Alcohol Taxes, Tax Revenues and the Single European Market

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Abstract

This paper addresses the issue of whether tax revenue from alcohol lost through cross-border shopping could be recouped by cutting excise duties. This in turn depends on the elasticity of demand for alcohol.

We use data from the Family Expenditure Survey 1978–96 to estimate own- and cross-price elasticities of demand for beer, wine and spirits before and after completion of the Single Market. We find no evidence of a significant change in elasticities after the Single Market. The tax rates on beer and wine are currently below their revenue-maximising rates, implying that a cut in the duty rate on beer or wine would lead to a decrease in indirect tax revenue from alcohol. We cannot reject that the current tax rate on spirits is at the revenue-maximising rate, implying that further increases in the duty on spirits are likely to cause indirect tax revenue to fall.

JEL classification: H21.

I. INTRODUCTION

Since the introduction of the Single Market, successive Chancellors have been under pressure to cut alcohol taxes to reduce the level of cross-border trade that is being driven, at least in part,[1] by differentials between duty rates in the UK and other EU countries. From an economic perspective, cross-border shopping is inefficient to the extent that decisions are determined by taxes rather than by

[1]Differences in pre-tax prices would also create an incentive for cross-border shopping.

underlying economic factors. A second problem from the government's point of view is that cross-border shopping represents a loss of indirect tax revenue — an estimated £185 million of lost excise duty and VAT receipts on beer, wine and spirits in 1996.[2] However, this contrasts with total duty and VAT receipts on beer, wine and spirits of £9,545 million in 1996–97.[3]

If the Chancellor were to cut duties, whether or not he would get more indirect tax revenue depends on the balance of two effects. Any consequent increase in domestic demand for alcohol would increase revenues (for a given tax rate), but the lower tax per unit of sales would cause revenues to fall (for a given level of demand). Given tax rates and spending, the overall effect on indirect tax revenue depends on the price sensitivity of demand for alcohol. Empirical estimates by Crawford and Tanner (1995) of the own-price elasticities of demand for beer, wine and spirits one year after the introduction of the Single Market have shown that cutting duties on beer and wine would lead to a loss of indirect tax revenue. In the case of spirits, however, the authors could not statistically reject the hypothesis that a cut in duties would lead to an increase in total indirect tax revenue.

This paper extends the analysis in two important ways. First, additional years of data from the Family Expenditure Survey (FES) up to the end of 1996 are used to re-estimate the price elasticities of demand for beer, wine and spirits and to reassess whether there is a revenue case for cutting — or increasing — alcohol duties. This is important since it may take time for consumers to change their behaviour following the completion of the Single Market. Second, we extend the analysis of the impact of duty changes on indirect tax revenue to take account of cross-price elasticity effects. If it is the case, say, that wine and spirits are close substitutes for beer, at least some of any increase in demand for beer that followed a cut in the duty on beer would be met by a fall in demand for — and revenue from — wine and spirits. This would make it less likely that a cut in beer duty is revenue-enhancing. We present empirical estimates of the cross-price elasticities and consider their implications for the revenue effects of changes in duty.

The plan of the paper is as follows. In the next section, we document trends in average real spending on beer, wine and spirits using FES data from 1979 to 1996.[4] We look separately at spending in the South-East, where we might expect cross-border shopping to have had a greater impact. Section III discusses the economics of alcohol taxation. In particular, we focus on the revenue implications of changes in alcohol taxes, and how to assess whether cutting duties will cause tax revenue to rise or fall. Section IV presents our empirical

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[2]HM Customs and Excise, 1998a. These estimates assume that 70–80 per cent of cross-border shopping is a substitute for domestically purchased alcohol.
[3]HM Customs and Excise, 1998b.
[4]The FES is an annual, random, cross-sectional survey of around 7,000 households per year.

estimates of the price elasticities of demand for beer, wine and spirits and our assessment of the impact of the Single Market on the price responsiveness of demand for beer, wine and spirits. Section V concludes.

II. LONG-TERM TRENDS IN ALCOHOL SPENDING

Mean weekly household spending on beer, wine and spirits bought in the UK[5] is plotted in Figure 1 using data from the FES since 1979.[6] Point-wise confidence intervals are shown at the 95 per cent level. Over the period, real spending on beer has remained fairly constant, with an average real increase between 1979 and 1996 of less than half a per cent each year. There has been a long-term decline in spending on spirits of 2.5 per cent on average a year and a steady

FIGURE 1

Average Weekly Household Spending on Alcohol (constant 1997 prices)

