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Discriminatory Taxation of Carbonated Beverages: The Case of Ireland

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DISCRIMINATORY TAXATION OF CARBONATED BEVERAGES: THE CASE OF IRELAND

Executive Summary

A study of the Ireland's decision to eliminate its discriminatory excise tax shows that the revenue loss associated with this action was far less than might otherwise have been expected.

Background - The Irish Excise Tax

From 1975 through 1992, soft drinks in Ireland were subject to a discriminatory excise tax.

- The tax, first introduced in 1916 and levied at £0.10/gallon in 1975, was increased in 1980 to £0.3721/gallon.
- Competing beverages such as coffee, tea and fruit juices paid no such tax.
- The tax was abolished in 1992.

The Economic Rationale Against Excise Taxes on Soft Drinks

Excise taxes on soft drinks generally are economically unjustified.

- Soft drinks do not impose significant external social costs, such as may be found with tobacco, alcoholic beverages, or motor fuels.
- The soft drink industry in Ireland uses no more resources than other consumer goods producers.

Demand for Soft Drinks Is Price and Income Elastic

The consumption of soft drinks in Ireland is sensitive to changes in price and income, and therefore are poor candidates for excise taxes that raise their prices.

- Analysis reveals the average price elasticity of demand for soft drinks to be -1.05. For every 10 percent reduction in the price of soft drinks, demand grew by 10.5 percent.
- Soft drinks also have a high-income elasticity of demand of 1.24. On average, for every 10 percent rise in income in Ireland, demand for soft drinks increased by 12.4 percent.

Effects of Eliminating the Irish Excise Tax

Given the elasticity of demand, the Irish government was able to partially offset the revenue loss resulting from the elimination of the excise tax through increased collections from the VAT.

- Elimination of the excise tax reduced soft drink prices, which in turn boosted demand for soft drinks.
- The potential increase in total value-added in the economy was equivalent to the amount of the tax elimination.
- The Irish government recovered at least 30 percent of the lost excise tax revenue through increased VAT and income tax revenues.

Conclusion

Eliminating the excise tax was the correct public policy choice for Ireland.

- The government removed a tax-induced distortion to consumer choice, and therefore increased national welfare.
- The cost and burden of administering the tax was eliminated.
- The fiscal loss to the government was significantly less than the revenue derived from the excise tax.

DISCRIMINATORY TAXATION OF CARBONATED BEVERAGES: THE CASE OF IRELAND

Roy Bahl* and Mary Beth Walker**

I. INTRODUCTION

This paper is a case study of discriminatory consumption taxation in Ireland. The focus is on the taxation of carbonated beverages, and the question is whether it is in the national interest to levy a special excise tax on soft drinks. The question may be posed in the reverse: can it be in the national interest to remove the special excise on soft drinks? Ireland provides a natural experiment for this analysis, because it has both imposed and removed such a discriminatory tax in the past two decades.

We investigate two hypotheses:

1. The imposition of discriminatory taxes on carbonated beverages cannot be justified as good tax policy. The elimination of such taxes can increase national welfare.
2. The revenue benefits of special excises have been overplayed. A reduction in the rate of special excise tax on soft drinks does not result in a commensurate revenue loss to the government, because there will be a significant demand response. An increase in the rate of special excise tax may result in a more-than-commensurate revenue loss.

The structure and the history of the taxation of soft drinks in Ireland is described in the next section. In Section III, we consider the rationale behind the imposition of special excise taxes in general, and the rationale for their imposition on soft drinks in particular. A general model for evaluating the revenue impacts of discriminatory taxes and an econometric analysis of

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special excises on soft drinks is presented in section IV. The issue of aggregate revenue impacts of eliminating the excise tax on soft drinks is taken up in section V. The final section of the paper summarizes the results.

II. TAX HISTORY, TAX STRUCTURE AND REVENUE YIELD

Soft drinks in Ireland have been subject to two indirect taxes: a special excise tax levied on physical production, and a value added tax which treats soft drinks as an item of general consumption. Under both indirect taxes, soft drinks have been singled out for discriminatory treatment.

Special Excise Tax

Irish tax law subjected soft drinks to an excise tax levied on a class of drink formally defined as *table waters*. This includes aerated waters and any beverages (including syrups and other liquids intended to be consumed only in a diluted form) put up for sale in bottles, cans, casks or other closed containers or receptacles, other than:

- (i) any liquor for the retail sale of which an excise license is required,
- (ii) milk and milk products, whether or not flavored,
- (iii) soups and broths, and
- (iv) fruit and vegetable juices which, in the opinion of the Revenue Commissioners, have not lost their original character through the addition of water or of other substances for sweetening, preservative or other purposes.

Table waters were subject to a special excise tax from 1916 until the abolition of this tax in 1992.¹ From 1975 through 1979, this special excise was levied at a rate of £0.10 per gallon produced, and was collected directly from the producer.² In 1980, the rate was increased to £0.37 per gallon, and held at that level until July of 1990. It was reduced to £0.29 per gallon at that time and finally abolished in November of 1992. This tax history is traced out in Table 1.³

The excise tax increase in 1980 was prompted by the need to raise more revenue and by the belief that a rate increase on price inelastic carbonated beverages would generate significant collections. The elimination of the special excise on *table waters* some 12 years after this rate increase was a result of many considerations. The EU was urging elimination of special excises on soft drinks in the name of tax rate harmonization, fiscal pressure had lessened, revenues from the special excise tax had eroded significantly, and various commissions had argued that the special excises were imposing efficiency costs (Government of Ireland, 1984).⁴ It is not clear whether fiscal planners no longer believed that soft drinks were price inelastic, or whether they were simply willing to risk the small revenue loss that might result. The government proposed and carried out elimination of the tax in two steps between 1990 and 1992.

Value Added Tax

Carbonated beverages are also subject to the value added tax, and here again there is rate differentiation. At present, soft drinks are treated as an item of regular consumption for tax purposes, rather than as a food and drink item. Most food and drink sold in retail shops is zero

¹ The excise tax on *table waters* was originally introduced to cover the cost of the Boer War.

² Imported *table waters* were subject to a parallel tax treatment.

³ Note that the production volumes presented in Table 1 are for soft drinks only, while the revenue figures are for all drinks classified as *table waters*. About three-fourths of the total production can be attributed to soft drinks.

⁴ For a discussion of the early EC views on a framework for harmonizing excises, see Cnossen (1987).

rated under the VAT, and taxed at 12.5 percent if sold in restaurants or through vending machines. This includes coffee and tea. Soft drinks are taxable at the top rate of 21 percent, irrespective of whether the purchase is made in a retail shop or a restaurant.

The VAT rate on soft drinks includes the excise duty in the base, hence there is a history of a cascading effect. The standard VAT rate in Ireland has been declining over the past two decades, as is shown in Table 1. The reduction from 23 to 21 percent in 1992 accompanied elimination of the special excise tax.

Revenue Yield and Revenue Potential

There is no question but that the soft drink industry is important and growing in the Irish economy. Note the rapid rate of soft drink production shown in column (3) of Table 1. The Soft Drinks Association of Ireland (1996, data sheet #9) reports that of the 12 largest food and drink sectors, soft drinks accounted for about 20 percent of the total retail spending. The retail spending totals for 1994 for the five largest categories are shown below:

	Amount (in £ millions)	Percent of Total Revenue Spending
Soft Drinks	£ 436	20
Fruit and Vegetables	£ 300	14
Milk	£ 300	14
Confectionary	£ 290	13
Bread	£ 193	9

The level of these consumer expenditures together with the high value added content of the carbonated beverage industry suggests a significant economic and revenue contribution by this sector of the Irish economy. These data also suggest that a significant share of the average consumer’s “food and drink budget” is allocated to these beverages.

To get a true measure of the total revenue contribution from the soft drink industry, we should study the revenue take from income taxes, the VAT, and property taxes, as well as that from special excises. In practice, a breakdown of the contribution of this sector to VAT and income taxes is not available. The revenue yield of the special excise, the one tax where we can get accurate data, was relatively small. By the time of its abolition in November of 1992, the special excise tax accounted for less than one-tenth of one percent of total budgetary tax collections, and even at its peak levels amounted to little more than 3 tenths of one percent (Table 2).⁵ Nor was there an elastic revenue response to GDP. Special excise tax revenues had grown at less than one-half of the rate of growth in GDP over the past decade (column 4 of Table 2). This is not an unexpected revenue performance from a tax levied against physical volume with no indexing for inflation, and the decline relative to GDP was further exacerbated by rate reductions in 1990. The average Irish resident was paying only about £1 per year in special excise tax in 1992 when the tax was abolished, and real per capita amounts had been falling since the late 1980's.

By comparison with other taxes, the yield of the excise duty on *table waters* was relatively insignificant, e.g., less than one percent of VAT revenues in 1992 (Table 3). The yield from the tax on *table waters* is also very small by comparison to excise duty on beer and spirits (Table 4). About 17 times more was raised from beer and 7 times more from spirits in 1992. The tax on soft drinks in Ireland, compared with other EU countries, is reported in Table 5. Ireland is now one of 9 countries that does not levy a special excise tax on soft drinks. However the 21 percent VAT rate applied to soft drinks is lower only than that in Denmark.

⁵ These revenue figures include all *table waters*, hence overstate the tax yield from soft drinks.

III. WHY DISCRIMINATORY EXCISES?

Why would Ireland, or any other country, impose a discriminatory excise? Are there conditions under which such measures can be justified as good public policy? What are the revenue implications of special excises, and how widespread is the practice? Are soft drinks a particularly good candidate for discriminatory tax treatment in the name of increasing the national welfare? The answers to these questions are integral to evaluating the impact of the discriminatory excise tax in Ireland, and to assessing the policy implications of its removal.

Neutrality and Fairness

To most fiscal economists, good tax policy begins with the rule of neutrality, i.e., the tax rate and base structure should not interfere with consumption, production or investment choices. Though no tax regime is perfectly neutral, the more broad-based it is, the closer it moves toward the goal of taxing all consumption and production activities at the same effective rate. Under broad based and flat rate taxes, economic decisions are influenced more by the conditions of the market and less by the tax rules.

Special excise taxes are the textbook example of how to violate the rule of neutrality. By raising the price of the taxed good relative to other goods, special excises bias consumption away from the taxed product. Consumer choices are thus distorted by the tax system, and the national welfare is harmed. This is the traditional thinking that has led most tax policy analysts to hold to Adam Smith's original maxim of neutrality and to argue for broad-based and non-discriminatory taxes (see Box 1).

