Equity and efficiency of a reform of Belgian indirect taxes

André DECOSTER *
Erik SCHOKKAERT
Katholieke Universiteit te Leuven

1 Introduction

During the last two decades (at least since Diamond-Mirrlees, 1971), there has been a real explosion of the academic literature on optimal taxation and tax reform. This literature has undoubtedly increased our understanding of the problem of taxation in a second best framework. The political impact of this work has been extremely limited, however. It is a striking fact that the ideas about tax reform which are now being proposed in most Western countries are hardly related to the theoretical results and sometimes even go in the opposite direction.

One of the causes of this paradoxical situation is the lack of telling empirical applications of optimal tax theory and the extreme sensitivity of the theoretical conclusions with respect to the specifications used. Although this is a genuine reflection of our lack of knowledge, it is not an attractive situation for practitioners, who have to make decisions in one way or another. If we want to bridge the gap between theory and practice, it seems that more empirical work is absolutely indispensable. Moreover, this work should be formulated so as to be useful to policy-makers.

In this paper we present some results about the structure of indirect taxes in Belgium. Our calculations are based on the theory of marginal tax reform, which will be summarized in Section 2 of the paper. That section is based on Ahmad and Stern (1984). The theory makes it possible to integrate efficiency and equity considerations in an elegant way. The latter are operationalized through a sensitivity analysis with respect to a parameter of inequality aversion. There will be a different tax reform proposal for each value of this parameter. Empirical results for Belgium are shown in Section 3. This section is really the heart of the paper and we will try to show that the information it contains may be practically relevant. In Section 4 we try to

* During the period of this research, A. Decoster was Fellow of the National Foundation for Scientific Research (N.F.W.O)

estimate and incorporate the social costs associated e.g. with tobacco consumption. Section 5 concludes.

Our results can be compared with the work of Wibaut (1987), who analysed the same problem within a model with Keynesian unemployment (i.e. excess supply of labour and commodities). He concentrates on finding Pareto-improving directions and works with a smaller number of commodities. We try to focus on the equity-efficiency trade-off and on the formulation of conclusions which are relevant for policy.

2 A simple method for evaluating a tax reform

For practical purposes, it seems best to accept that the decision maker starts with an existing tax system and will implement small and piecemeal changes only. This implies that we have to concentrate on the evaluation of a tax reform, rather than on the computation of a set of overall "optimal" tax rates which might differ considerably from the existing situation. The theory for such evaluation is now well understood and we will only briefly summarize it, basically following the treatment by Ahmad and Stern (1984). We only consider indirect taxes: in the next section we will return to the implications of this choice.

We assume that the producer prices $p_1, \ldots, p_N$ of the N commodities are fixed and that there are no pure profits [1]. Indirect taxes $t_1, \ldots, t_N$ increase the consumer prices $q_1, \ldots, q_N$

$$q_i = p_i + t_i \qquad i = 1, \ldots, N \tag{1}$$

We assume that there are H households in the economy and denote by $x_i^h(q)$ the quantity of commodity i purchased by household h. We write this quantity as a function of consumer prices only, because we assume factor income to be fixed (and untaxed). Aggregate consumption is then given by

$$X_i = \sum_h x_i^h \qquad i = 1, \ldots, N \tag{2}$$

The government collects a certain amount of revenue R through indirect taxes

$$R = \sum_i t_i X_i \tag{3}$$

[1] The assumption of perfectly elastic supply seems easier to accept for a small, open economy like the Belgian one.

and it cares about social welfare, represented by the function $W[v^1(q), \ldots, v^H(q)]$ where $v^h(q), h = 1, \ldots, H$, refers to the indirect utility function of household h, giving the maximum level of utility attainable by household h, when consumer prices are given by q.

Let us now consider the consequences of a marginal change in the tax t_i. This change will of course affect government revenue :

$$\frac{\partial R}{\partial t_i} = X_i + \sum_k t_k \frac{\partial X_k}{\partial q_i} \qquad (4)$$

It will also have an effect on social welfare :

$$\frac{\partial W}{\partial t_i} = \sum_h \frac{\partial W}{\partial v^h} \frac{\partial v^h}{\partial q_i} = - \sum_h \beta^h x_i^h \qquad (5)$$

where we use Roy's rule for the second step and define $\beta^h = \frac{\partial W}{\partial v^h} \cdot \frac{\partial v^h}{\partial m^h}$, m^h being the lump-sum income of household h. The parameter β^h therefore gives the marginal social valuation of one unit of income accruing to household h [2].

We want to compare the effects of changes in the different tax rates. We therefore define MC_i, *the marginal cost in terms of social welfare of an extra franc raised via the ith good.* To raise one extra franc, we have to increase the tax by $1/(\partial R/\partial t_i)$. The marginal welfare cost MC_i can therefore be defined as :

$$MC_i = - \frac{\partial W/\partial t_i}{\partial R/\partial t_i} \qquad (6)$$

and, using (4) and (5),

$$MC_i = \frac{\sum_h \beta^h x_i^h}{X_i + \sum_k t_k (\frac{\partial X_k}{\partial q_i})} \qquad (7)$$

Multiplying numerator and denominator in (7) by q_i leads to an expression which can be operationalized easily :

$$MC_i = \frac{\sum_h \beta^h (q_i x_i^h)}{q_i X_i + \sum_k \varepsilon_{ki} t_k^* (q_k X_k)} \qquad (8)$$

[2] A general interpretation of the welfare change measure in (5) is given e.g. by Boadway and Bruce (1984).

where ε_{ki} refers to the uncompensated price elasticity $\frac{\partial X_k/X_k}{\partial q_i/q_i}$ and $t_k^* = \frac{t_k}{q_k}$, the tax rate as a fraction of consumer price.

For the tax structure to be optimal, the marginal costs have to be equal for all commodities. Even without referring to such a social optimum, it is intuitively clear that social welfare can be increased if $MC_i \neq MC_j$, and with global tax revenue kept constant. If e.g. $MC_i < MC_j$ then social welfare will be increased by lowering the tax rate t_j and by an offsetting increase in the tax t_i, both changes being defined as in (4). It is important to realise that with this model we can only evaluate *marginal* changes in the tax structure. On the other hand, the kind of information obtained (what rates to decrease and the offsetting increases in other taxes) may be very important for the policy maker. Expressions (7) and (8) offer a possibility to integrate efficiency and equity in a consistent framework. The importance of such a consistent framework can hardly be overestimated.

