The Transaction Values Approach to the Formulation and Implementation of Economywide Equilibrium Models

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The views presented here are those of the author, and they should not be interpreted as reflecting those of the World Bank
Abstract

The paper presents a new approach for the formulation and implementation of economy-wide models. The approach uses extensively Social Accounting Matrices (SAM). It starts with the observation that each entry in a SAM is the value of a transaction which is the outcome of agents, behaviors and institutional arrangements in the economy under consideration. Each entry is explicitly modeled and the institutional arrangements are explicit as rules balancing the accounts of each agent in the economy. The new approach, called TV for transaction-values; (i) introduces flexibility in the choice of a model; (ii) facilitates the comparison of model results and actual data; (iii) reduces the time and financial resources needed to develop an economy-wide model and (iv) makes models easier to understand, document and replicate.
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1. Introduction

This paper presents a new and easier approach to the construction and use of applied economywide models.1/ Assume an economic adviser is asked about the appropriate policies with respect to domestic energy prices and their implications in terms of macroeconomic external and internal balance, output response, employment and income distribution. With a well designed economywide model specific to the economy under consideration, he would feel well equipped to provide the policy maker with helpful results. Most often such a model will not be available; furthermore building one would be thought of as a difficult, time consuming and costly effort.

The Transactions Value (TV) approach addresses many of the concerns model builders and users may have, in particular it substantially reduces the amount of effort needed to build and understand a model. The TV approach:

(i) allows the model builder and user flexibility in the choice of specifications; flexibility is needed to reflect in the model the issues to be addressed and the institutional and market arrangements specific to the economy under consideration;

(ii) makes models more transparent and easier to replicate; transparency and easy replication allow for a better communication of the behavior of the model and of its results; it also removes the exclusive relation between a model and its builder;

(iii) reduces the time needed to obtain results; the shorter the time needed to obtain results from a model, the more useful it is in the process of

---

1/ By this we mean macroeconomic as well as multisectoral economywide models. For the latter see, e.g., Blitzer, Clark and Taylor (1975) and Dervis, de Melo, Robinson (1982).
decision making; often the time given by policy-makers to the economic adviser is limited and long gestation lags are not affordable;

(iv) makes easier the comparison of the results of a model with actual data; by construction the base year solution of the model is identical with the base year data, hence growth rates derived from the model are directly comparable with actual observations.

The filiation of the TV approach can be traced back to the formulation of input-output models. The contribution of TV is the extension of the simple formulation and implementation of input-output to models that are not constrained to be linear and where prices are not necessarily independent of excess demands. The approach was originally suggested by G. Pyatt who worked extensively on Social Accounting Matrices (SAM, see, e.g., Pyatt and Roe, et al. [1977]) and had the intuition of the extension of the input-output method to TV. The first formulation of a model in TV was done by Grais and Pyatt (1981) for the SIAM1 model of Thailand. The first implementation of the approach used the same model, Drud and Grais (1981). By 1983, a general software package handling TV models is available and the number of applications is rapidly growing; the two outstanding examples are the SIAM2 model of Thailand (Amranand and Grais (1983)) and the MISR2 model of Egypt (Bhattacharya, Grais and Pleskovic (1983)). These last two applications have proved the practicability of the approach and of the software for relatively large scale models.1/

In the following the paper presents an overview of the TV approach to the formulation and implementation of economywide models. It then proceeds by

1/ The SIAM2 is built around a SAM with more than 500 accounts. The SAM of MISR2 has 360 accounts.
illustrating the approach with the MENES class of models.\footnote{MENES stands for Models of Equilibrium of National Economic Systems. It is also the name of the first king of Egypt who around 3000 BC united the kingdoms of lower and upper Egypt. TV provides a unified approach from data base to model results bringing data and behaviors in the same framework.} Section 2 presents an overview of the TV approach. Section 3 provides the accounting framework of the MENES class while section 4 discusses its specification of behaviors and technologies. In section 5, a numerical evaluation of the parameters of the specifications used on the MENES class is presented. The choice of models on the class is discussed in section 6. A comparison of the effects of increased taxation of agricultural exports between three models of the class is presented in section 7. Conclusions follow in section 8.

2. The TV Approach: An Overview:

The formulation and implementation of an economywide model requires four sets of information: (i) an accounting framework, (ii) a specification of behaviors and technologies; (iii) numerical values of parameters and (iv) constraints ensuring the consistency of the independent decisions of the agents intervening in the economy. The TV approach organizes these informations in a systematic way using a Social Accounting Matrix (SAM).

A SAM—see B. King (1982)—is an economywide accounting framework which goes beyond the United Nations System of National Accounts (UNSN) by encompassing income flows from the production activities, to factors of production, the various institutional agents in the economy and back to production activities. A SAM provides the accounting of an economy in a matrix format where each agent has a row and a column registering his receipts and outlays respectively. Thus each cell in a SAM represents a payment from a column to a row which is, in all generality, the value of a transaction. All entries in a SAM can therefore be regarded as representing
Transaction Values (TV's). The accounting framework of economywide models, specified along the TV approach, is provided by a SAM.