Box 1 : Taxation and Economic Efficiency

Economists worry about taxes that cause economic systems to become less efficient. An efficient position for the economy is one where consumers and producers may purchase and produce that bundle of goods that they most want. When this happens, national welfare is maximized. When tax systems get in the way of efficiency -- by driving up the price of one consumption good more than another, or one productive input more than another -- national welfare is harmed. Discriminatory taxes such as special excises increase the price of some goods more than others, cause an adjustment in consumption patterns and move consumers away from their most preferred position.

All discriminatory taxes are not bad from a point of view of national welfare. When person A's consumption harms society, a tax on the consumption or production of the offending good can improve economic efficiency. Likewise, discriminatory taxes and subsidies can be used to offset other market distortions, such as monopoly. Short of these special circumstances however, economic efficiency requires broad based taxes that apply the same tax rates to all competing goods and economic activities.

In fact, most countries do impose discriminatory taxes, with liquor, beer, cigarettes, gasoline and various kinds of luxury consumption the usual targets. One might ask the obvious question: If special excises are such a bad idea, then why are they so often used as an instrument of tax policy? There are a number of answers to this question.⁶ One is that there are conditions under which special excises can be justified as in the national interest. Another answer is that special excises are politically feasible by comparison with the other tax choices available. Taxation, after all, is one of the most politically sensitive of policy decisions. Finally there are justifications for tax structure choices that are completely outside economics and politics--such

⁶ The traditional justification is presented well in Tanzi (1995, pp. 56-64). For a more detailed discussion, see Cnossen (1991).

as reaching for the moral high ground-- and discriminatory taxes might be justified by such considerations. Most advocates of special excise taxes fall in one of these camps, and they usually argue one of the following five points in advocating discriminatory taxes.

Compensation for External Costs

The best economic justification for a discriminatory excise tax is that the additional tax is needed to compensate for an external effect related to the production and/or consumption of “undesirables.” For example, the consumption of cigarettes imposes health risks to smokers and to those who are around smokers, productivity losses to workers and therefore to the economy, and health care costs on society. The consumption of liquor increases the cost to society in the form of increased automobile accidents, drinking related crime, and the maintenance of alcohol abuse centers. Gasoline consumption is associated with increased levels of air pollution and increased congestion that must be suffered by others, and increased highway expenditures that must be financed by others.

Somehow, these external costs should be paid by the consumers and producers of the offending products. A discriminatory tax imposed on production or consumption of these items is meant to compensate society for these externalities, though revenues often are not adequate in amount. For example, the Irish Tax Commission cited one study that placed the external costs of alcohol consumption at about 40 percent of excise collections for alcoholic beverages during that period.⁷

⁷ Walsh (1980), as reported in “Excises on Alcoholic Beverages,” Chapter Eight (p. 113) of *Government of Ireland* (1984), notes the following: “The estimate for 1976 indicated that the cost of alcohol consumption borne by the state in that year was £63 million, whereas excise duties on alcohol amounted to £158 million.”

The externality rationale for imposing a special excise is consistent with economic theory and good economic practice. Discriminatory taxes used to compensate society for external costs can increase national welfare. Consumers of alcohol, tobacco, and gasoline, for example, are forced to pay a price for their consumption that reflects not only the value they place on the good, but also the cost they impose on society.

The externality justification, however, does not so easily fit the situation of soft drinks. Consider the merit of the three principal arguments that soft drinks do impose external costs that should be compensated with a special tax. The first has to do with who should pay the environmental cost of aluminum, plastic and glass containers that are not recycled, and with who should pay for the share of recycling cost that is now borne by government. On the one hand, there can be little argument but that consumers of soft drinks should bear their share of these costs, and an excise would seem to be a reasonable approach to recouping this cost. On the other hand, the share of the carbonated beverage industry in containers is relatively small. Only 2 percent of all household volume of waste is beverage containers according to the Ireland Soft Drink Association (1996). This relatively small share suggests that other consumer good industries should be subject to a similar tax based on their potential waste and recycle cost. Clearly, it would be infeasible to administer a differential excise tax for each industry, depending on their contribution to environmental problems. A special excise levied only on carbonated beverage consumption would not seem justified on these grounds.

The second externality argument is that soft drinks require government monitoring of packaging and labeling, and this imposes a cost for which taxpayers should be compensated. Again, the issue is that many other consumer goods require the same degree of monitoring.

Simply put, special excises are not the answer to compensating society for external costs of government monitoring of labeling and packaging.

Third, there is the point that carbonated beverages are a mixer for alcoholic drinks, and that a special excise would therefore discourage liquor consumption. This argument would seem to be a significant stretch, and has not been convincing to government fiscal planners in Ireland or elsewhere in the EU. Many have argued that soft drinks could as easily be viewed as a substitute for alcoholic beverages, as a complement to them.

The more accepted view is that soft drinks do not impose a social cost on society in the form of health risk, in the inducement of aberrant behavior by those who consume soft drinks, or by requiring special costly public infrastructure to meet the needs related to increased soft drink consumption and production. In short, a discriminatory tax on soft drinks is not justified on economic efficiency grounds. The Irish Tax Commission apparently took the point that there is a difference between the taxation of soft drinks and the taxation of alcoholic beverages. In 1992, they recommended no change in the tax treatment of beer and liquor, but did recommend the elimination of the tax on *table waters*. The rationale originally given by the Commission (1984, p. 123) is as follows:

“We see no justification on efficiency grounds for special taxes on table waters. We reject the argument that table waters which are used as ‘mixers’ for alcoholic drinks should bear some of the tax required to be raised to offset the costs of alcohol abuse. On grounds of efficiency, the costs imposed on the community by abuse of alcohol should only be borne by the consumers of alcohol. Table waters, although sometimes used in conjunction with alcohol, also provide a substitute for alcohol. We recommend that the excise duties on table waters be abolished.”⁸

⁸ The full text of this section of the Commission report is reproduced in Appendix A.

Immoral Behavior

Second, the special excise tax may be levied for moral reasons. Drinking and smoking are seen by some as immoral activities that ought to be discouraged, and higher taxes are imposed to raise the price of these activities in hopes of curtailing consumption. This argument is based on philosophical views rather than economics and cannot be evaluated using economic theory. However, it is difficult to see how the consumption of soft drinks would offend national sensibilities.

Reallocation of Resources

A third argument is that the government fears that production and consumption of non-essential goods and services will “crowd out” more productive uses of resources in the economy. A much better allocation of resources, some would argue, is heavier investment in capital intensive, export-oriented industries. To discourage the investment in activities such as cigarette or liquor production, governments often adopt discriminatory taxes that discourage domestic consumption or domestic production, or both. Government planners also make other unfavored activities the target of discriminatory taxes. For example, it also may be desired to discourage luxury consumption in favor of increased savings, or to discourage the consumption of foreign-produced luxury goods in favor of consumption of domestically produced goods.

There are many questions to rise about such justifications for special excises. First, it substitutes administrative decisions for market signals about what production is “best” for the economy, and raises the more general question about the extent to which the economy will be planned or market driven. Second, if tariff protection is part of this discriminatory tax regime, inefficiency in domestic production may be encouraged, and fundamental reforms in economic

policy may be delayed or postponed. Third, such policies require governments to identify “degrees of luxury” and to tax various consumer goods accordingly.⁹

To use this justification for a discriminatory tax on soft drinks would require one to believe that resources are being siphoned off from other more productive sectors, and to believe that increased soft drink production does not increase value added in the economy. This would be a difficult case to make in Ireland, where soft drink production may be characterized as having a high domestic value added component, a modest excess of exports over imports, and positive employment impacts.¹⁰ Though it is not one of the larger sectors of the Irish economy, the soft drinks industry utilizes an above average proportion of native ingredients and packing, amounting to over £44 million annually. These include 18 percent of the Irish Sugar Company’s industrial sales, 26 percent of the output of Associated Irish Gases and 17 percent of Irish Glass Bottle Company’s production. In addition, the industry absorbs 60 percent of the domestic metal cap production and virtually all P.E.T. containers and labels are of Irish manufacture.¹¹

Revenue Yield

The government may levy the specific excise to increase its revenues. The rationale is straightforward. The typical targets for special excises are thought to be price inelastic (see Box 2). If a good is price inelastic in its demand, then government can raise the tax rate and realize a

⁹ For discussions of this issue, see Tanzi (1991, Chapters 8 and 10), Bird (1992, Chapter 9), and Due (1988, Chapter 4).

¹⁰ One might also note a balance of payments effect. The soft drinks association estimates total exports for 1995 at about 21 million liters and total imports at about 60 million litres. Total domestic production was 276 million litres.

¹¹ Irish Soft Drinks Association, 1996, Data Sheet Number 7.

revenue increase.¹² This is accomplished because consumers cannot find good substitutes for these products, and therefore maintain something close to their pretax consumption level. Gasoline, alcoholic beverages and tobacco are commodities that are widely believed to fit this profile.¹³

Box 2: The Price Elasticity of Demand

The definition of price elasticity is the percent change in the quantity of a good demanded, divided by the percent change in the price of the good, holding all other factors constant. A good that is price inelastic in demand is one whose quantity demanded would decrease less than in proportion to a price increase. For example, a price elasticity coefficient of 0.25 would imply that if price was increased by 10 percent, quantity would fall by only 2.5 percent.

If the commodity is price elastic in its demand, a price increase will cause a more-than-proportionate reduction in quantity as consumers move to substitute goods whose price has not changed. For example, if the price elasticity coefficient is 1.25, a 10 percent increase in price will lead to a 12.5 percent reduction in the quantity demanded.

What is the relationship between the price elasticity of demand, the revenue increase to government, and an increase in an excise tax rate? In general, the more price inelastic the demand, the more revenue will be protected when the tax rate is increased. The more price elastic the demand, the greater will be the quantity adjustment and the more negative will be the impact on revenue. The reverse is true in the case of a tax reduction. However, in either case the final effect on revenue will depend on the elasticity of supply, i.e., whether producers face a rising marginal cost as they expand consumption.

¹² Supply side influences, which effect this result, are discussed below.