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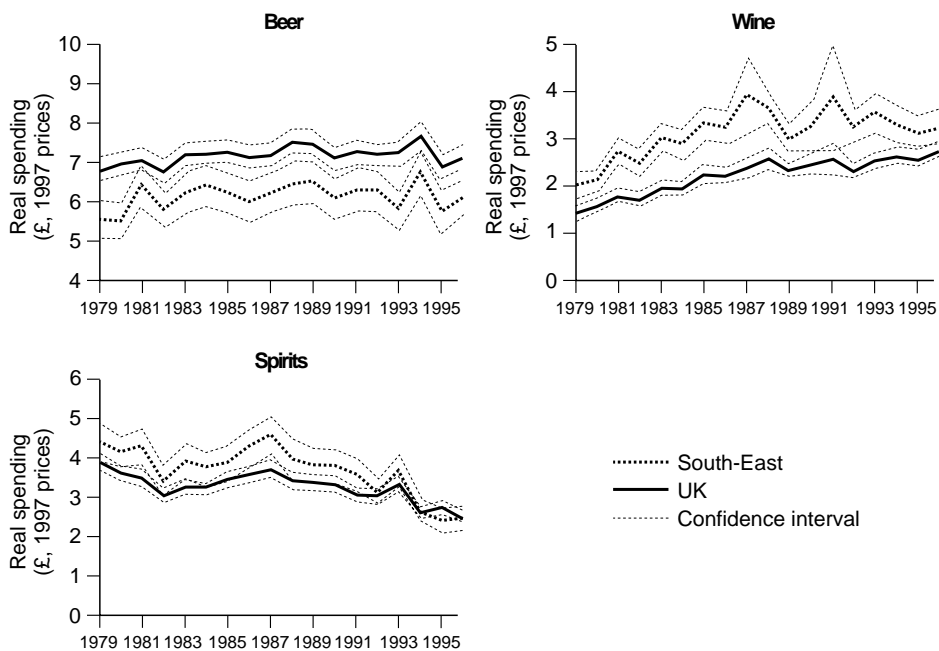
[5]Foreign purchases are not recorded in the FES. Note that we cannot take account of the fact that some domestically purchased alcohol may have been initially purchased in France and then illegally resold. For this reason, our analysis is concerned only with the impact of legitimate cross-border shopping.

[6]There is evidence that total spending on alcohol is under-reported in the Family Expenditure Survey. However, the fact that the level of under-reporting is consistent over time allows us to make reasonable inferences about changes in behaviour over time from changes in the data (see Tanner (1998)).

increase in spending on wine, which increased on average by 3.8 per cent each year.

Figure 1 also looks separately at sales in the South-East (including Greater London). Distance from the border affects the costs — and hence the profitability — of cross-border shopping. Here, we look at whether there are different regional trends in alcohol sales after the introduction of the Single Market at the beginning of 1993.

We allow for four possible effects of cross-border shopping on domestic demand for alcohol, reflecting combinations of a one-off downward shift in real spending and a slower growth in spending than prior to the completion of the Single Market. There is no evidence of either a discrete change or a change in the trend for beer and wine in the UK or in the South-East, and this is confirmed by regressing expenditure on beer and on wine on a yearly trend, a dummy for the Single Market and the dummy interacted with the trend (the results are reported in Appendix A). Both effects are significant[7] for spirits in the UK but the results show a one-off increase in the level of spending together with a greater downward trend. For spirits, we also find evidence of slower growth in spending in the South-East after the completion of the Single Market.

Other cost factors that may affect the profitability of cross-border shopping might include whether households have a van or a car and whether people in the household are in full-time work (which increases the opportunity cost of time). It should be noted that a full assessment of the effect of the Single Market requires us to control for these and other factors (such as changes in total spending and demographic variables) that may affect demand for alcohol, which we do in Section IV.

III. TAX RATES AND REVENUES

Two indirect taxes are charged on alcohol in the UK. All alcohol is subject to the standard rate of value added tax (17.5 per cent). In addition, excise duties are levied at different rates according to the type of alcohol. Duty on beer and spirits is charged — at different rates — according to alcoholic content. The rate of duty on wine is applied to volume of wine and is only loosely related to alcoholic strength. Since the same amount of duty applies to all wine within a range of strengths, the implied level of duty per unit of pure alcohol actually falls within the band as the alcoholic strength increases. Table 1 shows the levels of duty charged on beer, wine and spirits on a comparable basis of duty per litre of pure alcohol. Beer is the least heavily taxed, then wine, while spirits are the most heavily taxed. Alcohol in the form of spirits is taxed more than 70 per cent more heavily than alcohol in the form of beer.

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[7]At the 5 per cent significance level.

TABLE 1

Alcohol Taxes, January 1999

	Implied duty per litre of pure alcohol	*Duty + VAT as a percentage of final price*
Beer	£11.50	30%
Wine	£14.56	51%
Spirits	£19.56	62%

Note: Beer is defined as a pint of bitter bought on licensed premises at 3.9% abv, wine is a 75cl bottle of table wine at less than 15% abv and spirits is a 70cl bottle of whisky at 40% abv.
Source: HM Customs and Excise, 1998b.

Taking account of VAT as well as excise duties, 62 per cent of the final price of a bottle of spirits represents tax, compared with 51 per cent of the price of a bottle of wine and 30 per cent of the price of a pint of beer.[8] The higher duty on spirits is in spite of nominal cuts in the rate of duty on spirits in 1995 and 1996. Figure 2 shows the real values of excise duty on beer, wine and spirits since 1978.