Going beyond the accounting framework the TV's reflect underlying agent behaviors and technologies. Consumer expenditures result from utility-maximization, factor payments from profit-maximization: all sorts of allocation rules may be envisaged. Hence an economywide model involves the modelling of the entries of a SAM through explaining the behavior underlying the realized TV's. The specification of the behavior associated with each cell of the SAM will provide an almost complete information on behaviors and technologies.

Each cell specification does not however provide a full account of behaviors and technologies. Indeed it will generally include parameters whose values characterize behaviors and technologies at particular points in time and space. Any implementation requires full information on the specifications of each cell and necessitates also numerical values for behavioral and technological parameters. An advantage of the TV approach is that most of these parameters can be derived from the base year SAM, in such a way that the model reproduces the base year data. Other parameters must however be obtained from other sources.

Having told how each agent intervening in the economy takes his decisions, one question remains: what ensures the consistency of all independent decisions? A consistent equilibrium is achieved for some vector of prices, quantities and values which makes all accounts in the SAM balance. The balancing of each account will rely either on price, quantity, value or on all three types of adjustments. Defining for each account which of the price, quantity or value attached to it adjust will specify how all allocation decisions are made consistent and define equilibrium.
The TV approach has led to the development of a software for implementing and solving economy-wide models formulated along the lines described above. It requires from the user: (i) a SAM for a base-year, (ii) the TV specification of each cell; (iii) the values, taken by parameters, which cannot be derived from the SAM and (iv) the systems constraints indicating how each account balances. This information is then used to solve for an equilibrium under alternative assumptions on the policy parameters.

3. The Accounting Framework of the MINEG Class of Models.

A SAM is used to provide the accounting framework. As all SAM's, it has as many rows as columns in order to represent for each account its outlays and receipts. As in all accounting, the total of outlays has to be equal to the total of receipts, and thus each row sum has to be equal to the corresponding column sum.

One particular feature of a TV-SAM is that only transactions with the same valuation will belong to the same row account. A corollary of this is that each time there is a change in valuation a new account is needed. Here are two examples which illustrate this point. Following the UNSNA (1968) the cost of production of a commodity is its basic value, which changes to its producers value when indirect taxes are added and to its purchasers value when the trade margin and transportation costs are included. If one wants to track these different valuations of the commodity, there is a need to introduce three accounts for the commodity. Similarly if say labor is mobile across sectors, receiving the same wage throughout the economy, it can be represented with only one account. If there is no intersectoral mobility of labor and wages differ across sectors then labor services in each sector are different.

---

1/ In order to capture effects of changes in taxation, trade margins and (or) transportation costs.
and need to be represented with separate accounts. Thus one major characteristic of the SAMs used in the TV approach is that a new account is introduced each time there is a new valuation.

Table 1 presents a SAM with the features described above. It has thirty seven accounts which can be grouped into five broad categories: (i) factors of production, (ii) current accounts of institutions, (iii) capital accounts, (iv) activities, and (v) commodities. In columns 19 to 21, the distribution of the costs of production between value added and intermediate inputs is given for the three sectors of production. These columns define the gross outputs, values added and intermediate costs. In columns 22 to 24, the distribution of value added between capital and labor is presented. Columns 1 to 6 of the SAM show how the factor incomes are distributed to both domestic and foreign institutions (the total of the entries in columns 1, 2, 4 and 6 is GNP at factor costs). This distribution of factor incomes reflects the distribution of ownership of human and other assets in the economy. Most of factor incomes are directly distributed to households (row 7) who receive also some transfers from other institutions. In column 7, households pay taxes, the interest they owe and transfers abroad, they are then left with disposable income. The latter, in column 8, is distributed between consumption and savings. In column 9, consumption is split between committed and discretionary components,1/ while column 10 shows the allocation of the latter. Columns 11 and 12 show how government allocates its expenditures, and column 13 channels indirect tax collection to the revenue account of the government. In column 14 companies pay dividends to households, taxes to government, and save. All savings out of national income and foreign savings

1/ The distinction between committed and discretionary expenditures goes back to the Linear Expenditure System, R. A. Stone (1954).
### Table 1

The Data-SAM of the MENCS Class of Models

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

* In billions of bahts. This SAM is derived from data on Thailand for the year 1980.
go to row 15, a pool of combined savings. Column 13 shows the allocation of funds available for investment to the various sectors of economic activity. The corresponding amount of investment in agriculture, industry, and services is shown in columns 16 to 18. The sum of each of the rows 31, 32, and 33 give the domestic demands for the three goods exchanged in the economy. In columns 31 to 33, the sources of supply are shown: domestic production or imports. The transformation from the world price of imports to their landed value is presented in columns 28 to 30, while in columns 25 to 27, the derivation of the market value of domestic production appears. In row 19 to 21, domestic production is distributed between the domestic markets (column 25 to 27) and export markets (column 34 to 36). In the latter columns, the supply value of exports on the world market is formed. Finally row and column 37 feature all current transactions with the rest of the world.