¹³ McLure and Thirsk (1978) find evidence of price inelasticity for cigarettes and liquor in their review of the earlier literature.

Because governments are ever strapped for resources to support their expenditure programs, special excises have long been a favored target when budgets are tight. “Why not let smokers or luxury consumers finance a share of the budget deficit,” is a sentiment that resonates well with voters. An increase in the tax rate on gasoline or beer is a “quick revenue fix” because the collection machinery is already in place, and the money can begin to flow quickly. Increased taxes on drinking, smoking and luxury consumption are less dangerous in the eyes of a vote-seeking politician than are rate increases on the broad-based taxes.¹⁴

Do soft drinks, now subject to discriminatory taxes in many countries, carry these same advantages? That is, are excise taxes on soft drinks relatively palatable to voters, can they be easily collected at reasonable administrative cost, and is the demand price inelastic? In the case of Ireland, the answers, respectively, are yes, yes with a qualification, and no.

With respect to political acceptability, it was finally good economics and EU urging rather than taxpayer outcry that brought on the abolition of the *table water* excise. Soft drink producers were predictably unhappy about the discriminatory treatment of their product, but there did not appear to be a consumer-led rebellion to throw this tax out. This may well indicate the “invisible” nature of the excise tax from a point-of-view of consumers. The fact that the tax is not directly collected from consumers means that they may not fully realize the extent to which it increases the price of the beverage.

With respect to administrative costs, the Irish special excise tax was relatively easy to assess and collect. With respect to the differential treatment of soft drinks under the Irish VAT,

¹⁴ Increased motor fuel taxes may be a different story, especially in developing countries where tax increases have led to riots in the past.

however, there are some messy and potentially costly classification problems to be dealt with in administering the tax. (These are discussed in the next section).

The big difference between soft drinks and other subjects of special excises, however, may be the price inelasticity assumption. The demand for soft drinks is more elastic than has sometimes been supposed, precisely because there are good substitutes and because many of these substitutes are subject to differential tax treatment. Consider how a family might react to an increase in the price of soft drinks. Certainly there are good drink substitutes subject to different tax regimes, e.g., beer, coffee, tea, water, juices, syrups, tap water, etc., and the family might react by consuming more of the substitute. There also are a great many choices of soft drink products, and not all of these are subject to the same tax regime.¹⁵ And if soft drinks are partly consumed as a general entertainment good, they may be replaced by more expenditures on movies, ice cream, etc., if the relative price of soft drinks gets too high. As we show below with actual data for Ireland, the demand for soft drinks is not price inelastic, because there are good substitutes available at different prices. We are led to the conclusion that consumers will move to substitutes if discriminatory taxes are imposed, and will increase their consumption of soft drinks if discriminatory taxes are reduced. In the latter case, the increased consumption will significantly cushion any revenue loss occasioned by a tax rate reduction. A statistical analysis of the Irish experience supports this conclusion.

¹⁵ In a recent review of the soft drink industry in the European economy, Canadean (1997) suggested the wide range of consumer choices available. In a supermarket in Britain, there are 450 “buying options” for non-alcoholic beverages. Using a similar measurement method, they estimate that there are 320 in Belgium, 480 in France, 500 in Germany, 235 in Netherlands, 250 in Spain, and 170 in Italy.

Equity Justifications

One notion of equity is that higher income families should pay a greater proportion of their income in taxes than should lower income families. Special excises on luxuries, therefore, might be justified on grounds that they are a progressive and (some would say) an equitable form of tax. However, while soft drink consumption generally rises with increases in total and discretionary income, tax progressivity is not a strong reason for discriminatory taxation of soft drinks. Soft drinks are but one of a host of goods and services whose consumption rises as income levels grow, all of which could be equally attractive targets for taxation. In addition, a tax on soft drinks is unlikely to significantly change the overall degree of tax progressivity. Tax progressivity would not seem a strong reason for special tax treatment of soft drinks.

There is another dimension to equity that clearly argues against discriminatory taxation of soft drinks. *Horizontal equity* in taxation requires that equally situated individuals be treated the same by the tax system. Special excise taxes do not pass the horizontal equity test. If we consider the tax considerations that confront an individual seeking to spend £x on non-alcoholic drinks, we may observe the following for Ireland:

The special excise increases the price of soft drinks more than all other non-alcoholic beverages, including milk, tea and pure fruit juices.

Soft drinks, alcohol, bottled waters and health drinks are all taxable at 21 percent under VAT no matter where they are purchased. Coffee and tea are zero rated if purchased in a retail outlet, but 12.5 percent if purchased in a restaurant. Fruit juices are taxed at 21 percent unless purchased in a restaurant in which case they are taxed at 12.5 percent.

Soft drinks are taxed at 21 percent if purchased from a vending machine, but fruit juices are taxed at 12.5 percent if purchased from the same vending machine.

Prior to 1992, bottled waters were subject to a zero rate, but bottled waters with flavoring (e.g., sparkling water with lime) were subject to the standard VAT rate.

Cold take away food and (zero rated) drinks, for example sandwich and milk, is taxable at 12.5 percent, while the same sandwich with a soft drink is taxed at 21 percent. However, in the latter case, the proprietor may choose not to establish an inclusive price, in which case the VAT on the sandwich is 12.5 and on the soft drink is 21 percent.

There are numerous other anomalies in the taxation of soft drinks versus substitute products, so that the consumer has reason not to be neutral in his/her choices. All individuals who spend £x on a drink are not treated the same and the tax is *not* horizontally equitable. The tax administration implications of this differential treatment also are important, because every complication increases the cost of effective administration and/or reduces the probability of full compliance. The differential taxation of soft drinks, as has been practiced in Ireland with the special excise and the VAT, badly fails the horizontal equity test of a good tax.

IV. AN ANALYSIS OF THE DEMAND FOR SOFT DRINKS IN IRELAND

A simple reading of the data on soft drink production in Ireland (see Table 1) could lead one to speculate that there is a price elastic demand for soft drinks. Note the reductions in the volume produced in the aftermath of the excise tax increases in 1980, and the dramatic increases following the elimination of the excise tax and the lowering of the VAT rate in the early 1990's. But a simple eyeballing of the numbers can be misleading, because there were many factors affecting the level of soft drink consumption during these periods. These include other influences on the price of soft drinks such as increased production costs, the growth in the Irish economy and even the weather. Moreover, there is the question of the extent to which the tax rate changes were actually passed forward in the price of soft drinks. To gain an idea of the effects of price changes on the demand for soft drinks, it is necessary to construct an empirical model that takes such factors into account.

Following traditional economic theory, we have specified a model to estimate the determinants of soft drink consumption in Ireland.¹⁶ The demand for soft drinks in Ireland can be explained by four factors.

The price of soft drinks, inclusive of any taxes. The hypothesis is that the relationship is negative, i.e., that higher prices will discourage consumption. The question is whether higher prices will discourage consumption in proportion to the price increase.

The level of income. Soft drinks are a “normal” consumer good i.e., one could expect that the quantity of soft drinks consumed has increased over time, in a systematic way, with the increase in GDP.

Population growth. As the national population increases, the consumption of soft drinks will increase.

Consumer tastes. To get a true measure of the response of soft drink consumption to price changes, we must control for other factors that affect demand. In particular, weather in Ireland is cited as an important determinant of levels of soft drink consumption, and we introduce a weather variable in this time series analysis.

The price of alternate goods. Other goods may serve as either substitutes or complements to soft drinks and so changes in these prices might affect soft drink consumption.

Estimation of the demand for soft drinks is complicated by the fact that the observed soft drink price is determined by the interaction of supply and demand forces. In order to obtain statistically valid estimates of price elasticity of demand, there must be a control for the impact of demand on price. The stochastic model we estimate provides such a control. The model is specified in equations (1) and (2):

$$Q_d = F_1 (P_d, P_f, GDP, W, \text{error}) \quad (1)$$

$$P_d = F_2 (C, T_1, T_2, P_f, Q_{d-1}, GDP, W, \text{error}) \quad (2)$$

¹⁶ The basic elements of this analytic model, and the results, are presented here. The model and estimation, and more detail on the results, are presented in Appendix B.

where: Q_d is per capita consumption of soft drinks (1000 litres)¹⁷

P_d is the price of soft drinks, as measured by the national price index for carbonated beverages;

P_f is the price of food, as measured by the national price index for food items;
GDP is per capita Gross Domestic Product;

W is the average high temperature in July;

C is an index of the cost of production, measured here as the producer price index for drinks;

T_1 is the standard value added tax rate; and

T_2 is the excise tax rate on *table waters*.

The sources of all data are provided in Appendix C to this paper.

This model is estimated by instrumental variables methods, with all variables expressed in logarithms, for the period extending from 1975 through 1995. We have thus assumed constant elasticities with respect to all variables.¹⁸

The results of the econometric analysis, presented in Table 6, square with expectations. The explanatory variables that measure the price of soft drinks, income and weather are highly significant and with the correct signs. From this equation, we can predict the level of soft drink consumption during the 1975 through 1995 period with a high degree of accuracy (see Figure 1).

¹⁷ The dependent variable includes both domestic production and imports.

¹⁸ The model was also estimated in a linear form, with results presented in Appendix B. There are at least two important caveats to this analysis. Data on the price of all substitute products were not available; hence we are unable to estimate all relevant cross price effects. Even if data were available, the number of degrees of freedom available would not have allowed us to estimate even the most important of the cross price effects. We have estimated the cross price effects for only food and alcoholic beverages. Second, we have not taken account of price levels in Northern Ireland, and previous research has shown that smuggling and re-export can be an important revenue issue when price levels for certain commodities become too disparate (Fitzgerald, Quinn, Whelan and Williams, 1988). On this latter point, see also Bird, Perry and Wilson (1994) for a discussion of other excise goods.

The estimated price elasticity of demand for soft drinks is -1.10, and this is statistically significant. Our best estimate is that a 10 percent reduction in the price of soft drinks would lead to an 11 percent increase in the number of liters consumed, if all else were held constant (see Box 3). This estimate of the average consumption response to price changes of soft drinks in Ireland takes into account the several changes made in the excise and VAT rates over this 20-year period (see Table 1).