Table 1 Commodity classification and indirect tax rates

Commodity	Expenditures average consumer	Value added tax	Excise tax	Indirect tax rate (in %)
	(1)	(2)	(3)	[(2) + (3)]/(1)
Food	111 531	6 695	191	6.1741
Beverages	16 519	2 874	2 803	34.3665
Tobacco	6 918	392	4 339	68.3868
Clothing	49 145	7 436	-	15.1307
Rent	115 303	1 146	-	0.9939
Heating	51 114	6 941	-	13.5794
Durables	43 381	7 391	-	15.2767
Housing	12 340	885	-	7.1718
Personal care	27 144	2 077	-	7.6518
Transportation	72 001	12 742	10 329	32.0426
Leisure goods	45 648	5 319	-	11.6522
Services	9 368	135	-	1.4411

The information necessary to implement (8) can be divided into three categories. The first category consists of economic variables, which in principle can be directly observed: the individual expenditures on the different commodities ($q_i x_i^h$), the market expenditures on the different commodities ($q_k X_k$) and the tax rates t_k^*. For our empirical work we collected the consumption data for ten representative consumers, each corresponding with one decile of the Belgian consumer expenditure survey. We constructed 12 aggregate commodities, for which we computed the indirect tax rates using the detailed study of Paraire-Laguesse et al. (1986). The commodities and the tax rates are shown in Table 1. More information on the data has been collected in appendix A. It can be argued, of course, that important aspects of the problem are neglected by restricting ourselves to such a small number of aggregate commodities. However, there is an upper limit to the number of commodities which can be handled within this framework. This is mainly due to the second category of information.

This second category consists of the uncompensated price elasticities. These summarize behavioural reactions and have to be estimated. It is well known that the results for the computation of optimal tax rates may depend heavily on the specification of the demand system used for the estimation of these elasticities. For the analysis of marginal tax reform, however, one only needs aggregate price elasticities, evaluated at the actually observed price and consumption levels. It has therefore been suggested by Ahmad and Stern (1984) that tax reform results would be less dependent on the specification of the demand system used. In a companion paper (Decoster and Schokkaert, 1987) we compare three demand systems - Rotterdam, AIDS and CBS - and show that the suggestion of Ahmad and Stern (1984) is corroborated by our Belgian data. In this paper we present only the results for the CBS-system : the specification and the matrix of uncompensated price elasticities are also summarized in appendix A.

The pure value judgments, embodied in the welfare weights β^h, are classified in a third category. Since we do not want to impose a priori these ethical views, we will operationalize them through a sensitivity analysis. We therefore use the well known iso-elastic specification

$$W = \sum_h k \frac{(m^h)^{1-e}}{1-e} \qquad e \neq 1 \qquad e \geq 0 \qquad (9\text{ a})$$

$$W = \sum_h k \log m^h \qquad e = 1 \qquad (9\text{ b})$$

This specification implies that

$$\beta^h = k(m^h)^{-e} \qquad (10)$$

We normalize by putting the welfare weight for the poorest household, β^1, equal to one. This allows us to determine the constant k and we then get in general

$$\beta^h = (\frac{m^h}{m^1})^{-e} \tag{11}$$

Table 2 **Welfare weights for different e-values** [a]

Decile	$e = 0.0$	$e = 0.1$	$e = 0.5$	$e = 1.0$	$e = 2.0$	$e = 5.0$	$e = 10.0$
I	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
II	1.0000	0.9904	0.9531	0.9083	0.8251	0.6182	0.3824
III	1.0000	0.9823	0.9147	0.8367	0.7001	0.4101	0.1682
IV	1.0000	0.9811	0.9091	0.8265	0.6830	0.3856	0.1487
V	1.0000	0.9860	0.9321	0.8689	0.7549	0.4952	0.2452
VI	1.0000	0.9810	0.9086	0.8255	0.6814	0.3833	0.1469
VII	1.0000	0.9803	0.9054	0.8197	0.6719	0.3701	0.1369
VIII	1.0000	0.9729	0.8718	0.7601	0.5778	0.2538	0.0644
IX	1.0000	0.9637	0.8310	0.6906	0.4769	0.1571	0.0247
X	1.0000	0.9528	0.7852	0.6165	0.3801	0.0891	0.0079

[a] Equation (11) with m^h = total expenditures per adult equivalent

Income is only a poor welfare indicator for our data, since richer households are also of larger size. This will probably be taken into account by any reasonable ethical observer. We therefore used total expenditures per equivalent adult as our operationalization of m^h [3]. With the inequality aversion parameter $e = 0$, all welfare weights are equal to one. With $e > 0$, all $\beta^h < m^1$ because $m^h > m^1$, and weights attached to higher income households are lower than for lower income units. The rate at which the weights decline in moving up the income scale is determined by the value of e. In Table 2 we show the welfare weights of our ten representative consumers for seven different values of e.

[3] The equivalence scales used by the Belgian National Institute for Statistics are those of the League of Nations. These are far from perfect of course. The results are not very sensitive to this choice, however. Use of total expenditure per capita, for instance, does not lead to a very different pattern of welfare weights.

the constant k and

(11)

values [a]	
$e = 5.0$	$e = 10.0$
1.0000	1.0000
0.6182	0.3824
0.4101	0.1682
0.3856	0.1487
0.4952	0.2452
0.3833	0.1469
0.3701	0.1369
0.2538	0.0644
0.1571	0.0247
0.0891	0.0079

nt

r data, since richer
ably be taken into
herefore used total
nalization of m^h [3].
welfare weights are
$> m^1$, and weights
an for lower income
ving up the income
e show the welfare
ven different values

nstitute for Statistics
perfect of course. The
se of total expenditure
nt pattern of welfare

3 The evaluation of a reform in the Belgian indirect tax structure

In this section we discuss the results obtained from applying expression (8) to our Belgian data. To illustrate the trade-off between efficiency and equity, it seems interesting to rewrite (8) as

$$MC_i = \frac{\sum_h \beta^h \frac{x_i^h}{X_i}}{1 + \sum_k \varepsilon_{ki} t_k^* (\frac{q_k X_k}{q_i X_i})} \tag{12}$$

Let us first consider the case where we would neglect all changes in consumption pattern, i.e., we assume that $\varepsilon_{ki} = 0 \; \forall \; k, i$. Equation (12) then reduces to

$$MC_i = \sum_h \beta^h \frac{x_i^h}{X_i} \tag{13}$$

The marginal welfare cost of an increase in the indirect tax for any commodity, then coincides with the distributional characteristic of that commodity, as introduced by Feldstein (1972). This concept summarizes the variation of consumption patterns across income classes by weighting the market shares of the different households in the consumption of commodity i, using the β^h's as weights. In Table 3 we show the values of the distributional characteristics for the twelve commodities.