The SAM of table 1 has the standard features of SAMs and the particular one of having a new account for each new valuation. There is thus one row for labor because it is assumed to receive the same wage across the economy. Rates of return on capital are however supposed to be different between the three sectors, there are thus three accounts for domestic capital. Similarly each production activity has two accounts: a value-added account and a gross production one. This distinction is made in order to distinguish between the net price (value added price) and the price of gross output. Finally in columns 25 to 36, commodities are classified according to whether they are domestic, imported, composite or exported.¹

Finally some of the accounts of table 1 are more disaggregated than one would normally expect. This is done to show some sub-aggregates on which

¹ The same commodity may have a different valuation according to the channel of distribution.
behavioral allocations depend. Thus households allocate their disposable income between consumption and savings and then allocate their consumption between various goods. Furthermore, they first spend committed amounts and then allocate their discretionary expenditure. The households account is disaggregated into four because of the existence of these separate decisions. Other disaggregations in table 4 can be justified in the same way.

The SAM in table 1 is an accounting framework which is designed to capture via its disaggregation the issues which the analyst wishes to consider. The disaggregation reflects however already some a priori ideas on how decisions are taken in the economy and how valuations of transactions are made.

4. Behavior and Technology in the MANTES Class of Models

Let \( T \) be a square matrix of the same order and with the same configuration\(^1\) as the SAM in table 1:

\[
T = t_{ij}, i, j = 1, 2, \ldots, 37.
\]

Each element \(^2\) \( t_{ij} \) of \( T \) represents the value of a transaction and is the outcome of behavioral and technological conditions. All entries \( t_{ij} \) can be expressed as residuals or as analytical functions of three vectors, \( y, p \) and \( u \):

\[
t_{ij} = t_{ij}(y, p, u),
\]

(1)

(1) \( y \) is the vector of total outlays of each account:

\[
\Rightarrow T_i = t_{iy}, i = 1, 2, \ldots, 37;
\]

(ii) \( p \) is a vector of prices attached to a subset of the accounts of the SAM:\(^1\)

\[1/\] By configuration we mean that to all non-zero cells in the SAM correspond an element of the matrix \( T \).

\[2/\] We use \( i \) as a row index and \( j \) as a column index.
\[ p = \{p_j\}, \ j = 1, 2, \ldots, m, \text{ where } m \leq 37; \]

(iii) \( \mu \) is a vector of parameters: \( \mu = \{\mu_k\}, \ k = 1, 2, \ldots, K. \)

All behaviors and technologies can be described by specifying the functions in (1). Table 2 presents the list of specifications used in the models of the MENES class. In the following, the derivation of the relations in table 2 is explained.

4.1. The Non-Linear Expenditure System (NLES)

Consider the following generalization—Carlevato (1976)—of the Linear Expenditure System (LES), where \( d_i \) is consumption expenditure on commodity \( i \), \( p_i \) is the price of the commodity, \( P \) is a price index and \( r \) is total expenditure:\(^2\)

---

1/ The two vectors \( y \) and \( p \) imply a vector \( q = \{q_j\}, \ j = 1, 2, \ldots, m \) of quantities of the same order as the vector of prices.

2/ The expression in (2) is derived from the indirect utility function

\[ \psi(r, p_1, \ldots, p_n) = \frac{dz}{\psi(z)} - \sum_{i=1}^{n} b_i \log p_i, \]

where \( z = (r - \sum_{j=1}^{m} p_j y_j)/P \) and \( P = \prod_{i=1}^{n} p_i. \) The parameters \( \gamma_i \) are generally non-negative, \( \gamma_i \geq 0, \) and \( b_i > 1 \) and \( i < b_i < -1. \) A negative \( b_i \) reflects a declining share in discretionary consumption. Furthermore, \( \sum b_i = 1 \) and \( \sum b_i = 0. \) The function of \( z \) multiplying \( b_1 \) can be arbitrary, it need only be independent of \( i. \) The exponential used here allows an interesting interpretation of \( b_1^m \) and \( b_1^m + b_1^h \) as budget shares in discretionary expenditures for low and high values of the latter respectively.
Table 2

List of Specifications in the MENES Class of Models

1. \( t_{1j} = y_j \),

2. \( t_{1j} \) is a residual,

3. \( t_{1j} = \{ t_j / (1 + t_j) \} y_j \),

4. \( t_{1j} = c_{1j} y_j \),

5. \( t_{1j} = p_{1j} t_{1j}^0 f_{1j}^0 (\theta) \),

6. \( t_{1j} = \rho_{1j} f_{1j}^0 (\theta) (p_j^{n_j} X)\),

7. \( t_{1j} = t_{1j} f_{1j}^0 (\theta) (p_j^{n_j} X) n_{1j} (p_j^{n_j})^{1-n_{1j}} \),

8. \( t_{1j} = t_{1j} f_{1j}^0 (\theta) (p_j^{n_j} X) \),

9. \( t_{1j} = (t_{1j}^{0} / y_j^0) (p_j^{n_j} / p_j) y_j \),

10. \( t_{1j} = (t_{1j}^{0} / y_j^0) f_{1j}^0 (\theta) (p_j^{n_j} / p_j) y_j \),

11. \( t_{1j} = (t_{1j}^{0} / y_j^0) f_{1j}^0 (\theta) (p_j^{n_j} / p_j) y_j \),

12. \( t_{1j} = \rho_{1j} (t_{1j}^{0} / y_j^0) f_{1j}^0 (\theta) (p_j^{n_j} / p_j) y_j \),

13. \( t_{1j} = \rho_{1j} (t_{1j}^{0} / y_j^0) f_{1j}^0 (\theta) y_j \),

14. \( t_{1j} = (t_{1j}^{0} / y_j^0) + \rho_{1j} \{ \exp(-t_j / (y_j^0 \rho_j^0)) - \exp(\theta_j / y_j^0) \} y_j \),

15. \( t_{1j} \) predetermined by the user.