One possible economic justification for imposing additional taxes on alcohol relies on instances of market failure. First, people may lack information regarding some of the possible adverse health effects of drinking alcohol. If so, alcohol taxes can be used to reduce consumption to a level that individuals

FIGURE 2

Real Value of Excise Duties
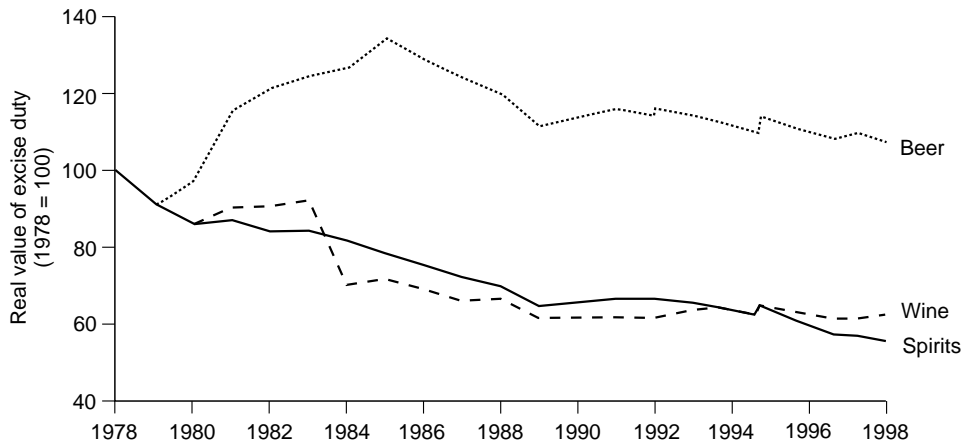
[8]Calculated using standard prices in HM Customs and Excise (1998b).

would choose if they were fully informed. Second, there may be external social costs, such as the potential anti-social consequences of drunkenness, that individuals do not consider when they decide how much alcohol to consume. Since the externality is linked to the quantity of alcohol, a sensible system would seem to be to tax the quantity of alcohol on a uniform basis. To justify taxing alcohol in different forms in different ways, it needs to be shown that consuming alcohol in different forms is associated with different levels of social cost.

In practice, these economic arguments may be used to justify imposing additional taxes on alcohol in the first place, but setting the actual levels of tax rates each year is more likely to be a question of raising revenue.[9] Crawford and Tanner (1995) discussed the relationship between the tax-inclusive and tax-exclusive prices and the own-price elasticity of demand at the point of revenue maximisation (assuming zero cross-price effects). Given the current tax-inclusive and tax-exclusive prices, there is a critical elasticity level that implies that the current tax rate is revenue-maximising. At this point, the revenue effect from a change in demand following a change in the level of duty exactly offsets the revenue effect per unit sold. If the actual elasticity is (absolutely) smaller than this critical level, then the actual tax rate is below its revenue-maximising level and increases in the tax rate will cause revenue to rise. Similarly, if the actual elasticity is (absolutely) larger than this critical level, then the actual tax rate is above its revenue-maximising level and revenue can be increased by cutting taxes. Comparing the critical elasticity levels for beer, wine and spirits with estimates of the own-price elasticities, Crawford and Tanner (1995) concluded that the rates of tax on beer and wine were below their revenue-maximising levels and that further increases in the rates of tax would cause tax revenues to rise. In the case of spirits, however, it could not be rejected that the current rate of tax was revenue-maximising.

However, their analysis considered only the effect of changing the tax rate on demand for the good itself and ignored the effects of changing the tax rate on demand for complements and substitutes that have additional indirect tax revenue implications if purchased domestically. If the duty on beer changes, this is likely to affect not only the demand for beer but also the demand for other goods. The extent to which these other goods are substitutes or complements (and the rate at which they are taxed) will determine the overall effect on indirect tax revenue. As an example, if spirits and wine are substitutes for beer, and beer duty is cut, then the fall in the price of beer will lead to a fall in demand for wine and spirits and hence a fall in revenue from these goods. This means that, for the overall effect on total indirect tax revenue to be positive, the own-price elasticity

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[9]Ramsey (1927) showed that to raise revenue with the minimum welfare loss, in the absence of lump-sum taxes, goods with the lowest compensated elasticities should be taxed the most as a proportion of price (assuming no cross-price effects). In this case, beer should be taxed the most heavily of the three types of alcohol, not the least, since demand for beer is less elastic than demand for wine or spirits, as our later empirical results show.

of beer would have to be (absolutely) larger than when no cross-price effects were considered. If spirits and wine are complements for beer, then the opposite is true.