It is obvious from (13) and (11) that these depend on the inequality aversion parameter. If we do not care about equity ($e = 0$) they are all equal to one. When e increases, necessities get a relatively higher and luxuries a relatively lower value for the distributional characteristic. Someone who is willing to neglect efficiency considerations and has a value $e = 2$ [4], could immediately derive from Table 3 his policy prescriptions: he would decrease indirect taxes on heating and food, and increase the tax rate on transportation and durables.

Let us now take the opposite position that equity does not matter at all, i.e. $e = 0$. In that case equation (12) reduces to

$$MC_i = \frac{1}{1 + \sum_k \varepsilon_{ki} t_k^* (\frac{q_k X_k}{q_i X_i})} \tag{14}$$

[4] This probably is a reasonable value - see Stern (1977).

Table 3 **Distributional characteristics**							
	$e = 0.0$	$e = 0.1$	$e = 0.5$	$e = 1.0$	$e = 2.0$	$e = 5.0$	$e = 10.0$
Food	1.000	0.9760	0.8872	0.7903	0.6346	0.3573	0.1721
Beverage	1.000	0.9749	0.8820	0.7813	0.6207	0.3397	0.1570
Tobacco	1.000	0.9762	0.8877	0.7907	0.6338	0.3503	0.1584
Clothing	1.000	0.9728	0.8728	0.7650	0.5948	0.3054	0.1270
Rent	1.000	0.9740	0.8783	0.7751	0.6119	0.3323	0.1560
Heating	1.000	0.9763	0.8887	0.7932	0.6398	0.3671	0.1847
Durables	1.000	0.9721	0.8695	0.7594	0.5866	0.2964	0.1212
Housing	1.000	0.9720	0.8694	0.7596	0.5885	0.3046	0.1361
Personal care	1.000	0.9747	0.8813	0.7799	0.6183	0.3359	0.1536
Transportation	1.000	0.9715	0.8668	0.7544	0.5782	0.2834	0.1079
Leisure goods	1.000	0.9728	0.8726	0.7648	0.5949	0.3069	0.1303
Service	1.000	0.9746	0.8806	0.7787	0.6162	0.3331	0.1523

and we only concentrate on efficiency aspects. Note that this expression is closely related to the "marginal cost of public funds", as defined e.g. by Browning (1976). The results are shown in the first column of Table 4.

The ranking of the MC_i's is indicated in the second column. When one does not care about distribution, one could propose to raise the tax on beverages and services and decrease the tax on tobacco and transportation.

The conflict between equity and efficiency is obvious when we compare the results in Table 4 with the equity case in Table 3, e.g. for $e = 2$. Drastic differences occur e.g. for transportation, beverages and food. Most people will not take one of these two extreme positions, however. The use of the complete expression (8) allows us to integrate equity and efficiency considerations. Interpretation becomes somewhat easier when we rewrite (8) in the way suggested by Ahmad and Stern (1984) as :

$$MC_i = \sum_h \beta^h \left[\frac{q_i x_i^h}{q_i X_i + \sum_k \varepsilon_{ki} t_k^* (q_k X_k)} \right] \qquad (15)$$

:ics

.0	$e = 5.0$	$e = 10.0$
l6	0.3573	0.1721
)7	0.3397	0.1570
)8	0.3503	0.1584
l8	0.3054	0.1270
l9	0.3323	0.1560
)8	0.3671	0.1847
36	0.2964	0.1212
35	0.3046	0.1361
33	0.3359	0.1536
32	0.2834	0.1079
19	0.3069	0.1303
32	0.3331	0.1523

that this expression
funds", as defined
ı the first column of

:cond column. When
ɔropose to raise the
tax on tobacco and

ɔvious when we com-
able 3, e.g. for $e = 2$.
beverages and food.
: positions, however.
to integrate equity
ɔmes somewhat eas-
ı Ahmad and Stern

(15)

Table 4 **Results for the Efficiency-Case**

	MC	Ranking
Food	1.1192	Tobacco
Beverage	1.0254	Transportation
Tobacco	2.4158	Heating
Clothing	1.1162	Leisure goods
Rent	1.1469	Personal care
Heating	1.2214	Rent
Durables	1.0807	Food
Housing	1.0363	Clothing
Personal care	1.1579	Durables
Transportation	1.3067	Housing
Leisure goods	1.1792	Beverages
Services	0.8533	Services

or, denoting the expression between brackets by λ_i^h, as

$$MC_i = \sum_h \beta^h \lambda_i^h \tag{16}$$

These λ_i^h 's have an attractive interpretation: they give the marginal cost (in *money* terms) to household h of the increase in the tax rate on commodity i. Equation (16) then shows that the global social marginal cost is a kind of weighted average of these λ_i^h's, the weights being given by the vector β, and hence dependent on the degree of inequality aversion (see Table 2).

Table 5 shows the marginal costs for the different deciles of the income distribution and the corresponding rankings. The working of the model is well illustrated by the rankings for food and transportation. Taxing food implies a high marginal cost for lower income groups and a low marginal cost for richer households. For transportation we see the opposite evolution. The maximin welfare criterion would suggest to consider only the first column in Table 5: the advice then would be to decrease the indirect tax on tobacco, heating and food and to increase the taxes on clothing, durables and transportation.

