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The Effect of the Value-Added Tax on the Tax Ratio

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Abstract

This paper provides evidence to support the widespread perception that the introduction of a value added tax raises the tax ratio. The introduction of value-added taxes is examined using event analysis on a sample of 11 European countries that introduced value-added taxes in the 1960s and 1970s. The paper reviews various reasons why the value-added tax may raise the tax ratio and examines empirically the effect of diversifying the sources of revenue on the tax ratio.

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## I. Introduction

This paper tests the proposition that the introduction of a value-added tax (VAT) will increase the ratio of government tax revenue to gross domestic product (the tax ratio). Despite the introduction of VATs by many European countries in the 1960s and 1970s, there has been little investigation to support or contradict the widespread perception that the introduction of a VAT will raise the tax ratio. 1/ This issue is of considerable interest to many countries either introducing, or considering the introduction, of such taxes. Portugal, Spain and Greece recently introduced VATs as part of their accession to the European Community, and New Zealand introduced a VAT in 1986. 2/ Other countries have considered the introduction of a VAT in recent years including Australia, the United States, Canada, and most recently Japan. 3/

The empirical tests suggest that, on average, a country introducing a VAT will record a higher tax ratio. The test is conducted in two steps. First, the revenue effect of the introduction of a VAT is examined by reviewing the experience of a sample of 11 European countries which introduced VATs in the 1960s and 1970s. 4/ These 11 countries are examined as a group using "event analysis" to ascertain the effect of the introduction of a VAT on the tax ratio. 5/ This test shows that the introduction of a VAT immediately increases the tax ratio, which then persists at the higher level. There is less definitive evidence that the growth rate of the tax ratio increases. Second, a cross-section of 23 "VAT and non-VAT" countries is examined to consider one hypothesis that has been provided to explain why the introduction of a VAT increases the tax ratio. This test suggests that at least some part of

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1/ Stockfish (1985) presented some evidence on the effect of a VAT on the tax ratio and concludes that there has been no effect. His method was to calculate "growth ratios" for VAT and non-VAT OECD countries. The growth ratio is the annual growth in a country's tax collections divided by the annual growth rate of GDP. This elasticity concept relates to growth rates rather than levels despite the conclusion drawn by Stockfish.

2/ Other countries that have introduced VATs, since 1985, are Morocco, Turkey, Indonesia, Taiwan, and (in a modified form) India.

3/ In the case of Australia, see Taxation Review Committee (1975). McLure (1983), pp. 185-86, outlines some of these proposals in the case of the United States.

4/ These countries and the dates of introduction of VATs are; Denmark (1967), France (1968), Germany (1968), Netherlands (1969), Sweden (1969), Norway (1970), Belgium (1971), Ireland (1972), Austria (1973), Italy (1973), and United Kingdom (1973). Luxembourg introduced a VAT in 1970 but is excluded from the study due to insufficient data.

5/ In many countries VATs replaced existing taxes and were intended to have no net revenue impact. If the introduction of VATs, in these cases, failed to have an impact on the tax ratio, there can still be a longer run effect on the tax ratio if the VAT has a higher elasticity than the taxes it replaced or because of discrete tax rate adjustments.

the higher tax ratio is attributable to a more diversified set of revenue sources. The measure of diversification, or tax mix, reflects only partly the use of VAT. However, both of these empirical tests must be interpreted with caution. Even if both tests are specified correctly they refer to the experience of the group as a whole. Whether any particular country will increase its tax ratio after introducing a VAT will ultimately depend on the specific nature of the tax reform. Relevant issues include whether the VAT extends the tax base, its effect on the effective rate of tax, and whether its introduction results in a more efficient tax system. <sup>1/</sup>

The second section of this paper will briefly review theoretical arguments supporting the hypothesis that the introduction of a VAT will raise the tax ratio. The third section will outline the method of event analysis and present the results of that analysis. The fourth section will present the cross-section test of the tax mix hypothesis. The final section will list the major conclusions.

## II. Theoretical Arguments on the Revenue Effect of a VAT

The theoretical rationale for the view that the introduction of a VAT will raise the tax ratio has not been made explicit. For example, Aaron (1981) observes that the tax ratio increased after the introduction of a VAT in several European countries. He expresses little doubt that the United States would experience a similar increase in the tax ratio if it introduced a VAT but he provides no theoretical rationale for that conclusion. McLure (1983) bases his conclusion that the introduction of a VAT will raise the tax ratio on the same empirical observation. In addition, he notes (p. 199) that large amounts of revenue could be raised with relatively small increases in rates because of the size of the VAT tax base. This proposition suggests, implicitly, that the tax ratio may increase initially on account of extension of the tax base and subsequently because of discretionary rate adjustments. In a political economy context, McLure's argument suggests that the tax ratio may increase following the introduction of a VAT because of the relatively lower political cost of increasing the rate of VAT compared to the alternative revenue sources (either the taxes replaced by the VAT or other taxes).

To the contrary, it has been suggested elsewhere that the introduction of a VAT will impede increases in the tax ratio. Gemmel (1985) claims that the tax ratio will tend to rise more slowly when the share of VAT receipts in total tax receipts is large relative to the share of

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<sup>1/</sup> See the appendix for a summary of the nature of the VAT reforms and subsequent changes to VAT rates in the sample countries.

income tax receipts. 1/ This claim is based on the argument that VAT receipts only increase in response to price growth but income tax receipts increase in response to both price and real income growth. Therefore the elasticity of tax receipts as a whole will be lower when the share of VAT receipts in total tax receipts is larger. However, this argument refers specifically to the growth of tax receipts rather than their level. The level of tax receipts will be influenced by the effect of the introduction of a VAT on the tax base, by discretionary tax rate adjustments as well as the elasticity of tax receipts.

Despite the absence of an explicit and well expounded theory, a number of arguments appear to lie behind the expectation of a higher tax ratio after the introduction of a VAT. These are summarized below:

1. The cost of tax collection and tax payment

A VAT is collected at various stages of production and this introduces a self-enforcing attribute to the tax system that is expected to lower the cost of tax collection. At each stage of production an individual pays tax on the gross value of his product and receives credit for tax paid at earlier production stages. Therefore, it is in the interest of a producer to ensure that all materials he purchases have value added tax paid on them and that they are correctly invoiced.

