

Fehr, Hans; Rosenberg, Christoph B.; Wiegard, Wolfgang

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Value-added taxation in the EC after 1992: Some applied general equilibrium calculations

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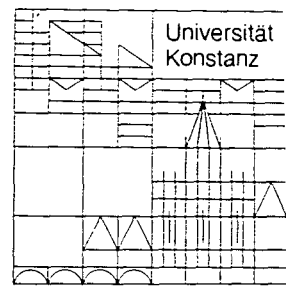
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**Sonderforschungsbereich 178
„Internationalisierung der Wirtschaft“**

Diskussionsbeiträge

Juristische
Fakultät

Fakultät für Wirtschafts-
wissenschaften und Statistik

Hans Fehr
Christoph Rosenberg
Wolfgang Wiegard

**Value-Added Taxation in the EC
after 1992:
Some Applied General Equilibrium
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**VALUE-ADDED TAXATION IN THE EC AFTER 1992:
SOME APPLIED GENERAL EQUILIBRIUM CALCULATIONS***

Hans Fehr
Christoph Rosenberg
Wolfgang Wiegard

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Correspondence to:

*Prof. Dr. Wolfgang Wiegard
Universität Regensburg
Institut für Volkswirtschaftslehre
einschließlich Ökonometrie
Postfach 397
D-8400 Regensburg*

**Umsatzsteuerharmonisierung in der EG nach 1992:
Berechnungen im Rahmen eines numerischen
allgemeinen Gleichgewichtsmodelles**

Zusammenfassung

Dieser Beitrag untersucht die quantitativen Effekte der jüngst vom ECOFIN-Rat beschlossenen Übergangsregelung für die umsatzsteuerliche Behandlung des Handels in der EG nach 1992. Zunächst werden die Funktionsweise des bisherigen Bestimmungslandprinzips und der neuen Regelung beschrieben und mathematisch formalisiert. Es folgt eine kurze Darstellung des sieben EG-Regionen und 14 Produktionssektoren pro Land umfassenden empirischen allgemeinen Gleichgewichtsmodells. Im letzten Teil wird zunächst theoretisch und dann anhand von Simulationsrechnungen auf die Wirkungen eines Wechsels zum Übergangssystems eingegangen. Bei einer Zerlegung der Wohlfahrtseffekte zeigt sich, daß internationale Steueraufkommensverschiebungen das Ergebnis quantitativ dominieren, während Substitutionseffekte kaum Einfluß auf die ökonomische Wohlfahrt haben. Bei einer großzügigen Versandhandelsregelung, die den Endkonsumenten Möglichkeiten der Steuerarbitrage eröffnet, gewinnen Niedrigsteuerländer auf Kosten ihrer EG-Partner.

**Value-Added Taxation in the EC after 1992:
Some Applied General Equilibrium Calculations**

Summary

This paper examines the quantitative effects of the transitional system of value-added taxation for intra-EC trade after 1992, as recently adopted by the ECOFIN-Council. First, the administration of the current destination principle and the interim solution are described and a mathematical formalization is provided. A short representation of the empirical general equilibrium model featuring seven EC regions and 14 production sectors follows. Finally, the effects of a switch to the transitional system are examined theoretically and by using policy simulations. When decomposing welfare effects, international tax revenue shifts prove to dominate, while substitution effects have relatively little influence on economic welfare. A generous arrangement with regard to long distance shopping, opening tax arbitrage possibilities to final consumers, favours low tax countries at the cost of their EC partners.

I. Introduction

As planned by the Commission of the European Communities, on New Year's Day of 1993 physical border controls within the European Community (EC) will be abolished. Currently, for most member states fiscal controls at the border represent an integral part of the administration of value-added taxes (VAT). Therefore, removing frontier controls will probably have far-reaching consequences for the administration, the revenue distribution and the economic effects of VAT.

In its famous White Paper the European Commission proposed to replace the current system of border tax adjustments by the so-called Clearing-House approach. This procedure was thought to preserve the revenue distribution prevailing under the destination principle (DP) even in the absence of fiscal frontiers. To cope with cross border shopping the Commission suggested the harmonization of VAT rates within some appropriate intervals. These suggestions were controversially debated in the scientific community as well as in the political arena. Meanwhile, the adoption of the Clearing-House has been postponed until 1997 and recently an interim solution was suggested by the Commission [COM (90), 182] and adopted by the European Council for Economic and Fiscal Affairs (ECOFIN-Council). Our idea is to model this transitional VAT arrangement in a general equilibrium framework and to compute its trade and welfare effects numerically.

Our paper is organized as follows: In the next section we discuss the current and future practice of border tax adjustments under VAT, describe in detail how tax liabilities will be calculated and derive the final VAT base under both regimes. Section three contains a short description of the structure of our applied general equilibrium model and of our data set. In the following section we present and discuss the computational results. We conclude with some final remarks.

II. The Formal Structure of Value-Added Taxation Before and After 1993

In this section we describe the current practice of border tax adjustments and discuss some of the details of value-added taxation after the completion of the internal market in 1993. We formulate the calculation of tax liabilities in mathematical terms in order to present the formal structure of value-added taxation in a very general context. This requires some precise notation.

On an aggregate level we distinguish between two trading blocks, the EC and the rest of the world (ROW). The European Community is disaggregated into its member states or blocks of member states. Let EC denote the index set of these member states, i.e.

$$EC = \{F, I, D, \dots\},$$

where „ F “ stands for France, „ I “ for Italy etc. W is the index set for all countries of the world, i.e. $W = \{EC, ROW\}$. In general, we denote by h an element of EC .

or of W . Finally, W_h or EC_h , are the index sets for the relevant countries *except* for country h .

Each country (or region) produces a given number of commodities which, for convenience, is taken to be the same in all countries. We define N to be the index set of this identical number of commodities in all countries. For tax purposes it may be important to distinguish services from (physical) goods¹. Let commodity s be services and let N_s denote the index set for all goods, i.e. all commodities other than services. In our model we employ the Armington (1969) assumption, according to which products are distinguished by their place of origin. This means that, for example, the first commodity in Germany is different from but possibly a close substitute to the first commodity produced in France, Italy or elsewhere. Think of French wine which is different from but may be similar to German or Italian wine. The Armington assumption is a convenient device in the empirical trade literature (Whalley, 1985, pp. 36-39), since it allows for so-called cross-hauling, and simplifies the numerical problems of calculating equilibria considerably. However, it has its price in excluding some possibilities of tax arbitrage between countries².

In the following, a subscript stands for commodities or industries, superscripts refer to countries. The more important symbols are

| | | | |
|----------------------|---|---|------------------------------|
| τ_j^h : | VAT rate for ... | } | commodity j in country h |
| Q_j^h : | production of ... | | |
| q_j^h : | producer price of ... | | |
| C_j^{hk} : | consumption of commodity j in country k , where j is produced in country h | | |
| $X_j^h (X_j^{hk})$: | country h 's total exports (exports to country k) of commodity j ³ | | |
| $M_j^h (M_j^{kh})$: | country h 's total imports (imports from country k) of commodity j | | |
| V_{ij}^{kh} : | intermediate use of commodity i , produced in country k , in the production of commodity j in country h . | | |

In order to avoid excessive notation we suppress index h or replace it by a dot whenever possible. More precisely, we write V_{ij} and V_{ij}^k instead of V_{ij}^{hh} and V_{ij}^{hk} etc.

All we need to describe the formal structure of VAT before and after the completion of the internal market are some accounting identities as well as equilibrium conditions. Behavioural assumptions and comparative static analysis do not become relevant until

¹ The taxation of services under VAT is particularly disturbing. Whereas some services are zero rated (financial intermediaries, housing, postal services), others are subject to the full VAT rate (as, for example, barber shop services). See Kay and Davis (1990) for details.

² See Norman (1990) for a critical assessment of the Armington assumption.

³ Quite obviously, the following relationship holds

$$X_j^h = \sum_{k \in W_h} X_j^{hk},$$

and similarly for imports.

the next two sections. We will start our exercise by illustrating the current practice of VAT border tax adjustments.