Table 5 Marginal costs for the different deciles and corresponding rankings

	I	II	III	IV	V	VI	VII	VIII	IX	X
FOOD	0.0561	0.0788	0.0915	0.1042	0.1155	0.1127	0.1271	0.1322	0.1412	0.1599
BEVE	0.0412	0.0635	0.0753	0.0809	0.1067	0.1064	0.1184	0.1252	0.1338	0.1740
TOBA	0.0859	0.1257	0.1810	0.2638	0.2740	0.2749	0.3037	0.3114	0.3105	0.2849
CLOT	0.0258	0.0455	0.0620	0.0809	0.1002	0.1126	0.1398	0.1538	0.1701	0.2257
RENT	0.0511	0.0756	0.0858	0.0922	0.1077	0.1023	0.1081	0.1372	0.1582	0.2287
HEAT	0.0760	0.0988	0.1017	0.1070	0.1207	0.1113	0.1348	0.1462	0.1465	0.1784
DURA	0.0227	0.0422	0.0542	0.0735	0.0931	0.1129	0.1273	0.1422	0.1705	0.2420
HOUS	0.0393	0.0512	0.0755	0.0686	0.0785	0.0911	0.0921	0.1227	0.1630	0.2541
PERS	0.0459	0.0690	0.0880	0.0931	0.1037	0.1219	0.1360	0.1469	0.1644	0.1890
TRAN	0.0166	0.0334	0.0550	0.0912	0.0990	0.1430	0.1771	0.1774	0.2223	0.2917
LEIS	0.0319	0.0517	0.0725	0.0878	0.0999	0.1232	0.1284	0.1578	0.1817	0.2445
SERV	0.0375	0.0412	0.0434	0.0998	0.0590	0.1101	0.0940	0.1066	0.1233	0.1383

I	II	III	IV	V	VI	VII	VIII	IX	X
TOBA	TOBA	TOBA	TOBA	TOBA	TOBA	TOBA	TOBA	TOBA	TRAN
HEAT	HEAT	HEAT	HEAT	HEAT	TRAN	TRAN	TRAN	TRAN	TOBA
FOOD	FOOD	FOOD	FOOD	FOOD	LEIS	CLOT	LEIS	LEIS	HOUS
RENT	RENT	PERS	SERV	RENT	PERS	PERS	CLOT	DURA	LEIS
PERS	PERS	RENT	PERS	BEVE	DURA	HEAT	PERS	CLOT	DURA
BEVE	BEVE	HOUS	RENT	PERS	FOOD	LEIS	HEAT	PERS	RENT
HOUS	LEIS	BEVE	TRAN	CLOT	CLOT	DURA	DURA	HOUS	CLOT
SERV	HOUS	LEIS	LEIS	LEIS	HEAT	FOOD	RENT	RENT	PERS
LEIS	CLOT	CLOT	BEVE	TRAN	SERV	BEVE	FOOD	HEAT	HEAT
CLOT	DURA	TRAN	CLOT	DURA	BEVE	RENT	BEVE	FOOD	BEVE
DURA	SERV	DURA	DURA	HOUS	RENT	SERV	HOUS	BEVE	FOOD
TRAN	TRAN	SERV	HOUS	SERV	HOUS	HOUS	SERV	SERV	SERV

Table 6 Marginal social welfare costs for different values of e

	$e = 0.0$	$e = 0.1$	$e = 0.5$	$e = 1.0$	$e = 2.0$	$e = 5.0$	$e = 10.0$
FOOD	1.1192	1.0924	0.9929	0.8845	0.7102	0.3999	0.1927
BEVE	1.0254	0.9996	0.9044	0.8012	0.6365	0.3483	0.1609
TOBA	2.4158	2.3582	2.1444	1.9102	1.5310	0.8461	0.3827
CLOT	1.1162	1.0859	0.9742	0.8538	0.6640	0.3409	0.1418

[illegible]	[illegible]								
PERS	PERS	RENT	PERS	BEVE	DURA	HEAT	PERS	CLOT	DURA
BEVE	BEVE	HOUS	RENT	PERS	FOOD	LEIS	HEAT	PERS	RENT
HOUS	LEIS	BEVE	TRAN	CLOT	CLOT	DURA	DURA	HOUS	CLOT
SERV	HOUS	LEIS	LEIS	LEIS	HEAT	FOOD	RENT	RENT	PERS
LEIS	CLOT	CLOT	BEVE	TRAN	SERV	BEVE	FOOD	HEAT	HEAT
CLOT	DURA	TRAN	CLOT	DURA	BEVE	RENT	BEVE	FOOD	BEVE
DURA	SERV	DURA	DURA	HOUS	RENT	SERV	HOUS	BEVE	FOOD
TRAN	TRAN	SERV	HOUS	SERV	HOUS	HOUS	SERV	SERV	SERV

Table 6 **Marginal social welfare costs for different values of e**

	$e = 0.0$	$e = 0.1$	$e = 0.5$	$e = 1.0$	$e = 2.0$	$e = 5.0$	$e = 10.0$
FOOD	1.1192	1.0924	0.9929	0.8845	0.7102	0.3999	0.1927
BEVE	1.0254	0.9996	0.9044	0.8012	0.6365	0.3483	0.1609
TOBA	2.4158	2.3582	2.1444	1.9102	1.5310	0.8461	0.3827
CLOT	1.1162	1.0859	0.9742	0.8538	0.6640	0.3409	0.1418
RENT	1.1469	1.1171	1.0074	0.8890	0.7018	0.3812	0.1789
HEAT	1.2214	1.1924	1.0854	0.9688	0.7815	0.4484	0.2256
DURA	1.0807	1.0505	0.9397	0.8207	0.6339	0.3203	0.1310
HOUS	1.0363	1.0073	0.9009	0.7872	0.6098	0.3157	0.1410
PERS	1.1579	1.1286	1.0205	0.9031	0.7159	0.3889	0.1779
TRAN	1.3067	1.2694	1.1326	0.9857	0.7555	0.3703	0.1409
LEIS	1.1792	1.1471	1.0290	0.9019	0.7016	0.3620	0.1537
SERV	0.8533	0.8316	0.7514	0.6645	0.5258	0.2843	0.1300

