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# *The Balance between Specific and Ad Valorem Taxation*

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## *Abstract*

A recurring issue in indirect tax design — most obviously, but not only, for goods traditionally subject to heavy excises — is the appropriate balance between specific and *ad valorem* taxation. Recent work has developed new perspectives on the issue, which is also one of the oldest in the formal study of public finance. This paper provides a broadly non-technical account of the central considerations that arise in choosing the balance between specific and *ad valorem* taxation, reviewing and somewhat extending the lessons of theory and experience. There emerge clear presumptions as to the relative effects of the two kinds of tax on such attributes as price, profits, product quality and variety. But the socially optimal balance between them is likely to be quite sensitive to the characteristics of the market at issue.

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## I. INTRODUCTION

Discussions of indirect tax policy naturally focus primarily on the *levels* of these taxes: on the effects of reducing VAT on domestic fuel and power, for example, or the impact of cross-border shopping on the appropriate rate at which to tax beer. In many markets, however — especially when the overall level of taxation is high — the impact of indirect taxes may also be powerfully affected by their *structure*. There are two main ways in which commodities are generally taxed: by a *specific* (or ‘unit’) tax, charged as a fixed amount per unit of the product and so, in effect, a tax on the volume of sales; and/or by an *ad valorem* tax, specified as a

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proportion of the product price and so, in effect, a tax on the value of sales. In principle, there are many other ways in which one could envisage commodity taxes being levied: one can conceive, for example, of taxes that bear differentially on marginal and fixed costs of production (Konishi, Okuno-Fujiwara and Suzumura, 1990), or of attempting to discourage monopolistic pricing by a tax related only to the unit price charged to consumers (Tam, 1991; Sumner, 1993). In practice, however, specific and *ad valorem* taxes are generally seen as the main possibilities.

This paper reviews the economic issues that arise in comparing *ad valorem* and specific taxes. Our concern, it should be emphasised, is thus not with the level at which some commodity is taxed, but solely with the balance between specific and *ad valorem* components within this total. Some examples will illustrate the potential importance of the issue:

- Since the 1970s, a central and contentious issue in the harmonisation of tobacco taxes in the European Union has been precisely the balance between specific and *ad valorem* components. The ratio of specific to total tax (on the most popular price category of cigarette) is currently required to lie between 5 and 55 per cent. Most member states are indeed close to one or other extreme of this range, and have proved reluctant to converge any further.
- Somewhat similar issues arise in connection with the harmonisation of taxes on alcoholic drink. Policy in the Union is for the excise to be wholly specific (though VAT, an *ad valorem* tax, is also levied). A number of recent and potential entrants, however, levy *ad valorem* taxes, and the question then arises as to the effects of the structural reform required by membership.
- One of the key issues that arose in designing the landfill tax introduced by the UK government in 1996 was whether the tax should be specific — an amount per tonne of waste — or *ad valorem* (HM Customs and Excise, 1995). The initial proposal was that it be *ad valorem*, the final decision that it be specific.
- In many transition economies, the need for wholesale reform of previous turnover tax systems has raised in stark form the question of whether excises on cigarettes, tobacco and other highly taxed goods should be predominantly specific or predominantly *ad valorem*.

The comparison between *ad valorem* and specific taxes is thus of continuing policy relevance.

The comparison is also one of continuing intellectual interest. It is both one of the oldest issues in the formal study of public finance and one in which recent years have seen significant new developments. The first to recognise that the two kinds of tax had potentially different effects was Cournot (1960), writing in the 1830s. His classic treatment of the monopoly case was then developed further by Wicksell (1959), writing at the turn of the century, and by Suits and Musgrave (1955). Increased understanding of and interest in forms of imperfect competition

and product differentiation have led to a revival of interest over the last 15 years or so, and to a series of results that cast new light on the comparison between the two forms of taxation. Much has been learnt, in particular, of their relative effects both on the price that the consumer faces and on the quality and variety of the taxed good that will be consumed. This in turn has enabled a more systematic approach to the issue of optimal tax design, albeit one with few wholly clear-cut general conclusions.

The purpose of this paper is to review, and somewhat extend, current knowledge on the relative properties and merits of specific and *ad valorem* taxes.<sup>1</sup> This involves a series of positive questions: how do the two taxes differ in their effects on such key quantities as prices, profits, tax revenue, product quality, product variety and the distribution of real income? We focus too on the central normative question of optimal tax design: what balance between the two kinds of tax best serves the social good? In considering this, we shall at times differentiate between the interests of three groups: consumers, who care about the price, quality and variety of the product on offer; producers, who care about their profits; and the government, which cares about tax revenue. This distinction is, of course, rather artificial: it is consumers, for example, who ultimately receive all profits<sup>2</sup> and who benefit from the public expenditure financed by tax revenues, and government is likely to care about the well-being of consumers. Nevertheless, it is clear that individuals' interests are not identical, and the distinction is useful in understanding the directions in which these various concerns are likely to press.

The main body of the paper is in two parts. Section II reviews the central theoretical considerations that arise in comparing specific and *ad valorem* taxes. Section III turns to the lessons of practical experience, reviewing the (small) econometric literature on the subject and outlining two recent reform episodes involving a substantive shift in the tax structure, before finally turning to matters of tax administration. Section IV concludes. Details of some novel theory and empirics are given in two short appendices.

## II. THEORY

The defining feature of a commodity tax is the creation of a wedge between the consumer price of a product (the price, that is, that final purchasers actually pay) and its producer price (the net price that the producer actually receives). The key distinction between *ad valorem* and specific taxes is that they create this wedge in different ways, and a good way to start comparing them is by exploring this

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<sup>1</sup>For brevity, we do not consider the comparison between specific and *ad valorem* tariffs that has received some attention in discussions of international trade: see, for example, Helpman and Krugman (1989). Many of the issues that arise there, of course, also arise, albeit in somewhat different form, in the purely domestic context with which we are concerned.

<sup>2</sup>At least in the absence (assumed throughout) of foreign ownership.

distinction. To this end, denote by  $v$  the rate of *ad valorem* tax (expressed as a proportion of the consumer price)<sup>3</sup> and by  $s$  the rate of specific taxation (specified, of course, as some fixed amount per unit of the commodity). Then the producer price of any good in which we might be interested, denoted by  $P_n$  (the subscript  $n$  being a reminder that this is the price net of commodity taxes), is simply the consumer price,  $P$ , less the specific tax,  $s$ , and *ad valorem* taxation,  $vP$ :

$$(1) \quad P_n \equiv (1 - v)P - s.$$

The fundamentally different ways in which the two taxes are defined will prove crucial. Specific taxation requires a precise definition of what it is that constitutes ‘one unit’ of the taxed good; *ad valorem* taxation does not. Thus a specific tax on smoking tobacco may be levied as a fixed amount per kilogram of fine cut tobacco, and a tax on beer as a fixed amount per hectolitre of beer of at least 12° Plato. Specific taxes are thus, in effect, taxes on particular characteristics of commodities: on the weight of tobacco or the volume of beer. But most goods are naturally thought of as bundles of a potentially quite large number of characteristics: packs of rolling tobacco of a given weight can vary, for instance, in the smoothness and moisture of the tobacco, the airtightness of the seal and the gaudiness of the packing; beer can vary in fizziness and in the pleasantness of the pubs in which it is drunk; even as apparently homogeneous a product as petrol differs in octane number, and the convenience and cleanliness of the locations in which it is sold. The importance of this is that any specific tax is likely to leave untaxed some characteristics of the good that are of importance to consumer and/or producer; *ad valorem* taxation, in contrast, bears on all characteristics whose value is reflected in the price charged to the consumer.

Returning to the identity in equation (1), one central policy conclusion is immediate. In a world of perfect competition, and in which the nature of the product being sold is immutable, the balance between *ad valorem* and specific taxation is a matter of no significance. For the essence of perfect competition is that firms perceive themselves to have so little market power that they take the price at which they can sell their product as given, unaffected by their own decisions. But if firms take  $P$  as fixed, then the *ad valorem* tax will simply be perceived by them as a fixed amount,  $vP$ , to be paid per unit sold, exactly equivalent to a specific tax of that amount. In the textbook model of perfect competition, with price-taking firms selling a homogeneous product of fixed quality — and leaving aside issues of uncertainty and administration (to which we

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<sup>3</sup>Thus  $v$  is the ‘tax-inclusive’ tax rate; the discussion could equally well be cast in terms of the ‘tax-exclusive’ rate  $v/(1-v)$ , which expresses tax paid as a proportion of the producer price (the only difference being that the latter is a bigger number).

turn in Sections II(3) and III(2) respectively)<sup>4</sup> — the balance between specific and *ad valorem* taxation is of no importance.

But it is, of course, stretching credulity too far to imagine firms always being so powerless, and in the rest of this section we address the considerations that arise when either or both of these restrictions — price-taking behaviour and a single fixed product quality — are relaxed. In doing so, it will help intuition to draw on two key differences between the two kinds of tax that emerge on considering the relationship in equation (1) more closely:

- *Ad valorem* taxation has a distinctive *multiplier effect*: since part of any increase in the consumer price goes to the government as tax revenue, in order to increase its net price by £1 a firm must increase the price charged to the consumer by more than £1. More precisely, increasing the producer price by £1 requires increasing the consumer price by  $\frac{£1}{1-v}$ : if the *ad valorem* rate is 60 per cent, for example, increasing the producer price by £1 requires increasing the consumer price by £2.50. Specific taxation, on the other hand, has no such effect: the producer price rises one-for-one with the consumer price.

The multiplier effect creates a clear disincentive for costly improvements in product quality. To break even, a firm whose product is taxed at 60 per cent must ask the consumer to pay £2.50 for a quality improvement that actually costs only £1. There is thus good reason to suppose that predominantly *ad valorem* taxation is likely to lead — all else being equal — to relatively low product quality. This same multiplier effect will also affect, of course, the impact of fixed costs of production, since these too will effectively be grossed up by the *ad valorem* tax rate. And in so far as there are likely to be fixed (and sunk) costs — of advertising, for example — associated with the operation of distinct firms or the presence of distinct brands, so one would expect this aspect of *ad valorem* taxation, exactly equivalent to an increase in such fixed costs, to be associated with relatively low product variety and, perhaps, the presence of relatively few firms.

