Estimating tax incidence, market power and market conduct: The European cigarette industry

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Abstract

Recent theoretical work has shown that the incidence of ad valorem and specific taxes may differ and each may be over or under-shifted onto consumers in the presence of imperfect competition. These results are used to derive a method of estimating market power and conduct. An application is made to the European cigarette industry. Previous empirical comparison of the incidence of ad valorem and specific taxes is limited. For a group of countries with broadly similar cigarette industries, there is evidence of undershifting of both taxes, with the specific tax having a significantly greater impact on price. The extremes of both perfect competition and monopoly can be rejected. Behaviour is no less competitive than the equivalent of Cournot. © 2001 Elsevier Science B.V. All rights reserved.

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JEL classification: H22; L13; L66

1. Introduction

Tax incidence is a fundamental issue in Public Economics. Identification of market power and measurement of the degree of competition are amongst the most

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important issues in Industrial Organisation. The taxation of cigarettes has been used to learn about each of these topics separately. (See Barzel, 1976; Johnson, 1978; Sumner and Ward, 1981 on tax incidence. See Sumner, 1981; Bulow and Pfeiderer, 1983; Sullivan, 1985; Ashenfelter and Sullivan, 1987 on market power and conduct.) In this paper, cigarette taxation is used to examine both sets of issues. Our first aim is to test the predictions of recent developments in the theory of commodity taxation (c.f. Delipalla and Keen, 1992). The second aim is to develop the literature on the estimation of market power and conduct by introducing a reduced form method which provides point estimates of the mark-up and the numbers equivalent of firms. This extends Sullivan (1985), who identified a lower bound on the latter parameter from comparative statics effects of a specific tax. Our method involves comparing the comparative static effects of specific and ad valorem commodity taxes.\(^1\) As with Sullivan (op cit), it only requires reduced form estimation. The third aim of the paper is to inform the design of cigarette tax policy and, in particular, the debate about the harmonisation of cigarette taxation in Europe.

Theoretical work on tax incidence has shown that commodity taxes may be over- or undershifted onto consumers in the presence of imperfect competition (Seade, 1985; Stern, 1987). Moreover, in such an environment, the incidence of ad valorem and specific taxes may differ, with the price effect of the former never exceeding that of the latter (Delipalla and Keen, 1992; Skeath and Trandel, 1994). Empirical comparison of the price effects of specific and ad valorem taxes is limited. The few studies which exist suffer from a lack of variation in the data, particularly with respect to the ad valorem rate (Barzel, 1976; Johnson, 1978; Sumner and Ward, 1981; Baker and Brechling, 1992). We use data from the EU, where all member states levy both a specific and an ad valorem tax on cigarettes and there is variation in both taxes across countries and time.

The new empirical industrial organisation (N.E.I.O.) literature is concerned with testing for market power and estimating the degree of competition without using accounting data on cost and/or profit (for surveys, see Geroski, 1988; Bresnahan, 1989; Carlton and Perloff, 1994). A distinction can be made between structural and reduced form approaches to the problem (Hyde and Perloff, 1995). The former is based mainly on the conjectural variations model and involves estimating a structural market demand function simultaneously with supply relation(s). Identification of the degree of market power and conduct is achieved through some variable which pivots the demand curve (Bresnahan, 1982; Lau, 1982). The advantage of the structural approach is its power. Not only can market power be tested but estimates can be made of the price–cost mark-up and the degree of

\(^1\)A specific, or unit, tax is a fixed amount per unit. An ad valorem tax is a proportion of price. It can be expressed as a percentage of the tax inclusive or tax exclusive price, i.e. it can be levied on the consumer or producer price. In our application, the former is true.
competition within the industry. There are four main disadvantages. First, data must be available on price, output, input prices and both demand and cost shifters. Second, misspecification of the structural demand and/or cost function will bias the estimates, and so the tests, of market power/conduct. Third, when using industry level data, the supply relation estimated does not correspond to the first order conditions unless firms are homogeneous. Otherwise, the supply relation is, in part, ad hoc and the parameters must be interpreted as industry averages (Bresnahan, 1989, p. 1030). Finally, the conjectural variations model is vulnerable to theoretical criticism. Given this, Bresnahan (1989) claims an ‘as-if’ interpretation of the estimated conduct parameter: It indicates behaviour is as competitive ‘as-if’ firms held certain conjectures. Corts (1999) demonstrates this argument is valid only under certain conditions.²

Tests of market power which do not involve estimation of structural demand and supply relations avoid the above mentioned problems at the cost of losing power with respect to the hypotheses which can be tested and the parameters which can be estimated. Hall (1988) provides a joint test of the hypotheses of perfect competition and constant returns to scale. The joint nature of the test impedes interpretation somewhat. Estimates of the degree of market power and market conduct can be obtained only by imposing further restrictions and with additional information available (Shapiro, 1987). Panzar and Rosse (1987) are able to test the extreme cases of market conduct, perfect competition and monopoly, but do not obtain an estimate of the degree of market power or competition. Sumner (1981) claimed the impact of a unit tax in a reduced form price equation identified the industry average mark-up and the firm level elasticity. Bulow and Pfleiderer (1983) demonstrated this claim was valid only for special cases of the demand function.³ Sullivan (1985) linked the method of Panzar and Rosse (op cit) with that of Sumner (op cit) and Bulow and Pfleiderer (op cit) to show the coefficients on a specific tax in reduced forms for price and quantity can be used to identify a lower bound on the numbers equivalent of firms. This allows testing of the hypothesis of monopoly, but not competition.⁴

We take this literature one step further by proposing a reduced form method which allows identification of market power and conduct. The hypotheses of both perfect competition and monopoly can be tested and the degree of competition estimated. As with Sullivan (op cit), since identification comes from the comparative static effects of taxes, the method only requires estimation of reduced form

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²Inference of market conduct from the estimated conduct parameter is valid only if the behaviour underlying the observed equilibrium is identical at the margin, and not just on the average, to a conjectural variations game.

³Genesove and Mullin (1998) also note that identifying the conduct parameter through the responsiveness of price to cost alone is essentially dependent upon the demand specification (p. 371).

functions. Non-equivalence of the price effects of specific and ad valorem taxes is an indication of market power. The price–cost mark-up is identified by taking the ratio of the price effects of the two taxes. Having estimated the mark-up, a parameter reflecting the conduct of the industry, that is the numbers equivalent of firms, is identified if the price elasticity of market demand is known or can be estimated.