$e = 0.0$	$e = 0.1$	$e = 0.5$	$e = 1.0$	$e = 2.0$	$e = 5.0$	$e = 10.0$
TOBA	TOBA	TOBA	TOBA	TOBA	TOBA	TOBA
TRAN	TRAN	TRAN	TRAN	HEAT	HEAT	HEAT
HEAT	HEAT	HEAT	HEAT	TRAN	FOOD	FOOD
LEIS	LEIS	LEIS	PERS	PERS	PERS	RENT
PERS	PERS	PERS	LEIS	FOOD	RENT	PERS
RENT	RENT	RENT	RENT	RENT	TRAN	BEVE
FOOD	FOOD	FOOD	FOOD	LEIS	LEIS	LEIS
CLOT	CLOT	CLOT	CLOT	CLOT	BEVE	CLOT
DURA	DURA	DURA	DURA	BEVE	CLOT	HOUS
HOUS	HOUS	BEVE	BEVE	DURA	DURA	TRAN
BEVE	BEVE	HOUS	HOUS	HOUS	HOUS	DURA
SERV	SERV	SERV	SERV	SERV	SERV	SERV

Less extreme ethical positions would advocate a weighting of the different columns of Table 5, according to equation (16). Results for different values of e are shown in Table 6. The first column (for $e = 0$) replicates the first column in Table 4 : only efficiency matters.

With increasing values of e, smaller weights are attached to richer households [5] . The working of the model again is illustrated nicely by the rankings for transportation and food. A closer inspection of Table 6 suggests that the marginal welfare costs are dominated by the efficiency element, i.e. that the rankings are rather insensitive to the degree of inequality aversion. Significant changes only occur for the highest values of e. This is consistent with earlier findings that the consumption patterns of different income groups are not sufficiently differentiated to ascribe an important distributive role to indirect taxes [6]. This effect may have been strengthened by the high aggregation level of our commodity definition.

Of course, one must be aware of the limitations of the exercise. The marginal character of the reform is in itself a serious restriction. Our results only indicate the direction of a tax reform and do not allow any conclusion about the magnitude of the changes in the rate structure. One therefore has to be very careful in deriving policy proposals from our results.

The second set of limitations relates to the specification of consumer behaviour in the model. Dynamic considerations (including the distinction between durables and non-durables and life cycle effects) have been neglected. Still more important is the complete neglect of income taxation and labour supply, which is to be explained by the lack of adequate data. Optimal tax theory suggests that, once we can assume to have an optimum income tax schedule, the pattern of commodity taxes crucially depends on the complementarity - substitution relationship between the different commodities and leisure (see e.g. Atkinson and Stiglitz, 1976 ; Christiansen, 1984). If goods are weakly separable from leisure in the utility function, optimal indirect taxes are uniform, if the government has at its disposal non-linear income taxation. This is disturbing since our specification of the demand system, in which labour supply is neglected, is legitimate only under this condition of weak separability. We therefore have to assume that the actual income tax system in Belgium is not optimal and that the in-

[5] The decline in all marginal social costs going from the left to the right in the table follows from the normalisation of the β 's. Comparisons are only meaningful within one column.

[6] See e.g. for Belgium Paraire-Laguesse et al. (1986). The problem is theoretically analysed by Sah (1983).

come tax cannot be fully exploited under tax reform. However, one may argue that this is a realistic assumption for practical policy purposes.

The third limitation of our exercise is related to the previous one. We have assumed that all markets are in equilibrium, including the labour market. If we were to include rationing on the labour market, the employment effects of the different indirect taxes could play an important role (see Wibaut, 1987).

A fourth problem with the approach in this section is our complete neglect of the external or merit good effects, associated with the consumption of certain commodities. Surely, without such considerations, it is impossible to justify the extremely high tax rates on e.g. tobacco and transport (petrol). This neglect explains why the marginal cost of taxing tobacco is the highest in Table 6, irrespective of the degree of inequality aversion. In the next section we will propose a method to integrate merit good effects in the analysis. It must be emphasized, however, that our Table 6 has a perfectly acceptable interpretation : it shows the marginal costs associated with the different indirect taxes, when we neglect merit good effects, i.e. accept consumer sovereignty and only take into account the individual's perception of his own welfare. This implies that someone who wants to depart from these results, has to do so on the basis of *other* considerations and has to make explicit his reasons for disavowing consumer sovereignty.

Despite the limitations and interpretational restrictions mentioned, we consider Tables 5 and 6 to be the main results of this paper and we would claim that they contain interesting information for a policy maker who wants to restructure the pattern of indirect taxes in Belgium. In the next section we will present some further exercises which can help with the interpretation of these tables.

4 Introducing merit good effects

It is not difficult to adapt the previous formulae to the situation where merit good effects play a role. A straightforward operationalization of these effects formulates the social welfare function as $W[v^1(q), \ldots, v^H(q), X_1, \ldots, X_n]$, indicating that what now also matters is aggregate consumption of the commodities, irrespective of individual utility levels. Equation (5) then changes to

$$\frac{\partial W}{\partial t_i} = -\sum_h \beta^h x_i^h + \sum_k \mu_k^* \frac{\partial X_k}{\partial q_i} \qquad (17)$$

where $\mu_k^* = \partial W / \partial X_k$. Equation (4) remains the same. Using the same manipulations as in the previous section, we can combine (17) and (4) to get expression (18) for the marginal cost, an expression which is completely analogous to (8)

$$MC_i = \frac{\sum_h \beta^h q_i x_i^h - \sum_k \mu_k \varepsilon_{ki}(q_k X_k)}{q_i X_i + \sum_k \varepsilon_{ki} t_k^*(q_k X_k)} \tag{18}$$

where $\mu_x = \mu_k^*/q_k$. Note that a positive value for μ_k may affect the marginal welfare cost of an indirect tax on all the other commodities, through the working of the cross price-effects.

The only new piece of information necessary to calculate (18) is a set of values for μ_k, the change in welfare caused by one franc of additional consumption of commodity k. This can obviously be considered to be a value judgment and, as for the β's, a sensitivity analysis would be a logical solution. It is not easy to interpret numerical values for μ_k, however, and therefore it is not obvious what values one could use for such a sensitivity analysis.

Table 7 Estimation results inverse optimum problem

e	0.0000	(5.3490)	0.0000	(0.6192)	0.0000	(0.7209)
λ	−1.3372	(1.8610)	−1.0964	(0.1838)	−1.0862	(0.2082)
μ_{BEVE}	—		−0.2293	(0.1219)	—	
μ_{TOBA}	—		−0.7092	(0.1027)	−0.6277	(0.1056)
μ_{HEAT}	—		0.1990	(0.0994)	—	
μ_{TRAN}	—		−0.3477	(0.0679)	−0.3189	(0.0762)
Sum of squared residuals	1.0375		0.0062		0.0135	

Note : Asymptotic standard errors between brackets.
The parameter e was constrained to be larger than or equal to zero.