The argument that the introduction of a VAT reduces the cost of tax collection suggests two propositions. First, for a given administrative outlay, a VAT will raise more revenue than an equal rate retail sales tax although the bases of the two taxes are equal. For example, Sweden introduced a retail sales tax in 1960 but only four years later a General Tax Commission proposed its replacement by a VAT. One reason given by the Commission was that the revenue potential of a retail sales tax is more limited than that of a VAT. The reason given for this view was that the risk of tax evasion is greater under a single stage sales tax than under a VAT collected at several stages. 2/ Sweden introduced a VAT in 1969. Second, it is more difficult to evade VATs than other major taxes such as the income tax. Despite this proposition, evasion of the VAT is prevalent in some countries. Most notably, one author concludes that evasion of the VAT is pervasive in Italy. Only in the manufacturing sector, which is dominated by large firms, is evasion less than 40 percent of possible tax collections. 3/ In reviewing the Dutch experience Cnossen (1981) observes that "the so-called built-in self-enforcement aspect of the tax ... is a much overrated advantage" (p.51). Nevertheless, when examining the effect of the introduction of a VAT on the tax ratio we are not concerned with the cost of tax

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1/ Although Gemmel discusses the effect of VATs, this theoretical proposition is cast more widely to contrast income taxes and any broad-based consumption taxes. VATs are just one type of broad-based consumption tax.

2/ See Normann (1981), p.63.

3/ See Pedone (1981), p.35.

collection per se. The relevant comparison is the cost of tax collection of a VAT vis-a-vis those of the previous system. The tax ratio may increase if the introduction of a VAT lowers the cost of collection of the tax system because, for a given outlay on administration, higher receipts will be expected.

## 2. Tax distortions and the size of the tax base

If the introduction of a VAT reduces tax distortions, this will, ceterus paribus, result in an increase in the size of the tax base and tax receipts. Tax induced distortions imply that individuals have adjusted their activities and factor supplies to minimize their tax payments. If a tax reform reduces distortions by limiting the opportunity for substitution effects the tax base will increase. The introduction of a VAT may reduce distortions for a number of reasons.

First, in the European countries which introduced VATs the size of the tax base was increased because of two factors; the VAT removed distortions associated with the taxes it replaced and because it extended the tax base to items that were not previously taxed. In many European countries the VAT replaced multistage turnover taxes. A multistage turnover tax is levied at each stage of production and hence the tax creates an incentive to minimize the number of steps in the production process despite any negative efficiency consequences. The VAT removes this incentive. In addition, in most European countries, the introduction of a VAT extended the tax base to include the relatively more buoyant service sectors which may have enhanced the elasticity of the tax system. The advantage of the VAT in reducing tax distortions is limited in practice by several factors. For example, in an effort to satisfy equity goals most countries have adopted multiple rate taxes for equity reasons although the introduction of these rate structures creates distortions. <sup>1/</sup>

Second, if the introduction of a VAT extends the tax base it may enable a reduction in high marginal income tax rates which has additional positive supply side effects over the medium-term. In some countries it has been suggested that a revenue neutral reform of introducing a VAT and reducing income tax rates, or even replacing the corporate income tax, will have positive supply side effects enhancing revenue over the longer term. A major objective of New Zealand's introduction of a VAT in 1986 was to enable it to improve the equity and efficiency of the income tax system.

Third, the incentive for tax evasion is reduced if the introduction of a VAT enables a reduction of the rates of other taxes. If tax rates on any particular tax are lower, the incentive to avoid that tax is also reduced.

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<sup>1/</sup> In an optimal tax framework it is possible to justify multiple rate taxation from an efficiency perspective. However, the typical rate structure of VATs does not follow the prescribed optimal tax rules.

### 3. Fiscal illusion

Governments are able to raise greater revenues than they otherwise would because the true opportunity cost of VAT revenues may not be apparent to taxpayers. Cnossen (1981), in reviewing the experience of the Netherlands with a VAT notes that, "a well designed retail sales tax would have the important advantage over the value-added tax of promoting tax consciousness. It has perhaps been too easy to increase the value-added tax whenever the need for additional revenue arose" (p.59). A second aspect of the fiscal illusion discussion has been that increasing the complexity of the tax system by diversifying the sources of revenue also facilitates growth of the tax ratio. <sup>1/</sup> Studies in the United States and Switzerland provide results which are consistent with this proposition. <sup>2/</sup> The diversification of revenue sources between income and consumption taxes may be consistent with this hypothesis.

### III. Event Analysis of the Introduction of VATs

#### 1. Methodology

A method of analysis is adopted which isolates the effect of the introduction of a VAT on the tax ratio by minimizing the effect of special factors and general economic conditions. There are numerous problems in determining definitively whether the introduction of a VAT raises the tax ratio. These problems cannot all be overcome, but a consideration of them suggests that it is inappropriate to focus on individual countries. First, there are country specific factors connected with the nature of the tax reform package; the VAT is unlikely to be the only element of tax reform and may be introduced in different ways in different countries. Consequently, in examining individual countries it is important to know whether the VAT extends the tax base, changes the rate of tax, and what adjustments are made to other taxes. All of the preceding factors can influence the tax ratio without implying anything about the intrinsic nature of the effect of introducing a VAT. Second, there are general factors which mean that drawing conclusions from the experience of individual countries can be misleading. For example, the timing of the introduction of the VAT in the business cycle can influence the magnitude of receipts and hence the tax ratio compared to what it would have been at another point in the cycle.

The method adopted to minimize these concerns is "event analysis" first employed by Fama et al (1969) and used frequently in the finance

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<sup>1/</sup> See Buchanan (1967).