BEST COPY AVAILABLE
\[ d_i = p_i y_i + \left( b_i^m + b_i^\Delta \exp\left[ -\beta \left( \frac{r - \tau p_i y_i}{\frac{1}{\beta}} \right) \right] \right) (r - \Sigma p_j y_j). \] (2)

The right-hand side of (2) has two terms. The first \( p_i y_i \) is committed expenditure on good \( i \); the second term describes the allocation of discretionary expenditure. In order to satisfy additivity the parameters \( b_i^m \) and \( b_i^\Delta \) in the second term of (2) have to satisfy the constraints:

\[ I b_i^m = 1 \text{ and } I b_i^\Delta = 0. \]

For zero values of the parameters \( b_i^\Delta \), expression (2) becomes the traditional LES.

Figure 1.a shows how the NLES appears in a TV SAM. Households allocate disposable income between savings and total consumption. The "total expenditure account" of figure 1.a shows the composition of total consumption between committed expenditures, spent on commodities, and a discretionary amount, channelled to the discretionary expenditure account. The latter allocates the total amount available for discretionary expenditure on the various commodities.

Consider now each committed expenditure. It is a \( t_{ij} \) entry in the SAM which can be expressed as follows:\(^2\)

\[ t_{ij} = p_i y_{ij} f_{ij}(\theta) \] (3)

in the base year, where all prices are normalized to 1, the expression in (3) becomes:\(^3\)

\[ t_{ij}^o = y_{ij} \] (4)

\(^1\) \( r \) is total expenditure.

\(^2\) \( f_{ij}(\theta) \) is a function of time (\( \theta \)) such that \( f(0) = 1 \).

\(^3\) "o" superscript indicates a base year value.
**Figure 1.a**
The NLES IN A TV SAM

<table>
<thead>
<tr>
<th>Total Expenditure Account</th>
<th>Discretionary Expenditure Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discretionary Expenditure Account</td>
<td>$y$</td>
</tr>
<tr>
<td>Commodities Accounts 1</td>
<td>$P_1 Y_1$</td>
</tr>
<tr>
<td>2</td>
<td>$P_2 Y_2$</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>$n$</td>
<td>$P_n Y_n$</td>
</tr>
</tbody>
</table>

* $y = r - \sum_j P_j Y_j$ is total discretionary expenditure.

**Figure 1.b**
The NLES IN TV Specifications

<table>
<thead>
<tr>
<th>Total Expenditure Account</th>
<th>Discretionary Expenditure Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discretionary Expenditure Account</td>
<td>2</td>
</tr>
<tr>
<td>Commodities Accounts 1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>$n$</td>
<td>6</td>
</tr>
</tbody>
</table>
The ratio of (3) to (4) is used to derive the TV specification for a committed expenditure:

\[ t_{ij} = p_i \tau_{ij} f_{ij}(\theta), \]

which is specification (6)\(^1\) in table 2 and appears in the total expenditure account in figure 1.b. If \( f_{ij}(\theta) \) reflected, say population growth, it would have the following specification \( f_{ij}(\theta) = \text{POP}_\theta / \text{POP}_0 \), where \( \text{POP}_\theta \) is population in period \( \theta \).

Let \( y_j \) be total expenditure; discretionary expenditure is what is left after committed expenditures are made, it is thus a residual. Residuals are represented with specification (2) of table (2), and figure 1.b shows, in the total expenditure account, discretionary expenditure as a residual.

Let \( t_{ij} \) be now the discretionary expenditure on commodity \( i \).

According to relation 2, it can be written as:

\[ t_{ij} = (b_{ij}^m + b_{ij}^A \exp(-\beta_j/y_j^0))y_j, \quad (5) \]

where \( y_j \) is total discretionary expenditure, \( p_j \) is the price index of the latter and \( b_{ij}^m, b_{ij}^A \), and \( \beta \) are parameters. Let \( a_{ij} \) represent the share of commodity \( i \) in discretionary expenditure in the current year; the expression for \( a_{ij}^0 \) is the terms between brackets in (5). In the base year:

\[ a_{ij}^0 = b_{ij}^m + b_{ij}^A \exp(-\beta_j/y_j^0), \quad (6) \]

\(^1\) Specification (6) of table (2) can also represent a commodity in totally inelastic supply but where the price is variable.
because all prices are normalized to unity. From (5) and (6), it is easy to
derive a relation between \( a_{ij} \) and \( a_{ij}^0 \):

\[
a_{ij} = a_{ij}^0 + b_{ij}^\Delta \left( \exp\left[ -\frac{y_i}{p_j} \right] - \exp\left[ -\frac{y_j^0}{p_j} \right] \right).
\]  (7)

Relation (7) leads directly to the TV specification (16)\(^{1/} \) of table 2, which is
also used in the second column of figure 1.b. The NLES ordinarily represented
by relation 2 would be represented in TV according to figure 1.b. The TV
formulation ensures the calibration of the NLES such that it reproduces the
base year data.

