpha}}^{\bar{\alpha}} \left[ \sum_{h=1}^H (u^h(\mathbf{x}^h; \alpha) + y^h) \right] dF(\alpha) \quad (3)$$

s.t. the resource constraint (2). The F.O.C. for an interior solution equates marginal utilities and costs for all individuals of the same type. That is, for each  $\alpha$ ,

$$u_i^h(\mathbf{x}^h; \alpha) - c_i(\alpha) = 0, \quad i = 1, 2, \dots, n \quad h = 1, 2, \dots, H \quad (4)$$

where  $u_i^h = \frac{\partial u^h}{\partial x_i}$ . The unique solution to (4), denoted  $\mathbf{x}^{*h}(\alpha) = (x_1^{*h}(\alpha), x_2^{*h}(\alpha), \dots, x_n^{*h}(\alpha))$ , and the corresponding total consumption of type  $\alpha$  individuals  $\mathbf{x}^h(\alpha) = (x_1^*(\alpha), x_2^*(\alpha), \dots, x_n^*(\alpha))$ ,  $x_i^h(\alpha) = \sum_{h=1}^H x_i^h(\alpha)$ . Individuals' optimum level of the numeraire  $Y$  (and hence utility levels) is indeterminate, but the total amount,  $y^*$ , is determined by the resource constraint,  $y^* = R - \int_{\underline{\alpha}}^{\bar{\alpha}} \mathbf{c}(\alpha)\mathbf{x}^*(\alpha)dF(\alpha)$ .

The *First-Best* allocation can be supported by competitive markets with individualized prices equal to marginal costs<sup>3</sup>. That is, if  $p_i$  is the price of good  $i$ , then efficiency is attained when all type  $\alpha$  individuals face the same price  $p_i(\alpha) = c_i(\alpha)$ .

When  $\alpha$  is *private information* unknown to suppliers (and not verifiable by monitoring individuals' purchases), then for each good firms will charge the same price to all individuals. This is called a (Second-Best) *Pooling Equilibrium*.

---

<sup>3</sup>The only constraint on the allocation of incomes,  $m^h(\alpha)$ , is that they support an interior solution. The modifications required to allow for zero equilibrium quantities are well-known and immaterial for the following.

### Pooling Equilibrium

Good  $X_i$  is offered at a price  $p_i$  to all individuals,  $i = 1, 2, \dots, n$ . The competitive price of the numeraire is 1. Individuals maximize their utility, (1), subject to the budget constraint

$$\mathbf{p}\mathbf{x}^h + y^h = m^h, \quad h = 1, 2, \dots, H \quad (5)$$

where  $m^h = m^h(\alpha)$  is the (given) income of the  $h$ -th type  $\alpha$  individual. It is assumed that for all  $\alpha$ , the level of  $m^h$  yields interior solutions. The F.O.C. are

$$u_i^h(\mathbf{x}^h; \alpha) - p_i = 0, \quad i = 1, 2, \dots, n \quad h = 1, 2, \dots, H \quad (6)$$

the unique solutions to (6) are the *compensated demand functions*  $\hat{\mathbf{x}}^h(\mathbf{p}; \alpha) = (\hat{x}_1^h(\mathbf{p}; \alpha), \hat{x}_2^h(\mathbf{p}; \alpha), \dots, \hat{x}_n^h(\mathbf{p}; \alpha))$ , and the corresponding type  $\alpha$  total demands  $\hat{\mathbf{x}}(\mathbf{p}; \alpha) = \sum_{h=1}^H \hat{\mathbf{x}}^h(\mathbf{p}; \alpha)$ . The optimum levels of  $Y$ ,  $\hat{y}^h$ , are obtained from the budget constraints

$$(5): \hat{y}^h(\mathbf{p}; \alpha) = m^h(\alpha) - \mathbf{p}\hat{\mathbf{x}}^h(\mathbf{p}; \alpha), \text{ with total consumption of } \hat{y}(\mathbf{p}; \alpha) = \sum_{h=1}^H \hat{y}^h = \sum_{h=1}^H m^h(\alpha) - \mathbf{p}\hat{\mathbf{x}}(\mathbf{p}; \alpha). \text{ The economy is closed by the identity } R = \sum_{h=1}^H m^h(\alpha).$$

Let  $\pi_i(\mathbf{p})$  be total profits in the production of good  $i$ :

$$\pi_i(\mathbf{p}) = p_i \hat{x}_i(\mathbf{p}) - \int_{\underline{\alpha}}^{\bar{\alpha}} c_i(\alpha) \hat{x}_i(\mathbf{p}; \alpha) dF(\alpha) \quad (7)$$

where  $\hat{x}_i(\mathbf{p}) = \int_{\underline{\alpha}}^{\bar{\alpha}} \hat{x}_i(\mathbf{p}; \alpha) dF(\alpha)$  is the *aggregate demand* for good  $i$ .

**Definition 1** <sup>4</sup> A *pooling-equilibrium* is a vector of prices,  $\hat{\mathbf{p}}$ , which satisfies  $\pi_i(\hat{\mathbf{p}}) = 0$ ,  $i = 1, 2, \dots, n$  or

$$\hat{p}_i = \frac{\int_{\underline{\alpha}}^{\bar{\alpha}} c_i(\alpha) \hat{x}_i(\hat{\mathbf{p}}; \alpha) dF(\alpha)}{\int_{\underline{\alpha}}^{\bar{\alpha}} \hat{x}_i(\hat{\mathbf{p}}; \alpha) dF(\alpha)}, \quad i = 1, 2, \dots, n. \quad (8)$$

---

<sup>4</sup>For general analyses of pooling equilibria see, for example, Laffont and Martimort (2002) and Salanie (1997).