<sup>2/</sup> In the case of the United States see Wagner (1976) and Baker (1983) and for a study of Switzerland see Pommerehne and Schneider (1978). These studies are cross section examinations of state or local jurisdictions.

literature. 1/ As its title indicates, event analysis is designed to examine the consequences of an "event". To do this it examines the group of entities which experienced the event. Although the chronological time of the event differs for all, or many, of the entities, event analysis abstracts from this difference by rearranging the data so as to center time around the occurrence of the event for all entities. This minimizes the effect of any special factors associated with particular countries by averaging across the sample. Perhaps the major drawback of this approach, in comparison with a single country study, is that although it may be possible to identify whether or not the introduction of a VAT had an effect on the tax ratio, this method does not identify the feature of the tax reform that generates the effect on the tax ratio. 2/

Event analysis focuses on the effect of the event by removing the effect of other systematic variables and examining the residuals of the model estimated. The steps in this analysis are as follows. A model to explain the tax ratio for any country is specified. The model is the same for all countries and does not contain any variables connected to the introduction of the VAT. The procedure is to define the year of introduction of the VAT as year 0 for each country. Year 0 is not the same chronological year for each country. Year 1 is defined as the first complete year after the introduction of the tax and year -1 as the last complete year prior to the introduction of the tax. Other years are defined in the same fashion. The model is estimated and the residuals of the estimated equation are derived for each country. The residuals are then summed across countries for each year and an arithmetic average derived; this gives an average residual for each year both prior to and following the introduction of the VAT. The behavior of these average residuals in the years surrounding the date of introduction of the VAT is then the focus of examination.

The event analysis method minimizes the effects of two factors that might otherwise produce misleading results. First, the effect of the business cycle is reduced because the experiences of individual country's are averaged and because time is centered on the introduction of the tax. Second, the effect of factors unique to particular countries is minimized by averaging the residuals from each country.

If the regression equation is appropriate the pattern of the average residuals will be consistent with one of three conclusions. First, if the introduction of a VAT has no effect on the tax ratio, the residuals would be randomly distributed around 0 and the expected value of the residuals before the introduction of a VAT would not be statistically different from the expected value of the residuals after the introduction of a VAT. Second, if the introduction of a VAT increased

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1/ Fama, Fisher, Jensen, and Roll (1969) were concerned with the relationship between stock splits of listed securities and various market variables.

2/ This issue receives some consideration in section 4.



the tax ratio, the residuals in the period after the introduction of the VAT would be systematically higher than before its introduction. This pattern of residuals would show that the tax ratio was higher after the introduction of the tax due to a factor not included in the estimated model. Third, if the introduction of the VAT reduced the tax ratio, the residuals would be systematically lower after the introduction of the tax.

## 2. The model and its estimation

The estimated model is linear and specifies that the ratio of government revenue to gross domestic product (the revenue ratio) is related to real gross domestic product as well as a constant term. This specification assumes that government expenditure is determined independently of government revenues. In turn, the separate determination of revenue and expenditure determines the deficit and hence the need for other financing. Dummy variables are employed to take account of breaks in some country data series. The IMF, International Financial Statistics is the source of the data.

Several alternative specifications of models explaining the tax ratio were considered. The number of these alternative specifications was constrained severely by data availability; the dearth of data reflected the lack of time series on all relevant fiscal variables and, in cases when data was available, by inadequate length of these time series. This lack of data also explains the use of the revenue ratio rather than the tax ratio; the revenue ratio will be taken as a good proxy for the tax ratio. <sup>1/</sup>

The model was estimated over the period 1955 to 1984 for the 11 European countries introducing VAT. The year in which the VAT was introduced was excluded from the regression because of the effects of the introduction of the tax during the year and because there are inevitably start-up costs for the administration of a new tax. The model was estimated with a correction for first-order autocorrelation. The estimated coefficients are generally significantly different from zero and explain a significant part of the variance in the revenue ratio. Nevertheless, it is a highly simplified model and any omitted variables are likely to affect the estimated regression residuals which could influence the results drawn from this analysis.

## 3. The results

The data are consistent with the hypothesis that the introduction of the VAT increased the revenue ratio; the estimated average residuals are, statistically, significantly greater after the introduction of the VAT than before its introduction. The average residuals fluctuate significantly but they tend to increase after the introduction of the

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<sup>1/</sup> The difference between total government revenue and tax revenue is nontax revenue.

VAT. However, of more relevance is the pattern of the cumulative residuals. Many countries introduced VATs in a purportedly revenue neutral way. However, over the medium-term the tax ratio may rise above its earlier level if, for example, the elasticity of the tax system is higher. The cumulative average residuals show a systematic pattern (Chart 1 and Table 1). The average residuals are negative before the introduction of the VAT and hence the cumulative value of the residuals becomes increasingly negative prior to the event. The VAT is introduced in year 0 and, immediately, the cumulative residuals begin to rise reflecting the positive average residuals after the introduction of VAT.

A one tail t-test was undertaken to examine whether the average residuals after the introduction of the VAT (post-VAT residuals) were significantly greater than those from before the introduction of the VAT (pre-VAT residuals). The null hypothesis is that the mean value of the pre- and post-VAT residuals are equal. The alternative hypothesis is that the mean value of the post-VAT residuals is greater than the mean value of the pre-VAT residuals. The null hypothesis is rejected if the following expression is greater than the relevant t-value. The expression is,

$$((x_1 - x_2) / \sqrt{n_1}) / s_1$$

where

$x_1$  is the mean value of the post-tax residuals,  
 $x_2$  is the mean value of the pre-tax residuals,  
 $n_1$  is the number of periods over which  $x_1$  is defined, and  
 $s_1$  is the standard deviation of the post-tax residuals.

