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Value-Added Taxes and Other Indirect Taxes in an EEC Country Model: The Italian Case

ROSSELLA BARDAZZI, MAURIZIO GRASSINI,
AND ERNESTO LONGOBARDI

ABSTRACT *Value-added taxes and other indirect taxes pose a special challenge to the I-O model builder. Because they affect price formation, they should be included in a model with a developed nominal side. This paper describes the treatment of indirect taxes in the Italian table. It recognizes that firms are not always able to deduct all VAT paid on inputs. It outlines the treatment of indirect taxes in INTIMO.*

1. Introduction

The Italian member of the INFORUM group, INTIMO (INTerindustry Italian MOdel) has fully integrated real and nominal sides. Because of this integration, it is very important to deal properly with the value added tax (VAT). In this paper we will try to clarify the treatment of these taxes in the Italian tables. Similar treatment is found in most other EEC tables. We will also refer briefly to the treatment of other taxes on production.

INTIMO has been described in a number of papers. The real side of the model is outlined in Grassini (1983b); the system of demand functions modeling private consumption (a set of 40 equations) is presented in Grassini (1983a); the foreign sector is based on 26 equations respectively for imports and exports on commodities and about 11 equations for imports and exports of services; the foreign sector is discussed in Barnabani (1983), Grassini (1983c) and Barnabani, Grassini (1985). The integration of the real and price side is covered in Ciaschini, Grassini (1983). The international linking of the INFORUM system of models is presented in Nyhus (1975). The price side of the Italian model is presented in Grassini (1987); a detailed analysis of the theoretical, analytical and statistical background for dealing with indirect taxes in an IO model is discussed in Bardazzi (1987).

Rossella Bardazzi, Maurizio Grassini, Ernesto Longobardi, Facoltà di Scienze Politiche "C. Alfieri", Università di Firenze, Florence, Italy (Sections 2-5 are primarily the responsibility of E.Longobardi; 6 of M.Grassini; and 7-12 of R.Bardazzi.)

In this paper, the new features of the indirect taxes in the INTIMO model are presented. A major issue in the negotiations for a "Europe without borders" by 1992 is what to do about value-added taxes which are currently remitted on exports at the border. The crux of this issue is the difference between the rates in different countries and in different industries. Clearly, multisectoral models such as INTIMO and other members of the INFORUM group are the right sort of tools for studying this issue. The careful treatment of the value-added tax and other indirect taxes has therefore become of utmost importance.

2. VAT as a Consumption Tax

The working mechanism of the Value Added Tax (VAT) can be briefly described. Each producer charges VAT to the buyer of his products (goods and services), applying the tax rate to the value of sales. All EEC countries except Denmark have different rates on various categories of goods and services. Generally, necessary goods are carry reduced rates, while luxuries bear augmented rates.

The producer's tax liability is given by the difference between the tax charged on his sales and that paid on his purchases of intermediate goods and services. In other words, all firms or professionals (who must be registered as VAT-liable persons) have to pay the VAT collected from their customers to the tax office, but they are allowed a deduction equal to the VAT they have themselves paid on goods and services (other than labor and financial services) bought from other firms. In this way, VAT is collected at every stage of production according to the value added.

The chain of VAT collection comes to an end when products get to final consumption: the final consumer has no way to deduct the VAT paid on his purchases and thus is the ultimate payer of the tax.

It should be clear that in fact firms act as *tax collectors*, while the consumer represents the actual taxpayer. Because VAT on investment goods is deductible in its full amount in the same tax year as it is paid, VAT appears essentially as a tax on final consumption -- at least in its initial incidence -- and is so considered in the economic literature.

3. Pre-retail Components of VAT

However, specific tax rules may prevent some firms from deducting the entire amount of VAT paid on their inputs. In this event, the chain of VAT collection ends before getting to final consumption; and the legal incidence (if not the economic one) of the tax rests on intermediate transactions and on investments instead of final consumption (Longobardi, 1990).