Equilibrium prices are weighted averages of marginal costs, the weights being the equilibrium quantities purchased by the different  $\alpha$  types. Writing (7) (or (8)) in matrix form:

$$\boldsymbol{\pi}(\hat{\mathbf{p}}) = \hat{\mathbf{p}}X(\hat{\mathbf{p}}) - \int_{\underline{\alpha}}^{\bar{\alpha}} \mathbf{c}(\alpha)\hat{X}(\hat{\mathbf{p}}; \alpha)dF(\alpha) = \mathbf{0} \quad (9)$$

where  $\boldsymbol{\pi}(\hat{\mathbf{p}}) = (\pi_1(\hat{\mathbf{p}}), \pi_2(\hat{\mathbf{p}}), \dots, \pi_n(\hat{\mathbf{p}}))$ ,

$$\hat{X}(\hat{\mathbf{p}}; \alpha) = \begin{bmatrix} \hat{x}_1(\hat{\mathbf{p}}; \alpha) & & 0 \\ & \ddots & \\ 0 & & \hat{x}_n(\hat{\mathbf{p}}; \alpha) \end{bmatrix}, \quad (10)$$

$\hat{X}(\hat{\mathbf{p}}) = \int_{\underline{\alpha}}^{\bar{\alpha}} X(\hat{\mathbf{p}}; \alpha)dF(\alpha)$ ,  $\mathbf{c}(\alpha) = (c_1(\alpha), c_2(\alpha), \dots, c_n(\alpha))$ , and  $\mathbf{0}$  is  $1 \times n$  zero vector  $\mathbf{0} = (0, 0, \dots, 0)$ . Let  $\hat{K}(\hat{\mathbf{p}})$  be the  $n \times n$  matrix with elements  $\hat{k}_{ij}$ ,

$$\hat{k}_{ij}(\hat{\mathbf{p}}) = \int_{\underline{\alpha}}^{\bar{\alpha}} (\hat{p}_i - c_i(\alpha))s_{ij}(\hat{\mathbf{p}}; \alpha)dF(\alpha), \quad i, j = 1, 2, \dots, n \quad (11)$$

where  $s_{ij}(\hat{\mathbf{p}}; \alpha) = \frac{\partial \hat{x}_i(\hat{\mathbf{p}}; \alpha)}{\partial p_j}$  are the substitution terms.

We can now state:

**Proposition 1.** *When  $\hat{X}(\mathbf{p}) + \hat{K}(\mathbf{p})$  is positive-definite for any  $\mathbf{p}$ , then there exist unique and globally stable prices,  $\hat{\mathbf{p}}$ , which satisfy (9).*

**Proof.** Appendix A.

We shall assume throughout that the condition in Proposition 1 is satisfied. Note that when costs are independent of  $\alpha$ ,  $\hat{p}_i - c_i = 0$ ,  $i = 1, 2, \dots, n$ ,  $\hat{K} = 0$  and this condition is trivially satisfied.

### 3 Optimum Commodity Taxation

Suppose that the government wishes to impose specific commodity taxes on  $\mathbf{X}_i$ ,  $i = 1, 2, \dots, n$ . Let the unit tax (subsidy) on  $\mathbf{X}_i$  be  $t_i$  so that its (tax inclusive)

consumer price is  $q_i = p_i + t_i$ ,  $i = 1, 2, \dots, n$ . Consumer demands,  $\hat{x}_i^h(\mathbf{q}; \alpha)$ , are now functions of these prices,  $\mathbf{q} = \mathbf{p} + \mathbf{t}$ ,  $\mathbf{t} = (t_1, t_2, \dots, t_n)$ . Correspondingly, total demands for each good by type  $\alpha$  individuals is  $\hat{x}_i(\mathbf{q}; \alpha) = \sum_{h=1}^H \hat{x}_i^h(\mathbf{q}; \alpha)$ .

As before, the equilibrium vector of consumer prices,  $\hat{\mathbf{q}}$ , is determined by zero-profits conditions:

$$\hat{q}_i = \frac{\int_{\alpha} (c_i(\alpha) + t_i) \hat{x}_i(\hat{\mathbf{q}}; \alpha) dF(\alpha)}{\int_{\alpha} \hat{x}_i(\hat{\mathbf{q}}; \alpha) dF(\alpha)} \quad i = 1, 2, \dots, n \quad (12)$$

or, in matrix form,

$$\boldsymbol{\pi}(\hat{\mathbf{q}}) = \hat{\mathbf{q}} \hat{\mathbf{X}}(\hat{\mathbf{q}}) - \int_{\alpha} (\mathbf{c}(\alpha) + \mathbf{t}) \hat{\mathbf{X}}(\hat{\mathbf{q}}; \alpha) dF(\alpha) = \mathbf{0} \quad (13)$$

where  $\hat{\mathbf{X}}(\hat{\mathbf{q}}; \alpha)$  and  $\mathbf{X}(\hat{\mathbf{q}})$  are the diagonal  $n \times n$  matrices defined above, with  $\hat{\mathbf{q}}$  replacing  $\hat{\mathbf{p}}$ .

Note that each element in  $\hat{K}(\hat{\mathbf{q}})$ ,  $k_{ij}(\hat{\mathbf{q}}) = \int_{\alpha} (\hat{p}_i - c_i(\alpha)) s_{ij}(\hat{\mathbf{q}}; \alpha) dF(\alpha)$ , also depends on  $\hat{p}_i$  or  $\hat{q}_i - t_i$ . It is assumed that  $\hat{X}(\mathbf{q}) + \hat{K}(\mathbf{q})$  is positive definite for all  $\mathbf{q}$ . Hence, given  $\mathbf{t}$ , there exist unique prices,  $\hat{\mathbf{q}}$  (and the corresponding  $\hat{\mathbf{p}} = \hat{\mathbf{q}} - \mathbf{t}$ ), which satisfy (13).

Observe that each equilibrium price,  $\hat{q}_i$ , depends on the whole vector of tax rates,  $\mathbf{t}$ . Specifically, differentiating (13) w.r.t. the tax rates, we obtain:

$$(\hat{X}(\hat{\mathbf{q}}) + \hat{K}(\hat{\mathbf{q}})) \hat{Q} = \hat{X}(\hat{\mathbf{q}}) \quad (14)$$

where  $\hat{Q}$  is the  $n \times n$  matrix whose elements are  $\frac{\partial \hat{q}_i}{\partial t_j}$ ,  $i, j = 1, 2, \dots, n$ .