Box 3: Confidence Intervals

The statistical results from any regression equation include both estimated coefficients and estimated standard errors. While the coefficients represent the impacts of changes in the right-hand-side variables (x) on the dependent variable (y), the standard errors measure the precision of the point estimate. The smaller the standard error (relative to the size of the coefficient), the greater the accuracy with which the impact of x on y is measured. As a rough rule-of-thumb, the estimated coefficient must be at least twice the size of the standard error in order for us to reject the hypothesis that the true effect of x on y is zero. We can use the standard errors to place confidence intervals around coefficients. In this analysis, the estimated coefficient on the logarithm of per capita GDP is 1.227, with a standard error of .074. There is 95 percent probability that the interval (1.082, 1.372) contains the true elasticity of demand with respect to income. This is calculated as $b \pm 1.96 \times .074$, where b represents the estimated coefficient. According to our estimates, there is a 95 percent probability that the true price elasticity lies between the interval -0.765 and -1.439.

The estimated income elasticity of demand for soft drinks is 1.23, and is statistically significant. A ten percent increase in GDP would lead to a 12.3 percent increase in soft drink consumption, if all else were held constant (see Box 3). The implication of this result is that people will spend a larger share of their income on soft drinks as income increases.¹⁹

¹⁹ It is important to remember that this is a partial effect, i.e., it shows how revenues respond to income increases, if all else is held constant. Therefore, any progressivity suggestion must be interpreted carefully. A progressive tax refers to a tax burden that increases with income level, as might be seen from study of a cross section of taxpayers at different income levels at a point in time. The elasticity reported here is based on a time series that shows how all consumers alter their spending over time. A high time series elasticity does not necessarily imply progressivity.

These results also show that the consumption of soft drinks responds positively and significantly to warmer weather. A one-degree higher July temperature, on average, is associated with a 0.32 percent higher level of soft drink consumption. This is an interesting finding. The Soft Drink Association of Ireland has classified 1989, 1990 and 1995 as “good summers” and 1986 and 1991 as “bad summers.” Our results predict that, all other things held constant, soft drink consumption is about 2 percent higher in good than in bad summers.

The price of substitute goods, measured here, as the price index for food, was not significantly different from zero. Alternately, we used the price of alcoholic beverages as an independent variable, but the results were much the same. While it seems clear that the price of substitute products is important, it is not clear how one defines a substitute for soft drinks. In any case, we cannot get a precise estimate of the cross price elasticities of demand for soft drinks.

These results challenge the conventional wisdom, i.e., that the demand for soft drinks is price inelastic. After we hold constant the effects of income growth and weather, we find that a one percent soft drink price reduction leads consumers to increase the quantity of soft drinks purchased by 1.10 percent.²⁰ The important policy implication of this result is that while a *reduction* in the tax rate will lead to a revenue loss, the loss will be offset to a significant extent by additional taxes collected from increased consumption of soft drinks. Conversely, an increase in the tax rate will lead to a revenue gain, but the gain will be offset to a significant extent by reduced consumption of soft drinks.

²⁰ If the price of food products is dropped from the estimation, the price elasticity of soft drinks rises to 1.11 and the 95 percent confidence interval becomes (0.992, 1.257). If a price index for alcohol is used in place of the price of food, the price elasticity for soft drinks is 1.05, with a 95 percent confidence interval of (0.656,1.452).

To demonstrate this important result, we have carried out a simulation to estimate the revenue impact of the reduction in the tax rates on soft drinks that occurred between 1990 and 1992.

Remember that the tax rate was lowered from £0.37 per gallon to £0.29 in July of 1990, and then completely eliminated in 1992. The VAT rate to which soft drinks are subject was lowered from 23 to 21 percent, effective in January of 1992. Our concern is with the period between the 1990 reduction and the 1992 elimination. In this simulation, we ask three questions:

1. How much did the price of soft drinks change in response to changes in the tax rate, after abstracting from the effects of all other factors that may have had a price impact (e.g., changes in production cost and general inflation.) We refer to this as the *tax-induced price change*.
2. What change in soft-drink consumption can we attribute to this tax-induced price change?
3. Given the answers to (1) and (2), what change in excise tax revenue can be attributed solely to the tax-induced price change?

The results of this experiment are explained in more detail in Appendix D.

With respect to the first question, *actual* soft drink prices in Ireland did not fall between 1990 and 1992.²¹ The actual price index for soft drinks was 378 in 1989, the year prior to the rate reduction, and had risen to 400 in 1992 (see Table 4).²² However, if the only change that took place had been the tax rate changes, the price would have fallen. Our simulation (discussed in Appendix D) shows that the price index for soft drinks would have fallen from 378.1 in 1981 to 366 in 1990 and then to 358 in 1992 (a 5.3 percent decline overall) if *only* the tax regime had

²¹ How could the consumer price index for soft drinks be rising when the tax rate was falling? There are a number of explanations. The cost of production was rising because of a tight factor market, and this more than offset the tax effect. Bad weather had a dampening effect on demand during part of the 1990-1992 period and this had an offsetting effect. About 15 percent of the sale of soft drinks took place in pubs where prices are more sticky.

²² The tax was abolished in November of 1992.

changed and all else had remained constant (column (2) of Table D-1). Clearly, there was a price dampening effect. However, it is important to note here that consumer prices did not fall by the full amount of the tax reduction.

The answer to the second question is that *actual* soft drink consumption did increase between 1990 and 1992 (shown in column (5) of Table D-1), but if only the tax-induced price effects are considered, the increase in consumption would have been greater. Actual consumption increased by 6.8 percent during this period, but we estimate that if only the tax induced price changes were considered, the increase would have been nearly 15 percent. Therefore, our model answers the first two questions as expected: after we control for weather and income effects, we can conclude that the tax rate reduction by itself would have driven down soft drink prices, (though not by the full amount of the tax) and would have led to increased soft drink consumption.

The third question, the impact on revenues, is the most interesting. Excise tax revenues collected from soft drinks did fall as a result of the tax rate decrease, from £18.3 million in 1989 to £15.0 million in 1990, as shown in column (1) below.²³ Our model suggests that this £3.3 million overstates the revenue loss. If we consider *only* that revenue decline due to the tax-induced reduction in price, our simulation in column (2) below shows higher expected revenue yields in each year. Our estimates of the tax yield due only to the tax rate reductions (holding income, weather, etc., constant) are 4.7, 6.5, and 12.5 percent higher than the actual yields in 1990, 1991, and 1992 respectively (see column 3 below). We would estimate that of the

²³ While we have data on actual total collections from all *table waters*, we do not have actual total collections from soft drinks. We estimate this latter amount as the product of actual production of soft drinks and the tax rate.

remaining revenue cost of the rate reduction (e.g., £2.8 million in 1990), about 30 percent is recaptured in the form of increased VAT and income taxes.

	Actual Revenue ^a (in millions)	Simulated Revenue (in millions)	Simulated As A Percent of Actual
1989	£18.3	---	---
1990	£15.0	£15.7	104.7
1991	£15.3	£16.3	106.5
1992	£16.0	£18.0	112.5

^a See footnote 21.

These actual and simulated revenue paths are described graphically in Figure 2. These results are consistent with the hypothesis that rate reductions on the excise tax were accomplished with relatively little revenue loss.²⁴

V. REVENUE EFFECTS OF ELIMINATING THE EXCISE TAX

Complete elimination of the special excise tax on carbonated beverages, as occurred in 1992, is another story. Certainly there was a revenue cost to the government, since the tax yielded nearly £17 million in its last full levy year (1991). The point we make here is that the true revenue loss associated with abolishing the special excise is much less than this amount because of compensating increases in the VAT and income tax revenues. The story we can tell about the *net* revenue effects is the following:

²⁴ One might ask how there can be a revenue loss due only to price effects with a price elastic demand for soft drinks and a per unit tax. Our findings suggest that the prices did not fall by the full amount of the tax, suggesting the possibility that marginal costs of production were rising as output expanded in the soft drink industry.

- (1) The elimination of the special excise tax drove down the price of soft drinks and led to an increased consumption of soft drinks.
- (2) Total consumer expenditures on soft drinks were slightly larger after than before the tax was eliminated.
- (3) Total value added in the economy increased by approximately the amount of the excise tax reduction (see Box 4).
- (4) At least 21 percent of this value added increase was returned to government in the form of increased value added tax.
- (5) The increased value added in the soft drink industry is subject to other taxes as well. The increased labor income is subject to the individual income tax, and the increased profits are subject to the corporate income tax. Additional amounts of the revenue loss may be made up from these taxes.

Box 4: Do Excise Tax Reductions Lead to an Increase in Taxable Value Added?

As the excise tax is reduced and the price of soft drinks falls, the consumption of soft drinks increases by a slightly more than proportionate amount. After the tax change, therefore, total expenditures on soft drinks are slightly more than before, but the quantity produced is greater. As soft drink producers begin to expand the amount of labor and capital they need to increase production, and assuming they are price takers in factor markets, they simply attract productive factors away from other industries. At the end of this adjustment process, total value added is larger by approximately the amount of the excise tax reduction. Of this amount, 21 percent is returned to government in the form of increased VAT on soft drinks.

The assumptions underlying this analysis, and therefore the results, might be challenged. Two other scenarios are worth considering: First, if capital and labor are underemployed in the Irish economy, then the net increase in value added might be greater, i.e., total national output will increase and the expansion of the soft drink sector will not displace as much economic activity in other sectors. Second, if soft drink producers are not price takers in factor markets (e.g., if the increased amount of labor they require raises the price of labor to all producers), the net increase in value added might be less than the amount of the tax reduction.

Box 4: Do Excise Tax Reductions Lead to an Increase in Taxable Value Added? (continued)

Our view is that the assumption laid out in paragraph one is realistic. Soft drink producers are a small share of the Irish economy, directly accounting for only 2100 employees. It would not seem unreasonable to assume that soft drink producers buy labor and capital at fixed, market determined rates. Neither would the full employment assumption seem too far-fetched. The forecast unemployment rate for 1996 is 11.4 percent as compared to the EU average of 10.9 percent. The strong rate of real GDP growth and the low rate of inflation also raises our level of comfort with the assumption that expansion of the soft drink industry requires that resources be transferred from other industries. To the extent we have erred in these assumptions, it is likely on the side of being too conservative, i.e., in the direction of underestimating the recapture from other taxes.

From this analysis, we can say that the net revenue loss to the government will be equal to the *difference* between the amount raised from the excise tax and the amount of recapture in the form of increased VAT and income tax from the soft drink industry. We might make a rough estimate of this amount, as outlined in Table 7.