Notice, moreover, that, by exactly the same token, the multiplier effect of *ad valorem* taxation means that a £1 fall in the consumer price reduces the net price received by the firm by less than £1: if the tax rate is 60 per cent, for example, a £1 fall in  $P$  reduces the producer price by only 40p. In this sense, *ad valorem* taxation is a public subsidy to price-cutting: part of the cost is

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<sup>4</sup>Lockwood (1996) makes the interesting point that the distinction between specific and *ad valorem* taxes is liable to matter, even under perfect competition, for the outcome in standard models of interjurisdictional tax competition. For the standard approach in such models is to focus on Nash equilibria in which each country takes the others' tax rates to be independent of its own. But it generally cannot be the case that taxes remain unchanged in both *ad valorem* and specific forms: if a specific tax remains unchanged, for example, when the world price of the taxed good falls, then the equivalent *ad valorem* rate must rise. The issue thus essentially concerns how one models equilibrium and the conjectures that support it rather than the form in which taxes are actually imposed.

borne by the government. Thus one might also expect *ad valorem* taxation to correspond, other things equal, to a relatively low consumer price.

- Specific taxation has a distinct *upgrading* effect when variants of the good differ in quality. As noted above, any specific tax is likely to leave untaxed some elements in the bundle of characteristics that makes up the product: the purity of the tobacco, for example, or the décor of the pubs. Increasing the specific tax will then lead to a shift of consumption towards such untaxed characteristics: lead, that is, to what is in effect an upgrading of the product, with purer tobacco in stronger packaging, less sawdust on the pub floor and pleasanter garage forecourts.

Such upgrading may reflect firms' own decisions as to the characteristic composition of their product: cigarette companies might choose, for example, to provide stronger and brighter packaging. Or it may reflect the market equilibrium in competition between brands of fixed quality. The first of these mechanisms is clear enough, and will be explored in some depth below. To see how upgrading might occur even when the quality of each product is fixed, consider a simple case of vertical product differentiation: a high- and a low-quality brand competing in a shared market, their prices being  $P_H$  and  $P_L$  respectively, with  $P_H > P_L$ . Imposing on both a common specific tax will raise the consumer price of each — by, let us assume, exactly the amount of the tax — which will then have two effects. The first is an income effect: since the price increases reduce the consumer's real income, one would expect consumption of both variants to fall.<sup>5</sup> Notice, however, that there is nothing distinctive about specific taxation in this: an *ad valorem* tax that raised roughly the same amount of tax revenue would reduce real income by roughly the same amount. It is the second effect of a specific tax that gives rise to the distinctive feature of upgrading. For since  $(P_H + s)/(P_L + s) < P_H/P_L$ , introducing a specific tax will cause the relative price of the high-quality brand to fall. (An *ad valorem* tax, of course, would leave this relative price unchanged.) Thus while both brands might suffer a reduction in the *level* of sales, one would expect this shift of relative price to lead to a substitution toward — and so an increase in the market share of — the higher-quality brand.

These two effects — multiplier and upgrading — are at the heart of much of what follows. But although highly suggestive as to the likely effects and merits of the two kinds of taxation, they do not in themselves enable one to answer any of the policy questions raised at the outset. How, for example, is one to weigh the tendency for a relatively high ratio of specific to *ad valorem* taxation to lead to a relatively high consumer price against its tendency also to sustain relatively high

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<sup>5</sup>The impact of this on the market shares of the two brands will depend on their relative income elasticities of demand: if, as one might expect, the high-quality brand has the higher income elasticity, then the income effect will reduce its market share.

levels of product quality and variety? Which of the two taxes is likely to be most effective in raising revenue? Are there any cases in which consumers, government and firms could all agree on the type of tax to be preferred? To address these and other issues, the rest of this section considers the implications of a series of features that create a real distinction between *ad valorem* and specific taxation.

### *1. Imperfect Competition when All Goods are Identical*

Suppose then that we leave the world of perfect competition, entering instead one in which firms perceive that the consumer price at which they can sell their product — and, importantly, we assume throughout this section that they all sell the same good, whose quality is immutable — depends to some degree on the amount that they sell. Under an *ad valorem* tax, they will then perceive the tax per unit,  $vP$ , also to depend on the numbers of units sold; under a specific tax,  $s$ , in contrast, it does not. One would thus expect, and indeed we shall shortly verify, that the two taxes will have different effects. Which is socially preferable?

Note first that imperfect competition in itself immediately creates a purely corrective role for commodity taxation (or, more precisely, subsidisation). For — in the absence of external effects of the kind discussed in Section II(4) below — profit maximisation will then typically lead to output levels below the ‘first-best’ efficient level at which consumers’ marginal willingness to pay for the good, as measured by the consumer price,  $P$ , is equated to the marginal cost to society of its production,  $MC$ . If the government is able to finance any deficit by lump-sum taxes (taxes, that is, that do not distort economic decisions at the margin), then it would be appropriate for it to induce an expansion of output to the first-best level by providing a sufficiently large output subsidy. And for this purpose it makes no difference which instrument is used: *ad valorem* or specific subsidies (or a combination of the two) would do equally well.

The more relevant case for our purposes is that in which the government does not have unrestricted ability to levy optimal lump-sum taxes — otherwise tax design would be a trivial matter — and so must deploy commodity taxation simply to raise revenue. The question then is how it can best design the tax system so as to raise the revenue required to finance public expenditure whilst doing least harm to consumer welfare, bearing in mind that consumers are also the ultimate recipients of any profits that firms earn. It will prove useful, too, to defer consideration of the distinct issues raised by differences in taste or income across consumers by assuming them, for the present, to be identical with one another. This then leads to a variant of what is known as the *Ramsey problem*, which we shall encounter in various contexts as the discussion proceeds: how should a government that needs to raise some fixed amount of tax revenue, and which seeks to maximise consumer welfare, set specific and *ad valorem* taxes if those are the only instruments available to it? Under perfect competition, it is clear, the balance between the two is irrelevant. Under imperfect competition, in contrast, there

emerges — so long as the (strong) assumption of a homogeneous product is retained — a quite clear preference for one over the other.

(a) Monopoly

Consider first the extreme form of imperfection in which there is a single monopoly producer.<sup>6</sup> Imagine we begin in a situation in which only a specific tax is imposed, at rate  $s_0$ . Equating marginal revenue net of tax to marginal cost,  $MC$ , the profit-maximising monopolist will produce at a level of output (and corresponding consumer price,  $P_0$ ) at which  $MR - s_0 = MC$ , where  $MR$  denotes marginal revenue before any commodity tax is paid. Now consider the effects of replacing this specific tax by an *ad valorem* tax set at a level  $v_0$  such that total tax would remain unchanged if the consumer price (and hence also total demand) did not change: that is, such that  $v_0 P_0 = s_0$ . Net marginal revenue under this *ad valorem* tax is then  $(1 - v_0)MR = MR - s_0 (MR/P)$ , and, since  $MR < P$  (because the demand curve, we naturally assume, is downward-sloping), it must be that  $(1 - v_0)MR > MR - s_0$ : that is, the shift to this *ad valorem* tax causes net marginal revenue at the initial output level to rise. And with net marginal revenue consequently now exceeding marginal cost at the initial output level, the profit-maximising firm will expand output in response to this tax shift, and the consumer price will consequently fall. Hence:

- Consumers gain from a shift towards wholly *ad valorem* taxation.
- The monopolist also benefits from the shift to *ad valorem* taxation. To see this, notice that the construction of  $v_0$  is such that the monopolist could keep profits unchanged simply by holding output and the consumer price at their initial levels. Thus the fact that the monopolist finds it even more advantageous to change output means that profits must actually increase.
- Tax revenue also increases on moving to *ad valorem* taxation. This follows from two observations: that (again by the construction of  $v_0$ ) tax revenue would have been unchanged had output remained at its initial level; and that the expansion of output shown above must increase revenue from the *ad valorem* tax,  $v_0$ . The reason for this latter feature is that (assuming marginal cost to be strictly positive) a monopolist will only produce at a point where the elasticity of demand exceeds one, implying that the reduction in the consumer price will lead to increased consumer expenditure and hence — since taxation is now wholly *ad valorem* — to increased tax revenue.

The conclusion — due to Skeath and Trandel (1994) — is thus strikingly unambiguous: with monopoly provision of a single good of fixed quality, consumers prefer *ad valorem* taxation because it leads to a lower price, firms

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<sup>6</sup>This case was the subject of the classic analyses of Cournot (1960), Wicksell (1959) and Suits and Musgrave (1955).



prefer it because it leads to higher profits and government prefers it because it leads to higher revenue.<sup>7</sup> There is no need to trade off the interests of these three groups: *ad valorem* taxation dominates specific.

(b) Cournot Oligopoly

It is natural to wonder whether this dominance result continues to hold in circumstances less extreme than pure monopoly. Thus we now relax the assumption that there is only one actual and potential firm, but retain for the moment the assumption that the product itself is of a single fixed quality. This latter assumption is clearly an unappealing one in the context of many heavily taxed commodities — it immediately precludes, for example, the upgrading effect noted above — and we shall see in Section II(2) that relaxing it has profound implications for the optimal tax structure. For the present, however, we consider a standard model of Cournot oligopoly, in which a fixed number of identical<sup>8</sup> firms sell a homogeneous good,<sup>9</sup> each taking as given when making its own output decision the output choices of all the others.<sup>10</sup> Industry output will then be lower than if all firms behaved competitively but greater than if they colluded to act as a single monopolist. This latter point reflects an externality operating between the firms that will prove important to our concerns: each firm recognises that the fall in price induced by an expansion of its own output will reduce its own revenues, but takes no account of the similar harm done to the profits of other firms. In pursuing their own self-interest, firms are thus led to produce more than is in their collective best interest.

Consider first the relative effects of the two taxes on the consumer price. One can certainly show — by a slight variant of the preceding argument — that for any wholly specific tax system, there exists a wholly *ad valorem* one that leads to a lower price and increased tax revenue.<sup>11</sup> In this sense, predominantly *ad valorem*

<sup>7</sup>This might at first sight seem inconsistent with the earlier claim that *ad valorem* and specific taxes are equally effective in eliminating the monopoly distortion altogether: the reconciliation lies in noting that the argument just given relies on  $s_0$  being strictly positive (perhaps because the government does need to raise some revenue), whereas the specific tax required to eliminate the monopoly distortion is strictly negative.