All principal minors of  $\hat{X} + \hat{K}$  are positive and it has a well-defined inverse. Hence, from (14),

$$\hat{Q} = (\hat{X} + \hat{K})^{-1} \hat{X}. \quad (15)$$

It is seen from (15) that equilibrium consumer prices rise w.r.t. an increase in own tax rates:

$$\frac{\partial \hat{q}_i}{\partial t_i} = \hat{x}_i(\hat{\mathbf{q}}) \frac{\left| \hat{X} + \hat{K} \right|_{ii}}{\left| \hat{X} + \hat{K} \right|} \quad (16)$$

where  $|\hat{X} + \hat{K}|$  is the determinant of  $\hat{X} + \hat{K}$ , and  $|\hat{X} + \hat{K}|_{ii}$  is the principal minor obtained by deleting the  $i$ -th row and the  $i$ -th column. In general, the sign of cross-price effects due to tax rate increases is indeterminate, depending on substitution and complementarity terms.

We also deduce from (15) that, as expected,  $\hat{K} = 0$ ,  $\frac{\partial \hat{q}_i}{\partial t_i} = 1$  and  $\frac{\partial \hat{q}_i}{\partial t_j} = 0$ ,  $i \neq j$ , when costs in all markets are independent of customer type (no asymmetric information), that is, the initial equilibrium is efficient:  $p_i - c_i = 0$ ,  $i = 1, 2, \dots, n$ .

From (1) and (3), social welfare in the pooling equilibrium is written

$$W(\mathbf{t}) = \int_{\underline{\alpha}}^{\bar{\alpha}} \left[ \sum_{h=1}^H u^h(\hat{\mathbf{x}}^h(\hat{\mathbf{q}}; \alpha)) - \mathbf{c}(\alpha)\hat{\mathbf{x}}(\hat{\mathbf{q}}; \alpha) \right] dF(\alpha) + R \quad (17)$$

The problem of optimum commodity taxation can now be stated: the government wishes to raise a given amount,  $T$ , of tax revenue:

$$\mathbf{t}\hat{\mathbf{x}}(\hat{\mathbf{q}}) = T \quad (18)$$

by means of unit taxes  $\mathbf{t} = (t_1, t_2, \dots, t_n)$  that maximize  $W(\mathbf{t})$ .

Maximization of (17) s.t. (18) and (15) yields, after substitution of  $u_i^h - q_i = 0$ ,  $i = 1, 2, \dots, n$ ,  $h = 1, 2, \dots, H$  from the individual F.O.C., that optimum tax levels, denoted  $\hat{\mathbf{t}}$ , satisfy:

$$(1 + \lambda)\hat{\mathbf{t}}\hat{S}\hat{Q} + \mathbf{1}\hat{K}\hat{Q} = -\lambda\mathbf{1}\hat{X} \quad (19)$$

where  $\hat{S}$  is the  $n \times n$  aggregate substitution matrix whose elements are  $s_{ij}(\hat{\mathbf{q}}) = \int_{\underline{\alpha}}^{\bar{\alpha}} s_{ij}(\hat{\mathbf{q}}; \alpha) dF(\alpha)$ ,  $\mathbf{1}$  is the  $1 \times n$  unit vector,  $\mathbf{1} = (1, 1, \dots, 1)$ , and  $\lambda > 0$  is the *Lagrange multiplier* of (18).

Rewrite (19) in the more familiar form:

$$\hat{\mathbf{t}}S = -\frac{1}{1 + \lambda} \left[ \mathbf{1}(\lambda\hat{X} + \hat{K}\hat{Q})\hat{Q}^{-1} \right]$$

substituting from (15)

$$= \frac{\lambda}{1 + \lambda} \mathbf{1}\hat{X} - \mathbf{1}\hat{K} \quad (20)$$

Equation (20) is our fundamental result. Let's examine these optimality conditions w.r.t. a particular tax,  $t_i$ :

$$\sum_{j=1}^n \hat{t}_j s_{ji}(\hat{\mathbf{q}}) = -\frac{\lambda}{1 + \lambda} \hat{x}_i(\hat{\mathbf{q}}) - \sum_{j=1}^n \hat{k}_{ji} \quad (21)$$

Denoting aggregate demand elasticities by  $\varepsilon_{ij} = \varepsilon_{ij}(\mathbf{q}) = \frac{\mathbf{q}_j s_{ij}(\mathbf{q})}{\hat{x}_i(\mathbf{q})}$ ,  $i, j = 1, 2, \dots, n$ , and using symmetry,  $s_{ij}(\mathbf{q}) = s_{ji}(\hat{\mathbf{q}})$ , (21) can be rewritten in elasticity form:

$$\sum_{j=1}^n \hat{t}'_j s_{ji}(\hat{\mathbf{q}}) = -\theta - \sum_{j=1}^n \hat{k}'_{ji} \quad (22)$$

where  $\hat{t}'_j = \hat{t}_j / \hat{q}_j$ ,  $j = 1, 2, \dots, n$  are the optimum ratios of taxes to consumer prices,  $\theta = \frac{\lambda}{1 + \lambda}$ ,

$$\hat{k}'_{ji} = \frac{1}{\hat{\mathbf{q}}_i} \int_{\alpha}^{\bar{\alpha}} (\hat{p}_j - c_j) \hat{x}_j(\hat{\mathbf{q}}; \alpha) \varepsilon_{ji}(\hat{\mathbf{q}}; \alpha) dF(\alpha) \quad (23)$$

where  $\varepsilon_{ji}(\hat{\mathbf{q}}; \alpha) = \frac{\hat{q}_i s_{ji}(\hat{\mathbf{q}}; \alpha)}{x_j(\hat{\mathbf{q}}; \alpha)}$ ,  $i, j = 1, 2, \dots, n$ .

Compared to the standard case,  $\hat{k}_{ji} = \hat{k}'_{ji} = 0$ ,  $i, j = 1, 2, \dots, n$ , the modified Ramsey-Boiteux Conditions (21) or (22), have the additional term,  $\sum_{j=1}^n \hat{k}_{ji}$  or  $\sum_{j=1}^n \hat{k}'_{ji}$ , respectively, on the R.H.S. The interpretation of this term is straightforward.