1. Border tax adjustments under the Destination Principle (DP)

At present, all countries with VAT in use apply the destination principle on international commodity transactions. According to this principle, a product is taxed where it is consumed; the VAT revenue generally accrues to the country where the consumption takes place. Exports leave a country free of any tax (exports are zero-rated), the VAT paid on inputs to exported commodities is refunded. On the other hand, VAT is collected on all imports⁴. This is accomplished by a system of physical border controls, providing documentary evidence that a commodity has, indeed, left the country. Similarly, frontier controls guarantee that VAT on imports will be paid by the importer, no matter whether this is a tax liable firm or a private household.

To simplify matters we neglect travellers' allowances and investment expenditures. Furthermore, we assume that there are no exemptions and ignore all other taxes, such as excises, income taxes or tariffs. We will introduce these taxes in a later section. As a final prerequisite we note that tax liability is calculated by the so-called credit (or invoice) method. Each firm liable to pay VAT calculates its gross tax liability by applying the statutory tax rate to its sales. From this amount it deducts the VAT it has paid on its purchases of intermediate (and investment) goods. Consider a firm $i \in N_s$ in country $h \in EC$ (where superscript h will be omitted in the following). Tax liability, T_i , is calculated according to

$$T_i = \underbrace{\tau_i q_i (Q_i - V_{ii})}_{\text{gross tax liability}} - \underbrace{\tau_i q_i X_i}_{\text{tax rebate for exports}} - \underbrace{\sum_{j \in N_i} \tau_j q_j V_{ji}}_{\text{tax rebate for use of domestic intermediate inputs}} - \underbrace{\sum_{k \in W_h} \sum_{j \in N} \tau_j q_j^k V_{ji}^k}_{\text{tax rebate for use of imported intermediate inputs}}. \quad (1)$$

For $i = s$ (i.e. for services) there is some qualification which will be explained below. Total VAT revenue, T , is obtained by aggregating individual tax liabilities over all firms and adding the import VAT. To calculate the latter it seems useful to decompose total imports into direct consumer purchases and imports of intermediate products, i.e.⁵

⁴ With respect to this import VAT, Article 95 of the Treaty of Rome states that „no Member State shall impose, directly or indirectly, on the products of other Member States any internal taxation of any kind in excess of that imposed directly or indirectly on similar domestic products“. In our context, this implies that τ_j^h is applied to comparable commodities imported from EC member countries.

⁵ A similar relation holds for country h 's exports to country k :

$$X_i^k = C_i^k + \sum_{j \in N} V_{ij}^k$$

Note that C_i^k is not just cross-border shopping but includes country h 's total direct consumer purchases from country k .

$$M_i^k = C_i^k + \sum_{j \in N} V_{ij}^k. \quad (2)$$

As far as imports of goods are concerned, the import VAT applies to both, imported intermediate products as well direct consumer purchases (travellers' allowances being neglected).

For services, matters are more complicated. Our assumption is that the import VAT is levied on intermediate service imports but not on direct consumption imports of services. Think of tourist expenditures on lodging abroad, which clearly include foreign VAT with no border tax adjustments being admitted. This implies, on the other hand, that the tax rebate for service exports does not include service purchases by foreign country residents⁶. Keeping these qualifications in mind, total tax revenue is obtained as

$$\begin{aligned} & \overbrace{\sum_{i \in N} \tau_i q_i (Q_i - V_{ii}) - \sum_{i \in N_s} \tau_i q_i X_i - \sum_{k \in W_h} \sum_{j \in N} \tau_s q_s V_{sj}^k - \sum_{i \in N} \sum_{j \in N_i} \tau_j q_j V_{ji} - \sum_{k \in W_h} \sum_{i \in N} \sum_{j \in N} \tau_j q_j^k V_{ji}^k}^{\text{domestic VAT revenue}} \\ & + \underbrace{\sum_{k \in W_h} \sum_{i \in N_s} \tau_i q_i^k M_i^k + \sum_{k \in W_h} \sum_{j \in N} \tau_s q_s^k V_{sj}^k}_{\text{import VAT}} = T. \end{aligned} \quad (3)$$

Substituting (2) and the domestic market equilibrium conditions

$$Q_i = C_i + \sum_{j \in N} V_{ij} + X_i \quad (4)$$

into (3) yields the final tax base

$$T = \sum_{i \in N} \tau_i q_i C_i + \sum_{k \in W_h} \sum_{i \in N_s} \tau_i q_i^k C_i^k + \sum_{k \in W_h} \tau_s q_s C_s^k. \quad (5)$$

This equation supports the widespread view that VAT essentially is a tax on consumption (from domestic or foreign sources). With respect to (physical) goods, revenue accrues to the country where the goods are consumed. This is a consequence of the destination principle. Note, however, that the origin principle applies to direct consumption exports of services; the respective tax revenue accrues to the country of origin (production). All this does no longer hold (in a strict sense) in the presence of exemptions; see Gottfried and Wiegard (1990) for the economic consequences of exemptions.

For completeness we derive the zero profit conditions for domestic firms as well as the balance of payments. Assuming perfect competition on commodity and factor markets, the zero profit condition for industry i (in country h) is given by

⁶ More formally, for $i = s, \tau_s q_s X_s$ in equation (1) has to be replaced by $\sum_{k \in W_h} \sum_{j \in N} \tau_s q_s V_{sj}^k$.

$$\begin{aligned}
\underbrace{rK_i + wL_i}_{\text{value added}} &= \underbrace{(1 + \tau_i)q_i(Q_i - V_{ii})}_{\text{gross receipts}} - \underbrace{\tau_i q_i X_i}_{\text{correction for export rebate}} - \underbrace{\sum_{j \in N_i} (1 + \tau_j)q_j V_{ji}}_{\text{purchases of domestic intermediate inputs}} \\
&\quad - \underbrace{\sum_{k \in W_h} \sum_{j \in N} (1 + \tau_j)q_j^k V_{ji}^k}_{\text{purchases of foreign intermediate inputs}} - \underbrace{\widehat{-T_i}}_{\text{tax liability}} \\
&\stackrel{(1)}{=} q_i Q_i - \sum_{j \in N} q_j V_{ji} - \sum_{k \in W_h} \sum_{j \in N} q_j^k V_{ji}^k. \tag{6}
\end{aligned}$$

Here w, r, K_i, L_i denote wage rate, rental price of capital, and the use of labor and capital in the production of commodity i , respectively⁷. Equation (6) illustrates that VAT rates are not directly relevant for production decisions.

In our model we assume labor to be internationally immobile, but we do allow for international capital movements in a worldwide homogeneous capital market. Let \bar{K} denote country h 's fixed supply of capital⁸ (again, we omit index h for simplification). Then $(\sum_{i \in N} K_i - \bar{K})$ represents inflows or outflows of capital services depending on whether the difference between domestic capital demand (by firms) and domestic capital supply (by the household sector) is positive or negative. Due to our homogeneity assumption, there is a uniform world rental price of capital, r . In the absence of international transfer payments, country h 's balance of payment is then given by

$$\begin{aligned}
&\underbrace{\sum_{k \in W_h} \sum_{j \in N} (q_s V_{sj}^k - q_s^k V_{sj}^k) + \sum_{k \in W_h} [q_s(1 + \tau_s)C_s^k - q_s^k(1 + \tau_s^k)C_s^k]}_{\text{trade in services}} \\
&+ \underbrace{\sum_{i \in N_s} (q_i X_i - \sum_{k \in W_h} q_i^k M_i^k)}_{\text{trade in goods}} + \underbrace{r(\bar{K} - \sum_{i \in N} K_i)}_{\text{net capital income received from or paid to abroad}} = 0. \tag{7}
\end{aligned}$$

A possible deficit (surplus) in the balance on goods and services has to be matched by an inflow (outflow) of capital income from abroad. Note that trade in direct consumption of services is valued at consumer (tax inclusive) prices whereas all other exports and imports are traded at producer prices. By Walras' Law, the balance

⁷ As to the service industry ($i = s$), the same qualifications as mentioned above apply to export rebates.