<sup>8</sup>Dierickx, Matutes and Neven (1988) and Denicolò and Matteuzzi (undated) examine the case in which firms differ in cost structure. Such asymmetries raise an additional consideration that tends to favour *ad valorem* taxation: the multiplier effect means that it disadvantages the less efficient firms (which, in a more competitive environment, would cease to exist).

<sup>9</sup>We take this to be a final consumption good; additional issues that arise in comparing *ad valorem* and specific taxes on intermediate goods in the context of imperfect competition are discussed by Colangelo and Galmarini (1996).

<sup>10</sup>The main results referred to in what follows remain valid with more general conjectures.

<sup>11</sup>Replacing a specific tax  $s_0 > 0$  by an *ad valorem* tax  $v_0 \equiv s_0/MR$  has no effect on output or (hence) the consumer price, since  $(1 - v_0)MR = MR - s_0$  (where  $MR$  is the marginal revenue perceived by the typical firm), but increases tax revenue because  $v_0P - s_0 = s_0 \left( \frac{P}{MR} - 1 \right) > 0$ .

taxation again corresponds to a relatively low price, as in the monopoly case. This bears on one distinctive implication of imperfect competition in which there has been much interest. Under perfect competition, the consumer price can never rise by more than the amount of any tax increase. Under imperfect competition, in contrast, taxes may be ‘over-shifted’: that is, the price to the consumer may (depending on the elasticity of the elasticity of demand) rise by more than the amount of the tax (Stern, 1987). One (testable) implication of this result on the relative price effects of the two kinds of tax is thus that while either may be over-shifted, this is more likely to happen with specific taxation than with *ad valorem*.<sup>12</sup>

The comparative effects of the two taxes on the consumer price are thus broadly the same as under monopoly. Now, however, one cannot go on from this to conclude that *ad valorem* taxation dominates specific. For there is no longer any guarantee that shifting to *ad valorem* taxation will increase profits. Certainly, the same argument as before implies that each firm expects to increase its profits by expanding output in response to the shift to *ad valorem* taxation; but now the externality at work between them means that what each perceives to be advantageous given the behaviour of others may be collectively harmful, given that all are behaving in the same way.

Indeed, Delipalla and Keen (1992) show that in the Cournot context there is a real sense in which profits are higher under specific than under *ad valorem* taxation. More precisely, imagine that a specific tax is initially in place, and consider the effects of a ‘small’ shift towards *ad valorem* taxation so constructed that total tax payable remains unchanged at the initial price. By exactly the same argument as for the monopoly case above — except that here the change is infinitely small — this will induce each firm to slightly expand its output. Since each firm is initially choosing its output so as to maximise its own profit, each firm’s expansion of its own output will have only a tiny effect on its own profits. But, as noted above, each firm has an adverse external effect on the others when it expands its output, so that when all expand their output together, each will suffer a harm from the output expansion of the other firms.<sup>13</sup> Thus the shift towards *ad valorem* taxation reduces profits.

In the Cournot case, there is thus a clear conflict of interest: consumers prefer *ad valorem* taxation in their role as consumers of both the taxed good and public expenditure, but prefer specific taxation in their role as producers. Quite where the public interest lies will then depend on the relative social weights attached to consumer surplus and to profits. For the bench-mark case in which the two are weighted equally, the advantage lies with *ad valorem* taxation. This is established by Delipalla and Keen (1992), who consider the Ramsey problem for the Cournot oligopoly case — with profits accruing to the representative consumer — but constrained too (for no particular reason other than analytical ease) by the

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<sup>12</sup>See Proposition 2 of Delipalla and Keen (1992).

<sup>13</sup>In the monopoly case, of course, there is no such external effect at work.

requirement that both tax rates be non-negative. The optimal specific tax, they show, is zero: any revenue needed is best raised by *ad valorem* taxation. This result is extended by Myles (1994), who removes the restriction to non-negative taxes and shows that — under somewhat tighter conditions — it is then possible to raise any tax revenue required and entirely eliminate the welfare loss from monopolistic output restriction by combining a specific subsidy with an *ad valorem* tax.<sup>14</sup>

(c) Free Entry

Suppose now that the number of firms is not fixed but instead determined endogenously by the condition that firms enter or exit the industry until profits are zero. The analytics of this case follow straightforwardly from those of Cournot oligopoly just described, for what leads when the number of firms is fixed to an increase in profits will now lead instead to an inflow of new firms. Thus a shift away from *ad valorem* taxation and towards specific — which we have seen would lead to an increase in profits if the number of firms were held constant — will instead attract new entry and so lead to an increase in the number of firms active in equilibrium.

Looking at the Ramsey problem, the question then becomes that of whether in terms of the social good there tends, in the absence of taxation, to be too few firms in equilibrium or too many. On the one hand, an increase in the number of firms has the beneficial effect of intensifying competition; on the other, it has the harmful effect of multiplying the number of times that the fixed costs associated with the existence of a distinct firm are incurred. The Cournot model turns out to have the feature that entry tends to be excessive:<sup>15</sup> and Ramsey taxation again calls for wholly *ad valorem* taxation, now as a means of checking this excess.

2. *Product Quality and Variety*

The analyses discussed above rely heavily on the assumption that all firms produce exactly the same good and, moreover, that the quality of that good is unchangeable. In practice, the effects of the tax structure on the nature of the product offered in equilibrium are often a major concern in framing the balance between specific and *ad valorem* taxes. In the context of the major excises, especially, it is clear that the markets for alcoholic drink and tobacco products are characterised by very strong branding and extremely marked product differentiation. To deal with these key features of such markets, we now shift the focus to the analysis of the impact of tax structure on product quality and variety.

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<sup>14</sup>Dillén (1995) derives a similar result in a somewhat different setting.

<sup>15</sup>See, for example, Mankiw and Whinston (1986).

(a) Quality

For simplicity, we focus mainly on a simple model in which product quality — by which we mean, as discussed above, quality measured in terms of some untaxed attribute — is determined endogenously by profit-maximising firms but (in order to abstract from imperfections of competition of the kind just analysed) a high degree of competitiveness is retained by supposing that firms take as given not the price at which they can sell their product but rather the level of utility that consumers require if they are to find the combination of price and quality offered by the firm acceptable. Firms thus choose both the price,  $P$ , at which they sell their product and its quality,  $q$ , but subject to the condition that the associated level of utility enjoyed by the consumer,  $V(P,q)$ , must equal or exceed some reservation level; and entry or exit occurs until, in equilibrium, each firm also breaks exactly even. There are assumed to be no fixed costs, so that, in equilibrium, price equals marginal cost.

Our interest centres around the condition characterising the profit-maximising choice of quality. This is that the marginal cost of raising the quality of any given level of output,  $MQ$ , equals the additional amount, net of taxes, that the consumer can be made to pay for that increase in the quality of each unit. This latter is given by  $(1 - v)MWP$ , where  $MWP$  denotes the consumer's gross marginal willingness to pay for an improvement in quality,<sup>16</sup> so that equilibrium requires

$$(2) \quad (1 - v)MWP = MQ$$

where we shall assume, for simplicity, that  $MQ$  is independent of the level of quality<sup>17</sup> and simply proportional to the level of output. (Note that the specific tax,  $s$ , does not enter explicitly into equation (2), the reason being that a change in quality does not affect the tax payable per unit of the good.) Consider, then, the likely effects on product quality of the two kinds of tax:

- An increase in the *ad valorem* tax,  $v$ , will call for an increase in  $MWP$  in order to preserve the equality in equation (2); and since one would typically expect the marginal willingness to pay for quality to fall as quality improves, one would typically expect a higher *ad valorem* tax to lead to a reduction in product quality. This is simply another manifestation, of course, of the multiplier effect discussed earlier.

There is, though, an important bench-mark case in which quality is unaffected by *ad valorem* taxation. This is that of a good whose only characteristic of interest to the consumer is the number of units of some service

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<sup>16</sup>More precisely, we define  $MWP$  to be the largest amount that the consumer is willing to pay for a small increase in  $q$ , so that (denoting derivatives by subscripts)  $MWP(P,q) \equiv -V_q/V_p$ .

<sup>17</sup>The natural alternative of supposing  $MQ$  to increase with  $q$  introduces additional effects that straightforwardly reinforce those now discussed in the text.

it delivers. The archetypal example here is the light bulb: all that matters to the consumer is the number of hours of lighting enjoyed, not (we assume) how many times the light bulb must be changed to ensure that flow of lighting. Interpreting now  $q$  as number of lit hours provided by a bulb, the consumer thus cares only about the effective price of one hour of lighting, which is simply  $P/q$ . Thus the firm can proceed by simply setting quality at whichever level ( $q^*$ , say) minimises the cost of producing an hour of lighting, and then deciding on the effective price,  $P/q^*$ , to charge for each such hour. Changing the *ad valorem* tax will then have no effect on the cost-minimising quality choice,  $q^*$ , but will simply change the price per light bulb,  $P$ .

- Although the specific tax,  $s$ , does not enter the condition (2) directly, it can have a powerful indirect effect: it affects the consumer price,  $P$ , which in turn will generally affect *MWP*. More precisely, one might expect consumers to be willing to pay more for an improvement in the quality of a good the higher is its unit price: there is no law decreeing that this must be the case, but intuition suggests that in so far as a high price leads to consumption of relatively few units of a good, so the quality of each such unit becomes more important to the consumer, quality to some degree compensating for quantity. If then *MWP* increases with  $P$ , specific taxation is likely to induce an increase in *MWP* that calls for an increase in quality to restore the equality in equation (2). Specific taxation, that is, will tend to be associated with relatively high product quality. This is especially evident in the light-bulb case: a specific tax  $s$  per light bulb implies a tax of  $s/q$  per hour of lighting that each bulb provides, which will clearly encourage an increase in durability. These observations, in turn, are essentially just a further articulation of the upgrading effect discussed more loosely above.

There is, though, one important bench-mark case in which quality is unaffected by specific taxation. This is the ‘full-price’ case, in which consumers care about the sum of the producer price and some function of quality: care, that is, only about  $P - h(q)$ , for some decreasing function  $h(\cdot)$ . Reducing the check-in time for an air journey, for example, or increasing the frequency of a rail service, conveys benefits that are likely to depend on the value attached to time savings rather than on the price of the ticket itself. In such a case, *MWP* is independent of price — business people are willing to pay the same amount for a reduced check-in time irrespective of the fare they pay — and the channel whereby specific taxation may affect quality just identified is thus closed: in the full-price case, quality is independent of the level of specific taxation (but, as is easily checked, is reduced by *ad valorem* taxation).