We extend the analysis to include cross-price effects. Crawford and Tanner (1995) show a special case of this more general approach where all the cross-price effects are zero. Denote the tax rate on good i by τ_i, total tax revenue from all goods by R, the quantity demanded by q_i and the tax-exclusive price by π_i; then the total indirect tax revenue function with n goods is given by

$$(1) \qquad R = \sum_{i=1}^{n} \tau_i \pi_i q_i$$

where q_i is a function of all tax-inclusive prices, p_i, the available budget, x, and a set of demographic, regional and other variables, $\mathbf{z}$:

$$(2) \qquad q_i = q(p_1, p_2, \ldots, p_n, x, \mathbf{z})$$

where $p_i = \pi_i (1 + \tau_i)$. Differentiating (1) with respect to τ_i, we obtain

$$(3) \qquad \frac{\partial R}{\partial \tau_i} = \pi_i q_i + \sum_{j=1}^{n} \tau_j \pi_j \frac{\partial q_j}{\partial \tau_i}.$$

By definition, assuming no change in the pre-tax price,

$$(4) \qquad \frac{\partial q_j}{\partial \tau_i} = \frac{\partial q_j}{\partial p_i} \pi_i$$

and

$$(5) \qquad \frac{\partial q_j}{\partial p_i} = \varepsilon_{ji} \frac{q_j}{p_i}$$

where ε_{ji} is the elasticity of demand for good j with respect to a change in the price of good i. Then, by substitution,

$$(6) \qquad \frac{\partial R}{\partial \tau_i} = \pi_i q_i + \sum_{j=1}^{n} \frac{\varepsilon_{ji} q_j \pi_j \tau_j}{1 + \tau_i} \quad .$$

In the next section, we calculate $\partial R / \partial \tau_i$ using estimates of the own-price elasticities of beer, wine and spirits and the cross-price effects.

Setting $\partial R / \partial \tau_i = 0$ and solving for the own-price elasticity of demand and the corresponding tax-inclusive prices at which total tax revenue is maximised (denoted ε_{ii}^{*} and p_i^{*} respectively), we obtain

$$(7) \qquad \varepsilon_{ii}^{*} = -\left\{ \frac{p_i^{*}}{p_i^{*} - \pi_i} + \sum_{j=1, j \neq i}^{n} \varepsilon_{ji} \frac{q_j}{q_i} \left[\frac{p_j - \pi_j}{p_i^{*} - \pi_i} \right] \right\},$$

which is the critical level of the own-price elasticity of demand that must hold if the current tax rate on good i is revenue-maximising.

Note that if there are no cross-price effects, then we get the result from Crawford and Tanner (1995) that the absolute value of the critical elasticity is simply the inverse of the amount of tax as a proportion of the tax-inclusive price. Including the cross-price effects increases the absolute value of the critical elasticity in the case of complements and reduces it in the case of substitutes. The bigger the absolute value of the cross-price effect, the greater the change in the magnitude of the critical elasticity. However, the impact of each cross-price effect is weighted by the ratio of the amount of tax per unit of the complement or substitute to the amount of tax per unit of the good itself. The more heavily taxed the complement, the bigger the revenue effect for a given change in demand for the complement and the more demand for the own good has to change to keep total revenue constant.

The Single Market

When consumers are able to engage in cross-border shopping, it is not only the level of demand for domestic complements and substitutes that will be affected by changes in the level of taxation. Another possible response to an increase in the price of a domestic good is for consumers to purchase the same good across the border. By providing an additional close substitute for domestically purchased alcohol, the effect of the Single Market is likely to increase the (absolute) level of elasticity for domestic alcohol (other things being equal). The fact that there are fixed costs to crossing the border means that not all consumers will buy alcohol across the border in spite of price differentials. Whether or not consumers engage in cross-border shopping is likely to be affected by their geographical proximity to the border as well as by factors such as access to transport and the opportunity cost of time. Initially, the Single Market is likely to lead to a one-off fall in the amount of alcohol bought in the UK as those with the lowest fixed costs of cross-border shopping switch to buying some or all of their alcohol across the border. Subsequent further increases in the price of domestic

alcohol will make it more attractive to consumers with slightly higher fixed costs to buy alcohol across the border. After completion of the Single Market, a given change in the price of alcohol in the UK is likely to result in a larger change in demand for domestic alcohol (other things being equal) — that is, an increase in the own-price elasticity of demand.

However, against this must be offset the possibility that a change in the characteristics of the set of consumers who continue to buy alcohol in the UK might work to reduce the price elasticity of demand. For example, only the most price-sensitive consumers might switch to buying alcohol across the border as a result of the Single Market, while the least price-sensitive consumers remain. This compositional effect may mean that the (absolute) elasticity among remaining domestic consumers actually falls. For this reason, the effect of the Single Market on the observed own-price elasticity of demand cannot be determined a priori but is an empirical matter which we investigate further in the next section.

The Single Market is also likely to have an effect on the cross-price elasticity of demand for other goods, including different types of alcohol. In practice, the decision to shop across the border is likely to be triggered by large price differentials on particular goods (trigger goods). But once consumers have decided to shop across the border, they are likely to buy other goods that are also available more cheaply but for which the cost savings may not be enough to cover the fixed costs of cross-border shopping. For a given increase in the price of a trigger good in the UK, we would therefore expect to see a greater reduction in domestic demand for these other goods as a result of cross-border shopping. After completion of the Single Market, the cross-price elasticity of demand for these other goods with respect to a change in the price of a trigger good is likely to be (absolutely) larger (other things being equal). Goods that are already complements before the Single Market are likely to become more complementary; goods that are substitutes before the Single Market are likely to become less so. If beer and wine, say, are substitutes, then before the Single Market consumers will respond to an increase in the price of beer by buying more domestic wine; after the Single Market they will buy more beer and wine across the border. Note that we would only expect to see significant changes in cross-price effects where one or both of the own-price elasticities also change. For example, we would only expect the price sensitivity of demand for beer with respect to the price of wine to change significantly if the own-price elasticity of demand for beer or wine has also changed significantly.