The method offers the power of the structural conduct parameter method without imposing the data requirements or the functional form assumptions of structural estimation. Of course, it does not come without cost; to be feasible, the method requires that the econometrician can observe a component of unit costs and a variable which pivots the (perceived) demand curve. These information requirements are satisfied in industries where both specific and ad valorem taxes are imposed and may be fulfilled in other contexts. Corts (1999) demonstrates that, in general, the structural conduct parameter method generates biased estimates. Empirically, Genesove and Mullin (1998) find the structural method to be largely validated although its performance is improved if partial cost information is employed. Essentially, our method involves the use of partial cost information, obtained from taxes, to move away from a structural estimation approach.

The paper is organised as follows. The theory of the relationship between market conduct and the incidence of ad valorem and specific taxes is presented in the next section. Tax incidence, market power and conduct parameters are written in terms of the comparative static effects of the taxes. In Section 3 we describe the setting of our empirical application – the European cigarette industry. Empirical implementation of the approach and the data are described in Section 4. Estimation issues are discussed and the results presented in Section 5. Section 6 concludes.

2. Market power and the relative incidence of ad valorem and specific taxation

We consider the conjectural variations model, as in Delipalla and Keen (op. cit.), only we look at the non-symmetric equilibrium. In an industry with \( n \) firms, the after-tax profit earned by firm \( i \) is

\[
\pi_i = \left( [1 - v] P(X) - s \right) x_i - c(x_i),
\]

(2.1)

where \( P \) is the consumer price, \( X \) is the industry output, \( x_i \) is the firm’s output, \( c(x_i) \) is the firm’s total cost of producing the given level of output and \( s \) and \( v \) are

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\(^5\)The precise meaning of equivalence is explained in Section 2.
the specific and (tax inclusive) ad valorem tax rates respectively. The strategic interaction between firms is captured by
\[
\frac{dX_i}{dx_i} = \lambda_i \in [0, n].
\]

With \( \lambda_i = 0 \), conjectures are “competitive”; \( \lambda_i = 1 \) corresponds to Cournot conjectures and \( \lambda_i = n \) to tacit collusion. The first-order condition for profit maximisation is given by
\[
(1 - v)(P(X) + \lambda'_i P X_i) - c_{x_i} - s = 0,
\]
with subscripts indicating derivatives. Dividing (2.2) by \( \lambda'_i \) and summing over \( i \), yields
\[
(1 - v)P \left[ \sum \frac{1}{\lambda'_i} + \frac{P X}{P} X \right] - \sum \frac{1}{\lambda'_i} c_{x_i} - s \sum \frac{1}{\lambda'_i} = 0.
\]

Solving (2.3) for \( P \) and using the elasticity of industry demand, \( e = -P/XP_X \),
\[
P = \frac{1}{1 - \frac{1}{e \sum \frac{1}{\lambda'_i}}}
\]
where
\[
\phi = \frac{1}{1 - v} \left( \frac{\sum \frac{1}{\lambda'_i} c_{x_i}}{\sum \frac{1}{\lambda'_i}} + s \right).
\]

Comparative statics show that taxes affect price as

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6 \( v \) is the ad valorem tax rate expressed as a percentage of the tax inclusive (i.e. consumer) price. This is consistent with the administration of the tax in our empirical application. While details change, our general results are robust to redefinition of the tax as a percentage of the tax exclusive price.

7 One may object to our derivation since it involves dividing through by \( \lambda' \) which, strictly, is not permissible if this parameter can take a value of zero, as it does under perfect competition. However, an alternative derivation for the competitive case, which involves extending the procedure of Musgrave (1959, pp. 295–299) to an environment in which both types of taxes coexist, produces exactly the same results. This alternative derivation is available from the authors on request.
\[
\frac{dP}{ds} = \frac{1}{1 - v} \frac{\sum \frac{1}{\lambda^i}}{\sum \frac{1}{\lambda^i} + 1 + A - E} 
\]

(2.6)

and

\[
\frac{dP}{dv} = \phi \frac{dP}{dx},
\]

(2.7)

where

\[
A = -\frac{\sum \frac{1}{\lambda^i} c_{x^i}}{(1 - v)P_x}
\]

and

\[
E = -P_{xx}X/P_x
\]

denotes the elasticity of the slope of the inverse demand function. Eq. (2.6) is immediate on applying the implicit function theorem to (2.3); (2.7) follows similarly on noting from (2.3) that

\[
P \sum \frac{1}{\lambda^i} + P_xX = \phi \sum \frac{1}{\lambda^i}.
\]

(2.8)

Comparing (2.6) and (2.7), using (2.4) and denoting the mark-up of gross price over tax-inclusive marginal cost \((P/f)\) with \(\mu\), so that

\[
\mu = \frac{1}{\left(1 - \frac{1}{e \sum \frac{1}{\lambda^i}}\right)}.
\]

we get

\[
\frac{dP}{dx} = \frac{\mu P}{P'}
\]

(2.9)

The comparative statics effects of the taxes differ in relation to the degree of market power and price. The dependence on price simply reflects the different units in which the taxes are measured. Re-arranging (2.9) to control for this, we have,
In perfect competition, $\mu = 1$ and the adjusted marginal effects are equal. However, with imperfect competition (i.e. $\mu > 1$), after adjusting for differences in measurement units, the price effect of the specific tax exceeds that of the ad valorem by a proportion given by the value of the mark-up. This result provides the basis of our method of testing the hypothesis of market power. Substituting estimated marginal tax effects from a reduced form price function into (2.10) gives an estimate of the mark-up.

Now consider the issue of tax incidence. Since prices are set above marginal cost in imperfect competition, there need not be full shifting of a tax onto the consumer; indeed, there can be over- or undershifting (Delipalla and Keen, 1992). In the presence of ad valorem taxation, evaluation of tax incidence is complicated by a “multiplier effect”. That is, a given increase in cost due to a change in taxation will require a greater increase in the consumer price, if the producer price is to remain constant, since part of the consumer price rise goes to the government in extra ad valorem tax revenue. In this context, one can consider whether there is full shifting of a tax onto the consumer by examining whether the producer price, $p' = (1 - \nu)P - s$, is invariant to the level of the tax. Then, the degree of tax shifting is given by

$$\frac{dp'}{ds} + 1 = \frac{dP}{ds} (1 - \nu) \quad (2.11)$$

and

$$\frac{1}{P} \frac{dp'}{dv} + 1 = \frac{1}{P} \frac{dP}{dv} (1 - \nu). \quad (2.12)$$

Expressions (2.11) and (2.12) are less than, equal to and greater than 1 with undershifting, full shifting and overshifting respectively. The outcome which emerges depends upon the value of parameters related to the market structure, cost structure and demand elasticity of the industry. Overshifting of the specific tax is necessary but not sufficient for overshifting of the ad valorem tax (Delipalla and Keen, 1992). In our empirical analysis, we used the estimated marginal tax effects to calculate the tax shifting parameters (2.11) and (2.12) and test the hypothesis of full shifting.