In a pooling equilibrium, prices are a weighted average of marginal costs, the weights being the equilibrium quantities, (9). Since demands, in general, depend on all prices, all equilibrium prices are interdependent. It follows that an increase in the unit tax of any good affects *all* equilibrium (producer and consumer) prices. This *general-equilibrium effect* of a specific tax is present also in perfectly competitive economies with non-linear technologies, but these price effects have no first-order welfare effects because of the equality of prices and marginal costs. In contrast, in a pooling equilibrium, where prices deviate from marginal costs (being equal to the latter only on average), there is a first-order welfare implication. The term  $\hat{k}_{ji} = \int_{\alpha}^{\bar{\alpha}} (\hat{p}_j - c_j(\alpha)) s_{ij}(\hat{\mathbf{q}}; \alpha) dF(\alpha)$  (or the equivalent term  $\hat{k}'_{ji}$ ) is a welfare loss ( $< 0$ ) or gain ( $> 0$ ) equal to the difference between the producer price and the marginal costs of type  $\alpha$  individuals, positive or negative, times the change in the quantity of good  $j$  due to an increase in the price of good  $i$ . As we shall show below, the sign of  $\hat{k}_{ji}$  (or  $\hat{k}'_{ji}$ ) depends on the relation between demand elasticity and  $\alpha$ .

As seen from (21) or (22), the signs of  $\sum_{j=1}^n \hat{k}_{ji}$ , respectively,  $i = 1, 2, \dots, n$  determine the direction that optimum taxes in a pooling equilibrium differ from those

taxes in an initially efficient equilibrium. We shall now show that the sign of these terms depends on the relation between demand elasticities and costs.

**Proposition 2.**  $\hat{k}'_{ji} > 0$  ( $< 0$ ) when  $\varepsilon_{ji}$  increases (decreases) with  $\alpha$ .

**Proof.** Appendix B.

An implication of Proposition 2 is that when all elasticities  $\varepsilon_{ji}$  are constant, then  $\hat{k}'_{ji} = 0$ ,  $i, j = 1, 2, \dots, n$ , (20) or (21) become the standard Ramsey-Boiteux Conditions, solving for the *same* optimum tax structure.

The intuition for the condition in Proposition 1 is the following:  $\hat{k}_{ji} < 0$  means that profits of good  $j$  fall as  $q_i$  increases, calling for an increase in the equilibrium price of good  $j$ . This 'negative' effect due to the pooling equilibrium leads, by (20), to a smaller tax on good  $i$  compared to the standard case. Of course, this conclusion holds only if this effect has the same sign when summing over all markets,  $\sum_{j=1}^n k_{ji} < 0$ . The opposite conclusion follows when  $\sum_{j=1}^n k_{ji} > 0$ .

## 4 Example: Taxation of Annuities

Consider individuals who consume three goods: annuities, life insurance and a numeraire. Each annuity pays \$1 to the holder as long as he lives. Each unit of life insurance pays \$1 upon death of the policy owner. There is one representative individual and for simplicity let expected utility,  $U$ , be separable and have no time preference:

$$U = u(a)z + v(b) + y \tag{24}$$

where  $a$  is the amount of annuities,  $z$  is expected lifetime,  $b$  the amount of life insurance and  $y$  the amount of numeraire. Utility of consumption,  $u$ , and the utility from bequests,  $v$ , are assumed to be strictly concave. As previously, we assume that the equilibrium values of all variables are strictly positive.

Individuals are differentiated by their survival prospects. Let  $\alpha$  represent an individual's 'risk-class' ('type  $\alpha$ ')  $z = z(\alpha)$ ,  $z$  strictly increasing in  $\alpha$ .  $\alpha$  is taken to be continuously distributed in the population over the interval  $\underline{\alpha} \leq \alpha \leq \bar{\alpha}$ , with

a distribution function,  $F(\alpha)$ . Accordingly, average lifetime in the population is  $\bar{z} = \int_{\alpha}^{\bar{\alpha}} z(\alpha) dF(\alpha)$ .

Assume a zero rate of interest. In a full information competitive equilibrium, the price of an annuity to type  $\alpha$  individuals is  $z(\alpha)$  and the prices of life insurance and of the numeraire are 1. All individuals will purchase the same amount of annuities and life insurance and, for a given income, optimum utility increases with life expectancy,  $z(\alpha)$ .

Let  $p_a$  and  $p_b$  be the prices of annuities and life insurance, respectively, in a pooling equilibrium. Individuals' budget constraints are:

$$p_a a + p_b b + y = m \quad (25)$$

Maximization of (24) s.t. (25), yields (compensated) demand functions  $\hat{a}(p_a, p_b; \alpha)$  and  $\hat{b}(p_a, p_b; \alpha)$ , while  $\hat{y} = m - p_a \hat{a} - p_b \hat{b}$ . Profits of the two goods,  $\pi_a$  and  $\pi_b$ , are:

$$\begin{aligned} \pi_a(p_a, p_b) &= \int_{\alpha}^{\bar{\alpha}} (p_a - z(\alpha)) \hat{a}(p_a, p_b; \alpha) dF(\alpha) \\ \pi_b(p_a, p_b) &= \int_{\alpha}^{\bar{\alpha}} (p_b - 1) \hat{b}(p_a, p_b; \alpha) dF(\alpha) \end{aligned} \quad (26)$$

Equilibrium prices, denoted  $\hat{p}_a$  and  $\hat{p}_b$ , are implicitly determined by  $\pi_a = \pi_b = 0$ . Clearly,  $\hat{p}_b = 1$  (since 1 is the unit cost for all individuals).