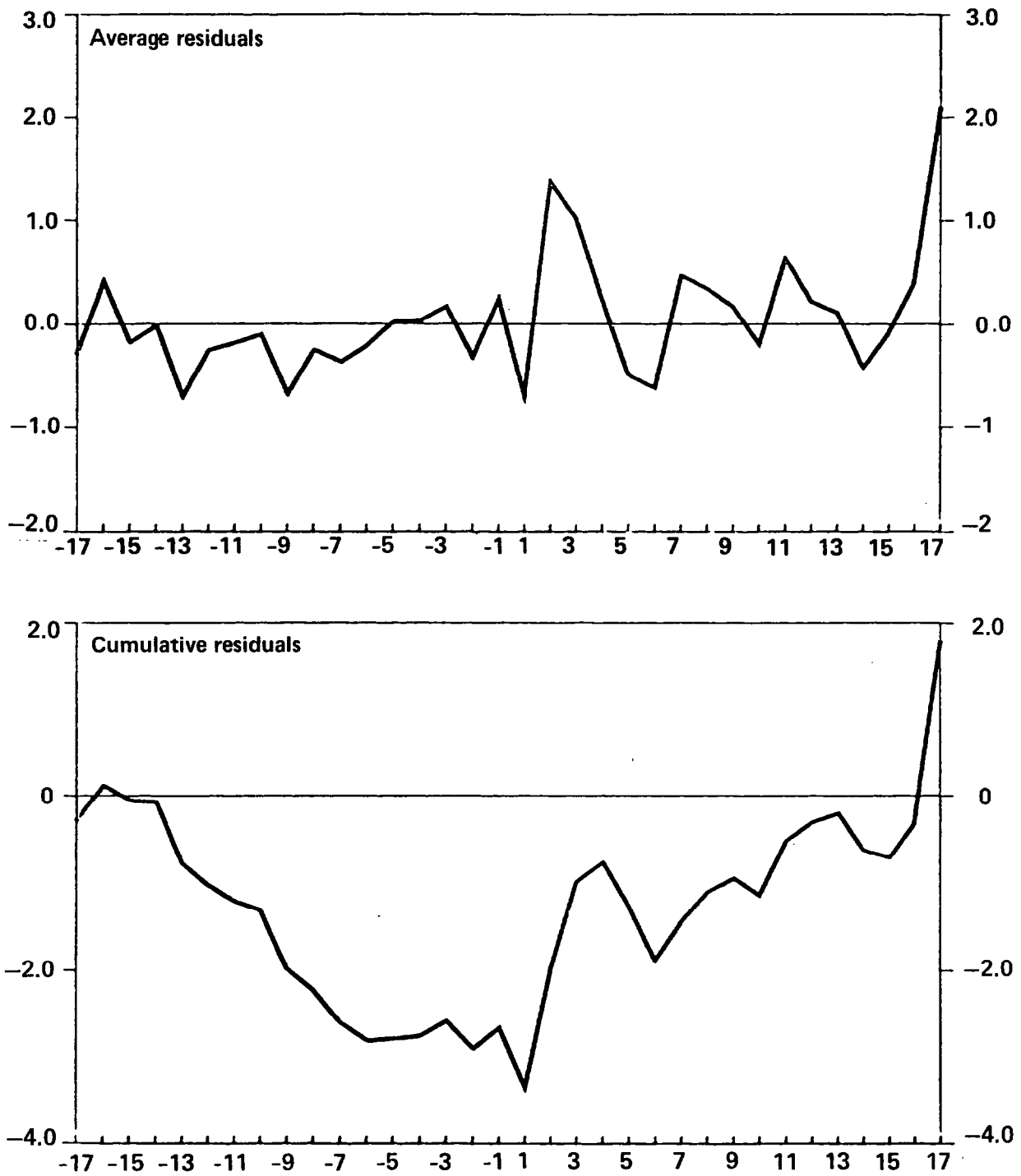
The alternative hypothesis is that the mean value of the post-tax residuals ( $x_1$ ) is greater than the pre-tax residuals ( $x_2$ ) and so a one tail test is used. The null hypothesis is rejected at the 2.5 percent level. 1/ Thus, it is concluded that countries experience higher revenue ratios after the introduction of VAT. The pattern of the residuals suggests that this higher level of the revenue ratio persists after the introduction of the VAT rather than being a one time increase.

These results should be interpreted with care. First, the results apply to the group of countries. A particular country's experience is compounded by other factors that are intentionally abstracted from here. Second, the results do not say anything about the inherent characteristics of the VAT. The effect of a tax reform, such as the introduction of a VAT, on the tax ratio will ultimately depend on its effect on the tax base, the rate of tax, and the effectiveness of tax collections. These factors will depend on the nature of the VAT and other tax reform measures associated with its introduction. Third, it is possible that a variable not included on the model, but temporally related to the introduction of the VAT, may be the driving force behind our results.

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1/ The relevant statistics for this test are shown in Table 2.

CHART 1  
LEVEL OF TAX RATIO



Source: Author's estimates.

Table 1. Residuals in Years Around the Introduction of VAT

Year	Average residuals	Cumulative residuals	Sample size
-17	-0.2922	-0.2922	3
-16	0.4105	0.1183	4
-15	-0.1791	-0.0608	5
-14	-0.0131	-0.0739	6
-13	-0.7073	-0.7812	8
-12	-0.2486	-1.0298	10
-11	-0.1819	-1.2117	11
-10	-0.0986	-1.3103	11
-9	-0.6799	-1.9902	11
-8	-0.2504	-2.2406	11
-7	-0.3708	-2.6114	11
-6	-0.2070	-2.8184	11
-5	0.0234	-2.7950	11
-4	0.0345	-2.7605	11
-3	0.1731	-2.5874	11
-2	-0.3258	-2.9132	11
-1	0.2484	-2.6648	11
1	-0.7019	-3.3667	11
2	1.3749	-1.9918	11
3	1.0084	-0.9834	11
4	0.2233	-0.7601	11
5	-0.5012	-1.2613	11
6	-0.6295	-1.8908	11
7	0.4562	-1.4346	11
8	0.3310	-1.1036	11
9	0.1600	-0.9436	11
10	-0.2016	-1.1452	11
11	0.6271	-0.5181	11
12	0.2098	-0.3083	8
13	0.1028	-0.2055	7
14	-0.4279	-0.6334	6
15	-0.0844	-0.7178	5
16	0.4046	-0.3132	3
17	2.1011	1.7879	1

Source: Authors estimates.