IV. EMPIRICAL EVIDENCE

This section uses data from the Family Expenditure Survey from 1979 to 1996 to examine the theoretical issues raised above. The resulting sample contains 118,178 observations. We estimate a system of demand equations for

domestically purchased beer, wine, spirits and other goods and obtain estimates of the own-price and cross-price elasticities of demand. We examine whether the Single Market has had an effect on domestic demand responsiveness by comparing estimates of elasticities before and after its completion. Using the estimated own- and cross-price effects, we test whether revenue is maximised and, if it is not, we assess whether further increases in the indirect tax rate are likely to cause indirect tax revenue to rise or fall.

1. The Model

We assume two-stage budgeting; that is, we assume that households behave as if they make a prior allocation of income to saving and broad categories of expenditure before they decide how much to spend on individual items within these categories.[10] This allows us to look at the allocation within a budget. We use the Quadratic Almost Ideal Demand System (QUAIDS) of Banks, Blundell and Lewbel (1997). This is an empirical model of how households allocate their spending across different groups of goods, given total expenditure levels (decided in a previous stage of the decision process), conditional on the relative prices of those goods, the level of total expenditure,[11] household composition and other observables. The general form of the model is

$$w_i^h = \sum_{k=1}^{n} \alpha_{ik} z_k^h + \sum_{j=1}^{n} \left(\gamma_{ij} + \delta_{ij} d_{SM}^h \right) \ln p_j + \beta_i \ln \left(\frac{x^h}{a(\mathbf{p})^h} \right)$$
$$+ \frac{\lambda_i}{b(\mathbf{p})} \left\{ \ln \left(\frac{x^h}{a(\mathbf{p})^h} \right) \right\}^2$$

where

$$\ln a(\mathbf{p})^h = \alpha_0 + \sum_{i=1}^{n} \alpha_{ik} z_k^h \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \left(\gamma_{ij} + \delta_{ij} d_{SM}^h \right) \ln p_i \ln p_j$$

and $b(\mathbf{p})$ is the Cobb–Douglas price aggregator,

$$b(\mathbf{p}) = \prod_{i=1}^{n} p_i^{\beta_i} .$$

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[10]Gorman, 1976.

[11]The level of total expenditure is treated as endogenous and we estimate the model by instrumental variables using total household income and total household income squared as instruments. The standard errors reported with the results reflect this.

For each good i, the budget share[12] of household h spent on beer, wine or spirits (w_i^h) is treated as a function of log prices ($\ln p_i$), the log of total non-durable expenditure deflated by a price index $a(\mathbf{p})^h$ ($\ln\left[x^h / a(\mathbf{p})^h\right]$), the square of the same term deflated by another price index $b(\mathbf{p})$, and a set of household characteristics (z_k^h). These include the age of the household head, the number of adults, the proportion of women and the number of children in the household, whether there is a smoker in the household and the number of cars. A dummy variable is also included for the South-East and this is interacted with the Single Market dummy (d_{SM}^h) to allow responses to the Single Market to vary regionally.

To capture the effect of the Single Market more generally, we include a Single Market dummy and interact it with log prices. We impose the usual restrictions on the empirical model: adding-up (the sum of the budget shares must be 1 so that all of the available budget is spent), homogeneity (doubling the budget and all the prices simultaneously does not affect demands) and symmetry (price responses in different equations are consistent).[13] The full restricted regression results are reported in Appendix C.[14]

2. Elasticity Estimates

From our results, we obtain estimates of the demand elasticities for beer, wine and spirits.[15] The estimated elasticities are reported in Table 2 for the four years up to the completion of the Single Market ($\hat{\varepsilon}_{ji}^{nsm}$) and for the four years following ($\hat{\varepsilon}_{ji}^{sm}$). Standard errors are shown in parentheses. The diagonal elements of the table are the own-price effects and the off-diagonal elements are the cross-price effects. In both time periods, beer is the least elastic of the three

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[12]Expenditure on beer, wine and spirits in the UK as a proportion of non-durable expenditure. Note that we are unable to address the issue of quality change in response to price changes with these data.

[13]Symmetry is slightly more complicated than usual in this model because of the way in which the dummy variable indicating whether or not each household was observed during the period of the Single Market multiplies the prices. This means that, for a household observed before the Single Market, the price terms are γ_{ij} (because $d_{SM} = 0$). But for a household observed after the completion of the Single Market, the price terms are $\gamma_{ij} + o_{ij}$ (because $d_{SM} = 1$). The symmetry restriction requires that the price terms for both types of household are symmetric: for pre-Single-Market households, this means $\gamma_{ij} = \gamma_{ji}$; for households observed during the Single Market, it means that $\gamma_{ij} + o_{ij} = \gamma_{ji} + o_{ji}$, for which $o_{ij} = o_{ji}$ is sufficient if $\gamma_{ij} = \gamma_{ji}$.

