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<th>Title</th>
<th>The revenue implications of tax harmonisation</th>
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The Revenue Implications of Tax Harmonisation

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Report prepared for the European League for Economic Co-operation.

Brendan Walsh and Ian Irvine were involved in the initial stages of this work. Any errors are, however, my responsibility.
(1) Introduction.

The Commission of the EEC has recently proposed a program to harmonise indirect taxes between member countries.¹ In essence, the Commission proposes a two-tier system for value added tax (VAT) based on a standard rate between 14% and 19% and a reduced rate within the range 4% to 9%, and that excise duties should be brought into line with existing EEC averages. The purpose of this report is to estimate possible changes in Irish government revenue arising from an implementation the Commission's proposals.

Given the current structure of indirect taxation in Ireland it is clear that these proposals must have important consequences for government revenue. Tables 1 and 2 give an indication of Irish indirect tax rates relative to those in other member states. Hence the Commission's proposals would imply a reduction in the rates of VAT on most goods in Ireland and significant falls in excise duties. The most notable exceptions would be for those goods and services which are currently zero-rated. The most important zero-rated goods in Ireland are food, rent and children's clothing. Assuming that Ireland is not accorded derogations on these commodities then tax harmonisation must imply increases in their prices.

Tax harmonisation therefore implies a change in the structure of relative prices. Food, children's clothing, fuel and

¹ Completion of the Internal Market: Approximation of Indirect Tax Rates an Harmonisation of Indirect Tax Structure, COM (87) 320 final.
rented accommodation would all rise in price while the prices of goods such as alcohol, tobacco, petrol and consumer durables would decline. As tax-induced price changes may significantly affect the pattern of consumer demand, the revenue consequences of the Commission’s proposals cannot be adequately assessed unless these variations are accounted for.

In this report I use standard econometric methods to estimate a consumer expenditure system from which I project changes in personal expenditure patterns following the implementation of tax harmonisation. A combination of the new tax rates and expenditures is then used to compute a predicted set of revenue estimates.

(2) Methodology.

Taxes on goods and services may consist of two components—excise duty which is a specific amount per unit sold and value added tax which is a percentage of the sum of excise tax and the seller’s price. Denoting per unit excise duty by $k$ and the VAT rate by $v$, the relationship between the consumer price and the seller’s price may be expressed as:

$$P = (1 + v)(Ps + k)$$  \hspace{1cm} (1)

where $P$ is the price paid by the consumer and $Ps$ is the price retained by the seller. In what follows it is more convenient to combine these taxes into a single rate and express the above relationship as:

$$P = (1 + t)Ps$$  \hspace{1cm} (2)
where the composite tax rate \( t \) may be defined as the ratio of tax revenue to seller's revenue. That is, multiplying both sides of (2) by total quantity sold, \( Q \), gives:

\[
PQ = PsQ + tPsQ
\]

(3)

Where \( PQ \) is total consumer expenditure which may also be defined as the sum of tax revenue and producer/seller revenue.\(^2\) Hence,

\[
PQ = R + Rs
\]

(4)

where, \( R \) is tax revenue from total sales of the good and \( Rs = PsQ \) or seller's revenue. Equating the right hand sides of (3) and (4) therefore gives:

\[
R = tPsQ
\]

(5)

Hence \( t = R/Rs \) of the ratio of total tax revenue to seller's revenue.

Defining the tax rate in this way makes (5) a convenient expression for illustrating the potential revenue implications of tax changes. At a constant seller's price, a change in the rate of tax, either in the form of a change in the VAT rate or excise duty, will affect revenue in two distinct ways. First, at any given \( Q \) an increase (decrease) in \( t \) will unambiguously raise (reduce) tax revenue. Second, as a change in the rate of tax leads to a change in the consumer price, the quantity purchased will change. If, for example, \( t \) is increased then \( P \) will rise and \( Q \) will fall leading to a decline in revenue. As these effects work in opposite directions, the total impact on tax revenue is ambiguous. In the appendix I show that the net effect of a change

\(^2\) Seller's revenue is assumed constant throughout the report.
in the tax rate will depend on the product of the price elasticity of demand and the portion of tax in consumer price. If the absolute value of this product is less than unity then revenue will rise (fall) as the tax rate rises (falls). Conversely, if the absolute value is greater than unity then revenue will change in the opposite direction to the tax rate.  