Table 2. Summary Statistics of Sample Residuals

	Sample size	Mean	Variance	Standard deviation
a. <u>The level of the tax ratio</u>				
Years prior to introduction of VAT	17	-0.0045	0.0002	0.0124
Years after introduction of VAT	17	0.0076	0.0005	0.0226
Total sample	34	0.0015	0.0004	0.0190
b. <u>The growth rate of the tax ratio</u>				
Years prior to introduction of VAT	17	-0.1568	0.0861	0.2935
Years after introduction of VAT	17	0.2619	0.5332	0.7302
Total sample	34	0.0526	0.3454	0.5877

Source: Authors estimates.

This will only be the case if this variable is important across all countries in the sample because event analysis minimizes country specific factors.

There is also some evidence that the rate of growth of the tax ratio is increased by the introduction of the VAT. The preceding analysis focused on the level of the tax ratio before and after the introduction of the VAT but did not draw any conclusions with respect to the growth rate of the ratio. The effect on the growth rate of the tax ratio was examined by testing a log form of the previously tested model. This procedure means that the coefficient on real gross domestic product is the elasticity of the revenue ratio with respect to real gross domestic product. An examination of the residuals in this instance (Table 3 and Chart 2) shows a similar, but less distinct pattern, than in the preceding examination of the level of the revenue ratio; the cumulative residuals decline until the period when the VAT is introduced and then they increase. Although the pattern is less definitive, a one tail t-test confirms that the data is consistent with the hypothesis that the introduction of the VAT raises the growth rate of the revenue ratio.

A conventional measure of the elasticity of revenues is the relation between the growth of nominal revenue and the growth of nominal gross domestic product. The introduction of the VAT had no statistical effect on elasticity measured in this fashion. <sup>1/</sup> This result, although somewhat puzzling, does not rebut the preceding conclusions. In the preceding equations the price, or inflation, effects on the growth or level of revenue are accounted for because the dependent variable is the ratio of revenue to nominal gross domestic product; the numerator and denominator are both influenced by the inflation factor. But, inflation is not adequately accounted for if the elasticity of revenue to inflation is greater than one because of, for example, income tax bracket creep. Messere (1983) argues that the data are consistent with the hypothesis that real growth is the main component of fiscal drag. When inflation began to increase in the 1970s most governments took measures to offset the inflationary effects on the tax system. Nevertheless, we reexamined our initial equations but with the addition of the gross domestic product deflator as another independent variable. There was no substantive change to our results. This showed a similar pattern of the residuals to those previously found; the introduction of the VAT increased the revenue ratio, although not as statistically strongly as before. <sup>2/</sup>

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<sup>1/</sup> The residuals for each country were weighted by the GDP for that year, in order to take account of different country sizes and currencies.

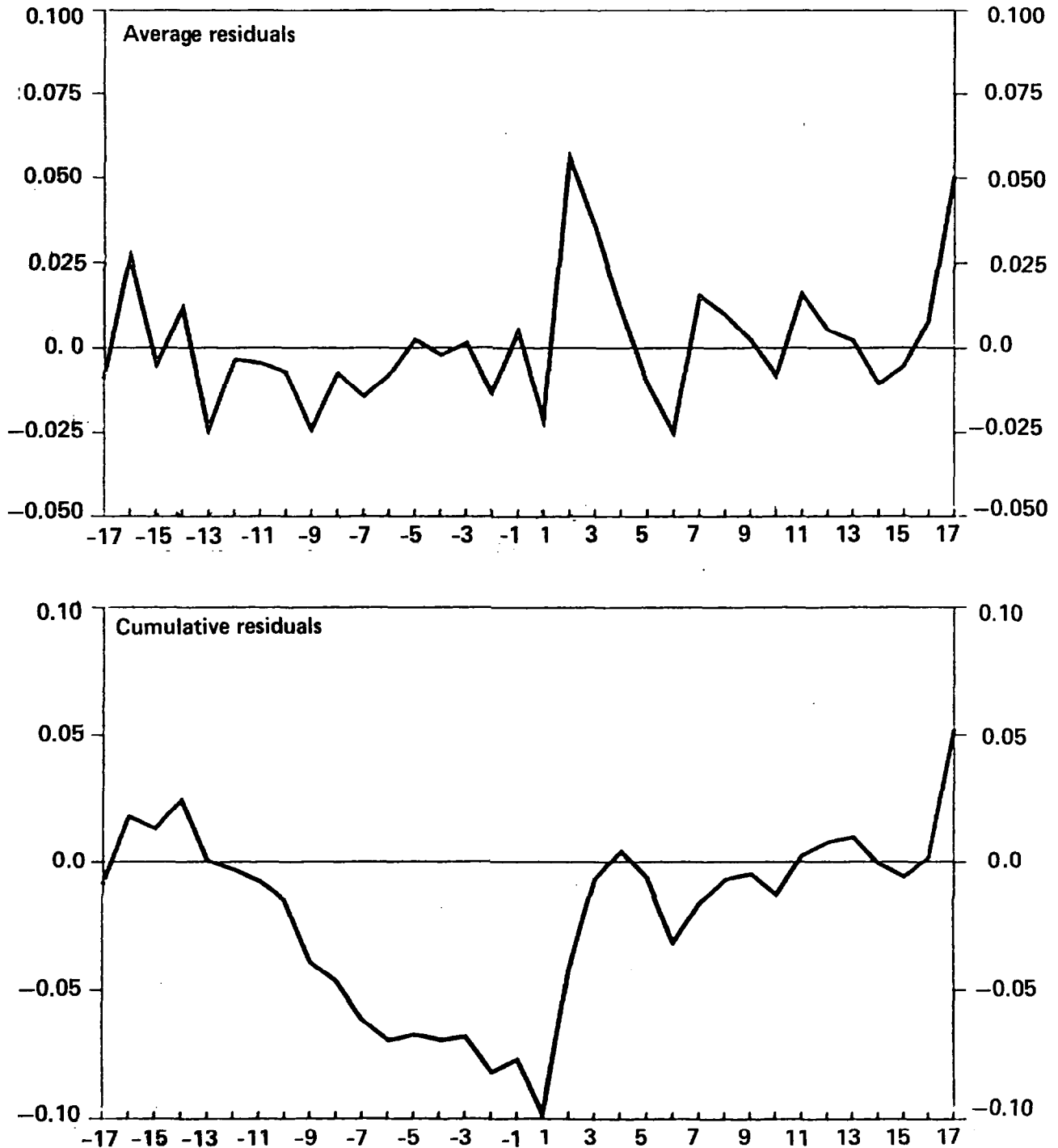
<sup>2/</sup> The divergence between results of examining the revenue ratio and the elasticity of revenue with respect to nominal gross domestic product is consistent with findings of Goode (1968) and Messere (1983). These authors show that there is no necessary positive relationship between developments in the revenue ratio and the elasticity of revenues.