⁸ An obvious implication is that the world capital stock is fixed as well.

of payment condition is automatically fulfilled if all markets clear and all domestic agents fulfill their budget constraints⁹.

Before closing this section let us note that our modelling of value-added taxation is fairly general. In the literature, e.g. McLure (1987), a “staged” production process is commonly used to illustrate the operation of VAT, distinguishing, for example, between manufacturing, wholesaling and retailing. This production structure, however, can be generated as a special case of ours by simply setting the appropriate variables equal to zero. Our formulation of VAT is closest in spirit to that of Bhatia (1982, 1988).

2. VAT between 1993 and 1997: The Transitional Arrangement

The abolition of physical border controls, as it is planned for 1993, requires some change in the operation of VAT. In its White Paper [COM (85) 310] and more specifically in its detailed draft proposals of 1987 [COM (87) 320-324], the European Commission originally favoured the so-called Clearing-House approach combined with a far-reaching harmonization of VAT rates and structures. However, these ideas provoked a controversial debate and numerous objections from member countries with the consequence that the original plan was postponed until 1997. For the transition period, the Commission of the European Communities developed some “transitional arrangements for taxation with a view to establishment of the internal market” [COM (90) 182/2]. At its meeting on December 3, 1990 the ECOFIN-Council has – in principle – adopted this proposal¹⁰. It was, however, slightly modified at the Council meeting on March 18, 1991¹¹. The basic aim still is to more or less maintain the destination principle during an interim period between January 1, 1993 and December 31, 1996, even in the absence of frontier controls.

In the Commission’s latest proposal any reference to the concepts of “exportation” or “importation” with respect to intra-community trade is completely avoided. In order to still guarantee taxation in the country of destination, the Commission had to create a substitute for border tax adjustments. Legally, this was achieved by exempting (more exactly: zero-rating) intra-Community transactions between taxable unities in the country of departure and by taxing the corresponding acquisition in the country of destination. To benefit from the exemption of supplies to other EC countries, the supplier in the country of departure has to prove that commodities have indeed been dispatched or transported to another member state. The purchaser, on the other

⁹ Neglecting other taxes, one has to assume that total VAT revenue is transferred back to the representative consumer in a lump-sum manner. Denoting transfers by Tr , the household’s budget equation is given by

$$r\bar{K} + wL + Tr = \sum_{i \in N} q_i(1 + \tau_i)C_i + \sum_{k \in W_A} \sum_{i \in N_s} q_i^k(1 + \tau_i)C_i^k + \sum_{k \in W_A} q_s^k(1 + \tau_s^k)C_s^k.$$

In the actual simulation model we additionally consider income taxes, public goods etc.

¹⁰ See Council of European Communities (1990).

¹¹ See Council of European Communities (1991).

hand, has to provide evidence that he is a registered trader. This requires considerable monitoring efforts and administrative co-operation, as for example described and evaluated in the Commission's proposal [COM (90) 183/2] or in Parsche et. al. (1990). But as far as intra-Community transactions *between registered traders* are concerned, the transitional arrangements seem practicable and appropriate to meet their objective, i.e. the taxation at the rates and under the conditions prevailing in the country of destination.

Problems may arise whenever tax exempt or non-taxable persons or institutions are involved in cross-frontier trade. Such difficulties may occur because of tax-induced shifts in demand to low-tax countries within the EC. To preserve trade neutrality the Commission suggested some special arrangements¹², which meanwhile have been slightly revised by the ECOFIN-Council¹³. With respect to cross-border sales to private households two special provisions were planned to ensure taxation according to DP.

Mail-order sales, which represent the bulk of cross-frontier sales to final consumers, should be taxed in the country of destination, provided that the vendor has an annual intra-Community turnover of more than 1 billion ECU. This requires shifting the place of taxation of such sales to the country of destination. The person liable to pay VAT is either the mail-order firm or a fiscal representative of the person acquiring the goods.

For cross-frontier acquisition of vehicles, which are believed to be particularly sensitive to tax rate differentials, the Commission proposed to levy the tax in the member state where the first registration (on a permanent basis) takes place.

These two special provisions have been meanwhile supplemented by the conclusions of the ECOFIN-Council of March 18, 1991. First, the Commission's arrangements for private motor vehicles is now extended to all intra-Community supplies of new vehicles, including sales of boats, aircraft and motorized land vehicles, regardless of the criterion requiring vehicles to be registered in the Member State of arrival. Secondly, the destination principle shall not only apply to intra-Community sales to final consumers via mail-order firms, but to *all* distance selling. If, however, the annual sales to a Member State do not exceed a certain amount, the vendor may choose whether the VAT rates of the destination or the origin country shall apply to his sales. This provision is thought as a means to reduce excessive administrative burdens for small and medium size enterprises. The exact level of the threshold has not yet been determined by the Council.

Our presumption is that the possibility to opt for either DP or OP is made use of whenever it is of mutual advantage for the vendor and purchaser from different EC Member States. For example, one can easily imagine that a great number of

¹² Tax exempt or not taxable institutions, for which the same rules as between registered traders shall apply, are not explicitly considered in our model. For a discussion see Gottfried and Wiegard (1990). Also, we will neglect some special provisions for small and medium size enterprises.

¹³ See Council of European Communities (1991). Strictly speaking, the decisions of the council are still mere expressions of political intentions. It seems safe to assume however that they will sooner or later become part of EC and hence national legislation.

legally independent enterprises is founded, which all keep their sales below the revenue threshold. After all, the efficiency of a market economy heavily depends on such clever exploitation of gains from trade. And there is good reason to believe that this will also hold for cross-frontier direct consumer purchases. In the following we attempt to determine the quantitative effects which result if the Council's option possibility is fully made use of. The actual extent of the effects will depend on the exact level of the sales threshold, transaction costs and some other factors. Hence, our results may be interpreted as the most extreme yardstick for an assessment of the transitional arrangement.

In our model we will attempt to capture this idea as follows: consumers in country $h \in EC$, when considering to buy commodities from member state k , may choose to purchase goods either according to the destination or according to the origin principle (i.e. at foreign prices), whatever the best bargain is¹⁴. More precisely this means that consumers in country h will directly buy from sellers in country $k \in EC_h$ according to the destination or origin principle depending on whether k is a high or low tax country as compared to h . To formalize this we have to introduce some additional notational complexities. Let us partition the set EC_h into the two (disjoint) subsets EC_h^L and EC_h^H where the first comprises the low and the second the high tax countries from the viewpoint of country h . Note that whether country k is a low or a high tax country may differ from commodity to commodity¹⁵.

Assuming that the present system of border tax adjustments is maintained for trade with ROW, i.e. exports from the EC to ROW are zero-rated, whereas imports from ROW are subject to import VAT, we can now restate the relevant equations from the first section. Under the transitional arrangement, tax liability of firm $i \in N_s$ (in country h) is calculated by (using the Commission's terminology)¹⁶

$$\begin{aligned}
 T_i = & \underbrace{\tau_i q_i (Q_i - V_{ii} - \sum_{k \in EC_h^L} C_i^k)}_{\text{gross tax liability excluding non-taxable sales to direct consumers}} + \underbrace{\sum_{k \in EC_h} \sum_{j \in N} \tau_j q_j^k V_{ji}^k}_{\text{tax liability on the acquisition of intermediate inputs from EC member countries}} \\
 - & \underbrace{\tau_i q_i X_i^{ROW}}_{\text{tax rebate for exports to ROW}} - \underbrace{\sum_{k \in EC_h} \sum_{j \in N} \tau_i q_i V_{ij}^k}_{\text{tax exemption of intra-community deliveries of intermediate inputs}} - \underbrace{\sum_{j \in N_i} \tau_j q_j V_{ji}}_{\text{tax rebate for the acquisition of domestic intermediate inputs}} \\
 - & \underbrace{\sum_{k \in EC_h} \sum_{j \in N} \tau_j q_j^k V_{ji}^k}_{\text{tax rebate for the acquisition of intermediate inputs from EC-member countries}} - \underbrace{\sum_{j \in N} \tau_j q_j^{ROW} V_{ji}^{ROW}}_{\text{tax rebate for the acquisition of intermediate inputs from ROW}} \quad (8)
 \end{aligned}$$

¹⁴ This view is shared by Boiteux (1988), Sinn (1990) and Krause-Junk (1990), for example.