In order to get some insight into these values, we solved the inverse optimum problem, as described by Christiansen and Jansen (1978). We thus started from the actual tax structure in Table 1 and computed the values for inequality aversion e, for λ and for "social costs" μ_k attached to tobacco and transport, for which this actual tax

structure would be
value judgments e
further discussed i
7. They obviously
present tax structu
cost to tobacco. The
its boundary value
indirect tax structu
et al., 1986).

Table

	Marginal co with social cos
FOOD	1.5363
BEVE	1.2613
TOBA	1.0021
CLOT	1.1058
RENT	0.9596
HEAT	1.1804
DURA	1.2057
HOUS	1.2791
PERS	1.3816
TRAN	1.1588
LEIS	0.7680
SERV	0.8206

We can now u
column of Table 7.
of Table 8. The sec
and 6 and gives the
we neglect merit go
the difference betw
that consumption
it leads to a small
substitution and co

[7] The parameter λ is
budget constraint i
pendix B).

[8] We give the results
the specific normali

structure would be optimal[7]. So doing, we tried to discover the *implicit value judgments* embodied in the present tax scheme. The method is further discussed in appendix B. The results are summarized in Table 7. They obviously stand to reason. The estimates indicate that the present tax structure is optimal only when one ascribes a large social cost to tobacco. The fact that the inequality aversion parameter e takes its boundary value zero reflects the well-known result that the present indirect tax structure in Belgium is regressive (see Paraire-Laguesse et al., 1986).

Table 8 **Introduction of merit good-effects**

	Marginal cost with social costs	Marginal cost without social costs	Social cost	Ranking with social costs	Ranking without social costs
FOOD	1.5363	1.1192	−0.4171	FOOD	TOBA
BEVE	1.2613	1.0254	−0.2359	PERS	TRAN
TOBA	1.0021	2.4158	1.4137	HOUS	HEAT
CLOT	1.1058	1.1162	0.0104	BEVE	LEIS
RENT	0.9596	1.1469	0.1873	DURA	PERS
HEAT	1.1804	1.2214	0.0410	HEAT	RENT
DURA	1.2057	1.0807	−0.1250	TRAN	FOOD
HOUS	1.2791	1.0363	−0.2429	CLOT	CLOT
PERS	1.3816	1.1579	−0.2237	TOBA	DURA
TRAN	1.1588	1.3067	0.1479	RENT	HOUS
LEIS	0.7680	1.1792	0.4112	SERV	BEVE
SERV	0.8206	0.8533	0.0328	LEIS	SERV

We can now use in (18) the estimated values of μ_k from the last column of Table 7. The results (for $e = 0$) [8] are given in the first column of Table 8. The second column reproduces the first columns in Tables 4 and 6 and gives the marginal welfare costs of the different taxes, when we neglect merit good effects. The third column shows these effects as the difference between the first two columns : a negative sign indicates that consumption of these commodities is socially desirable because it leads to a smaller consumption of tobacco and transportation via substitution and complementarity relationships. The rankings of the

[7] The parameter λ is the Lagrange multiplier associated with the government budget constraint in the Lagrangean of the maximization program (see Appendix B).

[8] We give the results for $e = 0$ only, because the values of the μ_k's depend on the specific normalisation chosen for the social welfare function.

costs are compared in the last two colums of Table 8. It is obvious that the ranking with merit good effects is different from the previous one. Large changes occur for tobacco, transportation and leisure.

One has to be very cautious with the interpretation of Table 8. In a certain sense the marginal costs given in the first column only illustrate the poor fit in the inverse optimum problem : if that fit had been perfect, all these welfare costs would have been equal. It basically is inconsistent to first solve an inverse optimum problem and then compute a direction of "welfare-improving" tax-reform. However, we feel that certainly the third column (the "net social costs", taking into account merit good-effects and relationships between the different commodities) gives some interesting insights which improve our understanding of the basic Tables 5 and 6. Without this exercise, for instance, it would have been impossible to see how strongly the welfare judgment of taxing leisure goods is affected by their complementarity with tobacco and transportation.

5 Conclusion

In this paper we applied the theory of tax reform to derive empirical results for the structure of indirect taxes in Belgium. These suggest that the marginal social welfare cost of increasing the indirect taxes on tobacco and heating is high, independently of the degree of inequality aversion, and if one neglects merit good effects. On the other hand it can safely be argued that the indirect tax rates on durables, housing and "other services" are relatively low. For the other commodities, the judgment will be more heavily dependent on value judgments concerning the income distribution.

To get an idea about the importance of the merit good component in the indirect taxes of tobacco and transportation, we solved an inverse optimum problem. These effects turned out to be considerable indeed, and to affect the whole structure of tax rates.

There are obvious limitations to our exercise : the concentration on marginal reforms and the assumption of fixed labour supply are the most important ones. Nevertheless, we feel that these types of empirical results throw a new light on the political problem of tax reform. Surely it is better to derive normative results from a consistently specified model, which allows to distinguish facts and values than to rely only on rather unstructured intuitions. We are ready to admit that results such as the ones presented in this paper do not *solve* the problem once and for all, but we claim that they are a valuable contribution to the discussion.

In this appen
calculate (8) in the

1 Consume

We use the a
penditures of a rep
sumer Expenditur
Statistical Institut

2 Structur

Belgium has
rates (0, 1, 6, 17,
scription of the di
our calculations in
for those twelve cc
Laguesse et al. (1
taxes paid over th

We then simp
categories. The re
complete picture o
quite important fo
was almost 30% of
excise taxes. Aver
macro-economic fi
of total expenditu
average consumer
are shown in the
columns it is strai
consumer price : t

3 Price an

To estimate
series informatior
performed so as t
described above.

It is obvious that
the previous one.
leisure.