4.2. Constant Elasticity Allocation Rules

Consider a producer who minimizes costs under a Constant Elasticity
of Substitution (CES) technology constraint. His costs on each input would be
described by specification (11) of table 2. The composition of the producer's
costs can be given in a column of a SAM like in figure 2 where a column
describes the payments to each input when the producer's problem is:

\[
\text{Min } \sum p_i x_i \text{ s.t. } \left[ \mathbf{E}_1 \left( e^\frac{q_i}{x_i} \right)^{-\rho} \right]^{\frac{-1}{\rho}} - q = 0. \]  (8)

In problem (8) \( p_i \) are the prices of the inputs \( x_i \) and the technology is a CES
with factor specific technical change; \( q \) is output. The distribution parameter
\( \rho \) verifies \( \rho > -1 \) to ensure concavity and is related to the positive elasticity
of substitution: \( \sigma = 1/(1+\rho) \). A solution of problem (8) is a \( t_{ij} \) entry in a
SAM, like in figure 2:

---

\(^{1/}\) Note that \( t_{ij} = a_{ij} y_j \). In specification (16) in table 2, \( b_{ij}^\Delta \) is replaced
by \( \rho_{ij} \). The parameters \( \rho_{ij} \) and \( \beta_{ij} \) can be made time dependent.
Figure 2
Constant Elasticity Allocation Rule

<table>
<thead>
<tr>
<th>Production Activity</th>
<th>Production Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 1 ( \beta_1 \sigma a_1 (\sigma - 1) (p/p_1)^{\sigma - 1} pq )</td>
<td>11</td>
</tr>
<tr>
<td>Input 2 ( \beta_2 \sigma a_2 (\sigma - 1) (p/p_2)^{\sigma - 1} pq )</td>
<td>11</td>
</tr>
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<td>.</td>
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<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Input n ( \beta_n \sigma a_n (\sigma - 1) (p/p_n)^{\sigma - 1} pq )</td>
<td>11</td>
</tr>
</tbody>
</table>

\[
t_{ij} = \beta_i^\sigma a_{ij}(\sigma_j - 1)^\theta (p_j/p_i)^{\sigma_j - 1} y_j, \quad (9)
\]

where \( y_j \) is the total value of the output. In the base year where all prices are normalized to unity and \( \theta = 0 \), (9) reduces to:

\[
t_{ij}^o = \beta_i^\sigma y_j^o. \quad (10)
\]

Combining (9) and (10), specification (11) of table 2 is derived:

\[
t_{ij} = (t_{ij}^o/y_j^o)^{\alpha_{ij}(\sigma_j - 1)\theta} (p_j/p_i)^{\sigma_j - 1} y_j.
\]
In table 2, specification (12) is a special case of (11) where $\sigma_j = 0$, it corresponds to a Leontief technology. Similarly specification (13) of table 2 corresponds to a Cobb-Douglas technology with $\sigma = 1$. Specifications (13) and (5) are identical except that in the latter, the cost share is provided by the user and not derived from the base year SAM. Although specifications 11, 12, 13 and 5 are presented as resulting from a producer's allocation problem, they can in fact be applied to any allocation problem: for example the allocation of domestic demand between domestic and imported goods—see Armington (1969).

4.3 Exchanges with the Rest of the World

A constant elasticity demand function for exports is given in specification 7 of table 2:

$$t_{ij} = t_{ij}^o f_{ij}(\theta)(p_j \pi_1^x)^{\eta_{ij}} (p_1)^{1-\eta_{ij}}.$$

Here $t_{ij}$ is a payment from the rest of the world to buy commodity $i$. This rest of the world expenditure depends on: (i) $p_j$, the price of foreign exchange, associated with the rest of the world account; (ii) the supply price in domestic currency, $p_1$ of the exported commodity; (iii) the price in dollars of substitutable goods on the world market, $\pi_1^x$ and (iv) the price demand elasticity $\eta_{ij}$. Again $f_{ij}(\theta)$ reflects independent shifts in the world demand curve. When the elasticity of exports is unity ($\eta_{ij} = 1$), specification (7) reduces to (8), in table 2. Specification (8) can also serve, when a unit value for $\pi_1^x$ is assumed, to represent shifts in the dollar-value of transfers from the rest of the world.

Let $q_j$ be a quantity of imports. Their landed value, inclusive of tariffs, is $p_j q_j = y_j$. Their value, before tariffs are levied, is $p_1 \pi_1^m q_j$ where $p_1$ is the price of foreign exchange and $\pi_1^m$ is the dollar-world price.
Our payments to the rest of the world for the imports can be represented by an entry $t_{ij}$:

$$p_{i}^m q_{j} = a_{ij} p_{j} q_{j}$$

(11)

where $a_{ij}$ is the share of the landed value going to the rest of the world. In the base year, expression (11) takes the form:

$$p_{i}^o q_{j} = a_{ij}^0 p_{j} q_{j}.$$ \hspace{2cm} (12)

Taking the ratio of (11) to (12), the following expression is derived:

$$a_{ij} = a_{ij}^o [(p_{i}^m/p_{i}^o) /(p_{j}/p_{j}^o)].$$

Normalizing base year prices to one, specification (10) of table 2 is obtained. It relates the world price and the exchange rate to the landed price of imports.