In row (1), we show the excise tax revenue loss of £16.0 million in 1992 to be 100 percent of the amount to be made up. Of this, 21 percent is recaptured in the form of increased VAT revenues (row 2).²⁵

In row (3) we estimate the increased individual income tax collected from increased payrolls. To make this estimate, we first assume that the labor and capital shares of increased value added (after payment of value added tax) are 75/25. The 75 percent of increased value added that is in the form of payrolls, is assumed to be taxed at an average rate of 6 percent. The estimated individual income tax revenue increase, then, is equivalent to $(.75)(.06)=4.5$, i.e., 4.5 percent of the excise tax revenue loss is recaptured in the form of increased individual income tax.²⁶

²⁵ For purposes of this illustration, we assume that the price elasticity of demand is unitary, i.e., consumers spend as much on soft drinks post-tax reform as they did pre-tax reform. In fact, our elasticity estimate suggests that they might spend a small percent more.

²⁶ We have no way to make an accurate estimate of the labor share and of the effective income tax rates in Ireland; therefore we assume these shares to illustrate the potential impacts. In fact, the top marginal personal income tax rate in Ireland is 48 percent, with a lower rate charged to capital gains; and the top corporate rate is 38 percent, with a lower rate charged to certain manufacturers.

In row (4) we show the increased amount of tax collected from capital, i.e., for the company income tax and the tax on capital income received by individuals. Using the same 75/25 assumption for the capital/labor share as above, and assuming an average effective tax rate of 10 percent on company profits and capital income received by individuals, we may calculate the revenue recaptured from taxes on capital as $(.25)(.1)=2.5$. That is, about 2.5 percent of the revenue loss is recaptured from income taxes on capital.

By these calculations, 28 percent of the amount of surrendered excise tax revenue is recaptured and 72 percent is a net revenue loss.

Further considerations suggest that the net tax loss may be even less. The issues here are that (a) all producers and all consumption goods are not treated the same under Irish tax law, and (b) the structure of certain industries is such that some make less of a revenue contribution than do others. An example of the first point is the application of a differential VAT rate to different forms of consumption, and an example of the second is the zero rating of exports under the VAT. The question that might be raised is whether increased soft drink consumption and production has displaced consumption and production in sectors that are taxed at a lower effective rate. If so, there is an additional positive revenue effect associated with the displacement, and the revenue loss due to the elimination of the excise tax is even smaller. This is a likely possibility in the case of the soft drink industry, for a number of reasons.

The export share of total output of the soft drink industry is very low, only about 10 percent. Exports are zero rated under the VAT, which means that they are not taxed and that tax payments on inputs are all refunded to the exporter. A shift toward production of a product like soft drinks with a higher domestic consumption share, *cet. par.*, could be revenue enhancing.²⁷

The soft drink industry has high domestic value added content, and imports relatively little of its inputs. If the import share of inputs is less than is the case for other sectors of the economy (e.g., producers of hot drinks), the shift to production in this sector is revenue enhancing.

²⁷ Of course one could argue that increased exports will eventually be balanced with increased imports, and the latter would be subject to VAT if they were not intermediate goods. Therefore, the long run revenue effects of shifting production toward an industry that produces for domestic markets will be less than the short run effects.

The increased consumption of soft drinks could come at the expense of some reduced consumption of alcoholic beverages and cigarettes. Any measure that discouraged consumption of these activities would be consistent with other national objectives and possibly would reduce external costs, but there would be negative (gross) revenue consequences.

Based on all of this information, what can we say about the net revenue effects at the time of the elimination of the special excise tax? Our best estimate is that about 30 percent of the revenue loss, and perhaps more, was recaptured by the existing tax system. To provide an updated estimate of this amount, we have carried out the following forecast. We have used the model developed for this analysis to project the consumption of carbonated beverages to the year 1995 *under the assumption that the excise tax had not been repealed*. Based on this forecast, we can estimate that the excise tax would have yielded £19.3 million. This means that in 1995 terms, with a 30 percent recapture rate, the Irish government raises £13.5 million less revenue than it would have if it had not abolished the excise tax. This amount is equivalent to about three-fourths of one percent of value added tax revenues in 1995. Therefore, in order for the *net* VAT increase to completely offset the net excise tax loss, using 1995 as a base year of calculation, the VAT rate would need to be increased by a negligible amount above its present level of 21 percent.²⁸ Elimination of the excise tax administration cost for *table waters* covers some of this loss, as do reduced compliance costs. Other minor improvements in tax administration efficiency (improvements that would amount to less than one percent of total revenue collections) could cover the remaining revenue loss. These computations suggest that when all

²⁸An increase in the standard rate from 21 percent to 21.1 percent would make up the shortfall.

factors are considered, abolition of the excise tax was accomplished with little revenue consequence.²⁹

V. CONCLUSIONS

Moving away from a discriminatory tax treatment of soft drinks would appear to have been good public policy in Ireland. It removed a tax-induced distortion to consumer choices, lowered administrative costs, and was accomplished with only a minor revenue sacrifice. We might summarize the results of this study in the following stylized facts:

1. The focus of this study is on the taxation of carbonated beverages, and the policy question is whether it is in the national interest to levy such a tax on soft drinks. Ireland provides a natural experiment for this analysis, because it has both imposed and eliminated such a discriminatory tax in the past two decades.
2. Soft drinks in Ireland have been subject to two indirect taxes: a special excise tax levied on physical production, and a value added tax that treats soft drinks as an item of general consumption. Under both indirect taxes, soft drinks have been singled out for what appears to be a discriminatory treatment.
3. The special excise was levied at a rate of £0.10 per gallon produced from 1975 through 1979, and was collected directly from the producer. In 1980, the rate was increased to £ 0.372 per gallon, and held at that level until July of 1990. It was reduced to £0.29 per gallon at that time and finally abolished in November of 1992. The revenue yield of the special excise was never very great. By the time of its abolition in November of 1992, it amounted to less than one-tenth of one percent of total budgetary tax collections. The average Irish resident was paying only about £1 per year in special excise tax in 1992 when the tax was abolished.
4. Carbonated beverages are also subject to the value added tax, and here again there is rate differentiation. At present, soft drinks are treated as an item of regular consumption

²⁹ Some may ask why the “multiplier effects” of expanded soft drink production are not counted. That is, the increased amount of tax on employees in the bottling industry, on the increased output in the sugar industry, etc. The answer is that expansion in these industries will use capital and labor that will almost certainly lead to some displacement from other sectors. Only if the expansion of the soft drink industry uses up idle resources will the so called “multiplier effects” be relevant. Our decision to ignore these “multiplier effects” leads to a conservative (overstated) estimate of the revenue cost of eliminating the excise tax on soft drinks.

for tax purposes, rather than as a food and drink item. Most food and drink sold in retail shops is zero rated under the VAT, and taxed at 12.5 percent if sold in restaurants or through vending machines. Soft drinks are taxable at the top rate of 21 percent, irrespective of whether the purchase is made in a retail shop or a restaurant.

5. Countries choose to levy excises on products whose consumption imposes external costs (tobacco, alcohol and motor fuels), and on products whose production and consumption siphons away resources that could be better used elsewhere in the economy. Equity reasons are another justification. Goods subject to excise taxes usually have the desirable feature of price inelasticity of demand, which suggests that tax rates can be increased without fear of a revenue loss.
6. These justifications cannot be used to make the case for taxing soft drinks. Soft drinks generate only two percent of the container waste in Ireland, hence are no more responsible for environmental problems than are most food and drink products. The Irish government, at the urging of the EU, abolished the excise tax because there was no externality justification. Neither is there a good argument that the soft drink industry is more of a resource user than other members of the consumer goods sector -- the soft drink industry generates a high value added, and has a relatively low import content. There is no hard evidence that the consumption of soft drinks is skewed more heavily towards higher income families than are other types of consumption goods, therefore justification of a special tax on soft drinks on grounds that it is progressive would not seem a starter.
7. There is a horizontal equity consideration that clearly argues against discriminatory taxation of soft drinks. *Horizontal equity* in taxation requires that the tax system not influence an individual's consumption choice. Yet in Ireland, we could observe the following:

The special excise increased the price of soft drinks more than all other non-alcoholic beverages, including milk, tea and pure fruit juices.

Soft drinks, alcohol, bottled waters and health drinks are all taxable at 21 percent no matter where they are purchased. Coffee and tea are zero rated if purchased in a retail outlet, but 12.5 percent if purchased in a restaurant. Fruit juices are taxed at 21 percent unless purchased in a restaurant in which case they are taxed at 12.5 percent.

Soft drinks are taxed at 21 percent if purchased from a vending machine, but tea is taxed at 12.5 percent if purchased from the same vending machine.

Prior to 1992, bottled waters were subject to a zero rate, but bottled waters with flavoring were subject to the standard VAT rate.

Cold take away food and (zero rated) drink, for example sandwich and milk, is taxable at 12.5 percent, while the same sandwich with a soft drink is taxed at 21 percent. However, in the latter case, the proprietor may choose not to establish an inclusive price, in which case the VAT on the sandwich is 12.5 and on the soft drink is 21 percent.

8. The bigger issue is the price elasticity of demand. Is the demand for soft drinks, like that for alcohol and cigarettes, price inelastic? The answer we get from the Irish data is that it is not. The results of an econometric analysis of the demand for soft drinks in Ireland show that most of the variation in soft drink consumption over the past twenty years can be explained by changes in prices, income and weather.

Our estimate of the price elasticity of demand for soft drinks is -1.10. That is, a 10 percent reduction in the price of soft drinks would lead to an 11 percent increase in the number of gallons consumed, if all else were held constant.

The estimated income elasticity of demand for soft drinks is 1.23. A ten percent increase in GDP would lead to a 12.3 percent increase in soft drink consumption, if all else were held constant. The implication of this result is that people will spend a larger share of their income on soft drinks as income increases.

The consumption of soft drinks responds positively and significantly to warmer weather. Our results predict that, all other things held constant, soft drink consumption is 2 percent higher in good than in bad summers.