¹⁵ Strictly speaking, index set EC_h^H and EC_h^L would have to be additionally split up according to commodity index i , since a country may be a high-tax country for one commodity, but a low-tax country for another commodity. Our numerical simulations will include this feature.

¹⁶ As to the service sector, the same qualifications as mentioned above apply.

Note that under the proposed transitional arrangement, firm i is liable to pay VAT upon the acquisition of inputs from other EC countries. At the same time, however, the acquiring firm is given a credit for this tax. So, in fact, such acquisitions bear no tax burden at all in the country of destination.

As an additional refinement, the above-mentioned special provisions for intra-Community trade in new vehicles have to be taken into account. Here we would have to generally apply the DP. In order to keep our representation at least somewhat transparent, this is not considered in the equations of this section, but will be taken into account in our simulation runs.

Country h will receive some additional VAT revenue from the following sources:

$$\underbrace{\sum_{i \in N_s} \tau_i q_i^{ROW} M_i^{ROW} + \sum_{j \in N} \tau_s q_s^{ROW} V_{sj}^{ROW}}_{\text{import VAT from ROW}} + \underbrace{\sum_{k \in EC_h^H} \sum_{i \in N_s} \tau_i q_i^k C_i^k}_{\text{VAT from direct consumer purchases in high tax EC countries}}$$

Aggregating tax liabilities of domestic firms (including the service sector) and adding the additional revenue from trade relations, total tax revenue (after quite obvious manipulations) is given as

$$\begin{aligned} \sum_{i \in N} \tau_i q_i C_i + \sum_{i \in N_s} \tau_i q_i^{ROW} C_i^{ROW} + \sum_{k \in EC_h^H} \sum_{i \in N_s} \tau_i q_i^k C_i^k + \sum_{k \in EC_h^H} \sum_{i \in N_s} \tau_i q_i C_i^k \\ + \sum_{k \in W_h} \tau_s q_s C_s^k = T. \end{aligned} \quad (9)$$

When compared with equation (5), the basic difference in national tax revenue between DP and the envisaged transitional arrangement is this: Country h does not collect any VAT revenue from direct consumption purchases from low-tax EC countries but instead keeps VAT on its supplies to high-tax member states.

The last equations may look somewhat complicated. It is, however, only the explicit (mathematical) formulation of our interpretation of the ECOFIN-Council's conclusion. Some notational complications are simply due to the change in terminology: Trade transactions with other EC countries are no longer labeled imports or exports but acquisitions from or supplies to other Member States.

Note that the zero profit condition (6) remains unchanged when switching from DP to the transitional taxation system. The balance of payment, however, will change and is given by

$$\begin{aligned}
0 = & \underbrace{\sum_{i \in N_s} [q_i X_i^{ROW} - q_i^{ROW} M_i^{ROW}] + \sum_{k \in EC_h} \sum_{i \in N_s} \sum_{j \in N} [q_i V_{ij}^k - q_i^k V_{ij}^{k \cdot}]}_{\text{trade in goods}} \quad (10) \\
& + \underbrace{\sum_{k \in EC_h^L} \sum_{i \in N_s} [q_i C_i^k - q_i^k (1 + \tau_i^k) C_i^{k \cdot}] + \sum_{k \in EC_h^H} \sum_{i \in N_s} [q_i (1 + \tau_i) C_i^k - q_i^k C_i^{k \cdot}]}_{\text{trade in goods}} \\
& + \underbrace{\sum_{k \in W_h} \sum_{j \in N} (q_s V_{sj}^k - q_s^k V_{sj}^{k \cdot}) + \sum_{k \in W_h} [q_s (1 + \tau_s) C_s^k - q_s^k (1 + \tau_s^k) C_s^{k \cdot}]}_{\text{trade in services}} + \underbrace{r(\bar{K} - \sum_{i \in N} K_i)}_{\text{net capital income}}.
\end{aligned}$$

Once again, this equation looks a lot scarier than it actually is. The only difference between (7) and (10) is that direct consumption sales to high-tax as well as direct consumption purchases from low-tax member states are valued at consumer prices in (10) but at producer prices in (7). Unfortunately this small difference requires a seemingly excessive notation.

In order to clarify the effects of the option possibility implied by the conclusions of the ECOFIN-Council, we perform a simulation experiment assuming that all cross-frontier sales to direct consumers are taxed according to the origin principle (OP). Such an arrangement is not seriously considered for adoption, but it provides some useful insights into the structure of the problem. In this case, the total tax revenue and the balance of payments equation are simplified considerably. Equation (9) changes to

$$T = \sum_{i \in N} \tau_i q_i C_i + \sum_{i \in N_s} \tau_i q_i^{ROW} C_i^{ROW} + \sum_{k \in EC_h} \sum_{i \in N_s} \tau_i q_i C_i^k + \tau_s q_s C_s^{ROW}, \quad (11)$$

while the middle part of (10) is reduced to

$$\sum_{k \in EC_h} \sum_{i \in N_s} [q_i (1 + \tau_i) C_i^k - q_i^k (1 + \tau_i^k) C_i^{k \cdot}]. \quad (12)$$

III. The General Equilibrium Model and the Data Base

In this section we will briefly describe the general equilibrium model and the data base underlying our calculations in the next section. Due to space limitations, a complete description of the model and the data is not possible in the present paper, but will be available on request (Fehr, Rosenberg and Wiegard, 1991).

1. The model structure

In principle, our theoretical model is a higher-dimensional analog of the $2 \times 2 \times 2$ general equilibrium model commonly used in international trade theory. Of course it is much more complicated and deviates in a number of points from the traditional Heckscher-Ohlin framework¹⁷. Basically, our model identifies two regions, the EC and ROW, with the EC being disaggregated into its member states. Each national economy exhibits the same dimensionality and the same structure of production and consumption decisions. Therefore, we can restrict ourselves to looking at the behavioural assumptions and equilibrium conditions of one typical country only.

a) The production side

Within each country we identify 13 domestically produced commodities which may be used for domestic consumption, as intermediate inputs in domestic production or as exports. Commodity 13 represents market services. As a fourteenth commodity we consider a collective consumption good which is produced and provided free of charge to private households by the government. This commodity is not traded but is consumed by households or used as intermediate input in the domestic production processes. There are two primary production factors (labor and capital) which are mobile between domestic production sectors. Capital is also mobile on an international level, whereas labor is assumed to be internationally immobile. In addition to domestically produced intermediate inputs each production sector uses imported intermediate inputs. Because of the Armington assumption, products are similar but differentiated according to the place of origin. Comparable intermediate products from different countries are aggregated to some "composite" intermediate commodity.

Each production sector produces exactly one commodity by use of a hierarchically nested constant returns to scale production function. For numerical calculations, specific functional forms have to be chosen. At the first level we assume a fixed coefficient technology with respect to composite intermediate products and value added. The value added nest is produced using labor and capital according to a constant elasticity of substitution (CES) technology. Similarly, within each composite intermediate input nest, substitution possibilities between domestic and imported intermediate inputs follow a CES function. At this level imported products are aggregated to a composite import commodity. Finally, the last level represents the decomposition of these composites into comparable import varieties from the different countries using Cobb-Douglas functions.

b) The household side

On the consumer side of each country, we assume a representative agent maximizing utility over consumption and leisure subject to his budget constraint. Collective

¹⁷ An excellent reference for this kind of applied general equilibrium models is Whalley (1985).

consumption goods are provided free of charge and enter the utility function in an additively separable manner (and, hence, can be omitted). The consumer derives his income from his supply of labor and capital services and from governmental transfers. His utility function is a nested combination of CES sub-utility functions. The choice between leisure and an overall composite consumption commodity is modelled according to a CES utility function. On a second level the composite commodity from the first level is decomposed into different consumption categories, which, on the third level, depend on comparable domestic and directly imported composite products (as, for example, domestic cars and cars from abroad). Finally, on the fourth and last level the composite import consumption commodity is split up into its single components, the direct consumer purchases from the different countries abroad (e.g. imported cars from France, Italy, Germany, etc.). On all decision levels we employ CES-utility (and hence demand) functions.

c) The government

There are two broad categories of governmental activities. On the one hand, a collective commodity is produced by combining primary factors of production and intermediate inputs, all of which are bought at market prices. Part of this collective good is subject to user charges and sold at producer prices to private industries; the other part is a pure collective consumption good. This "public good" is offered free of any charge to the representative consumer. We assume that the total supply of this commodity is fixed (for whatever reasons).