Sullivan’s (1985) method of estimating market conduct can be demonstrated by inspection of the first order condition (2.3). Faced with a similar expression, Sullivan could not solve for the conduct parameter,
\[ \sum \frac{1}{\lambda^i}. \]

without restricting marginal cost to be greater than some constant, i.e. \( c_x \geq c \).

Substitution of \( c \) for \( c_x \) in Eq. (2.3) and re-arranging gives,

\[ \sum \frac{1}{\lambda^i} \geq - \frac{(1-v)P_X}{[(1-v)P-c-s]} = - \frac{(1-v) \frac{dP}{ds} X}{[(1-v)P-c-s] \frac{dX}{ds}}. \quad (2.13) \]

Substitution of estimated marginal effects of the tax from reduced form price and quantity functions into the right-hand-side of (2.13) allows a lower bound on the numbers equivalent of firms to be calculated for various assumed values of \( c \).

However, in the presence of both specific and ad valorem taxes it is possible to go a step further and obtain point estimates of the conduct parameter. Note that from (2.4),

\[ \sum \frac{1}{\lambda} = \frac{1}{e \left( 1 - \frac{\phi}{P} \right)} = \frac{1}{e \left( 1 - \frac{1}{\mu} \right)} . \quad (2.14) \]

An estimate of the mark-up (\( \mu \)) is obtained using (2.10). For the elasticity of market demand, an extraneous estimate could be used. Alternatively, (2.14) can be rewritten as

\[ \sum \frac{1}{\lambda^i} \geq \left( - \frac{dX/ds}{dP/ds} \right) P \left( 1 - \frac{dP/P}{dP/ds} \right). \quad (2.15) \]

Provided one has data on market quantity, as well as price, the marginal effects of the taxes in reduced form price and quantity functions give an estimate of the degree of competition within the industry, in addition to the mark-up.

The above results are derived under the assumption of homogeneous products with no endogenous (to taxes) changes in quality. The realism of an assumption of homogeneous products can obviously be questioned. However, Anderson et al. (1997) show the results of Delipalla and Keen (op. cit.) on the relative incidence of the two taxes carry over to a model with horizontally differentiated products in Bertrand-Nash oligopoly.\footnote{While Anderson et al. (1997) relax the homogeneous product assumption, their model is more restrictive than Delipalla and Keen (1992) in respect of the market structures and consumer preferences admitted.} Prior to the imperfect competition model, consideration of the relative price effects of ad valorem and specific taxes focussed on their impact on quality in competitive markets (cf. Barzel, 1976; Kay and Keen, 1983,
The ranking of the relative price effects in this environment is consistent with that generated by the oligopoly model. When quality is measured in terms of some untaxed characteristic, a specific tax may lead to an upgrading in quality. Since the increase in quality per se tends to raise price, the actual price increase may exceed the (specific) tax increase. An ad valorem tax bears on all commodity characteristics whose value is reflected in consumer price, providing a disincentive to improve quality. Due to the “multiplier effect”, in order to increase producer price by 1, consumer price has to increase by $1/(1 - v) > 1$. Thus, when the ad valorem tax increases, it is likely to lead to a reduction in quality and, consequently, a price rise lower than the amount of the tax increase.

Such quality effects potentially jeopardise our strategy of using tax–price relationships to test for market power. We design our empirical application to minimise the potential for quality effects but nonetheless consider this as an alternative interpretation of our results.

3. The European cigarette industry

The European cigarette industry, being highly concentrated, provides an appropriate context for trying out our method of estimating market power and to test the recent developments in the theory of tax incidence allowing for imperfect competition. The estimates are not only of interest in relation to the academic economics literature but also as a source of information for a variety of policy discussions. There has been a long running debate in Europe over the harmonisation of cigarette taxes. Although all EU countries tax cigarettes heavily, there is a split between those favouring ad valorem taxation — roughly, the south — and those with a more balanced tax structure — roughly, the north. These differences have impeded fiscal harmonisation. Evidence on the relative effects of the two taxes might help to resolve the debate. The taxation of cigarettes is motivated, in part, by public health concerns. Evaluations of the effectiveness of taxation as an anti-smoking instrument have concentrated on the estimation of price elasticities of demand, adopting the assumption that taxes are fully shifted onto consumers (cf. Chaloupka and Warner, 1998). Tests of the validity of this assumption are important in assessing the health policy role, and the distributional effects, of cigarette taxation. The Tobacco Resolution proposed in the U.S. and the high profile legal actions taken against cigarette manufacturers there have focussed attention on the industry. Given the scale of the tax increases contemplated in the

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1 Cremer and Thisse (1994), in a model of vertical product differentiation with two firms where each produces a variant of a differentiated commodity, show that an increase in ad valorem taxation can actually reduce the consumer price. Their explanation is that ad valorem taxation reduces the quality of both variants, narrows the quality gap and intensifies price competition.
Resolution, knowledge of the degree of shifting of taxes onto prices and the conduct of the industry would be crucial in predicting the consequences of such legislation (Bulow and Klemperer, 1998).

The empirical analysis is based on data from the 12 members of the EU prior to its expansion in 1995. The high degree of concentration of the European cigarette industry can be seen from Table 1. In 1992/93, the top five firms in each country held in excess of 90% of the market in every case. A major difference in the nature of the markets across Europe arises from direct state involvement in France, Italy, Spain and Portugal. In these countries, the state has an effective monopoly on the manufacture and distribution of domestic cigarettes and the market is even more concentrated than it is elsewhere. The remainder of the market in these countries, and the vast majority of the market in the other countries, is dominated by a group of American and British multinationals. The exception is Denmark, where a private domestic company (Skandinavisk Tobak) enjoys an almost monopoly position. There are also differences in the nature of the product. In the