However, the above only considers revenue from a single good whereas total revenue is the aggregate of revenues over all goods. Consider, for example, two goods A and B. If the tax rate applied to A is increased the revenue yield from A will change according to the conditions described above. But B might be a substitute (compliment) for A, in which case both purchases of B and revenue from B will increase (decrease) as the price of A rises. Hence to project the change in aggregate tax revenue we need to know the price elasticity, or responsiveness, of demand for A and the elasticity of demand for B with respect to the price of A. Further, if the tax rate applied to B is also changed then an estimate of the overall effect on tax revenue requires knowledge of the price elasticity of demand for B and the elasticity of demand for A with respect to the price of B.

More generally, a comprehensive assessment of potential revenue changes requires a prior estimate of the way in which consumption patterns may vary as a consequence of tax-induced

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3 The elasticity of demand is defined as the % change in Q divided by the % change in P and is a measure of the price responsiveness of demand. If, for example, the elasticity is -0.5 then a 1% increase in P leads to a 0.5% decline in Q.
price changes. One method of obtaining such an estimate is to specify a 'demand system' which relates the consumption of each good or service to an appropriate vector of consumer prices and other determining variables such as real income. Estimates of the system's parameters can then be used to project the variations in consumption patterns and revenue changes which may follow any given set of price changes.

The demand system used in this report is based on the 'Almost Ideal Demand System' developed by Deaton and Muellbauer (1980). The methodology followed may be outlined as follows:

1. Consumer expenditure is divided into eleven categories. These are.

   Food and non-alcoholic beverages.
   Alcohol comprising beer, wine and spirits.
   Tobacco
   Clothing and footwear.
   Fuel and power - coal, heating oil, ESB etc.
   Petrol.
   Rent.
   Services.
   Durable goods.
   Transport equipment - cars etc.
   Other goods and services - non-durables, equipment and accessories, miscellaneous goods etc.

---

Note that the expenditure figures used relate to personal (i.e. non-business) expenditure.

2. The demand system specifies the expenditure share (expenditure on each good as a proportion of aggregate expenditure) as being determined by the eleven prices and total real consumer expenditure.

3. Annual data derived from various issues of National Income and Expenditure are used to estimate the system's parameters by standard econometric techniques. The sample period is 1953 to 1985.

4. The 1985 prices are changed in line with the alternative set of VAT rates and excise duties proposed by the Commission, and the estimates of the system's parameters are used to predict what the vector of expenditure shares would have been if these tax rates had actually been applied in 1985.\(^6\)

5. The predicted 1985 expenditures are then used to project tax revenue from each type of good and these estimates are compared with the actual revenues raised in 1985.

Actual and predicted revenues are computed as follows. Let \( R_{i,t} \) denote the actual revenue from good \( i \) in 1985. Seller's revenue from good \( i \) is, by definition, equal to the difference between consumer's expenditure and tax revenue. Hence, we can re-express (5) as:

\[
R_{i,t} = t_{i,t}(E_{i,t} - R_{i,t}) \tag{6}
\]

\(^6\) 1985 is the most recent year for which detailed personal expenditure is published. See National Income and Expenditure 1986 (CSO) published Jan. 1988.
where $t_{i1}$ and $E_{i1}$ denote the 1985 tax rate and expenditure on
good i. Rearranging gives:

$$R_{i1} = \frac{t_{i1}}{1+t_{i1}} E_{i1}$$

Hence revenue can be computed from two bits of information - the
tax rate and consumer expenditure. Predicted revenue from the
alternative set of tax rates is likewise computed by:

$$R_{i2} = \frac{t_{i2}}{1+t_{i2}} E_{i2}$$

where $t_{i2}$ is the new tax rate and $E_{i2}$ is the expenditure on good
i predicted by the estimated demand system.

(3) The Almost Ideal Demand System.