Aggregate quantities of annuities and life insurance are  $\hat{a}(p_a, p_b) = \int_{\alpha}^{\bar{\alpha}} \hat{a}(p_a, p_b; \alpha) dF(\alpha)$  and  $\hat{b}(p_a, p_b) = \int_{\alpha}^{\bar{\alpha}} \hat{b}(p_a, p_b; \alpha) dF(\alpha)$ , respectively. We assume (Appendix A) that:

$$\hat{a}(p_a, p_b) + \hat{k}_{11} > 0, \quad \hat{b}(p_a, p_b) + \hat{k}_{22} > 0$$

and

$$\left( \hat{a}(p_a, p_b) + \hat{k}_{11} \right) \left( \hat{b}(p_a, p_b) + \hat{k}_{22} \right) - \hat{k}_{12} \hat{k}_{21} > 0 \quad (27)$$

where<sup>5</sup>

$$\hat{k}_{1i} = \int_{\alpha}^{\bar{\alpha}} (p_a - z(\alpha)) s_{1i} dF(\alpha), \quad s_{1i} = \frac{\partial \hat{a}(p_a, p_b; \alpha)}{\partial p_i}, \quad i = a, b$$

and

$$\hat{k}_{2i} = \int_{\alpha}^{\bar{\alpha}} (p_b - 1) s_{2i} dF(\alpha), \quad s_{2i} = \frac{\partial \hat{b}(p_a, p_b; \alpha)}{\partial p_i}, \quad i = a, b$$

(28)

As seen in Figure 1 (drawn for the case  $k_{12} > 0$ ), the pooling equilibrium  $(\hat{p}_a, \hat{p}_b = 1)$  is unique and stable.

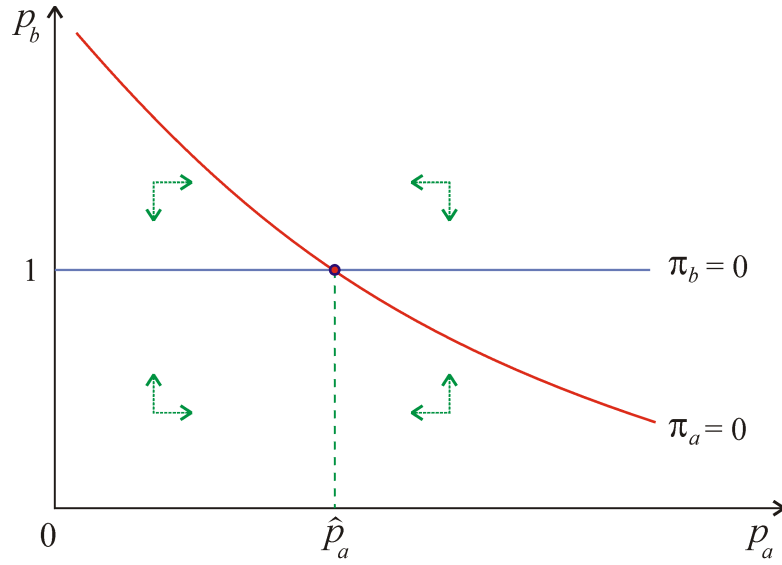


Figure 1

Now consider unit taxes,  $t_a$  and  $t_b$ , imposed on annuities and life insurance with consumer prices denoted  $q_a = p_a + t_a$  and  $q_b = p_b + t_b$ , respectively. Applying the optimality conditions (21), optimum taxes,  $(\hat{t}_a, \hat{t}_b)$ , satisfy the conditions:

$$s_{11}\hat{t}_a + s_{21}\hat{t}_b = -\theta\hat{a}(\hat{q}_a, \hat{q}_b) - k_{11} \quad (29)$$

$$s_{12}\hat{t}_a + s_{22}\hat{t}_b = -\theta$$

where  $0 < \theta < 1$ ,  $s_{ij}(\hat{q}_a, \hat{q}_b) = \int_{\alpha}^{\bar{\alpha}} s_{ij}(\hat{q}_a, \hat{q}_b; \alpha) dF(\alpha)$ ,  $s_{1i}(\hat{q}_a, \hat{q}_b; \alpha) = \frac{\partial \hat{a}(\hat{q}_a, \hat{q}_b; \alpha)}{\partial q_i}$ ,  $s_{2i}(\hat{q}_a, \hat{q}_b; \alpha) = \frac{\partial \hat{b}(\hat{q}_a, \hat{q}_b; \alpha)}{\partial q_i}$ ,  $i = a, b$ , and  $\hat{k}_{11} = \int_{\alpha}^{\bar{\alpha}} (\hat{p}_a - z(\alpha)) s_{11}(\hat{q}_a, \hat{q}_b; \alpha) dF(\alpha)$ .

<sup>5</sup>By concavity and separability, (24),  $s_{11} < 0$ ,  $s_{22} < 0$  and  $s_{12}, s_{21} > 0$ .

Equations (29) are the modified Ramsey-Boiteux Conditions for the case of one pooling-market.

To see in what direction the pooling equilibrium affects optimum taxes, write (29) in elasticity form, using symmetry  $s_{ij} = s_{ji}$ ,  $\varepsilon_{11} = \frac{\hat{q}_a s_{11}}{\hat{a}}$ ,  $\varepsilon_{12} = \frac{\hat{q}_a s_{12}}{\hat{a}}$ ,  $\varepsilon_{21} = \frac{\hat{q}_b s_{21}}{\hat{b}}$ ,  $\varepsilon_{22} = \frac{\hat{q}_b s_{22}}{\hat{b}}$  :

$$\varepsilon_{11}\hat{t}'_a + \varepsilon_{12}\hat{t}'_b = -\theta - \frac{\hat{k}_{11}}{\hat{a}} \quad (30)$$

$$\varepsilon_{21}\hat{t}'_a + \varepsilon_{22}\hat{t}'_b = -\theta$$

where  $\hat{t}'_a = \frac{\hat{t}_a}{\hat{q}_a}$  and  $\hat{t}'_b = \frac{t_b}{q_b}$  are the ratios of optimum taxes to consumer prices. Solving (30) for the tax rates, using the identities  $\varepsilon_{i0} + \varepsilon_{i1} + \varepsilon_{i2} = 0$ ,  $i = 1, 2$ , where 0 denotes the untaxed numeraire:

$$\frac{\hat{t}'_a}{\hat{t}'_b} = \frac{\varepsilon_{11} + \varepsilon_{22} + \varepsilon_{10} + \frac{\hat{k}_{11}}{\theta\hat{a}}}{\varepsilon_{11} + \varepsilon_{22} + \varepsilon_{20} - \frac{\hat{k}_{11}}{\theta\hat{a}}} \quad (31)$$