On the other hand, the government levies taxes and pays transfers and subsidies, the balance of which has to equal the production cost of the collective good. Apart from VAT the government levies production taxes, income taxes, as well as tariffs on trade with ROW. All taxes and tariffs are proportional except for the income tax, which is assumed to be linear.

d) The external sector

External sector balance in our model involves not only commodity trade (goods and services) but also flows of capital services between countries, generating flows of capital income paid to or received from abroad. As a consequence, the trade account does not necessarily have to be balanced. This is important when analyzing VAT harmonization proposals. Furthermore, note some of the differences between our model and the traditional Heckscher-Ohlin world. Most importantly, due to the Armington assumption products are imperfect substitutes across regions. This implies that complete specialization occurs. French wine is produced only in France, but consumed all over the world. Furthermore, there are a number of possible reasons why trade occurs between nations. For example, there are differences in production and demand function parameters between nations, different national factor endowments and tax systems. Finally, note that our model is a pure-barter general equilibrium model; only relative prices count, exchange rates, for example, do not matter.

e) Equilibrium conditions

We assume perfect competition on both commodity and factor markets. The number of firms within each industry has adjusted so that no production sector makes above normal profits. The zero profit conditions were given in the last section. At the equilibrium price vector, demand must equal supply for all goods and factors. Because Walras' Law is fulfilled for each country, it automatically holds globally.

2. The data set and numerical specification

Our data set refers to 1981, since more recent data are not available; all transactions are valued in ECU. Of the EC member states in 1981, we neglected Greece because of data difficulties and aggregated the U.K. and Ireland as well as Belgium and Luxembourg. What remains are the following seven EC countries: France (F), Belgium-Luxembourg (B-L), Netherlands (NL), Germany (D), Italy (I), Great Britain-Ireland (GB-IRL), and Denmark (DK). Central to our analysis is a set of interregional Input-Output Tables which are not supplied by official statistics (as EUROSTAT etc.). Here, our main source were the interregional transaction tables estimated by Langer (1987). He aggregates the 44 production sectors according to the NACE-CLIO4 Codes R 445 of EUROSTAT to thirteen production commodities. We undertook one minor change by disaggregating the 13th sector into services and public services, the latter being our collective commodity¹⁸. His estimates were supplemented by EUROSTAT data whenever necessary. As a data source for ROW we took a weighted average of U.S. and Japanese national accounts and Input-Output Tables. Our modifications required use of the RAS algorithm in order to guarantee consistency. The data base performs quite well when compared to the national accounts data. The ratios of VAT to total tax revenue, of total tax revenue to GNP, trade balances etc. are all within reasonable bounds.

With the data set for one base year alone, the theoretical model cannot be solved numerically. In addition, one has to pre-specify a sufficient number of exogenous parameters, mainly elasticities. The remaining production and utility parameter values are determined endogenously such as to exactly reproduce the base year's data set¹⁹. The choice of extraneously specified elasticity values may be of crucial importance for the results. As far as possible, we relied on a literature survey of estimates for trade, labor supply and substitution elasticities between labor and capital. Often enough, the available data do not allow for precise parameterization. In these cases we performed sensitivity tests to get some feeling for the variability of our results with respect to alternative parameter specifications. Obviously, this is not quite satisfactory but nonetheless common. Within the given limits of our paper

¹⁸ The fourteen commodities are: agriculture and forestry; energy, water and mining; chemicals; metal products; electric products; machinery; office equipment and computers; cars; other motor vehicles; food and drink; textiles and leather; other goods; market services; non-market (public) services.

¹⁹ This procedure is known as "calibration". See Mansur and Whalley (1984) and Lau (1984) for the pros and cons of this method.

it is impossible to give a detailed description of our data base. For more detailed information see Fehr, Rosenberg and Wiegard (1991).

IV. Simulation Results and Economic Interpretations

In this section we will analyse the results of our numerical comparative statics experiments. We begin with some general remarks on the effects of distortive taxes in open economies. After this we will present our simulation results and provide some economic explanations.

1. The economic background

The economic effects of distortive taxes can be best understood by considering a pareto-efficient free trade allocation. Neglecting intermediate inputs for a moment, the relevant marginal conditions are derived by solving the following optimization problem²⁰:

$$\begin{aligned} \max \quad & U^h(C_i^{hh}, C_i^{kh}, \ell^h | i \in N; k \in W_h) \\ \text{subject to} \quad & \\ & U^k(C_i^{kk}, C_i^{lk}, \ell^k | i \in N; l \in W_k) - \bar{U}^k = 0 \quad k \in W_h \\ & Q_i^k - f_i^k(K_i^k, L_i^k) = 0 \quad i \in N; k \in W \\ & Q_i^h - C_i^{hh} - \sum_{k \in W_h} C_i^{hk} = 0 \quad i \in N; h \in W \\ & \bar{E}^h - \ell^h - \sum_{i \in N} L_i^h = 0 \quad h \in W \\ & \sum_{h \in W} \bar{K}^h - \sum_{i \in N} \sum_{h \in W} K_i^h = 0. \end{aligned}$$

After some manipulations we obtain the relevant first order conditions:

$$\frac{\partial f_i^h / \partial L_i^h}{\partial f_i^h / \partial K_i^h} = \frac{\partial f_j^h / \partial L_j^h}{\partial f_j^h / \partial K_j^h} \quad h \in W; i \in N_j \quad (13a)$$

$$\frac{\partial U^h / \partial C_i^{hh}}{\partial U^h / \partial C_j^{hh}} = \frac{\partial f_j^h / \partial L_j^h}{\partial f_i^h / \partial L_i^h} \quad \left(= \frac{\partial f_j^h / \partial K_j^h}{\partial f_i^h / \partial K_i^h} \right) \quad h \in W; i \in N_j \quad (13b)$$

$$\frac{\partial U^h / \partial \ell^h}{\partial U^h / \partial C_i^{hh}} = \frac{\partial f_i^h}{\partial L_i^h} \quad h \in W \quad (13c)$$

²⁰ The utility and production functions are presented in the general form. ℓ^h is leisure time of the representative household in country h while E^h is the entire time endowment. Labor supply L^h is therefore $E^h - \ell^h$.

$$\frac{\partial U^h / \partial C_i^{hh}}{\partial U^h / \partial C_j^{hh}} = \frac{\partial U^k / \partial C_i^{hk}}{\partial U^k / \partial C_j^{hk}} \quad h \in W; k \in W_h; i \in N_j \quad (13d)$$

$$\frac{\partial U^h / \partial C_i^{hh}}{\partial U^h / \partial C_i^{kh}} = \frac{\partial U^k / \partial C_i^{hk}}{\partial U^k / \partial C_i^{kk}} \quad k \in W_h \quad (13e)$$

$$\frac{\partial U^h / \partial C_i^{hh}}{\partial U^h / \partial C_i^{kh}} = \frac{\partial f_i^k / \partial K_i^k}{\partial f_i^h / \partial K_i^h} \quad k \in W_h \quad (13f)$$

The first three equations are well known from closed economy models and can be explained quite easily. Equation (13a), the equality of the marginal rates of technical substitution between capital and labor in different industries, is the familiar marginal condition for an optimal factor allocation. Equation (13b) indicates the equality of the marginal rates of substitution (MRS) and the marginal rates of transformation (MRT) between commodities j and i in country h . According to (13c) the MRS between consumption and leisure equals the marginal product of labor. Whereas equations (13a) to (13c) refer to an optimal resource allocation within a country, the linkage between countries is established by the last three equations. In an international exchange optimum domestic and foreign MRS between the same goods are identical. While equation (13d) represents the MRS of two different goods which are produced in the same country, equation (13e) shows the MRS between the same goods which are produced in different countries. Equation (13f) is the necessary condition for an efficient international capital allocation. Due to the Armington assumption it deviates from the standard equality condition of marginal products of capital in alternative uses²¹.