The first step in deriving revenue projections is to model
the way in which consumer's allocate total expenditure across the
different goods and services. To this end I use a model of
consumer expenditure based on Deaton and Muellbauer's Almost
Ideal Demand System (1980). The Almost Ideal Demand System
assumes a simple linear relationship between the proportion of
total expenditure allocated to each good, an appropriate vector
of prices and real aggregate consumer expenditure. Estimates of
the model's parameters measure the response of each expenditure
share to given changes in prices. Once the parameters are
determined they can be used to predict how the consumption of
each good will vary in response to tax-induced price changes, and
the predicted expenditures can be used to compute revenue changes
at the new set of price changes.

One advantage of the Almost Ideal Demand System is its
flexibility in applying restrictions implied by economic theory. Economists normally approach the problem of consumer demand by assuming that individuals allocate a given income to different goods and services in order achieve maximum personal benefit or, in economists' language, to maximize utility. If individuals actually follow the economists' model and are utility maximizers, then demand functions which express optimum consumption levels in terms of prices and income must have certain characteristics. For example, the utility maximizing consumption allocation should be invariant with respect to an equal proportionate change in all prices and nominal income. Hence a period of inflation which left relative prices and real incomes unchanged would have no effect on the quantities of goods and services bought by individuals.

However, utility maximisation and the consequent properties of expenditure systems, are hypotheses about individual consumers and there is no concurrent presumption that they should be supported by aggregate data. As the estimates of the demand system are based on aggregate, or economy wide, expenditure data, imposing the utility maximising restrictions might lead to erroneous results. Hence I present estimates for restricted and unrestricted models. The restricted estimates are those derived from a model which satisfies utility maximisation, while the unrestricted model ignores these properties.

The estimates are given in Tables 3 (restricted) and 4 (unrestricted). Rather than present the estimated parameters, I give the matrix of own-price and cross-price elasticities for
each model. In each case the own-price elasticities are given on the principal diagonal. For example, using Table 3, the elasticity of demand for food with respect to changes in the price of food is estimated as -0.55 which implies that a 1% rise (fall) in price reduces (increases) consumption by 0.55%. Likewise, the own-price elasticity of demand for alcohol is estimated at -0.52 etc. The off-diagonal elements give the cross-price elasticities. Hence, a 1% rise (fall) in the price of alcohol reduces (increases) the demand for food by 0.22% while a similar change in the price of food decreases or increases alcohol consumption by 0.1%.

(4) Tax Rates.

The Irish indirect tax structure in 1985 may be summarised as follows:

Food, apart from 'luxury' items, essential services, children's clothing, rent and ESB bills were zero-rated for VAT.

Adult clothing and domestic heating fuels were subject to VAT at 10% with excise on the latter.

Alcohol (beer, wine and spirits), petrol, durable household goods, transport equipment and services were subject to both VAT at 23% and to specific excise duties.

Tobacco was subject to VAT at 25% and carried both specific and ad valorem excise taxes.

Under the Commission's harmonisation proposals, excise duties would be moved closer to the EEC average levels and member
countries would be permitted to operate two levels of VAT — a standard rate within the range 14% to 19% and a reduced rate within the range 4% to 9%. When projecting revenue changes I shall consider two cases. In each I assume that the proposed excise changes are put in place and that all goods and services are subjected to VAT at 19% with the exceptions of food, fuel, clothing and rent. These last four items are assumed to be subject to VAT at 4% in the first projection, and to 9% in the second. Tables 5 and 6 summarise changes in tax rates and consumer prices resulting from the harmonisation proposals.

Actual and revised tax rates on each class of good were computed as follows.

**Food.** 1985 consumer expenditure on food and non-alcoholic beverages amounted to £2622m. I assumed that 92% of this total was zero rated for VAT and that 8% or £209.76m (soft drinks, biscuits etc.) was subject to VAT at 23%. Revenue is therefore computed as (0.23/1.23)209.76 = £39.22m, implying seller's revenue of £2582.78m. Hence the 1985 tax rate is given by

\[ t_1 = \frac{39.22}{2582.78} = 0.015. \]

To compute the new tax rate I assume that all items in food expenditure are subject to VAT at the lower rate of 4% or 9%. Hence:

\[ t_2 = 0.04 \text{ or } 0.09 \]

**Alcohol.** 1985 consumer expenditure on alcohol amounted to £1230m. I assume that this total can be allocated to beer (60%) spirits (30%) and wine (10%). Given this assumption the 1985 tax rates on
each category can be computed as follows:

<table>
<thead>
<tr>
<th></th>
<th>Beer</th>
<th>Spirits</th>
<th>Wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure</td>
<td>£738m</td>
<td>£369m</td>
<td>£123m</td>
</tr>
<tr>
<td>Vat at 23%</td>
<td>138</td>
<td>69</td>
<td>23</td>
</tr>
<tr>
<td>Excise Revenue*</td>
<td>244</td>
<td>116.3</td>
<td>24.7</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>382</td>
<td>185.3</td>
<td>47.7</td>
</tr>
<tr>
<td>Seller's Revenue</td>
<td>356</td>
<td>183.7</td>
<td>75.3</td>
</tr>
<tr>
<td>Tax Rate</td>
<td>1.07</td>
<td>1.01</td>
<td>0.63</td>
</tr>
</tbody>
</table>

* From Report of The Revenue Commissioners (1985)

However as smuggling may have influenced the total revenue from sales of spirits, I use an alternative estimate based on O'Dwyer's (1987) figures for a typical bottle of spirits.\(^\text{*}\)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Price</td>
<td>£10.99</td>
</tr>
<tr>
<td>VAT at 23%</td>
<td>2.09</td>
</tr>
<tr>
<td>Excise Duty</td>
<td>5.60</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>7.65</td>
</tr>
<tr>
<td>Seller's Revenue</td>
<td>3.34</td>
</tr>
<tr>
<td>Tax Rate</td>
<td>2.29</td>
</tr>
</tbody>
</table>

As a tax rate equal to 2.29 for spirits implies total revenue of £256.8m on an expenditure base of £369m, seller's revenue is consequently revised downwards to £112.2m.

To compute the 1985 tax rate for the composite good alcohol the individual tax rates are weighted by the share of total seller's revenue allocated to each good. That is:

\[ t_1 = 0.66(1.07) + 0.20(2.29) + 0.14(0.63) = 1.26 \]

Proposals for changes in VAT rates and excise duties applying to alcohol may be summarised as follows:

<table>
<thead>
<tr>
<th></th>
<th>Beer</th>
<th>Spirits</th>
<th>Wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAT Rate 1985</td>
<td>23%</td>
<td>23%</td>
<td>23%</td>
</tr>
<tr>
<td>Proposed VAT rate</td>
<td>19%</td>
<td>19%</td>
<td>19%</td>
</tr>
<tr>
<td>Excise Duty 1985 (ECU's/hl)</td>
<td>86.4</td>
<td>2607</td>
<td>274</td>
</tr>
<tr>
<td>Proposed (ECU's/hl)</td>
<td>17.0</td>
<td>1271</td>
<td>17</td>
</tr>
</tbody>
</table>

The proposed changes imply the following tax rates:

<table>
<thead>
<tr>
<th></th>
<th>Beer</th>
<th>Spirits</th>
<th>Wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excise Revenue*</td>
<td>£48.07m</td>
<td>£91.45m</td>
<td>£1.53m</td>
</tr>
<tr>
<td>Seller's Revenue</td>
<td>356.00</td>
<td>112.2</td>
<td>75.30</td>
</tr>
<tr>
<td></td>
<td>404.07</td>
<td>203.65</td>
<td>76.83</td>
</tr>
<tr>
<td>Vat at 19%</td>
<td>76.77</td>
<td>38.69</td>
<td>14.59</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>124.84</td>
<td>130.14</td>
<td>16.12</td>
</tr>
<tr>
<td>Tax Rate</td>
<td>0.35</td>
<td>1.16</td>
<td>0.21</td>
</tr>
</tbody>
</table>

* ie. Excise revenue for beer = (17/86.4) times the actual 1985 level, etc. Hence the new tax rate is given by:

\[ t_2 = 0.66(0.35) + 0.20(1.61) + 0.14(0.21) = 0.493 \]

Tobacco. The 1985 tax rate on tobacco was computed as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure</td>
<td>£507.0m</td>
</tr>
<tr>
<td>VAT at 25%</td>
<td>101.4</td>
</tr>
<tr>
<td>Excise Revenue</td>
<td>296.9</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>398.3</td>
</tr>
<tr>
<td>Seller's Revenue</td>
<td>108.7</td>
</tr>
<tr>
<td>Tax Rate</td>
<td>[ t_1 ] = 3.66</td>
</tr>
</tbody>
</table>
The proposals for changes in the rate of tax on tobacco products may be summarised as follows:

Cigarettes: Specific excise reduced from 46.36 ECU's per 1,000 to 19.5 ECU's per 1,000. Hence the new rate is 42% of the old rate. Ad Valorem and VAT combined into a single tax of 53% of the retail price.