4.5. Other Specifications

Sometimes all the income received by an account is channelled to another account. In table 1 all labor incomes are given to households in the first column of the SAM. To represent such a flow indicating that the value of an entry is equal to the total value of the account it belongs to, TV uses specification (1) of table 2:

$$t_{ij} = y_{i}.$$ 

Now consider a column $j$ where one entry is an ad valorem tax, or a mark-up on the total of the other entries of the column:
\[
\sum_{i=1}^{n} t_{ij} = y_j \quad \text{and} \quad t_{kj} + \sum_{i \neq k} t_{ij} = y_j,
\]

where \( t_{kj} \) is determined as a share of \( \sum_{i \neq k} t_{ij} \). Let \( \tau_j \) be the tax rate, then the column sum \( y_j \) is:

\[
(1+\tau_j) \sum_{i \neq k} t_{ij} = y_j,
\]

while the amount of taxes paid is:

\[
t_{kj} = y_j [1 - (\sum_{i \neq k} t_{ij}/y_j)] = y_j [\tau_j/(1+\tau_j)].
\]

The above expression is specification (3) of table 2. It represents an amount of taxes, import tariffs or mark-up.

The last specification in table 2 (17) is self explanatory. It can be used for expressing transfers between different institutions or any other payment which the analyst wishes to define a priori in nominal terms.

In the TV approach, the first step is the appropriate design of the accounts of the economy in the form of a SAM. The second step is the definition of the behavioral and technological conditions in the economy which explain the behaviors of all the entries in the TV-SAM. For that purpose a specification need to be assigned to each cell in the TV-SAM. In the foregoing the derivation of the specifications used in the models of the MENES class is given. Table 3 maps these specifications into the TV-SAM assigning a behavior to each cell. Table 3 completes the second step in the TV approach and provides a description of behaviors and technologies.
Table 3
A TV-SAM of the MENES Class of Models

<table>
<thead>
<tr>
<th>Factors of Production</th>
<th>Current Account Institutions</th>
<th>Capital Accounts</th>
<th>Activities</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Household</td>
<td>Government</td>
<td>Investment</td>
<td>Production</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial Institutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-fixed Assets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Assets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Private</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Domestic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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5. A Numerical Evaluation of the Parameters in the MENES Class of Models

In order to be able to produce quantitative results, one needs to provide numerical values for the parameters of the TV specifications listed in Table 2. There are three categories of parameters to consider: (i) intercept-type, (ii) elasticities-type and (iii) trend-type.

All intercept-type parameters are re-expressed in the TV specifications in terms of values which appear in a SAM. All $t_{ij}^o$ and $y_j^o$ in Table 2 are values derived from a base year SAM. Thus the availability of a SAM for an appropriately chosen base year will enable one to derive all intercept-type parameters.\(^1\) Given that all prices are unity in the base year, this procedure defines the base-year SAM as a solution of the model. It thus provides a way to check the solution.

The second set of parameters are of the elasticity-type. They are the elasticities of the export demand functions, of the production functions, of import relations, of the system of consumption functions and of other relations which may appear in the system. Whenever this is possible one will try to get econometric estimates for these parameters. For the level of disaggregation of the MENES framework this is a relatively easy task for most applications. If the econometric approach is not possible because the available series are too short, then one can try to compute arc elasticities and average them. If also this approach is infeasible, one can combine "the deep knowledge of the economy" of a country specialist with estimates available for other economies and derive the necessary data. It should however be kept in mind that these elasticity-type parameters reflect

\(^1\) If a time series of SAM's is available one can conceive of a full information econometric estimation of a whole model. The estimation would produce estimates for all intercept-type parameters from which an "econometric" SAM could be derived and used as a base SAM.
adjustments within the period for which a solution is sought. Thus if the period is a year, the elasticities will describe the scope for substitution within the year. Another point to remember is that the adjustment responses to income and relative price changes are not systematically identical through time. This means that even if econometric estimates are available from time series and that the model is run on the future, the analyst should feel free, when he judges it necessary, to change the econometric estimates. This will typically be the case when structural changes happen rapidly in an economy. Table 4 provides a set of plausible parameters for the various elasticity parameters appearing in the models of the MENES framework.

The trend-type parameters are included in the specifications of the functions $f_{ij}(\theta)$. These will reflect shifts in demand functions, technical change and all sorts of variations not due to price and (or) income changes within the system. For export demand functions the $f_{ij}(\theta)$ can be specified as: $\exp[r_{ij}(\theta - \theta^0)]$. In this case, one needs an assessment of the value of $r_{ij}$'s. For exports, these will essentially result from the judgement the analyst can form on the developments in the export markets of the country under consideration. A lot of care, however, is needed in specifying the functions $f_{ij}(\theta)$ and the numerical values of their parameters. They will eventually influence heavily the model results. A misjudgement at the level of the $f_{ij}(\theta)$ can give wrong impressions on the long run trends in the economy.