9. These results challenge the conventional wisdom, i.e., that the demand for soft drinks is price inelastic. The important policy implication of this result is that while a *reduction* in the tax rate will lead to a revenue loss, the loss will be partially offset by additional taxes collected from increased consumption. Conversely, an increase in the tax rate will lead to a revenue gain, but part of the potential gain will be lost to reduced consumption.
10. We have estimated the revenue cost of the tax rate reduction between 1989 and 1992. The Irish government reports that revenues from the excise tax fell by 13 percent between 1989 and 1992. We estimate that if *only* the impact of tax rate reductions is considered, the 1992 level of taxes would be about the same as in 1989 (all measured in nominal terms). Increased VAT and income taxes will capture about 30 percent of the actual reduction in excise tax revenues.
11. We have used these results to simulate the revenue cost of the complete elimination of the excise tax in 1992. The actual loss to the government is well less than the £16 million it generated in 1992. We estimate that about 30 percent of this cost, and possibly more, would be recaptured with increased VAT and income tax revenues. The remainder, a better measure of the true revenue cost, could be recaptured with some combination of the cost savings from eliminating the excise tax administration

department, additional revenues generated from other improvements in tax administration, or with an increase in the standard VAT rate from 21 percent to 21.09 percent.

TABLE 1

THE TAXATION AND PRODUCTION OF SOFT DRINKS IN IRELAND: 1975-1996

Year	Value Added Standard Rate of Tax (in percent)	Special Excise Tax Rate (in £ per gallon)	Total Soft Drink Production ^a (in thousands of liters)	Comments
1975	25	0.10	105,597	
1976	25	0.10	110,458	
1977	25	0.10	118,415	
1978	25	0.10	135,247	
1979	25	0.10	156,306	
1980	25	0.37	147,683	Excise duty was increased as of Feb. 28, 1980.
1981	25	0.37	147,904	
1982	25	0.37	145,878	
1983	25	0.37	153,977	
1984	25	0.37	158,872	
1985	25	0.37	164,988	
1986	25	0.37	165,645	
1987	25	0.37	178,745	
1988	23	0.37	195,167	
1989	23	0.37	224,226	
1990	23	0.29	235,465	Excise Tax was reduced on July 1, 1990.
1991	23	0.29	239,705	
1992	21	0	251,300	Excise Tax was eliminated on November 1, 1992. Bottled water was moved from zero rate to the standard 21 percent rate under the VAT.
1993	21	0	270,000	
1994	21	0	292,000	
1995	21	0	336,000	
1996	21	0	353,000	

Source: Government of Ireland, Tax Code; Soft Drink Association of Ireland.

^a Includes imports.

TABLE 2
REVENUE YIELD FROM THE SPECIAL EXCISE TAX ON TABLE WATERS
IN IRELAND 1977-1992

Year	Total (in £)	In Per Capita Real Terms ^b (in £ per person)	As a Percent of Total Tax Revenue	As a Percent of GDP
1977	2,535,645	0.5796	0.1730	0.04227
1978	2,956,260	0.6425	0.1734	0.04160
1979	3,207,721	0.6036	0.1608	0.03852
1980	8,902,319	1.3975	0.3413	0.09042
1981	12,113,773	1.5650	0.3662	0.10140
1982	12,564,194	1.3740	0.3098	0.08927
1983	12,929,676	1.2693	0.2771	0.08318
1984	14,209,233	1.2735	0.2688	0.08234
1985	13,747,590	1.1581	0.2478	0.07347
1986	14,598,952	1.1881	0.2404	0.07410
1987	15,177,130	1.2010	0.2325	0.07202
1988	16,765,633	1.3057	0.2269	0.07400
1989	19,709,756	1.4749	0.2655	0.07762
1990	17,976,093	1.3058	0.2270	0.06635
1991	17,768,327	1.2470	0.2132	0.06303
1992 ^a	16,789,169	1.1396	0.1873	0.05599

Sources: *IMF, Government Finance Statistics Yearbook*, various years; The World Bank, *World Tables*, various years; and Government of Ireland, *Statistical Report*, various years.

^a The tax was abolished in November, 1992.

^b 1975 = 100.

TABLE 3

EXCISE TAX REVENUES FROM TABLE WATER AS A PERCENT
OF REVENUES FROM OTHER SOURCES: 1977-1992

Year	Company Income Tax	VAT	Individual Income Tax
1977	1.2369	0.78747	0.48483
1978	2.8983	0.71407	0.48864
1979	2.5060	0.76193	0.4382
1980	6.4045	1.89009	0.87881
1981	6.0569	1.96016	0.97221
1982	5.4156	1.31977	0.86174
1983	6.0138	1.08289	0.77843
1984	6.7663	1.03869	0.72201
1985	6.3062	0.98691	0.65309
1986	5.6585	0.95480	0.61289
1987	5.9286	0.95454	0.55839
1988	5.0047	0.91615	0.55041
1989	6.5049	1.01388	0.69621
1990	3.7844	0.91296	0.59347
1991	2.9913	0.88312	0.55147
1992	2.2719	0.77121	0.49177

Sources: *Government Finance Statistics Yearbook*, International Monetary Fund; *World Tables*, The World Bank; *Statistical Reports*, Government of Ireland.

TABLE 4

EXCISE DUTY REVENUE ON BEER AND SPIRITS

Year	Beer			Spirits		
	Amount (in £)	Percent of Tax Revenue	Percent of GDP	Amount (in £)	Percent of Tax Revenue	Percent of GDP
1975	66,115,308			48,756,467		
1976	91,102,277			61,859,150		
1977	97,385,870	6.6430	1.62345	68,153,933	4.6490	1.13615
1978	101,913,965	5.9774	1.43405	74,711,020	4.3819	1.05128
1979	118,815,848	5.9557	1.42693	86,499,290	4.3358	1.03882
1980	150,920,893	5.7868	1.53292	116,730,217	4.4759	1.18564
1981	189,681,654	5.7340	1.58771	135,960,087	4.1100	1.13804
1982	226,803,883	5.5918	1.61138	131,943,520	3.2530	0.93743
1983	232,050,197	4.9732	1.49283	116,028,687	2.4867	0.74644
1984	239,386,383	4.5287	1.38726	114,073,093	2.1580	0.66106
1985	243,934,608	4.3968	1.30370	116,365,039	2.0974	0.62191
1986	247,262,927	4.0708	1.25496	115,495,929	1.9015	0.58619
1987	243,065,874	3.7240	1.15335	108,891,574	1.6683	0.51669
1988	249,507,743	3.3772	1.10125	116,090,471	1.5713	0.51239
1989	268,572,191	3.6176	1.05765	116,878,799	1.5743	0.46027
1990	280,696,446	3.5450	1.03605	120,395,137	1.5205	0.44438
1991	281,833,910	3.3809	0.99979	121,312,368	1.4553	0.43035
1992	295,208,268	3.2925	0.98442	114,772,252	1.2801	0.38273
1993	272,446,671	3.0387	0.84378	118,567,030	1.3224	0.36721

Sources: IMF, *Government Finance Statistics Yearbook*; Government of Ireland, *Statistical Report*, various years.

TABLE 5

THE TAXATION OF SOFT DRINKS IN EU COUNTRIES

Country	VAT Rate (in percent)	Excise Tax
Austria	20.0	YES
Belgium	20.0	YES
Denmark	25.0	YES
France	5.5	YES
Germany	15.0	NO
Greece	8.0	NO
Ireland	21.0	NO
Italy	20.0	NO
Luxembourg	3.0	NO
Netherlands	6.0	YES
Portugal	12.0	NO
Spain	7.0	NO
Sweden	21.0	NO
United Kingdom	17.5	NO
Finland	17.0	YES

TABLE 6

RESULTS OF REGRESSION ANALYSIS ON PER CAPITA CONSUMPTION OF SOFT DRINKS
IN IRELAND^a: 1975-1996

	Regression Coefficient ^b	T-Value
Constant	-8.05	-19.40
Price Index for Soft Drinks ^c	-1.102	-6.43
Price Index for Food Products	0.004	0.01
Per Capita GDP	1.227	16.52
Average July Temperature	0.318	2.79

^a See Appendix A.

^b All variables expressed in logarithms.

^c Endogenous variable.

TABLE 7

NET REVENUE COST OF ELIMINATION OF THE SPECIAL EXCISE TAX ON SOFT DRINKS

	Amount (in £ millions)	Percent
1) Special Excise Tax Revenue Loss	16.0	100
2) VAT Increase From Soft Drinks	3.36	21
3) Individual Income Tax Increase ^a	0.72	4.5
4) Corporate Income Tax Increase	0.40	2.5
5) Net Revenue Loss	11.52	72.0

^a Assume that the labor/capital shares are 75/25 of increased value added, net of value added tax. Assume that the average rate of individual income tax is 6 percent and the average rate of tax on profits and capital income is 10 percent.