Cigars: Specific excise reduced to zero. Ad Valorem and VAT combined into a single tax of 35% of the retail price.

Smoking Tobacco: Specific excise reduced to zero. Ad Valorem and VAT combined into a single tax of 55% of the retail price.

To compute the new tax rate I assume that 93% of excise revenue is raised from cigarettes and that the average rate of VAT plus Ad Valorem is 53% of the retail price. Total revenue is given by the sum of excise revenue and 53% of total expenditure. Excise revenue is approximated by £116m (= .42£276.1m) and seller's revenue is £108.7m. Hence revenue is:

\[ R = 116 + .53(108.7 + R) \]

or

\[ R = 2.13(116) + 1.13(108.7) = £369.9 \]

The new tax rate is:

\[ t_2 = 369.9/108.7 = 3.4 \]

Clothing and Footwear. Tax rate is computed as follows:

1985 VAT rate on adult clothing = 10%
1985 VAT rate on children's clothing = 0%
Assumed composite tax rate \( t_1 = .08 \)
Proposed tax rate \( t_2 = .04 \)

Or \( t_2 = .09 \)
Fuel and Power. Fuel and power consists of personal consumer and expenditure on items such as electricity and domestic heating fuels. The former are zero-rated while the latter are subject to reduced VAT and, in some cases, excise duty. Hence I assume an aggregate tax rate of 0.06 for 1985. Under the harmonisation proposals all items would be subject to VAT at either 4% or 9% with little change in the excise components. Hence I assume new rates of 6% (VAT at 4%) or 10% (VAT at 9%).

Petrol. Personal expenditure on petrol in 1985 amounted to £446.2m giving revenue from VAT (23%) of £83.4m. Published excise revenues, however, include duty raised from commercial purchases and hence overstate the revenue from personal consumption. As an alternative I use O'Dwyer's (1987) figures for a litre of leaded petrol.

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Retail price</td>
<td>£0.645</td>
</tr>
<tr>
<td>VAT at 23%</td>
<td>0.121</td>
</tr>
<tr>
<td>Excise</td>
<td>0.256</td>
</tr>
<tr>
<td>Revenue</td>
<td>0.377</td>
</tr>
<tr>
<td>Seller's Price</td>
<td>0.286</td>
</tr>
<tr>
<td>Tax rate</td>
<td>1.410</td>
</tr>
</tbody>
</table>

With total expenditure of £446.2m a tax rate of 1.41 implies revenue from personal consumption of £261.0m composed of £83.4m VAT and £177.6m excise. The harmonisation proposals would reduce the VAT rate to 19% and excise duty from 357.1 ECU's/hl (1985 rate) to 340 ECU's/hl. If the same quantity were purchased, the new tax rate may be computed as follows:
Seller's revenue £185.2m
Excise* 169.1
354.3
VAT at 19% 67.3
Total revenue 236.4
Tax rate $\tau$ 1.27

* i.e. $(340/357.1)\times 117.6$

Rent. Zero-rated in 1985. New rate either 0.04 (4\% VAT) or 0.09 (9\% VAT).

Durable Goods. The tax rates on durable household goods are computed as follows.

1985 Expenditure £432.0m
VAT at 23\% 80.7
Excise 7.1
Total revenue 87.8
Seller's revenue 344.2
Tax rate $\tau_1$ 0.255

With a proposed VAT rate of 19\% and no change in excise duty, VAT revenue would be £69m giving a new tax rate of $\tau_2 = 0.214$.

Transport Equipment. The tax rates are computed as follows.

1985 Expenditure £340.0m
VAT at 23\% 63.6
Excise 150.2
Total revenue 213.8
Seller's revenue 166.2
Tax rate $\tau_1$ 1.694
With a proposed VAT rate of 19% and no change in excise duty, VAT revenue would be £54m giving a new tax rate of $t_2 = 1.620$.