The two kinds of tax are thus likely to have very different effects on product quality. These differences in turn point to the likelihood of different effects on the consumer price. Increasing a specific tax will generally lead to an increase in quality that may plausibly result in the consumer price rising by more than the

amount of tax paid: that is, the expectation is that a specific tax will be over-shifted. Increasing an *ad valorem* tax, in contrast, typically leads to quality degradation that may well lead to the consumer price rising by less than the amount of the tax. These qualitative implications are exactly the same, of course, as those that emerged from the earlier analysis of homogeneous product oligopoly. But the ‘over-shifting’ here, it should be emphasised, is of a quite different kind from that which may arise under Cournot oligopoly: here, it is entirely a reflection of an upgrading of product quality. By the same token, of course, the implication is that a finding that specific taxes are over-shifted in practice does not indicate non-competitive behaviour; it may instead signal a tendency to induce quality improvement.

Which form of taxation then is to be preferred? More precisely, what is the balance between specific and *ad valorem* taxation required to solve, in the present model of endogenous quality, the Ramsey problem of maximising consumer welfare subject to the constraint of raising some given amount of tax revenue?

Strikingly, it turns out that the optimal tax structure has the feature that, to a first approximation, it should leave the equilibrium level of quality the same as it would be in the absence of any tax.<sup>18</sup> This surprisingly stark result stems, it seems, from the absence from this model of any corrective role for taxation: distorting the level of quality achieves no useful object in raising revenue or bolstering consumer welfare.<sup>19</sup> This result in turn implies that the solutions to the Ramsey problem take simple and contrasting forms in the special bench-mark cases identified above: in the light-bulb case (quality unaffected by *ad valorem* taxation), *ad valorem* taxation is indeed fully optimal; conversely, in the full-price case (quality unaffected by specific taxation), wholly specific taxation is optimal.

The light-bulb and full-price cases are naturally thought of as polar extremes,<sup>20</sup> and for intermediate cases some mixture between the two taxes will be appropriate. That optimal mix turns out to have a very simple form: Delipalla and Keen (1996) show<sup>21</sup> that the optimal ratio of *ad valorem* to total taxation — exactly the quantity, interestingly, that is the subject of current harmonisation restrictions in the EU — is simply the price elasticity of the MWP, which we shall

<sup>18</sup>More precisely, the optimum has the feature that quality is unaffected by a small intensification of  $v$  and  $s$ . Though not noted by them, this follows from the analysis in Delipalla and Keen (1996): from their equation (3), the effect on equilibrium quality of a reform  $(dv, ds) = \alpha(v, s)$  that changes both specific and *ad valorem* taxes by the same (small) proportion  $\alpha$  is proportional to  $\theta(vP+s) - vP$ , where  $\theta \equiv \partial \ln(-V_q/V_p) / \partial P$  is the price elasticity of MWP; but their central result, discussed shortly, is that  $vP/(vP+s) = \theta$  at an optimum.

<sup>19</sup>Note that the result is nevertheless consistent with the usual second-best presumption that if one margin of choice must be distorted — as pricing decisions must be here in order to raise revenue — so too should others: for the rule (2) associated with quality choice typically is affected by the optimal tax system. The point rather is that the impact of this on  $q$  is offset by the consequences of the tax effects on  $P$ .

<sup>20</sup>They do not, however, bound all possibilities: one can conceive of still more extreme circumstances, in which optimal policy will require either an *ad valorem* or a specific subsidy.

<sup>21</sup>This is for the case in which the marginal utility of income is constant.

denote by  $\theta$  and assume (as we did above) to be positive. For it is  $\theta$  that governs the impact of the two taxes on quality. Consider, for example, the effects of increasing  $s$ . If quality were to remain at its initial level, price would rise by the full amount of the tax. If  $\theta$  is large, this price increase would lead to a large increase in  $MWP$ ; all else being equal, a large increase in quality would then be needed to restore the equality in equation (2). Reasoning similarly for an increase in  $v$ , if  $\theta$  is large then the large induced increase in  $MWP$  will go a long way towards offsetting the reduction in  $1-v$  that is a direct consequence of the tax increase, leaving only a relatively small reduction in the net marginal willingness to pay,  $(1-v)MWP$ , on the left-hand side of equation (2); and thus only a small reduction in quality will be needed to restore the equality. Recalling that the optimal tax structure leaves quality (approximately) unchanged, the trick — loosely speaking — is to combine quality-reducing *ad valorem* taxation with quality-increasing specific taxation in such a way that their effects on quality cancel out but the requisite amount of revenue is raised. This will generally require relatively heavy reliance on whichever tax has least effect on quality: when  $\theta$  is large, for instance, since (as we have just seen) it is *ad valorem* taxation that has relatively little effect on quality, so it is *ad valorem* taxation that should be used relatively heavily. The light-bulb and full-price cases are merely the special cases of this more general result and intuition in which  $\theta$  happens to take the extreme values 1 and 0 respectively.

(b) Variety

The discussion so far has been of a model in which only one variant of the product is offered in equilibrium, with attention focused on the quality of that single good. But most markets are characterised by some variety in the product on offer, and it is to this that we now briefly turn.

Consider first the balance between specific and *ad valorem* taxation in a simple model of horizontal product differentiation: differentiation, that is, such that there is no agreed ranking of products by consumers, but merely differences in taste as between, say, red cars and blue. The key consideration that emerges is the multiplier effect of *ad valorem* taxation on fixed costs: this implies, as discussed at the outset, that *ad valorem* taxation tends to reduce variety. The implications of this for commodity tax design depend on whether or not variety tends, in the absence of taxation, to be excessive: in a simple model of this kind<sup>22</sup> considered by Kay and Keen (1983), it is, and the optimal rate of *ad valorem* taxation is consequently high; indeed, they show that the *ad valorem* tax is optimally set so as to induce the appropriate level of variety and the specific tax — which is effectively a lump-sum tax in this model, since all consumers are assumed always to buy exactly one unit of the good — then set so as to raise any further revenue

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<sup>22</sup>That of Salop (1979).

required (which may conceivably mean a specific subsidy, set so as to return to the consumer any excess of proceeds from the corrective *ad valorem* tax over the revenue needed for public expenditure).

A rather different view of horizontal differentiation is embodied in the popular model of monopolistic competition of Dixit and Stiglitz (1977). In this formulation, consumers do not have a preferred type of the product in question but rather derive some benefit from a diversity of available choice; consequently, competition between firms is not localised with each competing most directly with others offering products of a similar type (as is the case in the model used by Kay and Keen (1983)) but rather is generalised. The appropriate balance between specific and *ad valorem* taxes in this model is explored in Appendix A of this paper. It is shown there that the key consideration is the importance consumers attach to diversity:<sup>23</sup> in particular, the sign of the optimal specific tax is independent of the revenue requirement and depends only on the strength of consumers' preference for diversity. When this is relatively low, the solution to the Ramsey problem involves a specific subsidy financed by a high *ad valorem* tax (which must also, of course, raise the tax revenue required): intuitively, it is then optimal to aim for relatively little variety but a high level of output of each variant (enabling the enjoyment of scale economies). If, on the other hand, the taste for diversity is strong, then optimal policy involves a positive specific tax, with the optimal *ad valorem* tax tending to zero as the taste for diversity becomes infinitely strong.

Tax effects in a model of vertical product differentiation — circumstances, that is, in which all agree that some variant is better than others — are considered by Cremer and Thisse (1994). They show that *ad valorem* taxation may then not merely be under-shifted (as it generally is in the model of variable quality in subsection (a) above) but may even lead to such a large reduction in quality, and such an intensification of price competition, that the consumer prices of the differentiated goods actually fall. Reflecting this, optimal policy<sup>24</sup> involves an *ad valorem* tax used to finance a specific subsidy (specific taxation being, for the same reason as in Kay and Keen (1983), lump-sum in this model). Interestingly, this is exactly as in the analysis of Kay and Keen (1983) discussed above, though the nature of product differentiation is very different.<sup>25</sup>

Different forms of product variety thus give rise to somewhat varying conclusions. Behind the differences of detail, however, a common theme emerges:

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<sup>23</sup>A qualitatively similar conclusion is reached, in a different model of product differentiation, by Anderson, de Palma and Kreider (1997).

<sup>24</sup>The objective function is the simple sum of utilities, with individuals differing in the strength of their taste for the differentiated good.

<sup>25</sup>A rather different conclusion is reached by Anderson, de Palma and Kreider (1997), who examine a model of vertical product differentiation in which product qualities are fixed. They find that specific taxation is more efficient if (*inter alia*) the cost difference between the variants is small: for then it is especially desirable to counteract the tendency to under-provision of the high-quality good by narrowing the relative differential in consumer prices.



other things being equal, predominantly specific taxation is more likely to be desirable the greater are the net benefits society derives from product variety.

### *3. The Level, Certainty and Stability of Tax Revenues*

Governments will naturally take a close interest in the implications of the balance between specific and *ad valorem* taxes for the tax revenues they receive. Reflecting this, a number of papers have considered the optimal balance between the two types of tax when the sole object of policy is to maximise tax revenue: see Bohanon and van Cott (1984 and 1991) and Kay and Keen (1987a and 1991). Interestingly, the qualitative features of the tax structure required to maximise revenue are very often essentially the same as those of that required for the Ramsey problem of maximising consumer welfare subject to a revenue constraint. For example, it follows from the results of Kay and Keen (1991) that the ratio of *ad valorem* to total taxation required to maximise revenue in the model of variable quality in Section II(2)(a) is exactly the same as that required to maximise consumer welfare subject to a revenue constraint: intuitively, the goal of revenue maximisation also creates no need to distort quality, so that the key result at the end of Section II(2)(a) — that, at the optimum, quality is unaffected by a small intensification of the tax system — applies in a context of revenue maximisation too. Hence so too does the result that the optimal ratio of *ad valorem* to total taxation is exactly  $\theta$ . Of course, the optimal *levels* of the two taxes will naturally differ between the case in which the object of policy is to maximise welfare subject to a revenue requirement and that in which it is to maximise revenue; but the *balance* between them does not. Given this close qualitative similarity of optimal tax structures, and for the sake of brevity, we need consider the implications of the tax mix for the level of revenues no further.