We can mention three main reasons why firms may not be entitled to full deduction.

Firstly, firms supplying goods and services which are exempted from VAT have no right to deduct the VAT paid on their taxed purchases. In fact, in the VAT system, exemption refers only to the last stage of the provision of goods and services and does not apply to the inputs necessary for providing them. The most important exemptions in the EEC countries concern insurance, financial services, and health services.

It should be pointed out that such a system of exemption is different from one of *zero-rating*, which concerns primarily exports. According to the destination principle, exports are zero-rated, that is, they are not taxed and the VAT which might have been paid at previous stages must be fully rebated. This implies that exporters maintain their full right to deduction.

The second reason why some intermediate transactions may end up taxed is connected with the general VAT principle that liable persons should be entitled to full deduction only on purchases which are strictly connected with production of taxable goods and services. For unincorporated businesses and professionals, it is often difficult to distinguish between productive inputs and personal consumption of the entrepreneur and his family. Several countries have therefore chosen to apply some general rules limiting the deduction of VAT paid on particular goods, such as fuels, passenger cars, restaurants and so on. Sometimes this system is also justified simply by the need for revenue. In countries where, as in France, these rules are very strict, some inputs may indeed bear some tax.

Finally, there may exist special "forfeit" (or "standardized") systems to tax small businesses, according to which deductible VAT is determined on the basis of some fixed economic parameters instead of actual expenses. In such cases, firms may bear part of the tax or, conversely, may enjoy a subsidy, according to whether the actual VAT paid exceeds or falls short of the deduction determined by the law.

In EEC countries, all these "impurities" of actual VAT systems seem to be quite important and to keep a consistent share of the tax within the network of intermediate transactions. (The French refer to this share as "les rémanences de T.V.A."). Thus while VAT was originally conceived as the economic equivalent to a retail tax with a different collection mechanism, a non-negligible component of it turns out to be instead equivalent to a pre-retail turnover tax.

Finally, special mention of the treatment of government agencies is necessary. Because they do not sell their services in the market, they cannot recover VAT paid on purchases from the private sector. In fact, VAT laws do not consider governmental bodies as liable persons but instead as final consumers. This provision produces another component of VAT revenue that does not flow from final private consumption.

4. The Agricultural Special System

In principle, farmers do not pay VAT on the value they add, but, unlike the professionals, are allowed to pass on to their customers a VAT credit for the VAT which they paid on purchased inputs. Furthermore, farmers, especially in some countries, are supposed not to be acquainted with the accounting techniques necessary to keep track of the VAT they have paid. A special system is therefore possible within present EEC agreements to simplify the calculation of the VAT credit farmers are allowed to pass on to their customers.

Essentially, farmers are allowed to choose to pass on a VAT credit which is simply a percentage of their sales. This percentage should, in principle, be set at the level needed to yield a sum equal, on average, to the tax paid by farmers on their inputs. With the percentage so set, the system would not produce any loophole in the tax law, because the tax liability would simply pass from the farmers to their customers. However, some countries, like Italy, make use of this system to subsidize the agricultural sector. They establish agricultural special rates which are consistently greater than the average VAT paid by farmers on their purchases. Because farmers do not have to pay VAT, they get a subsidy equal to the difference between the tax billed to their customers and that paid on their own purchases.

5. The VAT in the IO Table

Let's first imagine an "ideal" VAT system in which all the tax revenue derives from final demand. We could then think of two "pure" ways to represent VAT in an IO framework. In the first, all flows would be inclusive of the full amount of VAT. The actual payments of VAT by each sector would appear in the VAT row of the Value-added section of the table. In the second pure representation, no VAT would be included in any flow. Non-zero VAT entries would appear only in the VAT row of the final demand columns or in the VAT row of the columns of industries which cannot deduct VAT paid on inputs. The difference between these two pure tables provides us with the table of VAT flows. With either of these pure tables, the entries across the rows could be meaningfully summed, for they would all be on the same valuation basis, either with or without VAT. This summation, it must be stressed, is the most important operation in analysis with input-output tables. Any accounting scheme which introduces deliberate differences in the valuation of different cells in the same rows invites nonsensical computations.