<table>
<thead>
<tr>
<th></th>
<th>Top five firms</th>
<th>Total of top five</th>
<th>Total of multinationals</th>
<th>State producer</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5</td>
<td></td>
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<tr>
<td>Belgium</td>
<td>30% 28 17.8 13 6</td>
<td>94.8%</td>
<td>94.8%</td>
<td>0%</td>
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<tr>
<td>Denmark</td>
<td>78.8 n.a. n.a. n.a. n.a.</td>
<td>≈100</td>
<td>2.4</td>
<td>0</td>
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<tr>
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<td>37.2 24.3 18.9 8.6 6.4</td>
<td>95</td>
<td>95</td>
<td>0</td>
</tr>
<tr>
<td>Greece(^b)</td>
<td>33.8 18.5 9.9 5.6 5.4</td>
<td>73.2</td>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>Spain</td>
<td>66.1 13.7 9.8 5.3 4.4</td>
<td>99.3</td>
<td>33.7</td>
<td>66.1</td>
</tr>
<tr>
<td>France</td>
<td>45.2 28.6 12.2 11.1 1.2</td>
<td>98.3</td>
<td>54.0</td>
<td>45.2</td>
</tr>
<tr>
<td>Ireland(^c)</td>
<td>n.a. n.a. n.a. n.a. n.a.</td>
<td>≈100</td>
<td>≈100</td>
<td>0</td>
</tr>
<tr>
<td>Italy</td>
<td>46.9 45 n.a. n.a. n.a.</td>
<td>≈100</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Luxembourg</td>
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<td>n.a.</td>
<td>n.a.</td>
<td>0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>33 25 22 15 n.a.</td>
<td>&gt;95</td>
<td>≈95</td>
<td>0</td>
</tr>
<tr>
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<td>92.2 6.9 0.9 0 0</td>
<td>100</td>
<td>7.8</td>
<td>92.2</td>
</tr>
<tr>
<td>UK</td>
<td>39.8 35.4 14.5 2.8 n.a.</td>
<td>&gt;92.5</td>
<td>&gt;92.5</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^a\) Source: European Bureau for Action on Smoking Prevention (1995).

\(^b\) Shares of total sales held by five top domestic producers. The figure for multinationals is imports plus cigarettes produced for MNCs under license.

\(^c\) The MNCs account for almost the whole market.

\(^{10}\) The figure shown in the table for Greece is less than 90% but, as noted, this refers to the share held by domestic producers only. It is likely that including MNCs would push the figure above 90%.

\(^{11}\) Even in this case, an Anglo-American multinational has a one third share in the company.
four countries where the state is involved in production, the market is led by domestic brands made from European tobacco. In most of the other countries, Greece being a notable exception for most of the period of our analysis, the American tobacco brands of the multinationals lead the market.

Cigarette prices and taxes for the period of analysis, 1982–97, are summarised in Table 2. The prices refer to the highest selling category, defined by price (that is, the most popular price category (MPPC)), in each country. There are large differences in gross prices, with the lowest prices being in southern Europe. With two exceptions, the real gross price of cigarettes increased over the period. In a number of cases, the increase was substantial. The heavy burden of taxation is indicated by the large differences between gross and net prices. The smaller variance across countries in net prices indicates tax differences are, to an extent, responsible for the differences in gross prices. The tax burden has increased in a

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<td>55.21</td>
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<td>105.70</td>
<td>21.52</td>
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<td>69.40</td>
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<td>74.80</td>
<td>75.99</td>
<td>5.00</td>
<td>5.00</td>
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<tr>
<td>Ireland</td>
<td>100.10</td>
<td>144.20</td>
<td>26.88</td>
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<td>50.45</td>
<td>51.72</td>
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<td>13.97</td>
<td>72.60</td>
<td>72.99</td>
<td>1.58</td>
<td>5.00</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>43.45</td>
<td>71.95</td>
<td>14.80</td>
<td>22.55</td>
<td>65.95</td>
<td>68.66</td>
<td>5.15</td>
<td>5.03</td>
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<td>87.64</td>
<td>14.91</td>
<td>24.63</td>
<td>72.69</td>
<td>71.89</td>
<td>10.00</td>
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<td>30.65</td>
<td>30.58</td>
<td>9.33</td>
<td>5.75</td>
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<tr>
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<td>108.90</td>
<td>128.80</td>
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<td>78.73</td>
<td>54.12</td>
<td>54.41</td>
</tr>
</tbody>
</table>

* Source: see Appendix A – Data sources.
* Gross retail price of 1000 cigarettes in the most popular price category (MPPC) deflated by 1985 CPI, in ECUs.
* Gross price minus total tax. Total tax = specific tax + (ad valorem) (gross price). Ad valorem is the sum of the ad valorem excise rate and VAT, both expressed as proportion of tax inclusive (gross) price.
* For Spain and Portugal, first year is 1986, not 1982, for all variables.

12 The fall in price indicated for Greece is apparent, rather than real, reflecting depreciation of the currency.
number of countries and there is now a degree of consistency with respect to the level of taxation. This is the result of EU legislation, which now requires that the total tax burden be at least 70 percent of the gross price.

The lack of progress in harmonising the structure of cigarette taxation is apparent from the final two columns of Table 2. According to the theory discussed in Section 2, under imperfect competition specific taxation leads to higher prices, for a given tax revenue. It is understandable that there is greater tolerance of this type of taxation in some of the countries of northern Europe, where smoking prevention movements are more firmly established. In southern countries smoking prevention, although growing, is a politically sensitive issue because of the cultural and economic importance of tobacco. These countries prefer ad valorem taxation since, through the multiplier effect, it increases the price advantage to the local brands, often made from domestically grown tobacco, relative to those of the multinationals. Theory also predicts specific taxation is more advantageous for profit relative to ad valorem (Delipalla and Keen, 1992). The multinational companies predominant in the north of Europe would therefore be expected to lobby for this type of taxation. On the other hand, state producers might be more interested in tax revenue than profit and would be expected to favour ad valorem taxation. It is striking that in Portugal, where there is effectively a state monopoly, the burden of taxation is among the highest in the community, yet gross prices are among the lowest.

The differences in the preferred structure of cigarette taxation have impeded agreement on harmonisation. The first EU directive issued in 1972 (Directive 72/464/EEC) instructed all member states to introduce a mixed tax structure. The specific tax should be not less than 5% and not higher than 75% of the total excise duty. The directive was clearly in favour of predominantly ad valorem taxation; at that time the majority of EC members had an entirely ad valorem tax structure. Shortly afterwards, Denmark, Ireland and the UK, countries with predominantly specific taxation, joined the Community. A second directive was approved in 1977 (Directive 77/805/EEC) according to which the specific tax should be between 5% and 55% of the total tax burden including the VAT. This second stage was extended five times until 1985, when it was extended indefinitely. After several years of disagreement, in 1992, it was agreed that the overall excise duty should be no less than 57% of the final retail price of the most popular price category (all taxes included), and the VAT should be at least 15% of the final retail price (inclusive of excises). These directives implied a minimum overall tax level on

\[ \text{(13) Moreover, Cnossen (1992) argues that specific taxation is a better instrument to internalise the} \]
\[ \text{"external costs" that smoking imposes, since it hits the cause of the costs directly and does not tax items that do not contribute to the costs, such as wrappers, or even mitigate the effects of smoking, such as filters.} \]
cigarettes of 70% of the retail price. The ratio of specific to total taxation should be the same as in the 1977 Directive. From Table 2, it is apparent that there is a tendency for countries to locate toward either of the extreme bounds on this ratio.