We know that optimum tax ratios depend on complementarity or substitution of the taxed goods with the untaxed good,  $\varepsilon_{i0}$ ,  $i = 1, 2$ . The additional term, due to the pooling equilibrium in the annuity market, is  $\frac{\hat{k}_{11}}{\theta\hat{a}}$ , which may be negative or positive. Proposition 2 states that  $\hat{k}_{11} < 0$  when the elasticity of the demand for annuities increases with life expectancy,  $z(\alpha)$ . Observe that a higher  $z(\alpha)$  increases the amount of annuities purchased,  $\frac{\partial \hat{a}}{\partial \alpha} > 0$ . Hence, under this assumption, the additional term tends to (relatively) reduce the tax on annuities. The opposite argument applies when  $\hat{k}_{11} > 0$ .



## Appendix A

An interior pooling equilibrium,  $\hat{\mathbf{p}}$ , is defined by the system of equations

$$\boldsymbol{\pi}(\hat{\mathbf{p}}) = \hat{\mathbf{p}}\hat{\mathbf{X}}(\hat{\mathbf{p}}) - \int_{\underline{\alpha}}^{\bar{\alpha}} \mathbf{c}(\alpha)\hat{\mathbf{X}}(\hat{\mathbf{p}}; \alpha)dF(\alpha) = \mathbf{0} \quad (\text{A.1})$$

where  $\boldsymbol{\pi}(\hat{\mathbf{p}}) = (\pi_1(\hat{\mathbf{p}}), \pi_2(\hat{\mathbf{p}}), \dots, \pi_n(\hat{\mathbf{p}}))$ ,  $\hat{\mathbf{p}} = (\hat{p}_1, \hat{p}_2, \dots, \hat{p}_n)$ ,  $\hat{\mathbf{X}}(\hat{\mathbf{p}})$  is the diagonal  $n \times n$  matrix:

$$\hat{\mathbf{X}}(\hat{\mathbf{p}}) = \begin{bmatrix} \hat{x}_1(\hat{\mathbf{p}}) & & 0 \\ & \ddots & \\ 0 & & \hat{x}_n(\hat{\mathbf{p}}) \end{bmatrix}, \quad (\text{A.2})$$

while  $X(\mathbf{p}; \alpha)$  is the diagonal  $n \times n$  matrix:

$$\hat{\mathbf{X}}(\hat{\mathbf{p}}; \alpha) = \begin{bmatrix} \hat{x}_1(\hat{\mathbf{p}}; \alpha) & & 0 \\ & \ddots & \\ 0 & & \hat{x}_n(\hat{\mathbf{p}}; \alpha) \end{bmatrix}, \quad (\text{A.3})$$

and  $\mathbf{c}(\alpha) = (c_1(\alpha), c_2(\alpha), \dots, c_n(\alpha))$ .

It is well known from general equilibrium theory (Arrow and Hahn (1971)) that a sufficient condition for  $\hat{\mathbf{p}}$  to be unique is that the  $n \times n$  matrix  $\hat{\mathbf{X}}(\hat{\mathbf{p}}) + \hat{\mathbf{K}}(\hat{\mathbf{p}})$  be *positive definite*, where  $\hat{\mathbf{K}}(\hat{\mathbf{p}})$  is the  $n \times n$  matrix whose elements are  $\hat{k}_{ij} = \int_{\underline{\alpha}}^{\bar{\alpha}} (\hat{p}_i - c_i(\alpha))s_{ij}(\hat{\mathbf{p}}; \alpha)dF(\alpha)$ ,  $s_{ij}(\hat{\mathbf{p}}; \alpha) = \frac{\partial \hat{x}_i(\hat{\mathbf{p}}; \alpha)}{\partial p_j}$   $i, j = 1, 2, \dots, n$ .

Furthermore, if the price of each good is postulated to change in opposite direction to the sign of the profits of this good, then this condition also implies that price dynamics are globally stable, converging to the unique  $\hat{\mathbf{p}}$ .

Intuitively, as seen from (A.1), an upward perturbation of  $p_1$  raises  $\pi_1$  iff  $\hat{x}_1 + \int_{\underline{\alpha}}^{\bar{\alpha}} (\hat{p}_1 - c_1)s_{11}dF(\alpha) > 0$ , leading to a decrease in  $p_1$ . A simultaneous upward perturbation of  $p_1$  and  $p_2$  raises  $\pi_1$ , and  $\pi_2$  the  $2 \times 2$  upper principal minor of  $\Delta$  is positive, and so on. Convexity of profit functions is the standard assumption in general equilibrium theory.

## Appendix B.

### Proof of Proposition 1.

Assume that  $\varepsilon_{ji}(\hat{\mathbf{q}}; \alpha) = \frac{\hat{q}_i s_{ji}(\mathbf{q}; \alpha)}{\hat{x}_j(\mathbf{q}; \alpha)}$  increases with  $\alpha$ . Since in equilibrium

$$\int_{\underline{\alpha}}^{\bar{\alpha}} (\hat{p}_j - c_j(\alpha)) \hat{x}_j(\hat{\mathbf{q}}; \alpha) dF(\alpha) = 0 \quad (\text{B.1})$$

and, by assumption,  $c_j(\alpha)$  increases with  $\alpha$ ,  $\hat{p}_j - c_j(\alpha)$  changes sign once over  $(\underline{\alpha}, \bar{\alpha})$ , say at  $\tilde{\alpha}$  :

$$(\hat{p}_j - c_j(\alpha)) \hat{x}_j(\hat{\mathbf{q}}; \alpha) \geq 0 \text{ as } \alpha \leq \tilde{\alpha} \quad (\text{B.2})$$