[14]The parameter α_0 is fixed to be $\ln\min\{x\}$ (which is 0.288 in our sample) and the estimation is an iterative process which is treated as converged once the maximum absolute change in the parameter vectors becomes less than half of one per cent.

[15]The elasticities and their standard errors are calculated at mean budget shares.

TABLE 2

Estimated Elasticities for the UK

1989–92 $\hat{\varepsilon}_{ji}^{nsm}$

i	j		
	Beer	Wine	Spirits
Beer	–0.74 (0.119)	–0.73 (0.409)	–0.59 (0.389)
Wine	–0.19 (0.111)	–1.85 (0.673)	0.67 (0.533)
Spirits	–0.22 (0.151)	0.94 (0.760)	–0.86 (0.904)

1993–96 $\hat{\varepsilon}_{ji}^{sm}$

i	j		
	Beer	Wine	Spirits
Beer	–0.76 (0.094)	–0.60 (0.282)	–0.59 (0.329)
Wine	–0.17 (0.087)	–1.69 (0.464)	0.66 (0.449)
Spirits	–0.20 (0.120)	0.77 (0.525)	–0.86 (0.763)

Note: Standard errors are shown in parentheses.

TABLE 3

Estimated Elasticities for the South-East

1989–92 $\hat{\varepsilon}_{ji}^{nsm}$

i	j		
	Beer	Wine	Spirits
Beer	–0.67 (0.154)	–0.58 (0.331)	–0.57 (0.380)
Wine	–0.24 (0.144)	–1.69 (0.545)	0.65 (0.521)
Spirits	–0.28 (0.196)	0.76 (0.616)	–0.86 (0.884)

1993–96 $\hat{\varepsilon}_{ji}^{sm}$

i	j		
	Beer	Wine	Spirits
Beer	–0.69 (0.123)	–0.52 (0.249)	–0.65 (0.370)
Wine	–0.23 (0.115)	–1.61 (0.409)	0.75 (0.503)
Spirits	–0.27 (0.159)	0.68 (0.463)	–0.84 (0.856)

Note: Standard errors are shown in parentheses.

types of alcohol and wine is the most elastic. From the cross-price effects, we can see that beer and wine are complements, as are beer and spirits, while wine and spirits are substitutes. For example, the estimated own-price elasticity of beer before the Single Market was –0.74, indicating that a 1 per cent increase in the price of beer would reduce demand by an (expected) 0.74 per cent. Also, prior to the Single Market, a 1 per cent increase in the price of beer would reduce demand for wine by 0.73 per cent and demand for spirits by 0.59 per cent. Table 3 shows the elasticities for the South-East. These are not significantly different from those for the UK as a whole (see Appendix B).

Section II looked at levels of average spending on alcohol to gain some idea about the effect of cross-border shopping on domestic demand. We can now test formally whether there has been any significant change in the own-price and cross-price elasticities after the completion of the Single Market.[16] We test the null hypothesis that the true (population) elasticities are the same in the period before and after the Single Market ($H_0: \varepsilon_{ji}^{sm} = \varepsilon_{ji}^{nsm}$) against the alternative that the elasticities are not the same ($H_1: \varepsilon_{ji}^{sm} \neq \varepsilon_{ji}^{nsm}$). We perform the test only for the whole of the UK since these elasticities are not significantly different from those for the South-East. The t-statistics are reported in Table 4. We cannot reject the null of no change for any of the own- or cross-price effects.

We next turn to the issue of whether current rates of duty are revenue-maximising and, if they are not, whether a further increase in tax rates will cause total revenue to rise or fall. From equation (6), we can calculate $\partial R / \partial \tau_i$ for current tax rates and test whether it is equal to zero — the point at which revenue

TABLE 4

Test for a Change in the Elasticities after the Single Market for the UK

(t-statistic, $H_0: \varepsilon_{ji}^{sm} = \varepsilon_{ji}^{nsm}$)

i	j		
	Beer	Wine	Spirits
Beer	–0.10	0.25	0.00
Wine	0.11	0.18	–0.01
Spirits	0.08	–0.17	0.00

[16]Note that we are not looking at whether the elasticities for households with given characteristics have changed after the Single Market. We are merely testing whether the elasticity has changed taking into account that households may have different characteristics before and after the Single Market since it is this that matters for revenue.

TABLE 5

Test for whether Current Tax Rates are Revenue-Maximising

	Including cross-price effects		Excluding cross-price effects	
	$\partial R / \partial \tau_i$	*t-statistic,* $H_0: \partial R / \partial \tau_i = 0$	$\partial R / \partial \tau_i$	*t-statistic,* $H_0: \partial R / \partial \tau_i = 0$
Beer	5.29	7.16	7.49	23.48
Wine	1.34	2.21	0.55	0.98
Spirits	1.20	1.79	0.83	0.90

Notes:

Beer is defined as a pint of bitter bought on licensed premises at 3.9% abv, wine is a 75cl bottle of table wine at less than 15% abv and spirits is a 70cl bottle of whisky at 40% abv.