4. Empirical implementation and data

As emphasised above, our method relies on comparative statics for identification and so only requires reduced form estimation. Specifically, we estimate reduced form price functions with the taxes and other exogenous determinants of demand and cost conditions included as right-hand-side variables. From the coefficients on the tax variables, estimates of their marginal effects are calculated and substituted for the true values in expressions (2.10)–(2.12) and (2.14). The empirical counterparts of these expressions provide estimates of tax incidence, market power and market conduct. The empirical specification of the reduced form price functions and the exogeneity of the taxes are discussed in the next section.

The data cover 12 European countries over sixteen years. For ten countries, the data are for the period 1982–97; for Spain and Portugal, 1986–97. The data are for prices and taxes in operation at January 1 of each year. The price data are for 1000 cigarettes in the most popular price category (MPPC), which will vary across countries and, potentially, also across time. Variation across countries can be dealt with through country specific effects. Variation across time is more difficult to accommodate since this time effect would not be common across countries. An inference problem would arise if switches in the MPPC were correlated with tax changes. Various sources have been checked to identify any changes in the MPPC over the sample period. There are two cases of large jumps in the price of the MPPC which appear, at least in part, to arise from a switch of the leading price category: France 1988–89 and Greece 1993–94. In the former case, the problem has been dealt with by specifying different group effects for the periods 1982–88 and 1989–97. In the case of Greece, there are insufficient data points after the switch to allow a separate group effect for this period and so the Greek series has been truncated at 1993.

The specific tax is the monetary amount levied on 1000 cigarettes and the ad valorem rate is the sum of the ad valorem excise duty and VAT expressed as a percentage of the tax inclusive retail price. Sources for all of the data are given in Appendix A. As a control for cost variation, we include labour costs per worker in

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For two years we do not have data specific to January 1. For 1982 we use May 1 data and for 1995, July 1. This is unlikely to be a significant problem given there is little intra-year variation in the tax and price series. For the period 1982–90, we have quarterly data. Estimates obtained from annual and quarterly data showed little difference.
the manufacturing sector of the tobacco industry.\textsuperscript{15,16} As with all of the control variables, the data are for the year preceding the January 1 date to which the price and tax data refer. GDP per capita is included as a determinant of the level and price elasticity of demand. With the exception of GDP per capita, which is denominated in purchasing power standards, all monetary variables are converted to ECU$s. The ECU exchange rate is included, as an additional control, to avoid spurious correlation arising from depreciation or appreciation of a currency. All monetary denominated variables were deflated to 1985 prices using country specific consumer price indices.

5. Results

Given our method involves reduced form estimation, our choice of specification has been empirical. That is, we have searched for the specification which best fits the data subject to the statistical properties assumed by the estimator being satisfied.

Differences in the nature of the cigarette industry across Europe were discussed in Section 3. While some of these differences can be dealt with in estimation through the inclusion of country effects, others affect not only price levels but the tax responsiveness of prices. Indeed, according to the theoretical results, differences in market power and conduct should be reflected in tax–price relationships. In the context of a linear in levels specification estimated by OLS with country specific intercepts, the restriction of homogeneity in slope coefficients is decisively rejected \( F = 62.30 \) \( (p = 0.0000) \). We therefore look for sub-sets of countries across which this restriction has greater validity.

Country specific tax shifting parameters,\textsuperscript{17} calculated from individual country price regressions, are presented in Table 3.\textsuperscript{18} Given small sample sizes, these estimates cannot be expected to be particularly accurate. However, they are useful in identifying important differences in tax–price relationships across countries. In

\textsuperscript{15} For France and Luxembourg data specific to the tobacco industry were not available. Labour costs per worker across the whole of manufacturing industry were used instead. The appropriate data is absent for Ireland before 1985. For this period, data specific to food, tobacco and alcohol manufacturing are used. For many of the countries, labour cost data were not available for 1996. We used a forecast based upon an assumption of no real change in labour costs per worker between 1995 and 1996.

\textsuperscript{16} Unit labour costs in tobacco manufacturing were used as an alternative cost control but labour costs per worker were found superior with respect to significance and diagnostic tests. As a control for capital costs, real long-term interest rates were included initially but were found not to be significant and could be excluded without affecting the remaining coefficients.

\textsuperscript{17} That is, expressions (2.11), (2.12) and (2.10).

\textsuperscript{18} See notes to Table 3 for a description of the estimation procedure. Regression coefficients are available from the authors.
Table 3
Tax shifting parameters from individual country price regressions*

<table>
<thead>
<tr>
<th>Country</th>
<th>Ad valorem</th>
<th>Specific</th>
<th>Ratio of specific to ad valorem (μ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium (GLS)</td>
<td>0.7364</td>
<td>0.7870</td>
<td>1.0688</td>
</tr>
<tr>
<td>Denmark (OLS)</td>
<td>0.4017*</td>
<td>1.0374</td>
<td>2.5824</td>
</tr>
<tr>
<td>France (GLS)</td>
<td>0.5223</td>
<td>6.0432**</td>
<td>11.5710**</td>
</tr>
<tr>
<td>Germany (OLS)</td>
<td>1.0482</td>
<td>0.8223</td>
<td>0.7845</td>
</tr>
<tr>
<td>Greece (GLS)</td>
<td>1.1270</td>
<td>3.9724**</td>
<td>3.5248**</td>
</tr>
<tr>
<td>Ireland (GLS)</td>
<td>0.8686</td>
<td>1.2746**</td>
<td>1.4675</td>
</tr>
<tr>
<td>Italy (GLS)</td>
<td>2.7088**</td>
<td>3.5925**</td>
<td>1.3262**</td>
</tr>
<tr>
<td>Luxembourg (OLS)</td>
<td>0.3275</td>
<td>7.0090**</td>
<td>21.4032**</td>
</tr>
<tr>
<td>Netherlands (GLS)</td>
<td>0.5032**</td>
<td>0.6697*</td>
<td>1.3309**</td>
</tr>
<tr>
<td>Portugal (GLS)</td>
<td>0.3195**</td>
<td>1.1390</td>
<td>3.5654**</td>
</tr>
<tr>
<td>Spain (GLS)</td>
<td>0.4974</td>
<td>1.5102</td>
<td>3.0360</td>
</tr>
<tr>
<td>U.K. (OLS)</td>
<td>1.2870</td>
<td>1.1081**</td>
<td>0.8610</td>
</tr>
</tbody>
</table>

* Notes: The figures in columns 2, 3 and 4 are estimates of the expressions (2.12), (2.11) and (2.10) respectively. All parameters calculated, at respective sample means, from coefficients of individual country price regressions. Independent variables are specific tax, ad valorem tax rate, wage and GDP per capita. All variables in levels. Estimated by OLS, or GLS (Prais-Winsten) if Durbin-Watson did not indicate non-rejection of the null hypothesis at 1% level of significance. ** and * indicates parameter is significantly different from 1 at 5% and 10% level of significance respectively based on Wald test. Highest level of significance quoted where Wald test shows inconsistency in test of mathematically equivalent linear and non-linear restrictions. Standard errors calculated by delta method.