For better or worse, the Italian tables and those of other EC countries are based on a mixed approach, the so-called non-deductible VAT table. In this sort of table, any flow on which the purchaser can deduct the VAT is shown without the VAT. Other flows are shown with the VAT. The difference between this table and the pure table with no VAT on flows shows the location and primary incidence of non-deductible VAT. The difference between it and the pure table with all VAT included shows the flows of deductible VAT.

We will now examine how the non-deductible VATs approach affects the published tables, both for the standard case when all VAT on intermediate products is deductible and when some of it is not. Our basic position is that at least one and preferably both of the pure tables should be published along with the non-deductible VAT table, for without at least one table with uniform units across each row, many computations will be compromised. Alternatively, publication of a matrix of the non-deductible VAT flows would serve the same purpose.

6. VAT Accounting, Tax Collection and the Location of VAT Yield

Let us consider the price formation in sector j

$$p_j = \Sigma_i a_{ij} p_i + v_j \qquad (1)$$

where a_{ij} 's are technical coefficients,
p_i is the sector i price (without tax),
v_j is the value added per unit of output in sector j.

In what follows, for the sake of simplicity, we will disregard the investment component in the VAT mechanism. If we consider the ideal VAT case, which we shall henceforth refer to as the standard case, where all VAT on intermediate products can be deducted, the amount of VAT per unit of output actually paid to the government by producers in sector j, vat_j, is given by

$$vat_j = p_j t_j - \Sigma_i a_{ij} p_i t_i \qquad (2)$$

where t_i is the VAT rate. Equation (2) represents the heart of the VAT account. Each producer compiles such an account and pays its balance to the tax office. This account thus gives the *entrepreneur tax collector rule* within the VAT system. The price equation can then be defined by

$$p_j(1+t_j) = \Sigma_i a_{ij} p_i (1+t_i) + v_j + vat_j$$

which is obtained by rearranging equation (2) and adding it to equation (1).

In order to show the location of VAT yield we consider a two sector economy; q_1 and q_2 are the total outputs of the two sectors; q_{ij} is the amount of good i used to produce good j; c_1 and c_2 are the final consumptions of the two goods; p_1 and p_2 the two prices, v_1 and v_2 the two value added, t_1 and t_2 the two tax rates. By VAT_1 and VAT_2 we denote the direct VAT payments from industry 1 and 2, respectively. If we show the amount of VAT included in each cell of the table at the prices at which the transactions were made, we get a table like this:

	Intermediate demand		Final demand	Total
product 1	$q_{11}p_1t_1$	$q_{12}p_1t_1$	$c_1p_1t_1$	$q_1p_1t_1$
product 2	$q_{21}p_2t_2$	$q_{22}p_2t_2$	$c_2p_2t_2$	$q_2p_2t_2$
VAT payments	VAT_1	VAT_2		
total in column	$q_1p_1t_1$	$q_2p_2t_2$		

Reading the table by row we see that the total tax in each row is the value of the product multiplied by its tax rate.

$$q_1p_1t_1 = q_{11}p_1t_1 + q_{12}p_1t_1 + c_1p_1t_1$$
$$q_2p_2t_2 = q_{21}p_2t_2 + q_{22}p_2t_2 + c_2p_2t_2 \qquad (3)$$

Reading the same table by column we find the sectoral VAT in the standard case as follows:

$$VAT_1 = q_1p_1t_1 - q_{11}p_1t_1 - q_{21}p_2t_2$$
$$VAT_2 = q_2p_2t_2 - q_{12}p_1t_1 - q_{22}p_2t_2 \qquad (4)$$