Instead, we focus here on a distinct set of revenue concerns: the predictability, certainty and stability of tax revenues.<sup>26</sup> Such concerns are currently especially evident in many transition economies, which have faced the difficult problem of attempting fundamental reforms of their tax systems at the same time as needing to secure their revenue bases to maintain macroeconomic and perhaps also political stability. Excises are such a central part of the overall revenue picture in such countries that the certainty of their revenue yield has been a major concern in choosing between specific and *ad valorem* taxation: this has certainly been the case, for example, in Georgia and the Ukraine. Part of the certainty issue here relates to enforcement questions that we take up in Section III. Here, we focus instead on the potential uncertainty of taxes legally payable.

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<sup>26</sup>Another way in which uncertainty might affect the choice between specific and *ad valorem* taxation is raised and explored by Fraser (1985), apparently with small-scale agricultural producers in mind: since the two taxes have quite different risk-sharing properties — under an *ad valorem* tax, but not under a specific, for instance, price uncertainty is in part borne by the government — they will not be equivalent from the perspective of a risk-averse producer.

Such uncertainty might arise from a variety of sources and take a variety of forms. One central case is that in which, for reasons not modelled, the consumer price of the taxed good is uncertain. This might arise from stochastic variation in the price of some central input — we might be considering, for example, the potential revenue effects of an oil price shock — or just reflect uncertainty as to the behaviour of the industry; the deep source of the randomness need not concern us. We simply take it that while the aggregate demand function  $X(\cdot)$  is non-stochastic (and downward-sloping), its argument,  $P$ , is. Tax revenue,  $(vP + s)X(P)$ , then becomes random, and the question we ask is: in the face of such price uncertainty, how should the balance between *ad valorem* and specific taxes be set so as to minimise the variation in tax revenues?

It is clear that the price elasticity of demand,  $E$ , (defined to be non-negative) has a crucial role to play here. Suppose first that  $E = 0$ , so that aggregate sales,  $X$ , are unaffected by the price level. Clearly then all variation in revenue can be removed by using only specific taxes. If, on the other hand,  $E = 1$ , then consumer expenditure,  $PX$ , is independent of  $P$  and so all variation in revenues is eliminated by using only *ad valorem* taxation. Indeed, it is easily shown<sup>27</sup> that revenue from the taxed good is entirely unaffected by small changes in its consumer price — and by large ones too, if the demand curve is linear — if and only if<sup>28</sup>

$$(3) \quad \frac{vP}{vP + s} = E,$$

so that the share of *ad valorem* in total taxation is equal to the price elasticity of demand. Notice, moreover, that this condition does not restrict the overall *level* of taxation, only its composition. By choosing an appropriate mixture of specific and *ad valorem* taxes,<sup>29</sup> one can thus secure complete certainty of revenues at no cost in terms of the total revenue raised.

This rule invites illustrative calculations. Taking cigarettes, for example, Fry and Pashardes (1988) put the own-price elasticity of demand at around 0.5 for the UK, while Barnett, Keeler and Hu (1995) estimate it to be around 0.7 in the US. Such figures imply that a rough balance between specific and *ad valorem* components, with perhaps some leaning towards *ad valorem*, would best stabilise revenues.

Though neat, the rule in equation (3) is, of course, highly stylised. Two limitations deserve particular emphasis. The first is that it assumes the form of the demand function to be known: Kay and Keen (1982) show that stability of expected tax revenue in the face of uncertainty concerning the true value of the elasticity  $E$  requires a ratio of *ad valorem* to total taxation below the expected

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<sup>27</sup>By setting the derivative of revenue with respect to  $P$  to zero.

<sup>28</sup>The first statement of this result seems to be that in Tobacco Advisory Council (1980).

<sup>29</sup>Note that this means a specific subsidy if revenue is positive and  $E > 1$ .

value of the elasticity. Second, it neglects the impact that changes in the price of the good in question have on expenditure on other taxed goods: a change in the price of cigarettes will typically affect, for example, expenditure on, and hence tax revenue from, alcoholic drinks. The strength and direction of this effect depend on the rates at which other goods are taxed and the magnitude and sign of cross-price effects between the two sets of goods: if expenditure switches to untaxed contraband, for example, then of course equation (3) continues to apply. To get some feel for the possible importance of cross effects more generally, consider the case in which total expenditure is fixed. Whether the rule in equation (3) leads to too little or too much reliance on *ad valorem* taxation then depends on whether  $E$  is (respectively) less or greater than unity:<sup>30</sup> intuitively, if it is less, then an increase in  $P$  reduces expenditure on the other good and it becomes more important to extract revenue from the increased expenditure on the good in question through a relatively high *ad valorem* component. Suppose, for example, that  $E = 0.5$ , that the rate of tax applied to other goods is 15 per cent and that tax on the good of interest is 75 per cent of its consumer price. Constancy of overall tax revenue then requires a ratio of *ad valorem* to total tax of not 50 per cent, as equation (3) would imply, but 60 per cent.

#### 4. Externalities

External effects from consumption or production — effects, that is, borne by people other than those doing the consuming or producing — have long loomed large in the design (at least, the rhetoric of the design) of the major excises: those on alcoholic drink, tobacco products and hydrocarbons. More recently, of course, the growing interest in environmental taxes has lent further urgency to issues of appropriate tax design in the presence of externalities.

To a very large degree, the central issues raised by external effects concern the *level* of taxation, not — our concern here — its structure. There are, however, some direct implications for the appropriate roles of specific and *ad valorem* taxation.

The most fundamental is a straightforward application of a widely used general principle for the optimal targeting of policy instruments: to avoid unintended distortions on other margins of choice, the best instrument for correcting behaviour deemed inappropriate is the one that affects that behaviour most directly and exclusively.<sup>31</sup> For since most externalities can be traced to some particular

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<sup>30</sup>With total expenditure constant at  $M$ , and denoting by  $\tau$  the tax rate on other expenditure, total revenue,  $\{vP + s\}X(P) + \tau\{M - PX(P)\}$ , is unaffected by a small change in  $P$  if and only if  $\frac{vP}{vP + s} =$

$$E + \left( \frac{P}{vP + s} \right) \tau (1 - E).$$

<sup>31</sup>This is a general principle, not a universal truth: there may be circumstances in which instruments other than those most directly related to the distortion have a role. In the environmental context, this may be the case, for example,

characteristic of the good in question, the best response is likely to be a specific tax on that characteristic. In this important sense, externalities inherently point to specific rather than *ad valorem* taxation.<sup>32</sup>

Suppose, for example, that the external damage (or, perhaps, benefit) from drinking comes simply from drunkenness. Then one would expect the wisest policy response to be to tax drinks on the basis of their alcohol content, not on their value. *Ad valorem* taxation would discourage drinking in general — including harmless thirst-quenching — rather than inebriation in particular, and lead too to unnecessary deterioration of such characteristics as pub quality. Indeed, the general point here — that externalities inherently favour appropriate specific taxation — is already, in practice, a familiar one: awareness that the external damage of burning petrol increases with its lead content, for example, led to differentiation of the tax rate by that lead content.

The power of this point is also indicated by recent analyses of optimal environmental taxation under imperfect competition. Suppose that consumers suffer harm from the total of their consumption of some good, though each is so small that he or she takes no account of this in deciding his or her own consumption: the good might be the use of carbon fuels, for example, and the harm global warming. What is the appropriate policy response? If there is perfect competition, the answer is simple: consumption should be taxed, and it does not matter — for reasons noted at the outset above — whether that tax is specific or *ad valorem*: that equivalence does not contradict the presumption developed above concerning optimal targeting but simply reflects the very special feature of perfect competition that the two instruments are then equivalent. But now suppose the industry is organised as a Cournot oligopoly, of the kind discussed in Section II(1)(b). In this case, there are two distortions, and they point in opposite directions: the externality still points to output being too high in terms of the broad public interest, but the oligopolistic output restriction that we concentrated on earlier suggests that output will be too low. Not surprisingly, the nature of the solution to the Ramsey problem now depends on whether the externality is ‘small’ or ‘large’. If small enough, then the solution is exactly as if the externality did not exist, and consequently — as an application of the results referred to above — wholly *ad valorem* taxation is optimal. But Pirttilä (1997) shows that once the

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when individuals are heterogeneous and the optimal corrective tax is consequently differentiated across individuals: if person-specific taxes are for some reason impossible, indirect instruments — taxes or subsidies on goods other than the one that generates the externality — may be optimal: see the discussion in Myles (1995). We have in mind in this subsection the case in which individuals are identical, leaving to future work the interesting question of whether heterogeneity and the potential case for indirect instruments affect the optimal balance between specific and *ad valorem* taxation on the externality-generating activity itself.

<sup>32</sup>Matters become more complicated if the relevant market is vulnerable to exogenous shocks, but with no clear implications for the choice of instrument: it is a merit (respectively, weakness) of *ad valorem* taxation, for example, that the expansion of output induced by an unexpected shift of the demand (supply) curve is accompanied by an increase (reduction) in the tax wedge  $vP$  that mitigates (worsens) any adverse external effect of that expansion. See Dickie and Trandel (1996).

externality is large enough to have any effect on policy, the optimal tax structure switches immediately to the opposite extreme: wholly specific taxation is optimal. That is, either the externality makes no difference or — consistent with the general case for specific taxes argued above (the externality in this analysis, recall, being assumed related to the level of output, exactly the base of the specific tax) — it points to wholly specific taxation.

### *5. Distributional Considerations*

The discussion so far has effectively assumed all consumers to be identical, and so has abstracted from the possibility that the balance between specific and *ad valorem* taxation might have systematic effects on the distribution of economic welfare across the population. This neglect is indeed a feature of the literature in this area. Doubtless this is in large part because the distributional effect of commodity taxes seems likely to be determined primarily by their levels rather than their structure, and because other better-targeted devices — most obviously income tax and social security benefits — are available in developed countries to tailor distributional effects more precisely. Nevertheless, the potentially distinct distributional consequences of the two merit some attention as a neglected aspect of tax incidence, and one that may be of some importance in developing and transitional economies.