6. The Choice of a Model in the MENES Class: Systems Constraints

The information contained in table 3 defines implicitly an underdetermined system of equations: the MENES class of models. The next step is then to identify one model in the class corresponding to the views the analyst has on the economy under consideration. That model can then be used
Table 4
Parameters for the Models of the NENES Class

<table>
<thead>
<tr>
<th>Export Demand Functions: Elasticities,</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>$\eta_1 = 6.0$</td>
</tr>
<tr>
<td>Industry</td>
<td>$\eta_2 = 2.6$</td>
</tr>
<tr>
<td>Services</td>
<td>$\eta_3 = 2.0$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Armington Elasticities for Import Demand Functions,</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>$\sigma_1 = 0.8$</td>
</tr>
<tr>
<td>Industry</td>
<td>$\sigma_2 = 1.5$</td>
</tr>
<tr>
<td>Services</td>
<td>$\sigma_3 = 3.0$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elasticities of Substitution between Labor and Capital,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Industry</td>
</tr>
<tr>
<td>Services</td>
</tr>
</tbody>
</table>

Parameters of the Specifications of Discretionary Expenditures of Households
(Specification 16 in table 2)$^{1/}$:

$\rho_{ij} = 0$ for all $i, j$ and $\beta_j = 1$.

---

$^{1/}$ When $\rho_{ij} = 0$ the value of $\beta_j$ is irrelevant. It is here arbitrarily set to one.

for policy analysis. However most often different analysts will have different views and will probably pick different models in the class. Eventually the same analyst, after some experimentation with one model, will change his views. One major advantage of the TV approach and software is to
make the choice of a model and the change from one to another model in the
same class particularly easy. In the following the identification of three
models in the MENES class is discussed and their representation in the TV
formulation presented.

6.1. Variables and Equations in the MENES Class

The information contained in table 3 is explicit in tables 5 and 6. Table 5 gives the number of variables in the models of the MENES class, when the disaggregation is the one contained in the SAM of table 1. There are
(i) n total outlays $y_j$ corresponding to row and column sums; (ii) m prices $p_j$
associated with accounts for which a price can be defined; (iii) $m$
quantities $q_j$ corresponding to the accounts with prices and such that
$y_j = p_j q_j$ and (iv) g non-identically zero transaction values $t_{ij}$. In total
the number of variables is $n + 2m + g = 37 + 2(30) + 91 = 188$.

Table 6 explicits the system of equations underlying the TV-SAM of
table 3. It contains three sets of equations: (i) column equations; (ii) row
equations and (iii) identities defining quantities.

The column equations are obtained by adding up all entries in each
column: $y_j = \sum_i t_{ij}$. Such a summation will either define a price index
associated with the account or (and) the sum of the outlays of the
corresponding agent. For example adding up the entries in column 22 will lead
to:

1/ The TV software with the information contained in table 3, derives the
information explicit in tables 5 and 6. The latter is not required from
the user.

2/ For example in table 3, the price corresponding to column 1 is the wage;
the prices associated with accounts 2, 3 and 5 are rates of return. The
CPI is the price associated with account 9 while the exchange rate
pertains to account 37. Accounts 10, 12, 15 and 16 to 36 have price
indices with appropriate interpretations. In total there are $m = 30$
prices.
Table 5
Number of Variables in the MENES Class of Models

<table>
<thead>
<tr>
<th>The Variables</th>
<th>Generic Number</th>
<th>Number in the MENES Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total outlays</td>
<td>$y_j$</td>
<td>$n$</td>
</tr>
<tr>
<td>Prices</td>
<td>$p_j$</td>
<td>$m$</td>
</tr>
<tr>
<td>Quantities</td>
<td>$q_j$</td>
<td>$m$</td>
</tr>
<tr>
<td>Cell variables</td>
<td>$t_{ij}$</td>
<td>$g$</td>
</tr>
<tr>
<td>Total</td>
<td>$n + 2m + g$</td>
<td></td>
</tr>
</tbody>
</table>

$$\sum_{i} a_{1,22}^{\theta}[f_{1,22}(\theta)p_{1}/p_{22}]^{1-\sigma_{22}} = 1,$$

from which the marginal cost corresponding to a CES production function can be derived as:

$$p_{22} = \left(\sum_{i} a_{1,22}^{\theta}[f_{1,22}(\theta)p_{1}]^{1-\sigma_{22}}\right)^{1-\sigma_{22}}.$$

Similarly adding up the entries in column 11 will define total government outlays. Some of the columns will however not provide any additional equation. For example, summing the entries of column 14 will simply state that $y_{14} = y_{14}$. Counting all column equations one obtains 28. Three define total outlays and twenty five define prices.

By definition the sum of each row in the SAM of table 3 is the total receipts of the corresponding account. The 37 row equations define 37 total receipts. Taking the SAM row-wise, the first six equations are demands for
Table 6
Constraints in the MENES Class of Models