Then, by substituting from (3) for the first term on the right of (4), we obtain

$$VAT_1 = q_{11}p_1t_1 + q_{12}p_1t_1 + c_1p_1t_1 - q_{11}p_1t_1 - q_{21}p_2t_2$$
$$VAT_2 = q_{21}p_2t_2 + q_{22}p_2t_2 + c_2p_2t_2 - q_{12}p_1t_1 - q_{22}p_2t_2 \qquad (5)$$

which, after canceling out terms, becomes

$$VAT_1 = c_1p_1t_1 + q_{12}p_1t_1 - q_{21}p_2t_2 \tag{6}$$

$$VAT_2 = c_2p_2t_2 + q_{21}p_2t_2 - q_{12}p_1t_1$$

In the standard case the total yield is then equal to

$$VAT = VAT_1 + VAT_2 = c_1p_1t_1 + c_2p_2t_2$$

We can give a matrix representation of the non-deductible VAT flows:

0	0	$c_1p_1t_1$
0	0	$c_2p_2t_2$
VAT_1	VAT_2	

In this standard case, non-deductible VAT is found only on final demand. Note that in this table the sum of column i is not necessarily equal to the sum of row i. Rather the sum of the entries in the value-added row (the actual payments) is equal to the sum of all other flows (the "locations" of the VAT).

Let's now consider what happens to this table of non-deductible VAT flows as we move away from the standard case. We limit ourselves to two main sources of deviation: VAT exemptions and particular rules limiting the deduction.

If the product of sector i is exempted, we must have $t_i = 0$. We have noted the rule that firms producing exempted goods and services have no right to get a rebate of the tax they paid on purchased inputs. This rule may be expressed by imposing the condition $VAT_i \geq 0$ and that all the $q_{ji}p_jt_j$ become non-deductible VAT. The matrix of non-deductible VAT flows then becomes

0	0	0
$q_{21}p_2t_2$	0	$c_2p_2t_2$
0	VAT_2	

Consider now the case of tax rules limiting the deductibility of VAT on particular goods and services. Let us assume, for example, that VAT on q_1 (e.g. fuel) cannot be deducted. Equations (5) then become

$$VAT_1 = q_{11}p_1t_1 + q_{12}p_1t_1 + c_1p_1t_1 - q_{21}p_2t_2$$

$$VAT_2 = q_{21}p_2t_2 + q_{22}p_2t_2 + c_2p_2t_2 - q_{22}p_2t_2$$

and

$$VAT = VAT_1 + VAT_2 = q_{11}p_1t_1 + q_{12}p_1t_1 + c_1p_1t_1 + c_2p_2t_2$$

The table of non-deductible VAT, i.e. the table of VAT yield, becomes

Fuel	$q_{11}p_1t_1$	$q_{12}p_1t_1$	$c_1p_1t_1$	
Product 2	0	0		$c_2p_2t_2$
VAT payments	VAT_1	VAT_2		

We can see that deviations from the standard case have the effect of filling up the intermediate matrix with some positive values.

The case of agriculture is somehow similar to that one of exemptions. The special rules described above may be seen as imposing $t = 0$ for agriculture. The only tax will be that one paid by farmers on their inputs. The Italian tables, following Eurostat's suggestions, locate VAT on agricultural inputs on the final consumption flow.

In our two sector model, supposing that sector 1 is agriculture, the matrix of VAT yield would be

Agriculture	0	0	$q_{21}p_2t_2$
Product 2	0	0	$c_2p_2t_2$
VAT payments	0	VAT_2	

In such a way the subsidy (that, as we have seen above, is assured to the agricultural sector through the VAT system) does not appear explicitly: it results in an augmented value added in the sector.

Then it is clear that such a table of non-deductible VAT flows is very important for modeling because we need to know the location and the real amount of the yield of (not-deductible) VAT. In fact, equipped only with a table such as those published for EC countries in which the cells include the non-deductible VAT, it is impossible to express the flows in a given row in uniform units. If the units are not uniform across the row, addition across the row is meaningless; but all IO modeling hinges on addition across the row.