Progressivity is most obviously a potential concern in choosing the balance between specific and *ad valorem* components if the ‘rich’ choose to consume a better variant of the product than do the ‘poor’. A simple model of this kind, with vertical product differentiation driven by differences in income,<sup>33</sup> is considered in Kay and Keen (1987b): there, rich and poor never switch between the two goods and the quality of that consumed by the rich is determined endogenously in the manner of Section II(2)(a). A key distinction that immediately emerges as shaping the distributional effects of the two taxes is then whether rich and poor differ more in their expenditures on the taxed good or in the number of units they consume: if rich and poor buy the same number of physical units, for example, but the rich spend more on their variant, then an *ad valorem* tax will bear differentially on rich and poor whereas a specific tax will be akin to a (regressive) poll tax. Indeed, so long as the rich consume no fewer physical units than the poor, optimal policy in this model involves a positive *ad valorem* tax — even when preferences are of the full-price form — used in part to finance a specific subsidy:<sup>34</sup> in effect, the rich are taxed in order to make a distributionally attractive poll subsidy. Seeing adverse distributional consequences in unalloyed specific taxation, some developing countries — such as India — have adopted tiered specific taxes, the rate

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<sup>33</sup>Vertical differentiation in the model of Cremer and Thisse (1994) discussed in Section II(2)(b), in contrast, is driven by differences in strength of taste towards the differentiated good.

<sup>34</sup>There is an interesting similarity here with the result of Cremer and Thisse (1994) mentioned above, though these two models of vertical differentiation are quite different.

increasing (across bands) as the price increases: such a system has many similarities, of course, with *ad valorem* taxation.

It is a limitation of the Kay–Keen model, however, that there is assumed to be complete segmentation of the market between rich and poor. Myles (1988) shows that when there is no such segmentation — but, on the other hand, the qualities of two goods available are fixed — then the optimal tax structure can have counter-intuitive features: in particular, it may be optimal to subsidise the high-quality good. What underlies this surprising result is the observation — counter-intuitive, but rather robust — that since the rich choose to consume the higher-quality good, it must be the case that at some point the marginal utility of income must be higher when consuming the higher-quality good than when consuming the low-quality good. The explanation of this is rather involved,<sup>35</sup> but the implication is powerful and immediate: the usual prescription of redistributing — all else being equal — towards whichever group has the higher marginal utility of income means, in these circumstances, redistributing towards the better-off. Myles’s analysis is not motivated by, and so does not consider, the balance between *ad valorem* and specific taxation; and indeed the possibility arises in these models that one might wish to impose different specific and *ad valorem* taxes on each variant, instead of applying a common tax structure to all. It seems clear that there are here unresolved issues.

### III. PRACTICE

In this section, we first consider empirical evidence on the relative effects of the two taxes, and then we turn to administrative concerns.

#### 1. Empirical Evidence

The theoretical analysis of the comparison between specific and *ad valorem* taxation poses broadly two sets of tasks for empirical work. First, it suggests testable hypotheses by which the theory might be evaluated. It suggests in particular that, other things equal:

- predominantly *ad valorem* taxation tends to imply relatively low product quality and relatively little product variety; and
- predominantly *ad valorem* taxation tends to imply a relatively low consumer price: equivalently, specific tax increases are more likely to be ‘over-shifted’ than are *ad valorem* ones. This may result, recall, either (or both) from non-

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<sup>35</sup>Imagine two curves showing utility (on the vertical axis) as a function of income, one drawn on the assumption that the low-quality good is consumed, the other assuming that it is the high-quality good which is consumed. If those with low incomes prefer to consume the low-quality good while those on high incomes consume the high-quality good, then the latter curve must somewhere cut the former from below, at which point it must have the steeper slope (that is, the higher marginal utility of income).

competitive behaviour in the market for a homogeneous good or from tax-induced variations in product quality.

Second, the theory points to some key quantities whose value one would ideally wish to know when forming policy: we have seen, for example, that the optimal balance between *ad valorem* and specific taxation is likely to depend on the price elasticity of demand and, more exotically, on the price elasticity of the marginal willingness to pay for additional quality.

Such evidence as there is on these matters is conveniently divided into two types: econometric and case-study. We review these in turn and add a little to both.

(a) Econometric Work

While there are now several empirical studies focused on the question of whether commodity taxes are over-shifted,<sup>36</sup> there seem to be only three that recognise and address the distinction between specific and *ad valorem* taxation: Barzel (1976), its refinement by Johnson (1978), and Delipalla (1995).

These have a broadly common structure. None directly estimates quality effects, suitable measures of quality being unavailable. Instead, they estimate a reduced form in which the consumer price is regarded as a function of specific and *ad valorem* tax rates (and perhaps also of other variables of no direct interest). They explore the same broad question — whether the price effects of the two kinds of tax differ in the way that theory predicts — on two different datasets, both for cigarettes: Barzel and Johnson use a panel of US states for 1954–72; Delipalla uses a quarterly panel of European Union member states for 1982–90.

The conclusions, too, are broadly similar: all three studies find the effects of specific and *ad valorem* taxes to be significantly different, with the former leading to larger price increases than the latter (and indeed tending to be over-shifted). These are as the theory predicts, but the limitations of the underlying data are such that the conclusions must be heavily qualified. The informativeness of the US dataset is limited by the fact that, over the period studied, only one of the continental US states levied an *ad valorem* tax.<sup>37</sup> The member states of the EU, in contrast, are marked by a wide variation in the balance between specific and *ad valorem* components in the taxation of cigarettes. But these national tobacco tax structures show rather little variation over time — the exception being the Netherlands, whose experience we analyse in some detail below — so that the

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<sup>36</sup>Sumner (1981) is an early example; more recent studies include Baker and Brechling (1992) and Besley and Rosen (1994).

<sup>37</sup>It is reassuring that Johnson (1978) finds there to be a distinct tax effect even when controlling for state-specific effects; less so that he notes (in footnote 7) that the effect of the *ad valorem* tax in Hawaii — omitted in Barzel (1976) — runs counter to theory.

panel is in effect little more than a small cross-section. Though suggestive, the results from these studies are thus far from conclusive.

Note, too, that the methodology of these studies is such that they cannot distinguish between the two possible reasons why specific and *ad valorem* taxes might have distinct effects: quality adjustment and non-competitive behaviour. This limitation is unfortunate, since the two have quite different policy implications. If the difference reflects only imperfections of competition of the kind in Section II(1), for instance, then one should rely mainly on *ad valorem* taxation. What if it arises from quality variation? Delipalla (1995) shows that by interpreting the reduced form as arising from a model of quality variation of the kind in Section II(2)(a), one can infer an estimate of the elasticity of the marginal willingness to pay for quality, upon which, as noted above, optimal policy then hinges. But this estimate turns out not to be well determined, with estimates — and hence the optimal ratio of *ad valorem* to total taxation implied by the rule at the end of Section II(2)(a) — varying from 0.28 to 0.86.

#### (b) Case Studies

One of the principal obstacles to informative econometric work in this area is the infrequency with which tax authorities undertake major changes in the balance between specific and *ad valorem* taxation. Such structural shifts as do occur thus acquire particular interest. We consider here two such reform episodes.<sup>38</sup>

##### Tobacco Taxes in the Netherlands

One of the most spectacular shifts between specific and *ad valorem* taxation that Europe has seen in recent years is in the taxation of tobacco products in the Netherlands. At the start of the 1980s, the system was overwhelmingly *ad valorem*: only about 10 per cent of the tax on cigarettes was specific, and roll-your-own (RYO) — a cheap alternative to made cigarettes which has played a particularly important role in the Netherlands — bore no specific tax at all. By the end of the 1980s, however, the ratio of specific to total tax stood at the present level of 50 per cent for both product groups. Though some increase in the specific component was necessitated by the harmonisation measures in the European Community mentioned in Section I, the Dutch government decided to adopt a much heavier dose of specific taxation than it was formally obliged to. And its primary motives in doing so, it seems, were to bolster revenues from tobacco taxes and to increase their predictability. We focus here on the first of these objectives.

As can be seen from the numbers in Table 1, the shift towards specific taxation came in two steps:

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<sup>38</sup>The discussion here draws on London Economics (1995), where other (somewhat less informative) episodes are also considered.



- At the start of 1984, the ratios of specific to total taxation on both cigarettes and RYO were raised from the very low levels just described to 25 per cent. There was also a significant increase in the overall levels of taxation: by 13 per cent for cigarettes and 28 per cent for RYO (both in real terms).
- At the start of 1987, the common ratio of specific to total tax was further increased to 50 per cent, but this time the increase in specific taxation was accompanied by a cut in the *ad valorem* component sufficient to leave total tax almost unchanged: the real tax on the most popular price category (MPPC) of cigarettes rose by 3 per cent, that on RYO by 4 per cent.

For the first of these episodes, it is of course difficult to disentangle the consequences of the structural change from those of the increase in the level of taxation. What does leap from Table 1(c) is a massive 22 per cent fall in tobacco tax revenues in 1984. It is natural to suppose that this is very largely a reflection of the sharp increase in the level of tobacco taxes. Notice, however, that not all of the revenue change can reasonably be attributed to a simple contraction of demand in the face of a large price increase: with tax being about 70 per cent of the consumer price of cigarettes, a 13 per cent increase in tax will induce a 22 per cent reduction of tax revenues only if<sup>39</sup> the price elasticity of demand is

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<sup>39</sup>Here we use the observation that perturbing revenue,  $R = TX(P)$ , shows the proportional changes in revenue and the tax rate,  $T$ , to be roughly (when  $dP = dT$ )  $dR/R = \{1 - (T/P)E\}dT/T$ . The counterfactual is too simple, of course, in that it ignores RYO. But with the real price of RYO rising in 1984 by 19 per cent, the essential point is unaffected.