As is well-known, a pareto-efficient allocation as characterized by equations (13) may be decentralized by introducing a system of competitive markets and prices. Taxes, unless they are imposed in a lump-sum manner, distort the efficient choices by driving wedges between the respective MRTs and MRSs, or between producer and consumer prices. The income tax on wages drives a wedge between the marginal productivity of labor and the MRS between consumption and leisure. Assuming that border-crossing capital income flows are taxed according to the residence principle, the taxation of interest income does not interfere with the efficiency of international capital allocation. Factor taxes disturb the optimal factor allocation as described by (13a), and tariffs break up the equality of the MRSs in (13d) and (13e) and furthermore drive a wedge between the MRS and the MRT in (13f).

Finally, the VAT distorts the optimal coordination of consumption and production decisions as given by (13b), no matter whether it is applied according to the DP or the OP. This is the domestic distortion effect of VAT taxation. In addition, international commodity flows will be affected. If the VAT is applied according to the DP, equation (13d) changes to

²¹ If commodities are internationally homogenous, $\partial U^h / \partial C_i^{hh} = \partial U^h / \partial C_i^{kh}$. Then equation (13f) changes to the more familiar $\partial f_i^h / \partial K_i^h = \partial f_i^k / \partial K_i^k$.

$$\frac{\partial U^h / \partial C_i^{hh}}{\partial U^h / \partial C_j^{hh}} = \frac{(1 + \tau_i^h) \partial U^k / \partial C_i^{hk}}{(1 + \tau_i^k) \partial U^k / \partial C_j^{hk}} \quad h \in W; k \in W_h; i \in N_j \quad (14)$$

with the tax rates τ_i^h, τ_i^k for consumption of good i in country h and k , respectively. If the tax rates for similar goods differ between countries and the tax rates are applied according to the DP, relative consumer prices will also differ between countries. If, on the other hand, the OP is applied, equation (13d) still holds, but (13f) changes to

$$\frac{\partial U^h / \partial C_i^{hh}}{\partial U^h / \partial C_i^{kh}} = \frac{(1 + \tau_i^h) \partial f_i^k / \partial K_i^k}{(1 + \tau_i^k) \partial f_i^h / \partial K_i^h}. \quad (15)$$

Therefore, taxes levied according to the OP drive a wedge between international marginal rates of transformation²². The tax wedges in (14) and (15) are the reason for the international distortive effects of VAT taxation.

2. Numerical results and economic explanations

In this section we present the numerical results of our simulations of the transitional system. The general procedure is as follows: Starting from the benchmark equilibrium, we introduce a number of changes in the tax parameters and solve our model for a new equilibrium situation, the so-called counterfactual equilibrium. Policy conclusions are derived by comparing the endogenously determined price and quantity variables in these counterfactual equilibria with those of the benchmark equilibrium. We focus on the comparison of economic welfare. This will be captured by the Hicksian Equivalent Variation (HEV), which represents a widely accepted monetary welfare measure. A positive HEV indicates a welfare improvement, a negative HEV a welfare loss. In order to obtain aggregate world welfare gains or losses, we simply sum up the HEVs by country, a procedure some pure theorists may feel uneasy about. We are aware that $\sum HEV > 0$ is not sufficient for a potential improvement (see Ebert, 1985). However, in applied work it is quite common to neglect possible Boadway (1974) - or other - paradoxies.

Another warning seems to be in place. In the following tables we reproduce a lot of seemingly exact numbers. In view of some justifiable reservations against our choice of functional forms, of parameter values and of some aspects of our data base, the precise numerical results should not be overemphasized. More important are the broad policy lessons that emerge from the interpretation, and, above all, the valuable insights one gains in the forces underlying the results.

Table 1 contains the quantitative effects when switching from the current VAT to the envisaged transitional system. The first column represents the HEV values for

²² Because of

$$\frac{1 + \tau_i^h}{1 + \tau_i^k} = 1 + \frac{\tau_i^h - \tau_i^k}{1 + \tau_i^k}$$

the distortive effects basically depend on the difference between the domestic and the foreign tax rate on similar goods.

each country in billions of ECU, the second column shows HEVs as a percentage rate of national VAT revenue in the benchmark equilibrium. The problem with such numbers is that one never knows whether they are correct or not. All the general reader can do is to deliver some summary grunts of belief or disbelief, but he will be unable to check the correctness of the results. Obviously this is not a solid basis for sound economic analysis. Our firm conviction is that one should be able to explain the results in economic terms. So let us give it a try.

Changes in tax parameters will have welfare and revenue effects. Generally, these effects will have to be explained by recourse to income and substitution effects. Both effects arise in a closed as well in an open economy context. First, consider the closed economy. From the theory of optimal taxation it is well-known that for changes in economic welfare only substitution effects matter. We will call this the domestic substitution effect. In our context any domestic income effect is irrelevant for welfare considerations. This is due to our assumption that any additional tax revenue is transferred back to the domestic consumer in a lump-sum manner.

In the open economy case, income and substitution effects work as follows. The international substitution effect is due to the fact that a country can exercise some monopoly power on international commodity markets by use of its indirect tax system. Indirect taxes are some kind of a second best substitute for tariffs. More precisely, national welfare may be increased by more heavily taxing the home country's net importables as compared to its net exportables. This changes the international terms-of-trade (ToT) in favour of the home country and increases welfare. These effects have been clearly worked out by Georgakopoulos (1974) in a two country world with two homogenous commodities, or by Vandendorpe (1972) in an optimal taxation framework. Note that the domestic and the international substitution effects may work in opposite directions. In a welfare maximizing context, the international substitution effect requires some tax rate differentiation between net importables and net exportables, whereas the domestic substitution effect requires uniformity of tax rates – at least in our context, where the utility tree consists of a combination of homothetic utility nests. As a matter of fact, the international dominates the domestic substitution effect as long as tax rate differentials are not too large.

In an international setting, income effects are not only relevant for revenue but also for welfare considerations. International income effects are due to the existence of tax exports or tax imports. In the first case, the VAT revenue accrues to the home country whereas the tax burden is shifted to foreign residents. Therefore, a tax export is equivalent to a transfer from the foreign to the home country. But we know from the discussion of the so-called transfer problem²³ that this will generally decrease welfare in the donating country²⁴. Note that tax exports for one country are exactly offset by tax imports in another country. For the EC as a whole, tax exports and tax imports sum up to zero; basically we have a zero sum game.

²³ See, for example, Bhagwati and Srinivasan (1983, chapter 12).

²⁴ The effects on the ToT are less clear-cut, but the demand function specification which we assume will always lead to a deterioration for the donating country.

Of course, one would wish to isolate the welfare consequences of substitution from those of (international) income effects according to some type of a general equilibrium Slutsky-decomposition. In numerical analysis this can be accomplished by neutralizing any net tax exports by means of an appropriate system of redistributive transfers within the EC. What remains after actually compensating for tax exports and imports is the combined domestic and international substitution effect. In Table 1, the third column contains the isolated substitution effects, whereas the fourth column represents net tax exports as the difference between tax exports and imports. In both columns figures are expressed as a percentage of the base year's VAT revenue. The next two columns give the ToT effects. Total ToT effects resulting from the switch to the transitional VAT system are given in column six, whereas column seven contains ToT which are attributable to the international substitution effect. The eighth column will be explained below.