Figure 1
Predicted and Actual Soft Drink Consumption

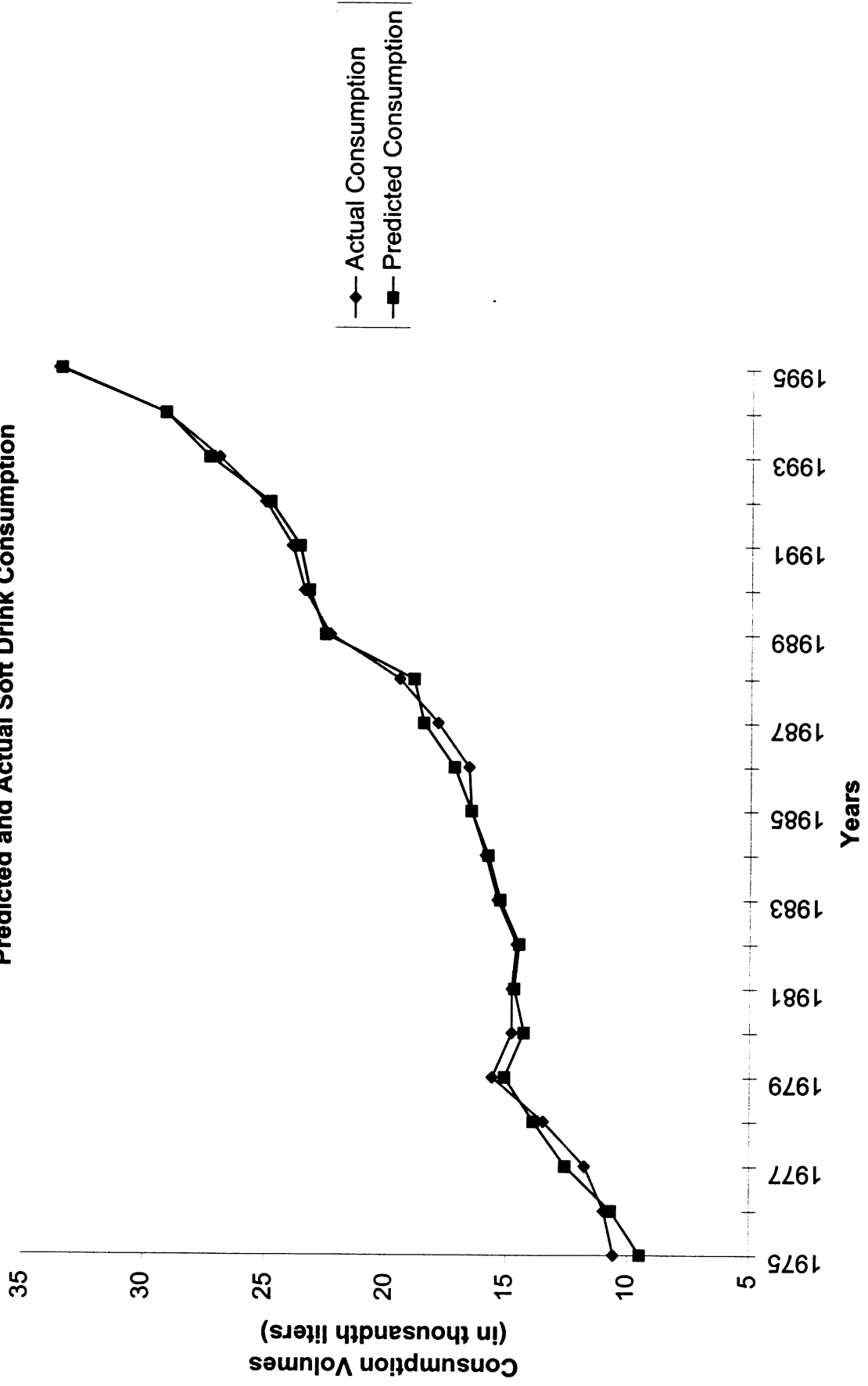
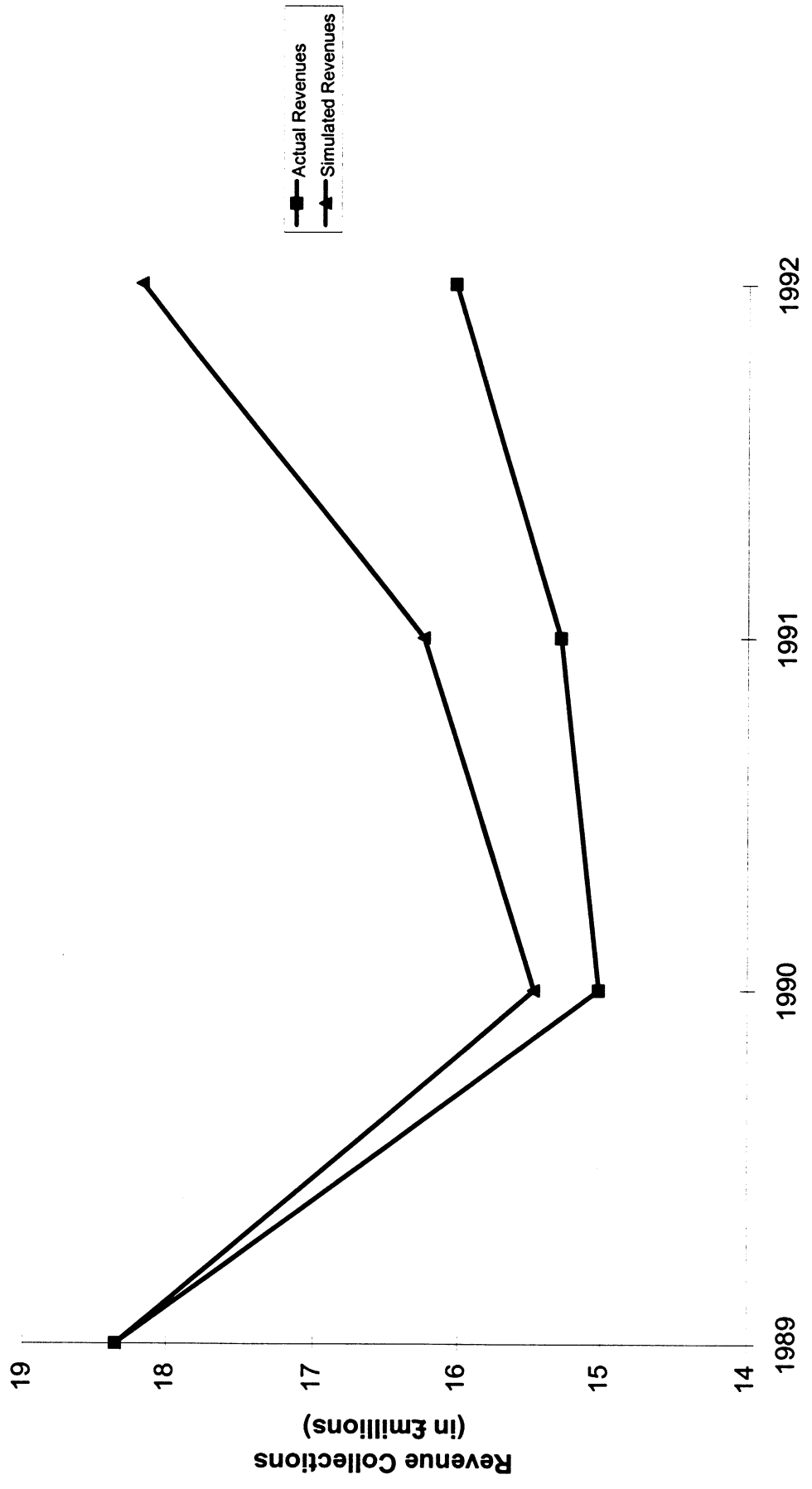


Figure 2

Actual Excise Tax Collections from Soft Drinks Compared with Tax Collection as Simulated under the Assumption that Tax Rates are Lowered but All Else Remains Constant



APPENDIX A

COMMISSION RECOMMENDATIONS ON THE EXCISE TAX ON TABLE WATERS

Table Waters

- 8.44 An excise duty of £0.372 per gallon applies to table waters. The term ‘table waters’ includes any aerated waters and any beverages (including syrups and other liquors intended to be consumed only in a diluted form) put up for sale in bottles, cans, casks or other closed containers or receptacles, other than:
- (i) any liquor for the retail sale of which an excise license is required,
 - (ii) milk and milk products, whether or not flavored,
 - (iii) soups and broths, and
 - (iv) fruit and vegetable juices which, in the opinion of the Revenue Commissioners, have not lost their original character through the addition of water or of other substances for sweetening, preservative or other purposes.
- 8.45 We see no justification on efficiency grounds for special taxes on table waters. We reject the argument that table waters which are used as ‘mixers’ for alcoholic drinks should bear some of the tax required to be raised to offset the costs of alcohol abuse. On grounds of efficiency, the costs imposed on the community by abuse of alcohol should only be borne by the consumers of alcohol. Table waters, although sometimes used in conjunction with alcohol, also provide a substitute for alcohol. We recommend that the excise duties on table waters be abolished.

Recommendations

- 8.46 We make the following recommendations:
- 12. Excise duties on alcohol may be justified on the basis that they charge the consumer for the external costs imposed on society by the consumption of alcohol. We have identified the main areas where costs and benefits arise but it is extremely difficult to quantify the net social costs in economic terms. In determining the excise duty on alcohol, account should be taken of the need to prevent the price of alcohol from becoming significantly higher in the Republic than in Northern Ireland and Britain.

13. Excises on alcohol should vary only with respect to the alcohol content of different beverages.
14. Subject to due consideration for the structure of the brewing industry, the duty on beer should be levied on a finished product basis.
15. The rebate of excise duty on beer produced by small brewers should be abolished when duty on beer is charged on a finished product basis.
16. All undenatured spirits (i.e. those containing pure alcohol) should be charged to excise duty at the standard rate.
17. Alcohol for medical purposes or for use in any art should continue to be exempt from excise duty.
18. Excise duties on table waters should be abolished.

Source: Reprinted exactly from *Government of Ireland 1984*, pp. 122-123.

APPENDIX B: METHODOLOGY

Because our ultimate goal is the estimation of the price elasticity of demand, a structural demand equation must be specified and estimated. From a methodological standpoint, the estimation of consumer demand equations is complicated by the fact that while individual consumers may perceive product prices as exogenous, in fact, both price and quantity are endogenously determined in markets. In order to obtain consistent estimates of demand elasticities, we must take into account the interaction of demand and supply forces in the determination of market prices and quantities.

Consumer demand theory suggests that the demand for a product depends primarily on its price, the prices of other goods, consumer income, and preferences. With aggregate data, the demands of the representative consumer are modeled. Note also that the use of aggregate data means that it is not possible to observe any heterogeneity in consumer preferences. We specify the structural demand equation as follows.

$$\log\left(\frac{Q_t}{pop_t}\right) = \beta_0 + \beta_1 \log(psd_t) + \beta_2 \log(pal_t) + \beta_3 \log\left(\frac{GDP_t}{pop_t}\right) + \beta_4 \log(jtemp_t) + error,$$

where Q_t = quantity of soft drinks purchased, measured in liters, pop_t = the population of Ireland, psd_t = the price of soft drinks, pal_t = the price of alcoholic beverages, GDP = gross domestic product, and $jtemp$ = the average temperature in July. The t subscript refers to the observation year. Thus, we specify the per capita consumption of soft drinks as a nonlinear function of the price of soft drinks, the price of a substitute good - alcohol, per capita GDP (as a proxy for income), and the average high temperature in July, as a preference variable. The double log specification is quite common in applied demand modeling and, of course, means that the constant price elasticity of demand is given by β_1 , the coefficient of $\log(psd)$.

Ordinary least squares estimates of this equation will be inconsistent since the price variable is endogenous to the equation and hence is correlated with the equation's error. The appropriate estimator is the instrumental variables estimator; this can be written as

$$\tilde{\beta} = (X'P_wX)^{-1} X'P_wy.$$

Here, X is the $n \times k$ matrix of explanatory variables in the demand equation and y is the $n \times 1$ vector of per capita consumption of soft drinks. If we define W as the $n \times \ell$ matrix of instruments, then P_W is the matrix that projects orthogonally onto the space spanned by the columns in W .