Hence,

$$(\hat{p}_j - c_j(\alpha)) s_{ji}(\hat{\mathbf{q}}; \alpha) < \frac{\varepsilon_{ji}(\hat{\mathbf{q}}; \tilde{\alpha})}{\hat{q}_i} (\hat{p}_j - c_j(\alpha)) \hat{x}_j(\hat{\mathbf{q}}; \alpha) \quad (\text{B.3})$$

for all  $\alpha \in [\underline{\alpha}, \bar{\alpha}]$ . Integrating on both sides of (B.3), using (B.1),

$$\int_{\underline{\alpha}}^{\bar{\alpha}} (\hat{p}_j - c_j(\alpha)) s_{ji}(\alpha) dF(\alpha) < \frac{\varepsilon_{ji}(\hat{\mathbf{q}}; \tilde{\alpha})}{\hat{q}_i} \int_{\underline{\alpha}}^{\bar{\alpha}} (\hat{p}_j - c_j(\alpha)) \hat{x}_j(\hat{\mathbf{q}}; \alpha) dF(\alpha) = 0 \quad (\text{B.4})$$

The inequality in (B.4) is reversed when  $\varepsilon_{ji}(\hat{\mathbf{q}}; \alpha)$  decreases with  $\alpha$ .

## References

- Arrow, K. and F. Hahn (1971) *General Equilibrium Analysis* (Holden-Day).
- Auerbach, A and J. Hines (2001) "Perfect Taxation with Imperfect Competition" in C. Cnossen and H. Sinn (eds.), *Public Finance and Public Policy in the New Century*, 127-153.
- Diamond, P. and J. Mirrlees (1971) "Optimal Taxation and Public Production, II: "Tax Rules", *American Economic Review*, 61, 261-278.
- Guesnerie, R. and J.-J. Laffont (1978) "Taxing Price Makers" *Journal of Economic Theory*, 19, 423-455.
- Laffont J-J and Martimort, D. (2002), *The Theory of Incentives* (Princeton).
- Lau, L., E. Sheshinski and J. Stiglitz (1978) Efficiency in the Optimum Supply of Public Goods" *Econometrica*, 46, 269-284.
- Myles, G. (1987) "Tax Design in the Presence of Imperfect Competition: An Example" *Journal of Public Economics*, 34, 367-378.
- Myles, G. (1989) "Ramsey Tax Rules for Economies with Imperfect Competition" *Journal of Public Economics*, 38, 95-115.
- Ramsey, F. (1927) "A Contribution to the Theory of Taxation", *Economic Journal*, 37, 47-61.
- Salanie, B. (1997) *The Economics of Contracts* (MIT).
- Salanie, B. (2003) *The Economics of Taxation* (MIT).
- Sandmo, A. (1975) "Optimal Taxation in the Presence of Externalities", *Swedish Journal of Economics*, 77, 86-98.
- Stiglitz, J. and P. Dasgupta (1971) "Differential Taxation, Public Goods and Economic Efficiency" *Review of Economic Studies*, 38, 151-174.

# CESifo Working Paper Series

(for full list see [www.cesifo-group.de](http://www.cesifo-group.de))

---

- 1752 Helge Berger and Michael Neugart, Labor Courts, Nomination Bias, and Unemployment in Germany, June 2006
- 1753 Chris van Klaveren, Bernard van Praag and Henriette Maassen van den Brink, A Collective Household Model of Time Allocation - a Comparison of Native Dutch and Immigrant Households in the Netherlands, June 2006
- 1754 Marko Koethenbueger, Ex-Post Redistribution in a Federation: Implications for Corrective Policy, July 2006
- 1755 Axel Dreher, Jan-Egbert Sturm and Heinrich Ursprung, The Impact of Globalization on the Composition of Government Expenditures: Evidence from Panel Data, July 2006
- 1756 Richard Schmidtke, Private Provision of a Complementary Public Good, July 2006
- 1757 J. Atsu Amegashie, Intentions and Social Interactions, July 2006
- 1758 Alessandro Balestrino, Tax Avoidance, Endogenous Social Norms, and the Comparison Income Effect, July 2006
- 1759 Øystein Thøgersen, Intergenerational Risk Sharing by Means of Pay-as-you-go Programs – an Investigation of Alternative Mechanisms, July 2006
- 1760 Pascalis Raimondos-Møller and Alan D. Woodland, Steepest Ascent Tariff Reforms, July 2006
- 1761 Ronald MacDonald and Cezary Wojcik, Catching-up, Inflation Differentials and Credit Booms in a Heterogeneous Monetary Union: Some Implications for EMU and new EU Member States, July 2006
- 1762 Robert Dur, Status-Seeking in Criminal Subcultures and the Double Dividend of Zero-Tolerance, July 2006
- 1763 Christa Hainz, Business Groups in Emerging Markets – Financial Control and Sequential Investment, July 2006
- 1764 Didier Laussel and Raymond Riezman, Fixed Transport Costs and International Trade, July 2006
- 1765 Rafael Lalive, How do Extended Benefits Affect Unemployment Duration? A Regression Discontinuity Approach, July 2006
- 1766 Eric Hillebrand, Gunther Schnabl and Yasemin Ulu, Japanese Foreign Exchange Intervention and the Yen/Dollar Exchange Rate: A Simultaneous Equations Approach Using Realized Volatility, July 2006