Table 1 about here

Keeping the above remarks in mind, our numerical results can be explained quite easily. First of all, one notes that on average around ninety percent of total welfare changes are due to tax exports or imports. For country h , these net tax exports are calculated as

$$\underbrace{\sum_{k \in EC_h^H} \sum_{i \in N_s} \tau_i q_i C_i^k}_{\text{tax exports}} - \underbrace{\sum_{k \in EC_h^L} \sum_{i \in N_s} \tau_i^k q_i^k C_i^k}_{\text{tax imports}}, \quad (16)$$

where prices and quantities have to be evaluated in the counterfactual equilibrium. This equation makes clear that for low tax countries tax exports will exceed tax imports. Therefore, these countries realize revenue and welfare gains at the cost of its high tax EC-trading partners. In our database, the latter are France, The Netherlands and Denmark. Note that the signs of net tax export and total ToT effects always coincide. The reason was given above. Whereas for a single country welfare changes due to net tax exports are quite considerable, they cancel out for the EC as a whole. Only (international and domestic) substitution effects remain, which, however, are surprisingly small. Note that the signs of the isolated substitution and corresponding ToT effects coincide. This points to the above-mentioned fact that international dominate domestic substitution effects. We will focus on Denmark as a high and Germany as a low tax country to explain the sign of these substitution effects.

Denmark clearly is a high tax country. In 1981 (as today) it applied a uniform VAT rate structure of 22 percent. After switching to the transitional system, Denmark will settle its direct consumption purchases from other EC countries according to OP. This means that direct consumption imports will carry the lower tax rates levied in other EC countries. As a consequence, both domestic and international substitution effects contribute to a (further) reduction in economic welfare. The domestic substitution effect is negative because VAT rates on final consumption will be differentiated; the international substitution effect is negative because, after 1992, Denmark's importables carry a lower tax load than its exportables.

Table 1: Welfare Effects of the Transitional System

| Country ↓ | HEV | HEV | Decomposing HEV (in %) | | TOT (in %) | | “first round” |
|--------------|---------------------|-------------|--------------------------------|------------------------------------|--------------|------------------------------|----------------------------------|
| | in bill. ECU (1) | in % (2) | substitution effects (3) | net tax ex- port effects (4) | total (5) | int. subst. effect (6) | net tax export effects (7) |
| F | -2250 | -4.34 | -0.32 | -3.98 | -1.58 | -0.09 | -3.86 |
| B-L | 281 | 3.50 | -0.11 | 3.75 | 0.70 | -0.02 | 3.89 |
| NL | -1198 | -10.02 | -0.34 | -9.95 | -2.13 | -0.09 | -9.81 |
| D | 1634 | 3.65 | 0.17 | 3.95 | 1.09 | 0.05 | 3.71 |
| I | 510 | 2.22 | 0.08 | 2.41 | 0.81 | 0.02 | 2.34 |
| GB-IRL | 1056 | 3.63 | 0.72 | 3.07 | 1.09 | 0.12 | 3.02 |
| DK | -287 | -3.88 | -0.55 | -3.24 | -1.51 | -0.21 | -3.00 |
| EG | -254 | | | | | | |
| ROW | -3 | | | | | | |
| ∑ HEV | -257 | | | | | | |

Table 2: Sensitivity Analysis

| Country ↓ | constant labor supply | | | | | | constant labor supply and constant input coefficients | | | | | |
|--------------|-----------------------|-------------|-------------------------|----------------------------|------------|-----------------------|--|-------------|-------------------------|----------------------------|------------|-----------------------|
| | HEV in bill. ECU | HEV in % | Decomposing HEV (in %) | | TOT (in %) | | HEV in bill. ECU | HEV in % | Decomposing HEV (in %) | | ToT (in %) | |
| | | | substitution effects | net tax ex- port effect | total | int. subst. effect | | | substitution effects | net tax - export effect | total | int. subst. effect |
| F | -3060 | -5.90 | -0.47 | -3.98 | -1.51 | -0.08 | -3372 | -6.50 | -0.65 | -3.96 | -1.64 | -0.12 |
| B-L | 356 | 4.44 | -0.16 | 3.74 | 0.66 | -0.01 | 368 | 4.58 | -0.26 | 3.73 | 0.68 | -0.03 |
| NL | -1619 | -13.54 | -0.47 | -9.95 | -2.00 | -0.07 | -1780 | -14.88 | -0.78 | -9.91 | -2.19 | -0.12 |
| D | 2317 | 5.17 | 0.19 | 3.94 | 1.04 | 0.05 | 2762 | 6.16 | 0.49 | 3.94 | 1.24 | 0.11 |
| I | 669 | 2.91 | 0.08 | 2.41 | 0.79 | 0.02 | 700 | 3.04 | 0.12 | 2.41 | 0.82 | 0.03 |
| GB-IRL | 1491 | 5.12 | 0.97 | 3.07 | 1.05 | 0.13 | 1650 | 5.67 | 1.24 | 3.06 | 1.16 | 0.18 |
| DK | -396 | -5.35 | -0.81 | -3.25 | -1.40 | -0.19 | -445 | -6.02 | -1.12 | -3.22 | -1.61 | -0.28 |
| EG | -242 | | | | | | -117 | | | | | |
| ROW | -52 | | | | | | -264 | | | | | |
| ∑ HEV | -294 | | | | | | -381 | | | | | |

Germany, on the other hand, was – and still is – a low tax country with respect to the standard rate. Therefore, all other EC-countries will import those products to which the standard rate applies according to OP. The corresponding shift in demand to German exports will change the ToT in favor of this country. That ToT and (international) substitution effects are rather small is due to the countervailing fact that Germany's reduced rate is considerably higher than in other EC countries.

There is another feature of our results which seems worth mentioning. In the last column of Table 1 we present “first round” net tax exports. These effects were computed by simply evaluating equation (16) with the benchmark equilibrium's prices and quantities. Hence, no general equilibrium calculations were necessary at all. Surprisingly, it turned out that “first round” effects are a very good approximation for the general equilibrium net tax export effects. Or, to put it the other way round: general equilibrium repercussions were relatively small. We performed some sensitivity analysis in order to examine whether this depends on the particular parameter configuration which was specified exogenously. In our standard case we assumed a labor supply elasticity of 0.15 in every country and substitution possibilities between domestic and foreign intermediate imports. In the first and second block of Table 2 these assumptions were relaxed. One first notes that only the magnitude, but not the sign of welfare effects changes. Second, it becomes clear that first round net tax exports are still a reasonable good approximation for general equilibrium net tax exports but less so for total welfare changes. The third message is that changes in welfare losses and gains are almost exclusively due to a change in substitution effects. The main influence of the change in labor supply elasticity is on the domestic economy. Hence, only domestic substitution effects will change. International substitution terms and the corresponding ToT remain (more or less) unchanged. One would suspect that the switch to a constant labor supply reduces domestic substitution effects and increases welfare. Some more careful consideration reveals, however, that this does not need to be the case. If the indirect tax structure is not optimally chosen, a country can gain by deliberately introducing some additional tax wedges. This is a basic lesson from second-best theory. Under variable labor supply the income tax constitutes such an additional wedge. Our intuition tells us that welfare effects should depend on indirect tax rate differentials as well as on the degree of complementarity between consumption goods and leisure. Unfortunately, the theoretical tax literature does not provide any clear-cut conclusions and we are left with some uneasy feeling. The results in the second block of Table 2 illustrate that the assumption of constant input coefficients between domestic and imported intermediates more strongly affects international substitution and the corresponding ToT effects. This is as it should be.

Table 2 about here

Table 3 reports the welfare effects of a switch from the current system of border tax adjustments to a hypothetical VAT system under which all cross-border direct consumer purchases are taxed according to OP. We consider this case to highlight the importance of the option possibility to choose between DP and OP permitted under the transitional system.