In most cases, the estimates suggest undershifting of the ad valorem tax (i.e. the parameter is less than 1). In three countries (Denmark, the Netherlands and Portugal), this undershifting is significant. In only one case (Italy) there is evidence of significant overshifting of the ad valorem tax. In contrast, six countries show significant overshifting of the specific tax, with only one (Netherlands) indicating significant undershifting. The theoretical prediction that the price effect of the specific tax exceeds that of the ad valorem under imperfect competition is confirmed in all but two cases (Germany and UK). In neither of these two theoretically inconsistent cases does the difference between the tax effects reach statistical significance. On the other hand, there are six cases in which the specific tax has a significantly greater impact on price than the ad valorem.

Estimates of the overshifting of the specific tax in France and Luxembourg are very large and result in extremely large ratios of specific to ad valorem effects. Such results probably reflect peculiarities in the market for cigarettes in each of these countries. In France, the market is led by a state producer, whereas cross-border shopping has a very large impact on the market in Luxembourg.19 These features might be expected to result in complex relationships between tax

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19 Up to 80% of cigarettes sold in Luxembourg are purchased by non-residents (European Bureau for Action on Smoking Prevention, 1995).
and price and to render the theoretical model we are interested in testing inapplicable. It is noticeable that the ratio of the two tax effects is also large for two (Portugal and Spain) of the remaining countries in which the state has monopoly control of domestic production. This ratio is also large in the case of Greece, where domestic manufacturers, using domestically grown tobacco, have a large share of the market. Italy, the final country with state production, is distinguished by estimates of a large degree of overshifting of both taxes.

As might be anticipated, results from individual country regressions suggest state production (France, Italy, Portugal and Spain), production from domestically grown tobacco (Greece) and a very large amount of cross-border shopping (Luxembourg) affect tax–price relationships. We therefore concentrate on estimates derived from a group of countries without these features (Belgium, Denmark, Germany, Ireland, Netherlands and UK – Group 1). As illustrated by Table 1, these countries display a degree of homogeneity with respect to market structure. With the exception of Denmark, they are all dominated by a small number of multinationals and there is similarity across the countries in the most popular type of cigarette. The ratio of the tax effects, which according to the imperfect competition model is the market power parameter, is estimated to be larger in Denmark than in the others from this group. This might reflect the greater degree of market concentration in this country. In the interests of efficiency, we choose to include Denmark in the core group countries and comment on the sensitivity of the results to its exclusion. Estimates from pooling the remaining countries (France, Greece, Italy, Luxembourg, Portugal and Spain – Group 2) are also presented. The peculiarities of the markets in these countries make them less interesting from the point of view of testing the model of imperfect competition, however, good estimates of the average degree of tax shifting across these countries are of interest in their own right.

Estimates of price regressions for Group 1 and 2 countries are presented in Table 4. The within groups (WG) estimator is used, Hausman tests reject the random effects specification. Time effects are significant and included for Group 1 but not Group 2. RESET tests favoured a levels specification for Group 1 and a log transformation of all variables for Group 2. Quadratic terms are included where they were found to be significant. Interaction effects were not found to be significant. All variables take the anticipated signs in each regression, with the exception of the negative wage effect in Group 2. The high $R^2$ values, while not unusual for this type of data and analysis, might suggest problems of non-stationarity. Given the length of the time series, no formal testing for unit roots is undertaken. However, it is reassuring that, at least for Group 1, estimation in first differences gave very similar results to those presented. The Durbin-Watson values are also reassuring in this respect. A dynamic specification
Table 4
Estimates of cigarette price equation. Dependent variable: price per 1000 cigarettes

<table>
<thead>
<tr>
<th></th>
<th>Group 1 countries</th>
<th>Group 2 countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Way WG (levels)</td>
<td>1 Way WG (logs)</td>
</tr>
<tr>
<td>Ad valorem tax</td>
<td>308.5128 (6.091)</td>
<td>5.7788 (11.189)</td>
</tr>
<tr>
<td>(Ad valorem tax)²</td>
<td>−209.1244 (−4.050)</td>
<td>3.5209 (9.650)</td>
</tr>
<tr>
<td>Specific tax</td>
<td>1.6250 (25.750)</td>
<td>0.1655 (8.609)</td>
</tr>
<tr>
<td>(Specific tax)²</td>
<td></td>
<td>0.0810 (2.989)</td>
</tr>
<tr>
<td>Labour cost per worker</td>
<td>0.4721 (4.700)</td>
<td>−0.1293 (−2.103)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>0.5947 (2.208)</td>
<td>0.1751 (4.144)</td>
</tr>
<tr>
<td>ECU exchange rate</td>
<td>−16.0185 (−9.021)</td>
<td>−2.2458 (−10.625)</td>
</tr>
<tr>
<td>(ECU exchange rate)²</td>
<td>0.1381 (6.800)</td>
<td>0.1284 (7.671)</td>
</tr>
</tbody>
</table>

Adjusted $R^2$              | 0.9962            | 0.9912            |

Homogeneity                 | 1.7459 (0.0365)   | 2.5820 (0.0042)   |

Reset                      | 0.1422 (0.8677)   | 1.0190 (0.3664)   |

Autocorrelation:            | 2.0178            | 1.8271            |
| Modified Durbin-Watson     |                  |                  |
| Correlation coeff. ($\rho$)| −0.0059           | 0.0864            |

Homoskedasticity:           | 30.25 (0.3031)    | 35.95 (0.0011)    |
| Breusch-Pagan              |                  |                  |
| $-\chi^2(k + m + T - 1)$  |                  |                  |

Significance of:            | 164.99 (0.0000)   | 94.83 (0.0000)    |
| Country effects            |                  |                  |
| $-F(m - 1, N - m - k)$     |                  |                  |
| Time effects               | 2.308 (0.0102)    | 1.539 (0.1241)    |
| $-F(T - 1, N - k - m - T + 1)$ |                  |                  |