Tax rates for beer, wine and spirits are obtained using typical prices from HM Customs and Excise (1998b) updated to March 1999 using RPI sub-indices.

The tax rate for all other goods is assumed to be 10.5%, reflecting the fact that approximately 60% of goods are subject to 17.5% VAT.

is maximised.[17] Note that, since the value of $\partial R / \partial \tau_i$ depends on the own- and cross-price elasticities, which we estimate from our model, and on spending on the goods considered, $\partial R / \partial \tau_i$ is itself an estimate and hence has a sampling distribution and a standard error. We test the null hypothesis that current tax rates are at their revenue-maximising levels ($H_0: \partial R / \partial \tau_i = 0$) against the alternative that they are not ($H_1: \partial R / \partial \tau_i \neq 0$) and report the t-statistics in Table 5.

We reject the null hypothesis for beer and wine but not for spirits. For beer and wine, $\partial R / \partial \tau_i$ is positive, which means that tax rates are below their revenue-maximising levels. However, we cannot reject that the current tax rate on spirits is at a revenue-maximising level, implying that a further increase in duty on spirits would lead to a fall in indirect tax revenue. Table 5 also reports $\partial R / \partial \tau_i$ ignoring cross-price effects, for comparison with Crawford and Tanner (1995). Again, we cannot reject the null hypothesis for spirits, which is in line with what Crawford and Tanner (1995) found. Excluding the cross-price effects, we also cannot reject that the current tax rate on wine is revenue-maximising. This shows the importance of taking account of cross-price effects. An increase in the price of wine following a duty rise will cause a fall in demand for beer (which is a complement for wine) but an increase in demand for spirits (which is

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[17]To calculate $\partial R / \partial \tau_i$ at 1999 tax rates, we update prices and total non-durable spending to March 1999 using RPI sub-indices and recalculate elasticities. Figures from the National Accounts are used for average spending on beer, wine, spirits and total non-durables.

a substitute for wine). The fall in demand for beer makes it more likely that an increase in duty on wine leads to a fall in total indirect tax revenue from alcohol. But the effect from the change in demand for spirits works in the other direction. The final effect on indirect tax revenue depends on the balance of the effects on indirect tax revenue from the change in demand for wine, beer and spirits. In fact, the increase in demand for spirits is likely to have the greatest indirect revenue effect (for a given level of demand) since spirits are the most heavily taxed form of alcohol. Hence taking account of the increase in demand for (and revenue from) spirits following an increase in the price of wine makes it more likely that increasing wine duty will increase total indirect tax revenue.

V. CONCLUSIONS

This paper addresses two related issues: first, the effect of the Single Market on domestic demand for alcoholic drinks; and second, whether there is a revenue case for changing the current level of duties. Duty on alcohol is an important source of revenue for the Chancellor and there has been concern about revenue lost to cross-border shopping since the completion of the Single Market in 1993. However, cutting duties will restore demand but will lead to a loss of tax on each unit sold. We show that the effect on indirect tax revenue of a change in the level of duty depends on the price elasticity of demand for the good itself and the cross-price elasticity of demand for other goods. We argue that the effect of the Single Market on price elasticities is a priori ambiguous. The availability of an additional substitute to domestically purchased alcohol is likely to increase the price elasticity of demand. But the fact that only the most price-sensitive consumers are likely to shop across the border is likely to work in the other direction. We use estimates of own- and cross-price elasticities for beer, wine and spirits to address these two issues.

We find no evidence of a significant change in the elasticity of demand for beer, wine or spirits after 1993, controlling for other household characteristics. We find that the duty rates on beer and wine are below their revenue-maximising levels, so cutting duty on those drinks is likely to cause indirect tax revenue to fall. We cannot reject that the current duty on spirits is at the revenue-maximising rate, implying that an increase in duty on spirits is likely to decrease indirect tax revenue. Given this result, and the bias against spirits in the amount of duty imposed per unit of alcohol when compared with other types of alcohol, there may be a case for not increasing the tax rate on spirits any further if the Chancellor does not want to lose revenue.

APPENDIX A
OLS Regression Results: Average Real Spending on Alcohol

Dependent variable: real expenditure on alcohol in the UK

Variable	Beer	Wine	Spirits
Yearly trend	0.34 (0.014)	0.08 (0.010)	–0.03 (0.010)
Single Market dummy	2.15 (1.544)	0.19 (1.070)	3.32 (1.693)
Single Market dummy × Trend	–0.14 (0.942)	–0.03 (0.065)	–0.22 (0.103)
Constant	6.89 (0.118)	1.48 (0.081)	3.64 (0.129)

Dependent variable: real expenditure on alcohol in the South-East

Variable	Beer	Wine	Spirits
Yearly trend	0.04 (0.022)	0.11 (0.233)	–0.05 (0.024)
Single Market dummy	0.32 (2.458)	3.17 (2.608)	4.96 (2.719)
Single Market dummy × Trend	–0.15 (0.150)	–0.24 (0.159)	–0.34 (0.166)
Constant	5.79 (0.187)	2.22 (0.199)	4.27 (0.207)

Note: Standard errors are shown in parentheses.