- 1767 Carsten Hefeker, EMU Enlargement, Policy Uncertainty and Economic Reforms, July 2006
- 1768 Giovanni Facchini and Anna Maria Mayda, Individual Attitudes towards Immigrants: Welfare-State Determinants across Countries, July 2006
- 1769 Maarten Bosker and Harry Garretsen, Geography Rules Too! Economic Development and the Geography of Institutions, July 2006
- 1770 M. Hashem Pesaran and Allan Timmermann, Testing Dependence among Serially Correlated Multi-category Variables, July 2006
- 1771 Juergen von Hagen and Haiping Zhang, Financial Liberalization in a Small Open Economy, August 2006
- 1772 Alessandro Cigno, Is there a Social Security Tax Wedge?, August 2006
- 1773 Peter Egger, Simon Loretz, Michael Pfaffermayr and Hannes Winner, Corporate Taxation and Multinational Activity, August 2006
- 1774 Jeremy S.S. Edwards, Wolfgang Eggert and Alfons J. Weichenrieder, The Measurement of Firm Ownership and its Effect on Managerial Pay, August 2006
- 1775 Scott Alan Carson and Thomas N. Maloney, Living Standards in Black and White: Evidence from the Heights of Ohio Prison Inmates, 1829 – 1913, August 2006
- 1776 Richard Schmidtke, Two-Sided Markets with Pecuniary and Participation Externalities, August 2006
- 1777 Ben J. Heijdra and Jenny E. Ligthart, The Transitional Dynamics of Fiscal Policy in Small Open Economies, August 2006
- 1778 Jay Pil Choi, How Reasonable is the ‘Reasonable’ Royalty Rate? Damage Rules and Probabilistic Intellectual Property Rights, August 2006
- 1779 Ludger Woessmann, Efficiency and Equity of European Education and Training Policies, August 2006
- 1780 Gregory Ponthiere, Growth, Longevity and Public Policy, August 2006
- 1781 Laszlo Goerke, Corporate and Personal Income Tax Declarations, August 2006
- 1782 Florian Englmaier, Pablo Guillén, Loreto Llorente, Sander Onderstal and Rupert Sausgruber, The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions, August 2006
- 1783 Adam S. Posen and Daniel Popov Gould, Has EMU had any Impact on the Degree of Wage Restraint?, August 2006

- 1784 Paolo M. Panteghini, A Simple Explanation for the Unfavorable Tax Treatment of Investment Costs, August 2006
- 1785 Alan J. Auerbach, Why have Corporate Tax Revenues Declined? Another Look, August 2006
- 1786 Hideshi Itoh and Hodaka Morita, Formal Contracts, Relational Contracts, and the Holdup Problem, August 2006
- 1787 Rafael Lalive and Alejandra Cattaneo, Social Interactions and Schooling Decisions, August 2006
- 1788 George Kapetanios, M. Hashem Pesaran and Takashi Yamagata, Panels with Nonstationary Multifactor Error Structures, August 2006
- 1789 Torben M. Andersen, Increasing Longevity and Social Security Reforms, August 2006
- 1790 John Whalley, Recent Regional Agreements: Why so many, why so much Variance in Form, why Coming so fast, and where are they Headed?, August 2006
- 1791 Sebastian G. Kessing and Kai A. Konrad, Time Consistency and Bureaucratic Budget Competition, August 2006
- 1792 Bertil Holmlund, Qian Liu and Oskar Nordström Skans, Mind the Gap? Estimating the Effects of Postponing Higher Education, August 2006
- 1793 Peter Birch Sørensen, Can Capital Income Taxes Survive? And Should They?, August 2006
- 1794 Michael Kosfeld, Akira Okada and Arno Riedl, Institution Formation in Public Goods Games, September 2006
- 1795 Marcel Gérard, Reforming the Taxation of Multijurisdictional Enterprises in Europe, a Tentative Appraisal, September 2006
- 1796 Louis Eeckhoudt, Béatrice Rey and Harris Schlesinger, A Good Sign for Multivariate Risk Taking, September 2006
- 1797 Dominique M. Gross and Nicolas Schmitt, Why do Low- and High-Skill Workers Migrate? Flow Evidence from France, September 2006
- 1798 Dan Bernhardt, Stefan Krasa and Mattias Polborn, Political Polarization and the Electoral Effects of Media Bias, September 2006
- 1799 Pierre Pestieau and Motohiro Sato, Estate Taxation with Both Accidental and Planned Bequests, September 2006
- 1800 Øystein Foros and Hans Jarle Kind, Do Slotting Allowances Harm Retail Competition?, September 2006

- 1801 Tobias Lindhe and Jan Södersten, The Equity Trap, the Cost of Capital and the Firm's Growth Path, September 2006
- 1802 Wolfgang Buchholz, Richard Cornes and Wolfgang Peters, Existence, Uniqueness and Some Comparative Statics for Ratio- and Lindahl Equilibria: New Wine in Old Bottles, September 2006
- 1803 Jan Schnellenbach, Lars P. Feld and Christoph Schaltegger, The Impact of Referendums on the Centralisation of Public Goods Provision: A Political Economy Approach, September 2006
- 1804 David-Jan Jansen and Jakob de Haan, Does ECB Communication Help in Predicting its Interest Rate Decisions?, September 2006
- 1805 Jerome L. Stein, United States Current Account Deficits: A Stochastic Optimal Control Analysis, September 2006
- 1806 Friedrich Schneider, Shadow Economies and Corruption all over the World: What do we really Know?, September 2006
- 1807 Joerg Lingens and Klaus Waelde, Pareto-Improving Unemployment Policies, September 2006
- 1808 Axel Dreher, Jan-Egbert Sturm and James Raymond Vreeland, Does Membership on the UN Security Council Influence IMF Decisions? Evidence from Panel Data, September 2006
- 1809 Prabir De, Regional Trade in Northeast Asia: Why do Trade Costs Matter?, September 2006
- 1810 Antonis Adam and Thomas Moutos, A Politico-Economic Analysis of Minimum Wages and Wage Subsidies, September 2006
- 1811 Guglielmo Maria Caporale and Christoph Hanck, Cointegration Tests of PPP: Do they also Exhibit Erratic Behaviour?, September 2006
- 1812 Robert S. Chirinko and Hisham Foad, Noise vs. News in Equity Returns, September 2006
- 1813 Oliver Huelsewig, Eric Mayer and Timo Wollmershaeuser, Bank Behavior and the Cost Channel of Monetary Transmission, September 2006
- 1814 Michael S. Michael, Are Migration Policies that Induce Skilled (Unskilled) Migration Beneficial (Harmful) for the Host Country?, September 2006
- 1815 Eytan Sheshinski, Optimum Commodity Taxation in Pooling Equilibria, October 2006