**Services.** Expenditure figures on services were computed as a residual.

1895 VAT rate 23% \[ t_1 = 0.23 \]

Proposed VAT rate 19% \[ t_2 = 0.19 \]

**Other Goods.** The tax rate for other goods is computed as follows:

1895 VAT rate 23% \[ t_1 = 0.23 \]

Proposed VAT rate 19% \[ t_2 = 0.19 \]

Tables 5 (reduced VAT rate 4%) and 6 (reduced VAT rate 9%) summarise the effects of harmonisation on tax rates and consumer prices. Weighting the consumer prices by expenditure shares gives average price reductions of 5.58% and 3.37%, depending on whether the reduced rate of VAT is 4% or 9%. The greatest effect is on the price of the composite good alcohol which declines by 34% relative to its actual level in 1985.

(5) Revenue Projections.

The predicted revenue changes are given in tables 7 (restricted model) and 8 (unrestricted model). Two sets of estimates are computed for each model depending on whether the reduced VAT rate is assumed to be 4% or 9%. The highest revenue loss is £351.3m for the unrestricted model with a 4% reduced VAT rate, and the lowest is £191.3m for the restricted model with a 9% reduced VAT rate. It is important to note that the data base consists of personal expenditure only and excludes revenue
sources such as business expenditures on petrol and diesel etc.

The results are, however, dominated by two goods - alcohol and food. Alcohol is important because it accounts for a higher proportion of revenues from expenditure taxes than any other good and because of the relatively large price reduction implied by the harmonisation proposals. With an own-price elasticity of approximately -0.48, a 1% fall in the price alcohol would increase the quantity purchased by 0.48% but would reduce expenditure by 0.52%. Hence, a 34% price reduction would increase consumption by 16% but reduce expenditure by 18% or £221.4m on the 1985 expenditure figure of £1,230m. As the ceteris paribus change in revenue depends of the change in the rate of taxation and on the change in expenditure (equation 8), a price change of this size must imply a substantial loss of revenue given the relatively low elasticity. Further, a 34% fall in the price of alcohol may also lead to significant changes in the revenue from complimentary goods even if the cross-price elasticities are relatively low. This, for example, explains why revenue from tobacco is projected to increase even though the own-price elasticity is relatively small.

Food, on the other hand, is important because it accounts for a high proportion of total expenditure and because its own-price elasticity is also less than one. Consequently, a rise in price will reduce consumption but increase expenditure which reinforces the revenue gain from the higher tax rate. Hence with

\[ \text{The expenditure elasticity is } 1 + \text{the demand elasticity.} \]
a reduced VAT rate of 9% the revenue gain from food can compensate for 40% to 50% of the revenue lost from alcohol, depending on which model is used. With a reduced VAT rate of 4% this compensation declines to approximately 14% to 18%. Hence the estimated revenue losses would be substantially larger if Ireland obtained derogations for food and other zero-rated commodities.

(6) Summary.

The methodology followed in this report was to base estimates of potential revenue changes on prior estimates of a demand system which account for variations in expenditure patterns resulting from tax-induced price changes. While there may be errors in the parameter estimates, this method has the advantage of being more coherent than one which makes purely arbitrary assumptions about how consumption may change as a consequence of tax harmonisation.

The resulting estimates for revenue loss appear to be relatively modest. For example, the maximum figure of £297.5m in Table 3 is equivalent to less than 5% of total tax revenue in 1985. The results must, however, be treated with some caution. First, the estimates for the demand system's parameters may differ from the true values. This is especially important in the case of alcohol where, given the magnitude of the price change, a minor modification to the elasticities may result in significant changes to the revenue projections. Second, the data relates to personal expenditure only and excludes revenue from business
expenditures on petrol etc. Third, the Commission's proposals for excise duties are based on EEC averages as at 1 April 1987. Given that these taxes tend to be moved in line with inflation they probably overstate the comparable figures for 1985. Finally, as harmonisation would bring Irish indirect tax rates into line with those in the UK, we could expect to see a sharp fall in the level of smuggling and a consequent rise in revenue on goods such as petrol and consumer durables.
### Table 1. VAT Rates.
(April 1 1987)