APPENDIX B
Test of whether the Elasticities for the South-East are the Same as Those for the UK as a Whole

Before the Single Market

t-statistic, $H_0: \varepsilon_{ji}^{nsm,uk} = \varepsilon_{ji}^{nsm,se}$

i	j		
	Beer	Wine	Spirits
Beer	–0.36	–0.29	–0.04
Wine	0.28	–0.18	0.03
Spirits	0.24	0.18	0.00

After the Single Market

t-statistic, $H_0: \varepsilon_{ji}^{sm,uk} = \varepsilon_{ji}^{sm,se}$

i	j		
	Beer	Wine	Spirits
Beer	–0.45	–0.21	0.12
Wine	0.42	–0.13	–0.13
Spirits	0.35	0.13	–0.02

APPENDIX C
Share Equation Regression Results

Test of homogeneity and symmetry: $\chi^2(12) = 128.30990$

n=118178	Dependent variable			
Variable	*Beer*	*Wine*	*Spirits*	*Other goods*
ln(expenditure)	–0.015 (0.0103)	–0.006 (0.0041)	0.019 (0.0062)	0.002 (0.0132)
[ln(expenditure)]^2	0.001 (0.0010)	0.002 (0.0004)	–0.001 (0.0006)	–0.003 (0.0012)
ln(beer price)	0.008 (0.0023)	–0.007 (0.0021)	–0.007 (0.0029)	0.005 (0.0030)
ln(wine price)	–0.007 (0.0021)	–0.009 (0.0035)	0.009 (0.0039)	0.006 (0.0041)
ln(spirits price)	–0.007 (0.0029)	0.009 (0.0039)	0.001 (0.0067)	–0.003 (0.0054)
ln(other price index)	0.005 (0.0030)	0.006 (0.0041)	–0.003 (0.0054)	–0.009 (0.0079)
SM	0.000 (0.0007)	0.002 (0.0003)	0.000 (0.0004)	–0.002 (0.0009)
SM×ln(beer price)	–0.002 (0.0041)	–0.005 (0.0039)	0.004 (0.0053)	0.003 (0.0053)
SM×ln(wine price)	–0.005 (0.0039)	0.002 (0.0064)	0.008 (0.0073)	–0.005 (0.0075)
SM×ln(spirits price)	0.004 (0.0053)	0.008 (0.0073)	–0.021 (0.0124)	0.009 (0.0099)
SM×ln(other price)	0.003 (0.0053)	–0.005 (0.0075)	0.009 (0.0099)	–0.007 (0.0144)
SE	–0.011 (0.0009)	0.001 (0.0005)	0.001 (0.0007)	0.010 (0.0011)
SE×SM	–0.001 (0.0012)	–0.001 (0.0006)	–0.002 (0.0008)	0.005 (0.0016)
Number of adults	0.008 (0.0004)	–0.006 (0.0002)	–0.003 (0.0002)	0.001 (0.0005)
Proportion of women	–0.063 (0.0007)	–0.001 (0.0003)	–0.008 (0.0004)	0.072 (0.0009)
Number of children	–0.008 (0.0002)	–0.003 (0.0001)	–0.004 (0.0001)	0.014 (0.0002)
Age	–0.001 (0.0000)	0.000 (0.0000)	0.000 (0.0000)	0.001 (0.0000)
Age^2	0.000 (0.0000)	0.000 (0.0000)	0.000 (0.0000)	0.000 (0.0000)
Wales	0.002 (0.0007)	–0.001 (0.0003)	0.000 (0.0004)	0.000 (0.0009)
Scotland	–0.013 (0.0006)	–0.002 (0.0002)	0.012 (0.0004)	0.002 (0.0007)
Christmas	–0.003 (0.0006)	0.003 (0.0003)	0.008 (0.0004)	–0.009 (0.0008)
Education	–0.004 (0.0003)	0.003 (0.0001)	0.000 (0.0002)	0.002 (0.0004)
Not working	–0.004 (0.0005)	0.001 (0.0002)	–0.002 (0.0003)	0.005 (0.0006)
Smoker	0.013 (0.0004)	–0.001 (0.0001)	0.004 (0.0002)	–0.016 (0.0005)
Number of cars	–0.010 (0.0003)	0.000 (0.0001)	–0.001 (0.0002)	0.011 (0.0004)
Constant	0.112 (0.0276)	–0.001 (0.0109)	–0.060 (0.0166)	0.949 (0.0353)

Notes:
SM is a dummy variable to capture the effect of the Single Market.
SE is a dummy variable for the South-East.
Wales, Scotland, Christmas, education, not working and smoker are dummy variables.
Standard errors are shown in parentheses.

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