:tation of Table 8.
first column only
:m: if that fit had
een equal. It ba-
num problem and
-reform. However,
cial costs", taking
etween the differ-
'hich improve our
; this exercise, for
rongly the welfare
· complementarity

orm to derive em-
ı Belgium. These
easing the indirect
of the degree of in-
ects. On the other
rates on durables,
he other commodi-
n value judgments

it good component
e solved an inverse
nsiderable indeed,

the concentration
our supply are the
se types of empir-
lem of tax reform.
. consistently spec-
'alues than to rely
y to admit that re-
solve the problem
ble contribution to

APPENDIX A

Data

In this appendix we describe the different pieces of information, used to calculate (8) in the Belgian situation.

1 Consumer expenditures

We use the average expenditure figures of each income decile as the expenditures of a representative consumer: these data are taken from the Consumer Expenditure Survey 1978-1979, carried out by the Belgian National Statistical Institute. The commodity classification is given in Table 1.

2 Structure of indirect taxes

Belgium has a rather differentiated VAT-structure with seven different rates (0, 1, 6, 17, 19, 25 and 33%), to be applied according to a detailed description of the different commodities. The choice of twelve aggregates for our calculations implied that we had to construct an average indirect tax rate for those twelve commodities. We therefore started from the work of Paraire-Laguesse et al. (1986) who computed for 53 commodities the ratios of indirect taxes paid over the total expenditures on each commodity (in 1982).

We then simply further aggregated these 53 goods into our twelve broader categories. The results are shown in the second column of Table 1. To get a complete picture of indirect taxes we also had to include the excise tax, which is quite important for some goods. In 1982 government revenue from excise taxes was almost 30% of the VAT-revenue. We only had macro-economic figures about excise taxes. Average taxes paid per commodity were obtained by dividing the macro-economic figures by the number of consumers (computed as the ratio of total expenditure in the National Accounts divided by expenditures of the average consumer in the study by Paraire-Laguesse et al., 1986). The results are shown in the third column of Table 1. With the data in the first three columns it is straightforward to calculate the indirect tax rate as a fraction of consumer price: the results are shown in the last column of Table 1.

3 Price and total expenditure elasticities

To estimate the price and total expenditure elasticities, we used time series information from the National Accounts. The aggregation was of course performed so as to maximize the correspondence with the expenditure figures described above. We estimated three demand systems: Rotterdam, AIDS and

CBS [9]. More information on the estimation results can be found in Decoster and Schokkaert (1987). In this paper we only use the results for the CBS-system. This system was proposed by Keller and Van Driel (1985) and is a kind of mixture of the Rotterdam- and AIDS-models. Each equation is specified as

$$\bar{w}_{it}(\Delta lnX_{it} - \sum_j \bar{w}_{jt}\Delta lnX_{jt}) = b_i \sum_j \bar{w}_{jt}\Delta lnX_{jt} + \sum_j s_{ij}\Delta lnq_{jt} + v_{it} \quad (19)$$

where $\bar{w}_{it} = \frac{w_{it}+w_{it-1}}{2}$. The coefficients b_i, $i = 1, \ldots, N$ are to be interpreted as the expenditure coefficients of AIDS and the price effects $[s_{ij}]$ are analogous to the price coefficients of Rotterdam.

To compute the price elasticities and total expenditure elasticities for our tax reform calculations, we used the estimation results for the complete system with negative semi-definiteness of the matrix S imposed. To ensure consistency with the other data we evaluated these elasticities with the budget shares of the different commodities, taken from the Consumer Expenditure Survey. These elasticities are shown in Table 9.

[9] For the estimation of these systems, we used the DEMMOD-program designed by A.P. Barten.

Table 9 Price and total expenditure elasticities - CBS model

	PRICE ELASTICITIES												TOTAL EXPENDITURE
	FOOD	BEVE	TOBA	CLOT	RENT	HEAT	DURA	HOUS	PERS	TRAN	LEIS	SERV	ELASTICITIES
FOOD	−0.267430	−0.082237	0.028732	0.084157	−0.140135	−0.042612	−0.108274	0.034155	0.005251	0.001593	−0.023068	0.008578	0.501285
BEVE	−0.722671	−0.243780	0.138233	0.220887	−0.331251	−0.091878	−0.281004	0.099255	0.004814	0.064240	0.010517	0.029086	1.103555
TOBA	0.623372	0.355295	−0.931866	−0.030654	−0.240015	0.030423	0.127263	0.407379	0.380594	0.114109	−0.534869	−0.123400	−0.177631
CLOT	−0.020017	0.055321	−0.024246	−0.787782	−0.329201	0.035638	0.018085	0.005255	−0.221797	−0.048447	−0.147301	−0.078069	1.542549
RENT	− 0.141359	−0.029658	−0.022340	−0.057165	−0.142553	−0.002393	−0.065939	0.036851	−0.009956	0.014093	−0.060010	−0.008633	0.489058
HEAT	−0.323952	−0.048180	− 0.014031	0.054159	−0.199369	−0.352687	−0.021402	−0.025808	−0.066796	−0.395841	−0.068031	−0.015897	1.477835
DURA	−0.716566	−0.139617	−0.015931	−0.088183	−0.598824	−0.101423	−0.491883	−0.017733	−0.017736	−0.069334	−0.428133	−0.066909	2.752273
HOUS	0.227012	0.115908	0.174861	0.095003	0.239102	−0.013348	0.111856	−0.896534	− 0.209516	−0.306640	−0.101937	−0.119084	0.683356
PERS	−0.057730	0.008314	0.067193	−0.294421	−0.111316	−0.039269	0.125473	− 0.101786	−0.222189	−0.328009	0.015322	0.054313	0.884087
TRAN	−0.058300	0.022145	−0.000800	0.031085	−0.039683	−0.165066	0.112328	−0.066876	−0.143420	−0.579497	−0.040632	0.122509	0.806191
LEIS	−0.125952	0.007256	−0.068265	−0.060970	−0.188266	−0.003277	−0.156828	−0.029565	0.005003	−0.059882	−0.223072	− 0.025827	0.929644
SERV	−0.610710	−0.013064	−0.193574	−0.928074	−0.920414	−0.292856	−0.653974	−0.393241	0.097378	1.026121	−0.677037	−0.829537	4.368789

APPENDIX B

Estimation of merit good effect

To estimate the valuation of social cost, which is implicit in the actual Belgian system of indirect taxation, we follow the procedure proposed by Christiansen and Jansen (1978). We assume that the present system is the solution to the following problem:

$$\underset{q}{Max}\ W(v^1,\ldots,v^H\ ,\ X_1,\ldots,X_N) \tag{20}$$

$$s.t. \quad \sum_i t_i X_i = R$$

where the external effect is operationalised through the appearance of aggregate consumption in the social welfare function.