Table 3. The Growth Rate of the Tax Ratio:  
Sample Residuals in Years Around the  
Introduction of VAT

Year	Average residuals	Cumulative residuals	Sample size
-17	-0.0090	-0.0090	3
-16	0.0267	0.0177	4
-15	-0.0049	0.0128	5
-14	0.0118	0.0246	6
-13	-0.0244	0.0002	8
-12	-0.0034	-0.0032	10
-11	-0.0047	-0.0079	11
-10	-0.0074	-0.0153	11
-9	-0.0244	-0.0397	11
-8	-0.0075	-0.0472	11
-7	-0.0147	-0.0619	11
-6	-0.0080	-0.0699	11
-5	0.0024	-0.0675	11
-4	-0.0023	-0.0698	11
-3	0.0014	-0.0684	11
-2	-0.0137	-0.0821	11
-1	0.0050	-0.0771	11
1	-0.0214	-0.0985	11
2	0.0559	-0.0426	11
3	0.0354	-0.0072	11
4	0.0111	0.0039	11
5	-0.0107	-0.0068	11
6	-0.0253	-0.0321	11
7	0.0152	-0.0169	11
8	0.0096	-0.0073	11
9	0.0021	-0.0052	11
10	-0.0082	-0.0134	11
11	0.0158	0.0024	11
12	0.0051	0.0075	8
13	0.0019	0.0094	7
14	-0.0109	-0.0015	6
15	-0.0050	-0.0065	5
16	0.0082	0.0017	3
17	0.0505	0.0522	1

Source: Authors estimates.

CHART 2  
GROWTH OF THE TAX RATIO



Source: Author's estimates.



#### IV. The "Tax-Mix" Hypothesis

In this section the tax-mix hypothesis--that diversifying the sources of tax revenues will increase the tax ratio--is examined. 1/ The preceding section suggested that the data is consistent with the hypothesis that the introduction of the VAT raises the tax ratio but did not indicate why that occurs. The tax mix hypothesis is one possible explanation for these results. The tax mix effect may work through one or more of the following ways; positive supply side effects, reduced incentives for evasion, extension of the tax base to more buoyant sectors of the economy, because consumption taxes are collected more effectively, or because of fiscal illusion arguments. 2/ If the tax mix hypothesis is valid, it may suggest that the introduction of a VAT is a sufficient, but not necessary, condition to explain the increase in the tax ratio. The increase in the tax ratio may also have come about if other forms of broad-based consumption taxes were introduced. 3/

Two alternative measures of tax mix are considered; the Herfindahl index and the entropy index. 4/ Each of these indices measures the contribution of the broad-based consumption tax and income taxes. A higher value of the Herfindahl index implies a lower degree of tax mix and the opposite is the case when the entropy index is used. Hence, if increasing the tax mix has a positive effect on the tax ratio, the coefficient on the Herfindahl index will have a negative sign and the coefficient on the entropy index will have a positive sign.

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1/ Increasing the tax mix, or diversification of the sources of tax revenue, is used here to refer to changes in the shares of the major broad-based taxes. Therefore, we look at broad-based consumption taxes and income taxes but do not view increased reliance on excises, for example, as increasing the tax mix.

2/ These factors were discussed in section 2.

3/ This hypothesis is qualitative. It does not enable us to draw any conclusions about the magnitude of the tax ratio change which may result from different means of increasing the tax mix.

4/ The Herfindahl index is defined as

$$\sum_{i=1}^n t_i^2$$

where  $t_i$  is the share of the  $i^{\text{th}}$  tax in the total and  $n$  is the number of taxes or sources of revenue being considered. The entropy index is defined as

$$-\sum_{i=1}^n t_i \log t_i.$$

A cross section test of 23 countries is undertaken for 1981. <sup>1/</sup> The dependent variable is the tax ratio. Several independent variables are employed. Our major interest is whether tax mix influences the tax ratio and we use the two index measures of the tax mix to resolve this question. The values of these indices, which lie between zero and one, are shown in Table 4. As a measure of income we use real gross national product per capita in U.S. dollars. The size of the agricultural sector in relation to gross domestic product is employed to proxy for the structure and stage of development of the more diverse economies in this sample. It would be expected that this variable would have a negative coefficient. Government expenditures, net of interest, as well as public debt are the remaining independent variables. It is predicted that both of these variables will have positive coefficients in explaining the tax ratio. The sources of the data for all of these variables are IMF and OECD.

The empirical results provide support for the hypothesis that an increase in the tax mix is associated with a higher tax ratio (Table 5). The equations are tested using, alternatively, the Herfindahl and the entropy indices of tax mix. The first equation is broadly comparable to the model employed in the previous section; the tax ratio is a function of a constant term and real gross national product per capita as well as the addition of the index measuring tax mix. The signs of the coefficients of the index measures of tax mix support the hypothesis that an increase in the tax mix will increase the tax ratio. All coefficients are significantly different from zero at a 1 percent level. The second specification adds, to the preceding equation, the share of agriculture as a percentage of gross domestic product. This coefficient is not significantly different from zero. A non-zero coefficient would be more likely in a sample which included developing countries. Most of the sample countries are highly developed. In addition, in this specification the coefficient on real gross national product per capita was only significant at the 2.5 percent level. The third equation reflects the Government budget constraint. The tax ratio is specified as a function of a constant term, real gross national product per capita, government expenditures net of interest payments as a percentage of GDP, public debt as a percentage of GDP, as well as a tax mix index. This equation implies certain assumptions about the pattern of government decisions on revenue and expenditures. The fiscal variables are determined recursively; first, expenditure is determined and secondly, revenue. <sup>2/</sup> If these magnitudes are determined simultaneously, or in a reverse order, then this is an incorrect

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<sup>1/</sup> The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States.