Exogeneity:                 | 138.22 (0.0000)   | 193.14 (0.0000)   |
| Country (and time) effects |                  |                  |
| $-\chi^2(k)$              |                  |                  |
| Sargan $-\chi^2$          | 6.0276 (0.9999)   | 30.9698 (0.2724)  |
| Taxes $-F(2, N - k)$       | 0.0468 (0.9864)   | 1.0388 (0.3940)   |
| Sargan $-\chi^2$          |                  |                  |

Notes: $N$-sample size; $k$, number of regressors; $m$, number of country groups; $T$, number of time periods; WG, within groups estimator; 1WAY, country fixed effects; 2WAY, country and time effects. GROUP 1: Belgium, Denmark, Germany, Ireland, Netherlands, UK. GROUP 2: France, Greece, Italy, Luxembourg, Portugal, Spain. Figures in parentheses next to coefficients are $t$-ratios (White corrected for Group 2). Figures in parentheses next to test statistics are $p$-values. Homogeneity is test of constant slopes across countries (within each group). Modified Durbin-Watson is that of Bhargava et al. (1982). Breusch and Pagan (1979) test statistic is distributed $\chi^2(k + m)$ for Group 2 where time effects are not included. Sargan is test for validity of instruments for taxes (used in exogeneity test).
was tried, through the inclusion of a lagged dependent variable, but was not found to be appropriate for either group.

The assumed homogeneity of the slope coefficients is rejected for Group 2 but cannot be rejected at the 1% level of significance for Group 1.\footnote{The restriction is rejected at 5% significance for Group 1. Provided variation in the parameters is random, the WG estimator gives consistent estimates of the mean (across country) vector of parameters (Hsiao, 1986, p. 132).} Similarity in the cigarette industries across Group 1 countries appears to give rise to similar tax–price relationships and justifies pooling of the data across these countries. While the within groups estimator allows for correlation between country fixed effects and the regressors, there remains the potential for endogeneity of the tax variables. For example, the EU rules on the level and structure of cigarette taxation may lead to dependence of the taxes on prices. Countries at, or close to, the lower limit on total taxes as a percentage of the retail price (70%) must raise taxes in response to a price increase. Further, being close to the lower (5%) or upper (55%) threshold for the specific tax as a proportion of total taxes will require a shift in the balance of taxation following certain price movements. Hausman tests, based on comparison between WG and two-stage WG estimates in which the tax variables are instrumented, indicate the null of exogeneity cannot be rejected for either group.\footnote{Given cigarette taxes are set with some regard to the state of the macroeconomy, the following were selected as instruments: real growth rates of private consumption and GDP, the general government deficit/surplus as a percentage of GDP and the unemployment rate. Given the quadratic specification, following Kelejian (1971), levels, squares and cross-products of all the exogenous variables are used as instruments.} This is perhaps to be expected for the Group 1 countries, given only one (Germany) had a tax burden very close to the 70% threshold. Further, with the exception of Belgium, these countries have a balanced structure of ad valorem and specific taxation. Only price falls, not the more likely price rises, cause problems for such countries attempting to keep within the upper limit on the tax structure ratio. Only two countries (Ireland and UK) were very close to this limit in any case.

Tax incidence (Eqs. (2.11) and (2.12)), market power (2.10) and conduct (2.14) parameters calculated from the coefficients on the tax variables and using sample mean values are presented in Table 5. The estimated parameters differ across the two groups of countries. In Group 1, there is significant undershifting of both types of taxes. Subtracting the “multiplier effect”, a unit increase in tax arising from a change in the ad valorem rate results in an increase in consumer price of 0.72, whereas a unit increase in the specific tax increases price by 0.92. The difference in the price effects is statistically significant. According to the theoretical model of Section 2, this result allows rejection of the competitive hypothesis. The results are consistent with the predictions of the model under imperfect competition: There is not full-shifting of the taxes and the specific tax has a greater impact on price than
Table 5
Tax shifting, market power and conduct parameters. (Calculated at respective sample means)

<table>
<thead>
<tr>
<th>Tax shifting</th>
<th>Group 1 countries</th>
<th>Group 2 countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Standard Error</td>
</tr>
<tr>
<td>Ad valorem</td>
<td>0.7212</td>
<td>0.0485</td>
</tr>
<tr>
<td>Specific</td>
<td>0.9235</td>
<td>0.0359</td>
</tr>
<tr>
<td>Ratio of specific to ad valorem (μ)</td>
<td>1.2805</td>
<td>0.0721</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nos. Equivalent of firms (∑ 1/λ)</th>
<th>Estimate (95% C.I.)</th>
<th>Estimate (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity = −0.1</td>
<td>45.65 (27.69–63.61)</td>
<td>31.46 (6.44–56.48)</td>
</tr>
<tr>
<td>−0.2</td>
<td>22.82 (13.84–31.80)</td>
<td>15.73 (3.22–28.24)</td>
</tr>
<tr>
<td>−0.3</td>
<td>15.22 (9.23–21.20)</td>
<td>10.49 (2.15–18.83)</td>
</tr>
<tr>
<td>−0.4</td>
<td>11.41 (6.92–15.90)</td>
<td>7.87 (1.61–14.12)</td>
</tr>
<tr>
<td>−0.5</td>
<td>9.13 (5.54–12.72)</td>
<td>6.29 (1.29–11.30)</td>
</tr>
<tr>
<td>−0.6</td>
<td>7.61 (4.62–10.60)</td>
<td>5.24 (1.07–9.41)</td>
</tr>
<tr>
<td>−0.7</td>
<td>6.52 (3.96–9.09)</td>
<td>4.50 (0.92–8.07)</td>
</tr>
<tr>
<td>−0.8</td>
<td>5.71 (3.46–7.95)</td>
<td>3.93 (0.81–7.06)</td>
</tr>
<tr>
<td>−0.9</td>
<td>5.07 (3.08–7.07)</td>
<td>3.50 (0.72–6.28)</td>
</tr>
<tr>
<td>−1.0</td>
<td>4.57 (2.77–6.36)</td>
<td>3.15 (0.64–5.65)</td>
</tr>
</tbody>
</table>

^ Notes: Figures in rows 1, 2 and 3 are estimates of expressions (2.12), (2.11) and (2.10) respectively. Remaining figures are estimates of expression (2.14) as calculated at various price elasticities. Standard errors calculated by delta method. p-value gives probability value from Wald test of parameter being different from 1.

^b The p-value for the Wald test of the mathematically equivalent linear test of the restriction is 0.0614.