The first-order conditions for this problem are (using Roy's rule)

$$-\sum_h \beta^h x_i^h + \sum_{k=1}^{N} \mu_k^* \frac{\partial X_k}{\partial q_i} = \lambda \left(X_i + \sum_k t_k \frac{\partial X_k}{\partial q_i} \right) \qquad \forall i \tag{21}$$

where $\mu_k^* = \dfrac{\partial W}{\partial X_k}$ $\qquad k = 1,\ldots,N$

and λ is the Lagrange multiplier associated with the government budget constraint in (20)

Using the definition of β^h given in the text, and after the usual manipulations to find an expression in the elasticities, (21) can be transformed into

$$\frac{-\sum_h \left(\frac{m^h}{m^1}\right)^{-e} q_i x_i^h + \sum_k \mu_k \varepsilon_{ki} q_k X_k}{\lambda \left(q_i X_i + \sum_k \varepsilon_{ki} t_k^* q_k X_k\right)} - 1 = 0 \qquad \forall i \tag{22}$$

where $\mu_k = \dfrac{\mu_k^*}{q_k}$.

We can summarize the complicated expression at the LHS as $f_i(e, \lambda, \mu_1, \ldots, \mu_N)$, making explicit that it depends on the unknown parameters $e, \lambda, \mu_1, \ldots, \mu_N$. We now introduce random disturbance terms $u_i, i = 1, \ldots, N$, in the model to account for non-systematic errors in the government's attempts to satisfy the optimality conditions. This gives

$$f_i(e, \lambda, \mu_1, \ldots, \mu_N) = u_i \quad \forall i \tag{23}$$

Estimates of the p
of squares $\sum_i u_i^2$. We
the SAS-package, which
assumed that the gover
imposed the restriction
that there were social co
transport and heating.
heating were small and
omitted them. Results
7. To attain convergence

AHMAD, E.and N. STE
Taxes, *Journal of P*
ATKINSON, A.B. and J
rect Versus Indirect
BOADWAY, R. and N.
Oxford.
BROWNING, E.K. (197
litical Economy, 84,
CHRISTIANSEN, V. (1
income tax?, *Journ*
CHRISTIANSEN, V. an
the Norwegian Syst
10, pp. 217-45.
DECOSTER, A. and E.
ferent Demand Syst
K.U. Leuven.
DIAMOND, P. and J. M
duction I-II, *Americ*
FELDSTEIN, M.S. (197
Public Prices, *Amer*
KELLER, W.and J. VA
tems, *European Eco*

Estimates of the parameters can then be found by minimizing the sum of squares $\sum_i u_i^2$. We therefore used the non-linear estimation routine from the SAS-package, which implements a Gauss-procedure. In a first round we assumed that the government did not take into account social costs, i.e., we imposed the restriction that $\mu_i = 0$ for all i. In a second round we assumed that there were social costs attached to the consumption of beverages, tobacco, transport and heating. The estimates for the social cost of beverages and heating were small and insignificantly different from zero. We therefore also omitted them. Results for the different estimation rounds are given in Table 7. To attain convergence we had to impose the condition that $e \geq 0$.

REFERENCES

AHMAD, E.and N. STERN (1984), The Theory of Reform and Indian Indirect Taxes, *Journal of Public Economics*, 25, pp. 259-98.

ATKINSON, A.B. and J. STIGLITZ (1976), The Design of Tax Structure : Direct Versus Indirect Taxation, *Journal of Public Economics*, 6, pp. 55-75.

BOADWAY, R. and N. BRUCE (1984), *Welfare Economics*, Basil Blackwell, Oxford.

BROWNING, E.K. (1976), The Marginal Cost of Public Funds, *Journal of Political Economy*, 84, pp. 283-98.

CHRISTIANSEN, V. (1984), Which commodity taxes should supplement the income tax ?, *Journal of Public Economics*, 24, pp. 195-220.

CHRISTIANSEN, V. and E.S. JANSEN (1978), Implicit Social Preferences in the Norwegian System of Indirect Taxation, *Journal of Public Economics*, 10, pp. 217-45.

DECOSTER, A. and E. SCHOKKAERT (1987), *Tax Reform Results with Different Demand Systems*, Discussion Paper, Center for Economic Studies, K.U. Leuven.

DIAMOND, P. and J. MIRRLEES (1971), Optimal Taxation and Public Production I-II, *American Economic Review* 61, pp. 8-27 and 261-78.

FELDSTEIN, M.S. (1972), Distributional Equity and the Optimal Structure of Public Prices, *American Economic Review* 62, pp.32-6.

KELLER, W.and J. VAN DRIEL (1985), Differential Consumer Demand Systems, *European Economic Review* 27, pp. 375-90.

PARAIRE-LAGUESSE, Y. et al. (1986), De Weerslag van de Indirecte Belastingen op de Verdeling van de Gezinsinkomens in België, *Documentatieblad van het Ministerie van Financiën* 7/8, pp. 9-32.

SAH, R.K. (1983), How much redistribution is possible through commodity taxes?, *Journal of Public Economics*, 20, pp. 89-101.

STERN, N. (1977), *The Marginal Valuation of Income*, in M.J. Artis and A.R. Nobay (eds.), Studies in modern economic analysis, Blackwell, Oxford, pp. 209-54.

WIBAUT, S. (1987), A Model of Tax Reform for Belgium, *Journal of Public Economics*, 32, pp. 53-77.

1 Introduc

La question
savoir comment
peuvent être am
"équivalents" rec

L'observatio
son de leur appa
vailleurs peuvent
toutefois, que le
crimination exist
caractéristiques
ces différences so
miques (Stiglitz,
dividu s'estime
sociale, de sa ca
tiques, de sa nati
physique, etc. (W

La source d
fonction d'objecti
contraintes de st
emple, de pratiq
pective plus insti
du travail — débo
1980). L'origine
d'information du

La discrimin
pensée issu des t
entation, la discr
travail de "goûts
Les modèles perm
res fondées sur
des consommate