TABLE 1  
The Taxation of Tobacco Products in the Netherlands  
(a) The taxation of cigarettes

	<i>Specific tax (DFI per 20)</i>	<i>Ad valorem tax (incl. VAT)</i>	<i>Ratio of specific to total tax (on MPPC)</i>	<i>Total tax (DFI per 20)</i>	<i>Price (of MPPC, DFI per 20)</i>	<i>Consumption (million pieces)</i>
1982	0.24	0.65	0.10	2.35	3.25	—
1983	0.25	0.65	0.10	2.45	3.38	—
1984	0.70	0.55	0.25	2.78	3.79	16,033
1985	0.69	0.54	0.25	2.75	3.82	16,468
1986	0.69	0.54	0.25	2.75	3.81	16,529
1987	1.41	0.36	0.50	2.83	3.94	16,184
1988	1.39	0.36	0.50	2.79	3.89	16,263
1989	1.37	0.35	0.51	2.71	3.84	16,345
1990	1.34	0.35	0.50	2.67	3.81	18,265
1991	1.31	0.35	0.50	2.64	3.79	18,388
1992	1.44	0.35	0.50	2.88	4.12	17,590
1993	1.61	0.36	0.50	3.23	4.49	16,116
1994	1.62	0.36	0.50	3.24	4.49	16,530
1995	1.63	0.36	0.50	3.26	4.53	17,150

(b) The taxation of roll-your-own

	<i>Specific tax (DFI per kg)</i>	<i>Ad valorem tax (incl. VAT)</i>	<i>Ratio of specific to total tax</i>	<i>Total tax (DFI per kg)</i>	<i>Price (DFI per kg)</i>	<i>Consumption (million kg)</i>
1982	0.00	0.52	0.00	33.9	65.43	—
1983	0.00	0.52	0.00	34.4	66.46	—
1984	11.05	0.42	0.25	44.1	78.86	18.3
1985	11.15	0.41	0.25	44.5	80.48	18.4
1986	11.14	0.41	0.25	44.5	80.40	18.3
1987	23.18	0.27	0.50	46.3	84.60	17.6
1988	22.89	0.27	0.50	45.7	83.61	17.2
1989	22.72	0.27	0.50	45.4	83.66	17.0
1990	22.07	0.26	0.50	44.2	84.17	17.8
1991	21.92	0.26	0.50	43.8	84.83	17.9
1992	29.09	0.28	0.50	57.9	100.88	16.2
1993	36.28	0.31	0.50	72.6	115.61	14.5
1994	36.11	0.31	0.50	72.2	116.36	15.2
1995	35.65	0.31	0.50	71.3	115.00	14.9

(c) Revenue from tobacco excises (million DFI)

*Specific and Ad Valorem Taxation*

1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2,512	2,750	2,155	2,335	2,361	2,335	2,306	2,284	2,305	2,449	2,703	2,804	2,834	3,079

Note to Table 1: Figures are in 1995 prices; tax and price are time-weighted averages over the calendar year.  
Sources of Table 1: Nominal data are taken from various issues of *Sigaretten- en Kerftabakindustrie, Tabak*; conversion to real terms uses the GDP deflator from *OECD Economic Outlook*.

implausibly high, at around 3.8. It thus seems that the 1984 reform may have coincided with some other shock to the demand for cigarettes (cross-border shopping, for example, may have played a role): and it may be that the revenue effects were exacerbated by some down-trading towards cheaper and less heavily taxed products. In itself, however, the 1984 reform offers few clear lessons on the impact of rebalancing specific and *ad valorem* components.

The 1987 reform, in contrast, is as pure an example of a structural shift as one could imagine, so that one might hope it to be more informative on our present concerns. The immediate effects were not dramatic. Revenue, which had recovered somewhat in 1985, remained broadly stable in the late 1980s; but here, of course, the general state of the economy is likely to have played a role. More fundamental, one suspects, were some profound changes in market positions that took place during the later 1980s, and which are naturally attributed, in large part, to the shift towards specific taxation. The theory above suggests that this shift would favour relatively high-quality products. There is, indeed, some evidence that more expensive (and therefore, presumably, better-quality) brands of cigarette did gain market share. Moreover, within the tobacco market widely defined, there was a clear weakening in the position of RYO relative to cigarettes: between 1984 and 1991, sales of cigarettes rose by 15 per cent while sales of RYO fell by 2 per cent (both measured by volume). Thus the shift towards specific taxation seems to have brought about substantial upgrading from RYO to cigarettes.

In 1992, the Dutch government substantially increased the real levels of taxation on both cigarettes and RYO — by 9 per cent and 32 per cent respectively — whilst retaining the balance between specific and *ad valorem* components unchanged. As is clear from Table 1(c), this was followed by a substantial increase in tax revenues. The contrast between this and the marked loss of revenue after the 1984 reform is striking. Though clearly not a complete explanation of these very different experiences, it seems likely that an important part of the story is the effect of heavier specific taxation in eroding the role of RYOs as a cheap alternative to cigarettes.

For a more satisfying interpretation of the Dutch experience, one naturally looks to econometric analysis. Data limitations and the relatively short time period involved severely restrict the possibilities. While the results must therefore be read with some care, two simple regressions — developed and reported in Appendix B — are of particular interest as tending to confirm that specific and *ad valorem* taxes have indeed had identifiably distinct effects in the Netherlands and,

moreover, that the pattern of effects is consistent with the occurrence of upgrading in the Dutch cigarette market. One set of results indicates that specific and *ad valorem* taxes have significantly different effects on the consumer price, which — as theory predicts — tends to rise more with specific taxation than with *ad valorem*. The second suggests that, conditional on the price of the MPPC, the total volume of cigarettes consumed tends to be lower the greater is the ratio of specific to total tax; which is as one would expect if consumers tend to react to a shift towards specific taxation by smoking fewer but better cigarettes.

#### Alcoholic Drink in Sweden

In 1992, the Swedish government fundamentally reformed its tax treatment of alcoholic drinks. This reform comprised two components. One was the complete elimination of *ad valorem* taxation (other than VAT), which had previously been very substantial: 60 per cent, for example, on spirits. The second was a reformulation of the specific taxes, which had previously been independent of alcohol content within the broad categories of drink: taxation was henceforth to be more closely related to alcohol content, which was to be taxed at broadly the same rate both within and across categories of drink.

In contrast to the Dutch tobacco tax reform, the objective of the Swedish reform was not to increase tax revenues. In part, the objective was to comply with requirements for membership of the EU, as described in Section I.<sup>40</sup> More fundamentally, however, the reform was introduced with the deliberate purpose of reducing alcohol consumption. Though revenue was not to be jeopardised — so that the reform was designed to be broadly revenue-neutral — the motivation was thus closer to a concern with externalities of the kind discussed in Section II(4).

The elimination of the *ad valorem* tax obviously tends to favour higher-priced drinks, while the shift towards specific taxation by alcohol content clearly favours relatively less alcoholic drinks. Thus one would expect the reform to lead to increased sales of high-quality drinks of relatively low alcohol content. That, indeed, is exactly what was observed, and the effect, moreover, was very significant. In the market for spirits, for example, Swedish vodka — a relatively cheap, high-alcohol drink — experienced a price increase of 6 per cent between 1991 and 1992, over which time sales (in litres) fell by 17 per cent. Bells' whisky, on the other hand — a less alcoholic but more expensive drink — fell in price by 7 per cent and increased sales by 10 per cent. Similarly large shifts towards expensive less alcoholic drinks were experienced in the wine and fortified wine sectors.

It is an immediate implication of the discussion in Section II(4) — indeed, simple common sense — that in so far as the object of policy was to reduce alcohol consumption, shifting towards a specific tax related to alcohol content was

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<sup>40</sup>EU requirements led to further reforms in 1995 and 1997, but these are of no special interest for our present concerns.

a wise strategy. Per capita consumption of pure alcohol in Sweden, which had been broadly stable or increasing since the mid-1980s, did indeed fall slightly between 1991 and 1995, by a little under 2 per cent,<sup>41</sup> though it is unclear how significant this is in the context of what seems to be a secular decline.

## *2. Administrative Issues*

Two main sets of administrative issues arise in considering the appropriate balance between the two taxes.

### (a) Inflation Adjustment

The choice between *ad valorem* and specific taxes has often been heavily swayed, in practice, by the observation that whilst the amount of *ad valorem* tax payable on a unit of the product increases in proportion to its price and so rises automatically in line with general inflation, such inflation erodes the real value of a specific tax fixed in nominal terms.

Quite why this point should have received as much weight as it evidently has is by no means clear. For there would seem an obvious way to avoid these difficulties: simply index the specific component, with uprating at whatever frequency is felt necessary to track inflation. In practice, however, governments appear for some reason reluctant to follow this course: only Sweden automatically indexes specific taxes. And there is indeed a real difference between the smooth adjustment of an *ad valorem* tax and the discontinuous adjustment of an indexed specific tax: in a general inflation, with the prices of all goods — including the one being taxed — rising at the same rate, an *ad valorem* tax leaves relative prices unchanged over time whereas relative prices do change under a periodically indexed specific tax, with that of the taxed good jumping upwards at the time of uprating. Such movements in the relative price do imply real welfare losses and damage tax revenue, since they encourage consumers to shift purchases from periods after uprating to periods just before. There is thus reason to suppose that political resistance to indexed specific taxes will be greater than resistance to *ad valorem* taxes, though this effect should be weaker the more frequent are the adjustments. But even this problem of infrequent adjustment can be overcome: the specific component might be specified in terms of some hard foreign currency. This strategy has been adopted by some transition economies, including Romania and Kazakhstan. Nevertheless, it seems clear that inflation adjustment will remain a major concern of practitioners.

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<sup>41</sup> *World Drink Trends 1995: International Beverage Consumption and Production Trends*, NTC, Henley-on-Thames.

(b) Evasion Issues

There is an inherent difference between the kind of monitoring by the authorities that is required to implement the two kinds of tax: a specific tax requires monitoring the volume of sales; *ad valorem* taxation requires monitoring the value. In many contexts, this may have little significance for the choice between them: systems of fiscal markers, for instance, can be and are applied to both kinds of tax.

There are two sets of circumstances, however, in which the relative ease of monitoring may affect the appropriate tax structure. One is that in which the technology is such that — even when taxpayers are honest — one attribute is significantly cheaper to monitor than the other. It was partly in order to avoid the need for landfill sites to acquire weighbridges, for example, that HM Customs and Excise initially favoured an *ad valorem* form for the landfill tax. Such costs may, of course, sometimes be mitigated by reconsidering the way in which a unit of the commodity is defined for purposes of specific taxation. In the UK, for example, the specific tax on beer was formerly based on the wort — the liquid before fermentation — which required an arbitrary allowance to be made for wastage; now it is assessed on the final product. Ultimately, the question is whether the characteristics that one can conveniently tax are close enough to those that one wishes to tax.