7. The Computation of VAT Yield

The VAT yield is a side result of an input-output model with real and nominal sides integrated. In an IO model, we have the matrix A (the input-output coefficient matrix) and we get price, output, and final demand vectors from the solution; having the tax rates for each flow (a scenario set of parameters), we can transform the real flows into nominal flows, and applying the tax rates to each flow and summing up the non-zero VAT yields we get the total net VAT revenue.

8. The Computation of VAT Inflation

The impact of VAT on prices is strictly endogenous and acts in the nominal side of the model. In order to give evidence of this impact we must remember how prices are measured in price equations. In general, for sector i, we can consider a price p_{io} at the base year and a price p_{it} at time t; price as an index number is then equal to 1 at the base year and to p_{it}/p_{io} at time t. In the nominal side of the model, prices enter as index numbers. When prices include VAT, (as in private consumption), for sector i, we have $p_{io}(1+t_{io})$ in the base year and $p_{it}(1+t_{it})$ at time t where t_{it} and t_{io} are VAT rates. The index number of the price in the base year is still equal to 1, but at time t it will be equal to $p_{it}(1+t_{it})/p_{io}(1+t_{io})$. We can see that the price index inclusive of VAT is equal to the price index net of VAT times the VAT factor index, which is given by the ratio $(1+t_{it})/(1+t_{io})$. Then we can move to the consumer prices by applying, in addition to production prices, the VAT factors which are determined by considering changes in the structural tax rates or by designing tax scenarios.

Because of the exceptions that leave some VAT charges on intermediate consumption, VAT factors influence prices through the price equations. Of course, VAT factors apply only when VAT charge is not equal to zero. If the VAT on private consumption expenditure has a direct impact on inflation, VAT on intermediate consumption may be expected to exert an even greater influence on inflation.

9. Excises and Other Taxes on Production in an IO Table

The indirect taxes (other than VAT) are a component of value added. In general, in an IO table there is one row in the VA sector which contains revenues paid by each sector under the item "taxes on production." Each flow derives from a mix of different taxes which have a different behavior and a different impact on inflation according to their nature and bases. First of all, it is convenient to make clear the types of such taxes.

Such taxes are duties on production and imports. The first and most important group consists of

a) taxes on commodities collected in proportion of the quantity (specific taxes) or the value of goods and services (ad valorem taxes) produced in a country;

b) other indirect taxes on production, namely duties affecting the utilization of factors as well as some rights or licenses for resident firms.

Following this classification, in the Italian case we have a very complex set of indirect taxes where we can roughly identify 39 kinds of duties: some of them are very important in terms of yield, such as fuel taxes; some others are irrelevant and represent only an anachronism in the fiscal system, such as the consumption tax on sugar.

We can interpret the production taxes row in the value-added area of an IO table as the column sum of a matrix of indirect taxes where each row identifies a kind of duty and each column represents an industry. While official IO tables contain this production taxes row, in order to make an I-O model that is useful for policy analysis, we must be in the position to evaluate the effects of modifications of rates and types; that is to say, we need not just a row but a matrix.

Some tax revenues may be allocated to specific sectors, others may not. One can try to build the production taxes matrix as far as the first type is concerned; for the case of non-sectoral taxes one must hope for help from official statistical institutions. Thanks to the help of ISTAT (Istituto Centrale di Statistica, the Italian National Statistical Bureau), the Italian model is now provided with a production tax matrix for 45 sectors and 39 kinds of duties.

We can follow two approaches in order to model production taxes in an IO model. To forecast the economy, we need to evaluate such taxes per unit of output at the

sectoral level. One can tackle the problem by assuming that taxes can be, on one hand, explained by behavioral equations or, on the other hand, by managing the rates for each kind of tax and for each sector. The two approaches are outlined in the following sections.