<table>
<thead>
<tr>
<th>Country</th>
<th>Reduced</th>
<th>Standard</th>
<th>Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>1 &amp; 6</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>Denmark</td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>2.1 &amp; 4</td>
<td>5.5 &amp; 7</td>
<td>18.6</td>
</tr>
<tr>
<td>Germany</td>
<td>7</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>6</td>
<td>18</td>
<td>36</td>
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### Table 2. Excise Rates.
(April 1 1987)

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<td>Cigarettes ECU/1000</td>
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<tr>
<td>Petrol ECU/1000lts</td>
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* per hl of pure alcohol
Table 3. Elasticities Restricted Model*.

<table>
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<th>A</th>
<th>T</th>
<th>C</th>
<th>U</th>
<th>P</th>
<th>R</th>
<th>D</th>
<th>E</th>
<th>S</th>
<th>O</th>
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</table>

* F=Food, A=Alcohol, T=Tobacco, C=Clothing, U=Fuel, P=Petrol, R=Rent, D=Durables, E=Transport Equipment, S=Services, O=Other Goods.

Table 4. Elasticities Unrestricted Model*.

<table>
<thead>
<tr>
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<th>F</th>
<th>A</th>
<th>T</th>
<th>C</th>
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<th>P</th>
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</table>

* F=Food, A=Alcohol, T=Tobacco, C=Clothing, U=Fuel, P=Petrol, R=Rent, D=Durables, E=Transport Equipment, S=Services, O=Other Goods.
Table 5. Tax and Price Changes.  
Reduced Vat Rate = 4%

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<td></td>
<td>1985 New</td>
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<td>1.85</td>
</tr>
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<td>3.660 3.400</td>
<td>2.39</td>
</tr>
<tr>
<td>Clothing</td>
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<tr>
<td>Fuel</td>
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<tr>
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<td>1.98</td>
</tr>
<tr>
<td>Rent</td>
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</tr>
<tr>
<td>Durables</td>
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</tr>
<tr>
<td>Trans. Equip.</td>
<td>1.694 1.620</td>
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</tr>
<tr>
<td>Services</td>
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</tr>
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<td>Other Goods</td>
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</tr>
<tr>
<td>Weighted Ave</td>
<td></td>
<td>1.73</td>
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</tbody>
</table>

* Based on 1980=1

Table 6. Tax and Price Changes.  
Reduced Vat Rate = 9%

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<th>Prices*</th>
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</tr>
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<td>Tobacco</td>
<td>3.660 3.400</td>
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<td>1.694 1.620</td>
<td>1.97</td>
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<tr>
<td>Services</td>
<td>0.230 0.190</td>
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<td>Other Goods</td>
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<td>1.71</td>
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<tr>
<td>Weighted Ave</td>
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</table>

* Based on 1980=1
Table 7. Revenue Changes £m, Restricted Model.

<table>
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<tr>
<th>Item</th>
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Table 8. Revenue Changes £m, Unrestricted Model.

<table>
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<th>Reduced Vat Rate = 9%</th>
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<tr>
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<tr>
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<td>261.3</td>
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<tr>
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<td>142.0</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>1865.0</strong></td>
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</tbody>
</table>
Appendix.

A. Tax rates and Tax Revenue.

Equation (5) in the tax relates revenue from one good \((R)\) to the tax rate \((t)\), the seller's price \((P_s)\) and the quantity sold. That is:

\[ R = tQ \]

Letting \(d\) denote "change in" then:

\[ dR = [Qdt + tdQ]P_s \]

The change in \(R\) per unit change in \(t\) is therefore:

\[ dR/dt = [Q + tdQ/dt]P_s \]

However \(dQ/dt = (dQ/dP)(dP/dt)\) where \(dQ/dP\) = the change in consumer demand per unit change in \(P\) and \(dP/dt = 1\). The elasticity of demand is defined as \(E = (dQ/dP)(P/Q)\). Hence \(dQ/dP = E\). Thus:

\[ dR/dt = [1 + (t/P)E]R_s \]

as \(E < 0\), \(dR/dt > 0\) if \((t/P)E < 1\) in absolute value. Note that as \((t/P) < 1\) then price inelasticity is a sufficient condition for \(dR/dt > 0\).