<sup>2/</sup> There have been several studies, using Granger causality, attempting to determine whether revenue causes expenditure or the reverse. See, for example, Blackley (1986).

Table 4. Herfindahl and Entropy Indexes of Tax Mix  
for the Sample Countries, 1981

	Herfindahl indices	Entropy indices
Australia	0.82	0.14
Austria	0.51	0.30
Belgium	0.58	0.27
Canada	0.69	0.21
Denmark	0.59	0.26
Finland	0.60	0.26
France	0.50	0.30
Germany	0.56	0.28
Greece	0.51	0.30
Ireland	0.58	0.26
Italy	0.57	0.27
Japan	1.00	0.00
Luxembourg	0.66	0.23
Netherlands	0.56	0.28
New Zealand	0.76	0.18
Norway	0.59	0.26
Portugal	0.51	0.30
Spain	0.59	0.26
Sweden	0.63	0.24
Switzerland	0.70	0.21
Turkey	1.00	0.00
United Kingdom	0.63	0.24
United States	0.79	0.16

Sources: OECD, Revenue Statistics of Member  
Countries; and authors estimates.

Table 5. Cross Section Analysis of Tax Mix Hypothesis

Equation	Coefficients and t-values							Adjusted R <sup>2</sup>	DW	SEE
	Constant	Real GNP per capita	Agriculture as percent GDP	Net expenditure as percent GDP	Public debt as percent GDP	Herfindahl index	Entropy index			
1	2.4546 (9.3532)*	0.0011 (4.4785)*	...	...	...	-2.2975 (-4.3580)*	...	0.62	2.04	4.88
2	2.1540 (4.3085)*	0.0011 (4.3014)*	...	...	...	...	2.5026 (4.4022)*	0.63	2.04	4.89
3	2.4925 (9.1320)*	0.0008 (2.3520)**	-0.3773 (-1.4296)	...	...	-2.2730 (-4.0397)*	...	0.65	2.12	4.76
4	2.2161 (3.8914)*	0.0007 (2.2508)**	-0.3744 (-1.4370)	...	...	...	2.4621 (4.0851)*	0.65	2.12	4.76
5	2.1354 (1.9518)	0.0008 (3.4297)*	...	0.5289 (5.3130)*	0.0901 (2.6034)**	-2.1038 (-1.5890)	...	0.83	1.96	3.43
6	1.3466 (0.9680)	0.0007 (3.2611)*	...	0.5336 (5.2819)*	0.0870 (2.4776)**	...	2.1549 (1.3958)	0.82	1.93	3.49

Source: Authors estimates.

\* Significant at a 1 percent level.

\*\* Significant at a 2.5 percent level.

specification. <sup>1/</sup> With this qualification in mind, we note that the coefficient on real gross national product per capita and net expenditure are significant at a 1 percent level and the coefficient on public debt is significant at a 2.5 percent level. The coefficients on the tax mix indices are no longer statistically significant but they continue to have signs consistent with the tax-mix hypothesis. This equation explains a relatively high degree of the variance of the tax ratio, particularly for a cross-section analysis, and the standard error is lower.

#### V. Conclusion

This paper examined the effect on the tax ratio of the introduction of a VAT. There is a widespread perception that the introduction of a VAT will increase the tax ratio although no sound theoretical rationale has been spelt out that supports this view. Nevertheless, several reasons were suggested why this might be correct. These included the cost of tax collection, the reduction of tax distortions, and fiscal illusion.

The focus of this paper was on an empirical examination of the experience of 11 European countries which introduced VATs in the period 1967 to 1973. The hypotheses tested were that the introduction of the VAT increased the level and growth rate of the tax ratio. These hypotheses were tested using the method of "event analysis". In addition, one hypothesis--the tax mix hypothesis-- explaining why the introduction of a VAT may increase the tax ratio was examined by a cross section analysis of 23 countries.

The empirical examination supported the hypothesis that the introduction of a VAT will be associated with an increase in the tax ratio. There was weaker evidence that the growth rate of the tax ratio was increased as a result of the introduction of the VAT. These conclusions must be interpreted carefully. First, the conclusions relate to the experience of the group as a whole and may not apply to particular countries. Second, the effect on the tax ratio may reflect the nature of the tax reform rather than any inherent characteristics of the VAT. Third, the results may indicate, at least in part, that the tax ratio will increase by diversifying the sources of revenue between a broad-based income tax and any broad-based consumption tax.

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<sup>1/</sup> These concerns are considered in Tabellini (1985).

The Nature of the VAT Reform in Selected European Countries

This appendix provides a brief survey of the nature of VAT reforms and review subsequent developments in VAT rates. <sup>1/</sup>

1. Austria

The VAT was introduced in Austria in 1973. It replaced a multi-stage turnover tax which had been levied at a uniform rate of 5.5 percent. The VAT was introduced with a standard rate of 16 percent. The present standard rate is 20 percent.

2. Belgium

The VAT was introduced in Belgium in 1971. It replaced a turnover tax, which had been imposed at a 7 percent rate, and an invoice tax, which had been imposed at a rate of 0.7 percent. The VAT was introduced with a standard rate of 18 percent. The present standard rate is 19 percent.

3. Denmark

The VAT was introduced in Denmark in 1967. It replaced a single stage wholesale sales tax. The VAT was gradually extended to cover all services. The VAT was introduced with a standard rate of 10 percent. The present standard rate is 22 percent.

4. France

The VAT was introduced in 1968 although a VAT had been applied to the industrial sector since 1954. The 1968 reform extended the tax base and replaced a local tax on services. The standard rate of VAT was set at 16.6 percent. Prior to 1977 there were either five or six rates; this has now been reduced to four. The standard rate is 18.6 percent.