...the ad valorem.\textsuperscript{23} The theory also suggests that the ratio of the price effects of the two taxes is an estimate of the mark-up (μ) of gross price over (tax-inclusive) marginal cost. This is estimated to be 1.28.\textsuperscript{24} There are no previous estimates available for Europe with which to compare this estimate. Applebaum (1982), following a structural approach, estimates a mark-up of 2.84 in the U.S. tobacco industry.

Since we have no quantity data corresponding to the price data we employ, that is the MPPC, we use (2.14), rather than (2.15), to estimate the numbers equivalent of firms. Point estimates and 95% confidence intervals are given in Table 5 for various values of the price elasticity of demand (−e). Estimated competitiveness is lower the higher the assumed magnitude of the price elasticity. The literature

\textsuperscript{23} Adjusting for the different units of measurement.

\textsuperscript{24} The pattern and statistical significance of the results for Group 1 are not changed if Denmark is excluded. It is reassuring, given the near monopoly supply in Denmark, that this exclusion results in a fall in the estimate of the mark-up.
provides a wide range of estimates of the latter, with some clustering around a value of $-0.4$ (Chaloupka and Warner, 1998). At this value, our estimate of the numbers equivalent of firms is 11.41 for Group 1. This lies within the range of estimates of the lower bound on the numbers equivalent of firms in the U.S. cigarette industry calculated by Sullivan (1985). From the figures provided in Table 1, it is apparent that, in general, there are five or six firms operating in each of the markets included in Group 1. At a market price elasticity of $-0.4$, the 95% confidence interval for the numbers equivalent does not include 6, suggesting firms in these markets are behaving in a manner which is more competitive than the equivalent of Cournot. Assuming higher values for the price elasticity, the equivalent of Cournot behaviour could not be rejected. However, even assuming a unitary price elasticity, the confidence interval does not include 1, allowing rejection of the hypothesis of tacit collusive behaviour.

The results for Group 2 indicate significant overshifting of both taxes. Overshifting of the specific tax is particularly marked – subtracting the "multiplier effect", a unit increase in tax is estimated to raise price by more than two. The difference in the price effects of the two taxes is significant at 10% but not 5%. Given the presence of state producers within this group, it might be argued that the results should not be interpreted according to the theory of Section 2, which assumes profit maximisation. If such an interpretation is made, the results suggest a mark-up of 1.47. A higher mark-up for this group of countries than for Group 1 is consistent with a priori expectation given knowledge of differences in market structure. The numbers equivalents of firms estimates are smaller than for the first group of countries, suggesting less competitive behaviour. The equivalent of Cournot behaviour could not be rejected for a value of the price elasticity as low as $-0.2$. Assuming a price elasticity at, or above, $-0.6$ would not allow rejection of collusive behaviour. While the potential inapplicability of the theoretical model to Group 2 countries must be acknowledged once more, it is interesting that the estimate of low competitiveness is consistent with a priori expectation given the very high industry concentration in these countries.

6. Conclusions

This paper had three principle aims. First, to test predictions from the theory of commodity tax incidence. Second, to introduce and apply a new method of estimating market power and conduct. Third, to inform policy debates on tax harmonisation in Europe and the use of cigarette taxation as an instrument of health policy.

The results reveal that commodity taxes are not always fully shifted onto consumers. For a group of northern European countries with similar market structures and quality of cigarettes (Group 1), there is evidence of undershifting of both ad valorem and specific taxes, with significant differences between the two.
In a remainder group of mainly southern European countries, there appears to be overshifting of both taxes, with, again, a significantly greater effect of specific taxation. While these results are consistent with the predictions of the imperfect competition model discussed in Section 2, quality effects could also be responsible for the specific tax having a larger impact on price than the ad valorem. However, according to Kay and Keen (1991), neither undershifting of both taxes, nor overshifting of both, is a plausible scenario under the quality model. Also, it is difficult to identify changes in quality to which the undershifting in Group 1 and overshifting in Group 2 could be attributed. Imperfect competition is a more persuasive explanation.25

For Group 1, for which the theoretical model has greater relevance, the results allow rejection of both market extremes — perfect competition and collusive behaviour. More specifically, firms’ behaviour in these markets would appear to be no less competitive than the equivalent of Cournot and are probably more competitive than this. If the results from Group 2 are interpreted within the context of the theoretical model, they suggest less competitive behaviour than in Group 1, with the equivalent of Cournot not being rejected and, at perhaps implausibly high price elasticities, collusive behaviour not being rejected.

Given our empirical finding that the specific tax has a greater impact on price, differences in preferences for the form of cigarette taxation across Europe are understandable. If northern governments want high prices, to satisfy the health lobby, and high profits, to please the multinationals, specific taxation is the preferred option. Governments in southern Europe are less exposed to these lobbies and favour ad valorem taxation in order to maintain the price advantage to the domestic products. Our empirical confirmation of the differential effect of the two types of tax suggests there will be little progress in harmonising the structure of cigarette taxation across Europe provided governments continue to pursue different objectives. Further, the finding that the effect of a given tax varies across Europe makes harmonisation even less likely.

Estimates of the distributional effects of taxation are typically generated under the assumption that commodity taxes are fully shifted. Our estimates show that this assumption does not always have empirical validity. Under the assumption of full shifting, cigarette taxation has been found to be regressive. Given the overshifting found in the south, concerns, if any, over such regressivity should be intensified. On the other hand, cigarette taxes might not be as regressive as is thought in the north, given evidence of undershifting, particularly of the ad valorem tax. In both cases, the empirical findings suggest a more careful analysis

25Another explanation for the undershifting in Group 1 could be cross-border shopping. While this is a growing issue, it is unlikely to have been significant for the greater part of the period covered in this analysis. Also the problem is reduced by the exclusion of Luxembourg from this group.
of tax incidence. A similar warning applies to analysts of cigarette taxation as an instrument of health policy.

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Appendix A. Data sources

The price and tax data are taken from the Summary of Tax Structures on Cigarettes in E.C. Member States obtained from the European Commission (D.G. XXI) Excise Duty Tables and the Confederation of European Community Cigarette Manufacturers. Total labour costs and employment in the tobacco (manufacturing) industry were supplied by Eurostat from their DEBA database.


National CPIs were obtained from Eurostat’s NEWCRONOS database. Price and specific tax data were deflated using the CPI specific to January each year. Other variables were deflated using the CPI for the appropriate year. In 1997 Eurostat changed from using National CPIs to its new Harmonised Indices of Consumer Prices (still country specific but calculated using a common methodology). Price and tax data for January 1 1997 were deflated using this new CPI series. ECU exchange rates were obtained from Eurostat’s NEWCRONOS database.

References