10. Behavioral Equations for Indirect Taxes

In this case the attention is focused on the production tax per unit of output ignoring the rate structure of this value added component. In other words, one can proceed without the indirect tax matrix. Anyway, we assume that we have a time series of vectors ...$\mathbf{ts}_{-2}$, $\mathbf{ts}_{-1}$, $\mathbf{ts}_o$, $\mathbf{ts}_1$, $\mathbf{ts}_2$... - where $\mathbf{ts}_o$ is the production taxes row in the IO table. The tax rates are, then, equal to

$$\mathbf{t}_o = \hat{\mathbf{q}}_o^{-1}\,\mathbf{ts}_o$$

where

$\mathbf{q}_o$ is the total output vector at the base year, and
$\hat{\mathbf{q}}$ is a diagonal matrix with total outputs along the main diagonal.

We can compute the corresponding vectors of tax rates relative to real output

$$\mathbf{t}_t = \hat{\mathbf{q}}_t^{-1}\,\mathbf{ts}_t$$

at time t. It's important to stress that the vector $\mathbf{t}$ is an "average rate" because it shows the average burden on every single sector.

On modeling the evolution of the value added components (Almon, (1981), (1983)) we compute the tax indexes as

$$\mathbf{d}_t = \hat{\mathbf{t}}_o^{-1}\,\mathbf{t}_t$$

and we subsequently model vector $\mathbf{d}_t$. The behavioral equations for each component of vector $\mathbf{d}_t$ have to take into account the rough distinction of these taxes into two groups: a) specific taxes and b) ad valorem taxes. If we do not inspect how tax laws may have modified tax rates, sectoral tax indexes can be interpreted by means of a simple sectoral price indexation scheme (Bardazzi (1987), Grassini (1987)) which, in general, can be referred for sector i as $d_{it} = f(p_{it})$. In the Intimo model this function is simply linear.

When one prefers to model vector $\mathbf{d}_t$ by using tax changes and/or designing tax scenarios, then we move to the second approach described in the next section.

11. Tax Rates Scenarios

This case relies upon a production taxes matrix mentioned above. Let us call this matrix $\mathbf{U}$ with as many rows as the sectors in the IO table and as many columns as the kinds of indirect taxes considered. The tax rates matrix $\mathbf{U}_A$ is given by

$$\mathbf{U}_A = \hat{\mathbf{q}}^{-1}\mathbf{U}$$

The elements of $\mathbf{U}_A$ are tax rates and can be divided into a group of excise tax rates and a group of ad valorem tax rates. Matrix $\mathbf{U}_A$ must be defined for each year; one can expect excise tax rates to change more rapidly than the other group of tax rates; in fact we have to consider that the updating of excise tax rates must take place frequently in order to maintain the tax yield in line with inflation; this is not the case of ad valorem indirect tax rates which imply an automatic indexation. In general, we can consider matrix $\mathbf{U}_A$ with two columns related to the two groups of production taxes; let t_{iqt} and t_{ivt} be the two tax rates on quantities and ad valorem in sector i. The tax index at time t in sector i is given by

$$d_{it} = t_{iqt} + t_{ivt} * p_{it}$$

which is the variable that acts in the price equation. On the other hand, the sectoral yield is given by $q_{it} * d_{it}$.

12. Final Comments

Indirect taxes affect price formation; therefore, they must be included in an IO model with a developed nominal side. The level of complexity on modeling indirect taxes qualifies the IO model as a policy simulation tool. On computing price vectors (producers' and consumers' prices) by means of a multisectoral model, we must include the effect of production taxes as well as VAT taxes; this can be accomplished by means of simple indexation of production taxes in the producers price equations and applying VAT factors to consumer prices. When an IO model is used as a fiscal policy simulation tool, we need to deal with tax rate scenarios and to evaluate tax yields; in this case we need a model with prices and outputs endogenous to get endogenous nominal flows from which to obtain tax yields by applying structural tax rates or specifically chosen for simulation exercises.

A fiscal policy simulation input-output model must then have a real and a nominal side fully integrated; it must be able to properly mix tax scenarios like the ones described above. INTIMO is such a model.

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