One immediately notes that the level and the distribution of HEVs are quite different in Tables 1 and 3. Germany, for example, was the primary winner under the transitional system, but is the primary loser in Table 3. The important point to note, however, is that the pattern of economic explanations remains the same. In both tables, net tax export effects clearly dominate the domestic and international substitution effects. Whereas the sign of these substitution effects is the same in both tables, the sign of the net tax export effects changes in the case of Germany and Denmark. The reason is that net tax exports are now given by the difference

$$\underbrace{\sum_{k \in EC_h} \sum_{i \in N_s} \tau_i q_i C_i^k}_{\text{tax exports}} - \underbrace{\sum_{k \in EC_h} \sum_{i \in N_s} \tau_i^k q_i^k C_i^k}_{\text{tax imports}}. \quad (17)$$

Obviously, for a high tax country such as Denmark the value of (17) is definitely greater than that of (16). The opposite conclusion holds for a low tax country such as Germany. This explains the change in sign of net tax export effects for these two countries. The exact level of the HEV for each country depends on the balance in direct consumption trade, on international VAT rate differentials and on whether aggregate direct exports or imports face higher or lower tax rates. Once again, "first round" effects are a reasonable approximation for general equilibrium net tax exports, which, in turn, explain the greater portion of welfare changes. However, note that the importance of substitution effects increases. This is due to the fact that now all direct consumption imports are taxed according to OP. In case of Germany, all imports from other EC countries, which are subject to the standard VAT rate will carry a higher tax load than comparable domestically produced commodities. Domestic consumers will substitute domestic for foreign products. This changes world prices in favor of the home country (Germany) and increases national welfare.

Table 3 about here

V. Related Work and Conclusions

In this final section we will briefly comment on some related work which has not yet been mentioned in the main body of our paper. There are three broad strands in the literature which may be relevant in our context.

The first one are some theoretical contributions on welfare or Pareto improving indirect tax harmonization, represented by papers as Keen (1987, 1989), Turunen-Red and Woodland (1990) or Haufler (1991a, b). These studies offer considerable economic insights if there is complete freedom to choose the direction of indirect tax harmonization, but they are of little help when evaluating the current harmonization proposals in the EC.

The second strand of literature includes the numerous publications on Europe '92. Among them are simulation studies – for example, Smith and Venables (1988) or Norman (1989) – which address the trade and welfare consequences of the European

Table 3: Welfare Effects When Direct Consumption Purchases Are Taxed According to OP

| Country ↓ | Variable Labor Supply/Input Coefficients | | | | | | Constant Labor Supply/Input Coefficients | | | | | | First Round |
|--------------|---|-------------|-------------------------|----------------------------|------------|-----------------------|---|-------------|-------------------------|----------------------------|------------|-----------------------|-----------------------------|
| | HEV in bill. ECU | HEV in % | Decomposing HEV (in %) | | TOT (in %) | | HEV in bill. ECU | HEV in % | Decomposing HEV (in %) | | ToT (in %) | | net tax ex- port effects |
| | | | substitution effects | net tax ex- port effect | total | int. subst. effect | | | substitution effects | net tax ex- port effect | total | int. subst. effect | |
| F | -936 | -1.80 | -1.17 | -0.58 | -0.10 | -0.31 | -1601 | -3.09 | -2.27 | -0.54 | -0.25 | -0.47 | -0.34 |
| B-L | 504 | 6.27 | -0.58 | 7.30 | 1.47 | -0.07 | 669 | 8.33 | -1.37 | 7.25 | 1.41 | -0.14 | 8.18 |
| NL | -480 | -4.01 | -0.72 | -3.31 | -0.96 | -0.12 | -745 | -6.23 | -1.63 | -3.26 | -1.03 | -0.20 | -2.97 |
| D | -1306 | -2.91 | 0.61 | -3.97 | -1.41 | 0.24 | -1657 | -3.70 | 2.13 | -4.01 | -1.26 | 0.48 | -5.27 |
| I | 235 | 1.02 | 0.08 | 1.08 | 0.53 | 0.06 | 352 | 1.53 | 0.18 | 1.07 | 0.57 | 0.08 | 0.56 |
| GB-IRL | 1511 | 5.19 | 1.21 | 4.26 | 1.48 | 0.25 | 2425 | 8.33 | 2.18 | 4.24 | 1.63 | 0.35 | 3.77 |
| DK | 223 | 3.00 | -2.82 | 5.83 | 3.37 | -0.81 | 271 | 3.66 | -5.00 | 5.94 | 2.95 | -1.26 | 8.85 |
| EG | -249 | | - | | | | -286 | | | | | | |
| ROW | -13 | | | | | | -156 | | | | | | |
| ∑ HEV | -262 | | | | | | -442 | | | | | | |

integration process in general, with no particular emphasis on the taxation issue. The effects of the abolition of fiscal frontiers is the main core of some other papers. The first to mention is Parsche, Seidel and Teichmann (1988), a careful and detailed examination of the consequences of VAT and excise duty harmonization. The second is a piece by Lee, Pearson and Smith (1989), which is supplemented by a paper by Symons and Walker (1988). In several respects, these papers may be considered superior to our approach. However, they have the drawback of being restricted to single countries and therefore can only tell part of the story.

Finally, there are the numerous studies incorporating VAT in computable general equilibrium models, for example Hamilton and Whalley (1986), Ballard and Shoven (1987), Ballard, Scholz and Shoven (1987) and Kehoe et.al. (1988). Compared to our study, however, the modelling of VAT is very crude. The tax credit method, for example, is hardly ever mentioned. Furthermore, the emphasis is not on tax harmonization issues. The only study, dealing with EC tax harmonization issues in an applied general equilibrium context is Whalley (1976). Our paper may be seen as an improved and updated version of his approach, applied to the current policy debate.

Despite some possible objections against computable general equilibrium models we do not see any real alternative when complicated tax harmonization issues are on the agenda. After all, these models have a solid microeconomic foundation and are capable of capturing even quite detailed institutional features of the tax system. What makes this approach so useful are not the seemingly precise figures which are produced, but the deeper insights into complex tax (or other economic) problems one gains.

In short, the basic lessons from our analysis are the following. First, welfare changes are dominated by international income effects due to tax exporting or importing activities. Second, domestic and international substitution effects are relatively small. Third, "first round" effects in our case are a reasonable good approximation for general equilibrium net tax export effects. In fact, we had to employ a rather complicated computable general equilibrium model to learn that one could grasp the dominant quantitative features just as well without it.

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WORKSHOP ON
ISSUES IN INTERNATIONAL ECONOMICS: QUESTIONS TO AND ANSWERS FROM
COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS

JULY 8-9, 1991
UNIVERSITY OF KONSTANZ

MONDAY, JULY 8, 1991

10.00 Opening Address

Wolfgang Franz (Dean, University of Konstanz)

Bernd Genser (University of Konstanz)

"General Equilibrium Economics: Computation and Application"

John Whalley (University of Western Ontario)

11.00 **Session 1: International Taxation**

"Value-Added Tax Harmonization in the EC"

Wolfgang Wiegard/Hans Fehr/Christoph Rosenberg (University of Regensburg)

"Commodity Tax Reform under the Restricted Origin Principle"

Andreas Haufler (University of Konstanz)

14.30 **Session 2: Factor Supply**

"Simulation Models of Labour Supply"

Alan Duncan (Institute for Fiscal Studies, London)

"An Intertemporal General Equilibrium Model for Austria with Application to Foreign Trade"

Christian Keuschnigg (University of Bonn)/Wilhelm Kohler (University of Innsbruck)

17.00 **Session 3: Environment**

"CGE Modelling of International Public Goods: Air Quality and Global Warming"

John Piggott (University of New South Wales)

TUESDAY, JULY 9, 1991

09.00 Session 4: Imperfect Competition and Growth

"AGE Models in International Economics with Special Reference to Imperfect Competition and Increasing Returns to Scale"

Albert Schweinberger (University of Konstanz)

Growth and International Capital Movement: A Simulation Study

Karl-Josef Koch (University of Konstanz)

(presentation cancelled due to accident)

10.45 Round Table: "The Payoff of Investment in CGE - Modelling"

Chair: Bernd Genser

Introductory Statements:

John Chipman (University of Minnesota)

Friedrich Schneider (University of Linz)

Closing Address: Bernd Genser