5. Germany

The VAT was introduced in 1968. It replaced a tax on gross turnover. The VAT was intended to reform the tax structure without increasing tax revenue. The VAT was introduced with a standard rate of 10 percent, six months later the rate was increased to 11 percent. The standard rate is now 14 percent.

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<sup>1/</sup> The sources for this appendix are Aaron (1981), International Bureau of Fiscal Documentation (1986), OECD Economic Surveys (various years), and Price Waterhouse Company (1979).

6. Ireland

The VAT was introduced in Ireland in 1972. It replaced a turnover tax and a wholesale sales tax which had been levied from 1963 and 1966, respectively. The rates of VAT at the time of its introduction corresponded to the rates of tax of those taxes which it had replaced. The present standard rate is 25 percent.

7. Italy

The VAT was introduced in Italy in 1973. It replaced a multistage turnover tax, excises, stamp taxes, and a range of other minor indirect taxes. The introduction of the VAT was combined with the introduction of personal and company income taxes which replaced a schedular income tax system. The tax has been imposed at as many as ten different rates and never fewer than four. There have been many changes in tax rates. The standard rate of tax at the time of introduction of the tax was 12 percent. The present standard rate is 18 percent.

8. The Netherlands

The VAT was introduced in 1969. It replaced a multistage turnover tax from which retailers were exempt. The general rate of the turnover tax was 5 percent with luxury rates of 7 and 15 percent. The VAT was imposed with a standard rate of 12 percent although one half of the tax base was either zero rated or subject to a 4 percent tax rate. The present standard rate is 19 percent.

9. Norway

The VAT was introduced in Norway in 1970. It replaced a retail sales tax which had been levied at an effective rate of 13.6 percent. The VAT was imposed with a standard rate of 20 percent and involved some extension of the tax base. The standard rate is unchanged.

10. Sweden

The VAT was introduced in 1969. It replaced a retail sales tax which had been introduced in 1960. The retail sales tax had a 4 percent rate. The VAT was introduced with the standard rate of 10 percent, inclusive of tax, but after a few changes was increased to 19 percent in 1980 (23.5 percent exclusive).

11. United Kingdom

The VAT was introduced in 1973. It replaced a purchase tax (a sales tax charged at the wholesale level) and the selective employment tax (a payroll tax principally on services). The introduction of the VAT implied only a small change in the tax base at least in term of the range of goods covered. The standard rate of VAT was initially 10 percent, went to 8 percent in 1974, and went to 15 percent in 1979.

Table 1. Rates of VAT in Sample Countries

Country	Date	Rates 1/			
		Standard	Intermediate	Increased	Reduced
Austria	01/73	16.00	--	--	8.00
	01/76	18.00	--	--	8.00
	01/78	18.00	--	30.00	8.00
	01/81	18.00	13.00	30.00	8.00
	01/84	20.00	--	32.00	10.00
Belgium	01/71	18.00	14.00	25.00	6.00
	01/78	16.00	--	25.00	6.00
	07/81	17.00	--	25.00	6.00
	01/83	19.00	17.00	25.00	6.00
Denmark	07/67	10.00	--	--	--
	04/68	12.50	--	--	--
	06/70	15.00	--	--	--
	09/75	15.00	--	--	9.25
	03/76	15.00	--	--	--
	10/77	18.00	--	--	--
	10/78	20.25	--	--	--
	07/80	22.00	--	--	--
France	01/68	16.66	13.00	20.00	6.00
	12/68	19.00	15.00	25.00	7.00
	01/70	23.00	17.60	33.33	7.50
	01/73	20.00	17.60	33.33	7.00
	01/77	17.60	--	33.33	7.00
	07/82	18.60	--	33.33	7 & 5.5
Germany	01/68	10.00	--	--	5.00
	07/68	11.00	--	--	5.50
	01/78	12.00	--	--	6.00
	07/79	13.00	--	--	6.50
	07/83	14.00	--	--	7.00
Ireland	11/72	16.37	11.11	30.26	5.26
	09/73	19.50	11.11	36.75	6.75
	03/76	20.00	--	35.00	10.00
	03/79	20.00	--	40.00	10.00
	05/80	25.00	--	--	10.00
	09/81	25.00	--	--	15.00
	05/82	30.00	--	--	18.00
	03/83	35.00	--	--	23.00
	03/84	35.00	--	--	5/18/23
	03/85	23.00	--	--	10.00
	03/86	25.00	--	--	10.00



Table 1. Rates of VAT in Sample Countries, (concluded)

Country	Date	Rates 1/			
		Standard	Intermediate	Increased	Reduced
Italy	01/73	12.00	--	18.00	6.00
	01/75	12.00	18.00	30.00	6.00
	03/76	12.00	18.00	30.00	6.00
	05/76	12.00	18.00	30.00	6 & 9
	12/76	12.00	18.00	30.00	1/3/6/9
	02/77	14.00	18.00	35.00	1/3/6/9/12
	07/80	15.00	18.00	35.00	2 & 8
	11/80	14.00	15 & 18	35.00	1/3/6/9/12
	01/81	15.00	18.00	35.00	2 & 8
	08/82	18.00	20.00	38.00	2/8/10/15
	04/84	18.00	20.00	30/38	2/8/10/15
	12/84	18.00	--	38.00	2 & 9
Netherlands	01/69	12.00	--	--	4.00
	01/71	14.00	--	--	4.00
	01/73	16.00	--	--	4.00
	10/76	18.00	--	--	4.00
	01/84	19.00	--	--	5.00
Norway	01/70	20.00	--	--	--
Sweden 2/	01/69	10.00	--	--	--
	01/71	15.00	--	--	--
	06/77	17.10	--	--	--
	09/80	19.00	--	--	--
United Kingdom	04/73	10.00	--	--	--
	07/74	8.00	--	--	--
	11/74	8.00	--	25.00	--
	05/75	8.00	--	25.00	--
	04/76	8.00	--	12.50	--
	06/79	15.00	--	--	--

Sources: European Commission, Value Added Tax, Price Waterhouse (1979), OECD Economic Surveys.

1/ All countries also have zero-rated items.

2/ Rates are inclusive of tax.

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