The next step is the specification of the matrix of instruments. Valid instruments are variables with nonzero asymptotic correlation with the variables in X and that are uncorrelated asymptotically with the structural errors in the demand equation. In this particular case, we want to make sure that the instruments include supply factors. For this model, possible instruments include excise and value-added tax rates, the producer price index for drinks, and other predetermined variables from the demand equation. Changes in the tax rate will impact supply and changes in the drinks PPI approximate changes in production costs. The demand equation is over-identified as there are more columns in W than in X . Note that the specification of a structural supply equation is not necessary because structural estimates of supply parameters are not required.

Several different specifications for W were tried. Most worked well, in the sense of providing a good "fit" for psd . The specification used to produce the reported version of the demand equation is provided below in the form of a reduced form equation for price (psd).

$$\log(psd_t) = \alpha_0 + \alpha_1 EXC_t + \alpha_2 VAT_t + \alpha_3 DKWPI_t + \alpha_4 \log\left(\frac{GDP_t}{pop_t}\right) + \alpha_5 \log(jtemp_t) + \alpha_6 \log\left(\frac{Q_{t-1}}{pop_{t-1}}\right) + \alpha_7 \log(psd_{t-1}) + error.$$

In this equation, EXC and VAT refer to excise and value-added tax rates, while $DKWPI$ refers to the drinks producer price index, which serves as a proxy for production costs. The lagged values of price and per capita consumption were included to allow for the autoregressive behavior of psd .

The estimation results for the reduced form price equation are as follows:

Variable Name	Estimated Coefficient	Estimated Standard Error
EXC	0.0027	0.0004
VAT	0.0211	0.0073
DKWPI	0.0107	0.0016
log(GDP/POP)	0.2869	0.1019
log(JTEMP)	-0.0256	0.0666
log((Q/POP) _{t-1})	-0.1300	0.0964
log(PSD _{t-1})	0.0179	0.1678
C	1.2084	0.7770

This particular reduced form equation fits the data very well; the R^2 is .999.

Under appropriate regularity conditions, it can be shown that the instrumental variable estimator is asymptotically normally distributed:

$$\sqrt{n} \cdot (\tilde{\beta} - \beta_0) \sim N \left(0, \sigma_0^2 p \lim_{n \rightarrow \infty} (n^{-1} X' P_W X)^{-1} \right).$$

In the expression for the variance of the asymptotic distribution, σ_0^2 is the variance of the structural error. Finite sample results for the instrumental variable estimator rely primarily on Monte Carlo results. While some overidentification is desirable (moments of the IV estimator exist only up to the degree of overidentification), there is evidence to suggest that the bias of the IV estimator increases as $\ell - k$ increases.¹

Estimation results, using data from 1975 to 1995, are provided in the table below. Recall that the dependent variable in the regression is the log of per capita consumption of soft drinks.

Variable Name	Estimated Coefficient	Estimated Standard Error
Log(PSD)	-1.054	0.203
Log(PAL)	-0.067	0.248
Log(GDPPC)	1.250	0.079
Log(JTEMP)	0.327	0.111
C	-8.126	0.401

¹Theoretical results from demand theory show that additive errors on consumer demand equations exhibit conditional heteroskedasticity. However, the extremely small sample available here makes the use of heteroskedastic-consistent standard errors problematic, so that the standard errors reported here assume homoskedasticity.

Our results that the estimated price elasticity of demand is -1.05, with a standard error of 0.203. This means that a 95% confidence interval around the true coefficient is (-.657, -1.257).²

Results for the other parameters are also mostly consistent with our expectations. The negative estimated coefficient on the price of alcoholic beverages indicates that soft drinks and alcoholic drinks are complements, however, the large standard error on this coefficient makes any precise inference impossible. The other coefficients indicate that increases in per capita GDP result in substantial increases in the quantity demanded of soft drinks and the tastes for soft drinks increase in years with warmer summer weather.³

An arbitrary assumption in the above model is that demand for soft drinks can be approximated by a double log (or constant elasticity) specification. There is no obvious way to test this assumption as there is no completely general functional form that nests the double log model. It is possible, however, to examine a different specification to see if the same basic results hold. To accomplish this, we also estimated a linear demand function:

$$\frac{Q_t}{pop_t} = \alpha_0 + \alpha_1 psd_t + \alpha_2 pal_t + \alpha_3 gdppc_t + \alpha_4 jtemp_t + error.$$

The set of instruments used to estimate this equation were the same as for the previous specification, except that variables were used in levels rather than logs. The linear model results are presented below.

Variable Name	Estimated Coefficient	Estimated Standard Error
PSD	-0.00008	5.72E-5
PAL	-0.00007	4.70E-5
GDPPC	1.18E-5	7.65E-6
JTEMP	0.00088	0.0003
C	0.0286	0.0102
AR(1)	0.700	0.2595

In this case, the price elasticity of demand is not constant; instead elasticity is given by $\epsilon_t = \left(\hat{\alpha}_1 \cdot \frac{psd_t}{q_t} \right)$, and changes as price changes along a demand curve. Note that the coefficient on price is computed holding constant the effects of the other variables in the demand curve, so that -0.00148 measures the impact of a unit change in price, holding income and preferences constant.

²We also tested whether an autoregressive term was appropriate to include in the demand equation. The estimated autocorrelation coefficient was close to zero, with a large standard error, hence we dropped it from the equation.

³We also examined whether a first order autoregressive term would be useful in the demand equation. The estimated autocorrelation was close to zero, with a large standard error, so we did not retain it.

APPENDIX C

DATA SOURCES

Volume Production of Soft Drinks: Soft Drinks Association of Ireland

Revenue from Table Waters, Beer, and Spirits: Ministry of Finance, Government of Ireland

Revenue from Major Sources: *Government Finance Statistics*, IMF.

Consumer Price Index: Central Statistics Office, Government of Ireland

Price Index for Soft Drinks: Central Statistics Office, Government of Ireland

July Temperatures: Ireland Meteorological Service

APPENDIX D

ESTIMATED EXCISE TAX REVENUE IMPACT OF THE EXCISE TAX AND VAT RATE REDUCTION IN 1990.

The separate revenue impact of the 1990 reduction in the excise tax rate on carbonated beverages from £0.379 to £0.29 is difficult to analyze because of the substantial changes in many of the relevant variables. If these other factors (e.g., weather, income level, production costs) were held constant, we would expect that the price index for soft drinks would drop as a result of the tax decline. The *actual* price index rose from 378.1 to 385.2 between 1989 and 1990 and again to 395 in 1991 (Column 4 of Table D-1). This increase in the price of soft drinks reflects, among other things, the increase in the producer price index for soft drinks (which we take as a proxy for production costs) and increasing real income over this period. A similar problem of disentangling the price effect from everything else occurs on the consumption side. *Actual* consumption of carbonated beverages rose in 1990 and again in 1991 and 1992, despite the price increase. This is no doubt due to strong increases in per capita GDP and the strong income elasticity of demand for soft drinks. Our best estimate of the *actual* situation is that excise tax revenues from carbonated drinks fell from £18.3 million in 1989 to £15.0 million in 1990 (an 18 percent decrease) and then rose to £15.3 million in 1991, (a 2 percent increase).

In order to isolate the impact of the tax-induced price change on consumption and hence on excise revenues, we must first construct a price index for soft drinks that reflects *only* the drop in tax rates. This was done using our estimated price equation (see Appendix B), but holding the values of all variables other than the tax rates constant at their 1989 levels. This simulated price index is shown in Column (2) in Table D-1 and may be compared with actual prices in Column (4). We then predict consumption quantities in 1990 and 1991 based on our estimated demand

equation, but using the new simulated price index (and GDP and weather at actual 1990 and 1991 levels). The simulated consumption quantities are shown in Column (3) in Table D-1. These figures show that if the price of soft drinks had reflected the tax cut and *with other variables held at their actual 1990 levels*, consumption of carbonated beverages would have risen by over 8 percent between 1989 and 1990. In this scenario, consumption would continue to rise, so that by 1992, simulated soft drink consumption exceeds actual consumption by 13.5 percent. The excise tax revenue yields associated with these consumption levels are £15.5 million in 1990, £16.2 million in 1991 and £18.2 million in 1992.

TABLE D-1

SIMULATED VARIABLES IN THE ESTIMATION OF THE REVENUE IMPACT OF THE EXCISE TAX
AND VAT RATE REDUCTION BETWEEN 1990 AND 1992.

Year	Excise Tax Rate	P	Q	PSD	LTR
1975	10.00	...	105597.0	100.0000	105597.0
1976	10.00	...	110458.0	110.3000	110458.0
1977	10.00	...	118415.0	117.7000	118415.0
1978	10.00	...	135247.0	128.0000	135247.0
1979	10.00	...	156306.0	144.3000	156306.0
1980	37.20	...	147683.0	176.3000	147683.0
1981	37.20	...	147904.0	215.6000	147904.0
1982	37.20	...	145878.0	265.7000	145878.0
1983	37.20	...	153977.0	296.1000	153977.0
1984	37.20	...	158872.0	313.5000	158872.0
1985	37.20	...	164988.0	326.3000	164988.0
1986	37.20	...	165645.0	344.3000	165645.0
1987	37.20	...	178745.0	354.0000	178745.0
1988	37.20	...	195167.0	366.2000	195167.0
1989	37.20	378.10	229000.1	378.1000	224226.0
1990	29.00	366.95	245571.1	385.2000	235465.0
1991	29.00	366.95	256224.9	395.0000	239705.0
1992	29.00	358.25	281829.2	400.4000	251300.0
1993	0.00	338.06	323110.7	391.7000	270000.0
1994	0.00	338.06	353300.4	399.6000	292000.0
1995	0.00	338.06	412371.9	407.6000	336000.0

Legend:

P = price simulated to reflect tax rate reductions in 1990 and beyond, holding all else constant at 1989 levels. Simulated values in boldface.

Q = predicted quantity based on P and actual income level and weather conditions. Simulated Values in boldface.

PSD = actual index of soft drink prices.

LTR = soft drink consumption measured in thousands of liters.

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