The second and perhaps most fundamental case in which monitoring differences may matter is that in which taxpayers are dishonest, and find it easier to misrepresent volume rather than value, or vice versa. This has been a particular concern in several transitional economies, where the supply of heavily excised goods is largely by import. Border controls then have a crucial role in bringing these goods into tax. In the context of cigarettes, for example, such checks have proved vulnerable to false invoicing, understating the true value of goods imported and so liable to any *ad valorem* tax. Especially when systems of record-keeping are rudimentary, physical volume may be easier to check, and specific taxation to that extent preferable.

#### IV. CONCLUSIONS

Three broad conclusions merit some emphasis. The first, and perhaps most important, is simply that the balance between specific and *ad valorem* taxation can matter a very great deal for the interests of consumers, producers and government. Second, theory suggests, and experience generally confirms, that predominantly specific taxation tends to lead to relatively high levels of price, product quality and variety. The third is that there are no unambiguous conclusions as to the optimal balance between the two taxes, which proves quite sensitive to the particular characteristics of the market at issue. There are examples in which wholly *ad valorem* taxation is optimal, and there are others in

which wholly specific taxation is optimal. In the very broadest terms, however, predominantly *ad valorem* taxation seems most likely to be attractive — in terms of both consumer welfare and the amount of tax revenue raised — in markets characterised by marked monopolistic output restrictions and little actual or potential heterogeneity of the product. Specific taxation, on the other hand, seems most likely to be appropriate when the preservation of product quality is a particular concern and/or some negative externality associated with consumption of the good can be conveniently linked to one of its measurable characteristics, which is then an appropriate basis for taxation. Clearly, then, there is no general prescription as to the appropriate balance between the two taxes, which indeed is likely to differ quite markedly over distinct contexts. Theory points us towards some quantities that one would ideally wish to know in order to decide an appropriate tax structure — such as the price elasticity of the marginal willingness to pay for quality — but their reasonably precise measurement remains some way from practicability in most applications, not least because of the difficulties, both conceptual and practical, of measuring product quality. The models of imperfect competition used in the literature are also, in important respects, special cases. But while there thus remains much to be done — in, for example, exploring richer models of vertical differentiation and examining empirically the impact of tax structure on product quality and variety — there exists a rich body of theory and experience from which to draw some potentially powerful insights.

**APPENDIX A: THE OPTIMAL BALANCE BETWEEN SPECIFIC AND AD VALOREM TAXATION UNDER MONOPOLISTIC COMPETITION**

The purpose here is to explore, briefly, the optimal balance between *ad valorem* and specific taxation in the model of monopolistic competition in (Section 1 of) Dixit and Stiglitz (1977).

There is a single representative consumer with homothetic preferences

$$(A.1) \quad U\left(x_0, \left\{ \sum_{i=1}^N x_i^{1/(1+\beta)} \right\}^{1+\beta} \right)$$

defined over a numeraire good zero (taken to be untaxed) and a composite of the consumption  $x_i$  of each of  $N$  variants of a differentiated product;  $\beta \in (0, \infty)$ . Homotheticity implies that in the symmetric equilibria with which we shall be concerned, the consumption of each variant is of the form

$$(A.2) \quad x = \frac{\alpha(P^*)}{PN}$$

(lump-sum income — constant throughout the analysis — having been normalised to unity), where  $P$  is the common consumer price and  $P^*$  a price index equal, in symmetric equilibrium, to  $N^{-\beta}P$ . Welfare depends only on  $P^*$ , in which it is strictly decreasing: thus the value placed on diversity is greater the larger<sup>42</sup> is  $\beta$ . Each firm produces just one variant, choosing its output level to maximise profits,  $\{(1-\nu)P_i - s - c\}x_i - F$  (where  $c$  denotes marginal cost, assumed constant, and  $F > 0$  denotes fixed costs), taking  $P^*$  as given when doing so. This implies

$$(A.3) \quad P = \frac{(c+s)(1+\beta)}{1-\nu}.$$

The number of variants available in equilibrium is then tied down by equation (A.3) and a free entry condition: the details need not concern us. Using the zero profit condition, the second-order condition of the typical firm's problem is readily shown to imply  $\nu < 1$  at an optimum.

Consider then the Ramsey problem in this model: that of choosing  $\nu$  and  $s$  to maximise welfare subject to raising some prescribed amount of tax revenue,  $R$ . It so happens that there is no purely corrective role for taxation in this model, so that  $\nu$  and  $s$  are both optimally set to zero if  $R = 0$ : this follows from the result of Dixit and Stiglitz that the no-tax equilibrium is constrained efficient, in the sense that it is impossible to do any better so long as one is unable to make lump-sum transfers to firms. For the case in which  $R > 0$ :

**PROPOSITION:** *The optimal ad valorem tax is strictly positive. The optimal specific tax is negative (respectively: zero; strictly positive) if and only if  $\beta > 1$  (iff  $\beta = 1$ ; iff  $\beta < 1$ ).*

*Proof:* Since welfare depends only on  $N^{-\beta}P$  and (from the zero profit condition) the revenue requirement  $(\nu P + s)nx \geq R$  is equivalent to  $\{(p-c)x - F\}n \geq R$ , equation (A.2) implies that the problem reduces to that of choosing  $N$  and  $P$  to minimise  $N^{-\beta}P$  subject to

$$(A.4) \quad \left\{ (p-c) \frac{\theta(N^{-\beta}P)}{PN} - F \right\} n \geq R.$$

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<sup>42</sup>This interpretation also follows on noting, as is shown in Dixit and Stiglitz, that  $(1+\beta)/\beta$  is the elasticity of substitution between any two variants: the lower is  $\beta$ , the easier it is to substitute between them and, in that sense, the less valuable is diversity.



Multiplying the necessary condition on the choice of  $P$  by \_\_\_\_\_ and adding the result to the necessary condition on  $N$ , some rearrangement, using again the revenue constraint, gives

(A.5) \_\_\_\_\_

To see that  $v > 0$  at an optimum, note first that combining equation (A.5) with equation (A.3) gives

(A.6) \_\_\_\_\_ ,

so that  $v < 0$  would imply

(A.7) \_\_\_\_\_

where the first inequality reflects the implication of  $R > 0$  that  $P > c$ , the equality uses equation (A.6), and the final conclusion that  $v^{P+s} < 0$  implies strictly negative tax revenue, a contradiction.

Turning to the optimal specific tax, consider the three possibilities:

1.  $> 1$ : From equation (A.3),  $P > 0$  implies that  $c+s > 0$ ; which, from equation (A.6), implies \_\_\_\_\_  $> 0$ ; having just seen that  $v > 0$ , the conclusion that  $s > 0$  follows from equation (A.6).
2.  $= 1$ : That  $s = 0$  in this case is immediate from equation (A.6).
3.  $< 1$ : Again recalling that  $v > 0$ , the conclusion that  $s < 0$  is again immediate from equation (A.6).

**APPENDIX B: THE TAXATION OF TOBACCO PRODUCTS IN THE NETHERLANDS: FURTHER ANALYSIS**

A natural and key first question to ask is whether the distinction between specific and *ad valorem* taxation is of any significance in explaining developments in the Dutch market for tobacco products or whether, on the contrary, the market behaves ‘as if’ it were a perfectly competitive one in which the two taxes are exactly equivalent. In such a market, the equilibrium price would be determined by

the market-clearing condition  $X(P) = S((1-\nu)P - s)$ , where  $S(\cdot)$  denotes the market supply curve. Perturbing this, one finds

$$(B.1) \quad \frac{dP_{cig}}{P_{cig}} = \frac{ds}{(1-\nu)P} + \frac{d\nu}{1-\nu} + \frac{dX}{X} - \frac{dS}{S}$$

where  $\epsilon_S > 0$  denotes the elasticity of supply and  $\epsilon_X < 0$ . Thus one might test for equivalence by regressing the change in the (real) consumer price of cigarettes,  $P_{cig}$ , against  $P_{cig}d\nu/(1-\nu)$  and  $ds/(1-\nu)$  and checking for equality of coefficients. Allowing for first-order serial correlation by using Cochrane–Orcutt, one finds

$$(B.2) \quad \frac{dP_{cig}}{P_{cig}} = \alpha \frac{ds}{(1-\nu)P} + \beta \frac{d\nu}{1-\nu} + \epsilon$$

$$R^2 = 0.89; DW = 2.08,$$

the figures in parentheses below the coefficients being t-ratios. At around unity, the coefficients in equation (B.2) are of broadly the magnitude one would expect. On the issue of central interest, a Wald test rejects the null hypothesis of identical coefficients at 3 per cent. The two types of tax thus have significantly different effects, with specific taxation tending to increase price more than *ad valorem* taxation; this is again as theory predicts, though of course the result might be due to either (or both) departures from competitive price-setting or quality upgrading.

In the absence of detailed market share information, one might look for evidence of upgrading by asking whether the ratio of specific to total taxation has any independent impact on the total number of cigarettes smoked (over and above any impact it has via the general price level for cigarettes): intuitively, as that ratio rises, so one might expect individuals to respond — for the reasons set out at the start of Section II — by consuming smaller amounts of higher-quality variants. Controlling for the general level of activity by the inclusion of aggregate consumption,<sup>43</sup>  $X_{agg}$ , including a linear time trend,  $TIME$ , and instrumenting the potentially endogenous  $P_{cig}$  (by the contemporaneous tax rates  $\nu$  and  $s$ ),<sup>44</sup> one finds:

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<sup>43</sup>Data for which are taken from *IMF Financial Statistics*.

<sup>44</sup>Results from ordinary least squares (OLS) are almost identical to those reported here.

(B.3)

$$R^2 = 0.88; \text{Sargan, } F(1) = 3.71 (0.05).$$

The signs and magnitudes appear broadly sensible, though the price elasticity seems rather high and the effect from aggregate consumption surprisingly strong. There is no immediate evidence of first-order serial correlation.<sup>45</sup> While the result in equation (B.3) must thus be interpreted with caution, taken in that spirit the significantly negative effect of the ratio of specific to total taxation provides some very tentative sign of upgrading at work: switching from *ad valorem* to specific taxation whilst holding the price of cigarettes broadly constant significantly reduces the volume of cigarette consumption.

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<sup>45</sup>The null hypothesis that the coefficient on the lagged residuals from the regression in equation (B.3) is zero cannot be rejected at standard significance levels.

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