<table>
<thead>
<tr>
<th>Column Equations</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. ( p_j = 1/\sum_i a_{ij}/p_i )</td>
<td>( j = q )</td>
<td>( j = q )</td>
<td>( j = q )</td>
</tr>
<tr>
<td>B. ( y_j = \sum_i t_{ij} )</td>
<td>( j = 9, 11, 37 )</td>
<td>( j = 9, 11, 37 )</td>
<td>( j = 9, 11, 37 )</td>
</tr>
<tr>
<td>C. ( p_j = \Pi_i a_{ij} )</td>
<td>( j = 10, 15 )</td>
<td>( j = 10, 15 )</td>
<td>( j = 10, 15 )</td>
</tr>
<tr>
<td>D. ( p_j = \sum_i a_{ij} f_{ij}(\theta)p_i )</td>
<td>( j = 12, 16, 17, 18, 19, 20, 21 )</td>
<td>( j = 12, 16, 17, 18, 19, 20, 21 )</td>
<td>( j = 12, 16, 17, 18, 19, 20, 21 )</td>
</tr>
<tr>
<td>E. ( p_j = { \sum_i a_{ij} f_{ij}(\theta) }^{1-\sigma_j} )</td>
<td>( j = 22, 23, 24, 31, 32, 33 )</td>
<td>( j = 22, 23, 24, 31, 32, 33 )</td>
<td>( j = 22, 23, 24, 31, 32, 33 )</td>
</tr>
<tr>
<td>F. ( p_j = (1 + t_{ij}) a_{ij} p_i )</td>
<td>( j = 25, 26, 27, 34, 35, 36 )</td>
<td>( j = 25, 26, 27, 34, 35, 36 )</td>
<td>( j = 25, 26, 27, 34, 35, 36 )</td>
</tr>
<tr>
<td>G. ( p_j = (1 + t_{ij}) a_{ij} p_i \Pi_j )</td>
<td>( j = 28, 29, 30 )</td>
<td>( j = 28, 29, 30 )</td>
<td>( j = 28, 29, 30 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Row Equations</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H. ( y_i = \sum_j t_{ij} )</td>
<td>( i = 1, 2, \ldots, 37 )</td>
<td>( i = 1, 2, \ldots, 37 )</td>
<td>( i = 1, 2, \ldots, 37 )</td>
</tr>
</tbody>
</table>

among them are:

| I. \( y_{10} = \text{Residual (}t_{10,9}\text{),} \) | | | |

| J. \( y_{15} = a_{15,8} y_8 + \text{Residual (}t_{15,11}\text{)} + a_{15,14} y_{14} + \text{Residual (}t_{15,37}\text{).} \) | | | |

Definitions of quantities

| K. \( y_j = p_j q_j \) | \( j = 1, 2, 3, 5, 9, 10, 12, 15, \ldots, 37 \) | \( j = 1, 2, 3, 5, 9, 10, 12, 15, \ldots, 37 \) | \( j = 1, 2, 3, 5, 9, 10, 12, 15, \ldots, 37 \) |

1/ All \( a_{ij} \) are shares: \( a_{ij} = t_{ij}/y_j \) of the cell value to the total value in the column. A "o" superscript indicates a base year value.

2/ The \( t_{ij} \)'s have the specifications given in tables 2 and 3.
the services of the various factors of production and define their income. Equations 7 to 14 determine the institutional incomes: households, government and companies. They do also, because of the disaggregation, define households' disposable income, total, and discretionary expenditures. This is also the case for government current consumption and proceeds from indirect taxation. Equation 15 to 18 determine the savings and allocation of funds in the economy. Equation 15 defines total available savings from both national and foreign sources, while equations 16, 17 and 18 tell how much each of agriculture, industry and services gets out of total funds. Going further down the rows of the SAM, equations 19 to 21 determine the demands faced by each production sector. The latter are from both domestic and foreign sources. The demands for the services of autonomous factors of production are defined in equations 22 to 24. All equations from 25 to 36 are demands for various commodities by various sources. Finally equation 37 is a demand for foreign exchange.

The third set of equations in Table 6 defines quantities. There are \( m = 30 \) accounts with prices; hence the total outlays of each of these accounts can be expressed as \( y_j = p_j q_j \) which defines the quantities. The NENES models have thus \( m = 30 \) additional equations.

To each cell of the SAM of Table 3, a TV specification is assigned. Most of these specifications are explicit functions defining the behavior of the entry in terms of prices, values and parameters. These functions are equations defining the variables \( t_{ij} \). However a few cells are defined as residuals—government savings, the current account deficit, households discretionary expenditures. As residuals these entries have no independent equations defining them. Therefore to the 28 column equations, 37 row equations and 30 equations defining quantities, 88 equations explaining
transaction values can be added. In total the number of equations identified in the
foregoing is 183 = 28 + 37 + 30 + 88.

Let $y^r_i$, $y^c_i$ denote total receipts and outlays for account $i$, respectively. At equilibrium all accounts of the TV-SAM must balance implying: $y^r_i = y^c_i$, $i=1,2,...,37$. However if $n-1$ accounts balance, the $n^{th}$ will also be in equilibrium. This is a version of Walras Law which implies that no condition to balance the last account is required. Therefore out of the 183 equations identified in the preceding one need to be dropped. Hence the underdetermined system of equations in the models of the MENES class, as formulated in table 3, includes 188 variables and 182 equations.

6.2. The Choice of Models in the MENES Class

From the foregoing one model of the class will be identified by the imposition of six additional constraints. If one analyst believes that the economy under consideration has surplus labor and idle capital, and that it can borrow from abroad as much as it needs at a given exchange rate and invest as much as it wants then he would tend to fix the following variables:

- $p_1$ the wage,
- $p_2, p_3, p_5$ the rates of return on capital in the three sectors,
- $q^{15}$ real gross fixed capital formation,
- $p_{37}$ the exchange rate.

These additional constraints identify one particular model in the class corresponding to the views of the analyst. In so doing he would have chosen a Keynesian-type model, with fix-prices and where output is demand driven. It would describe a Factor Surplus Free to Borrow (FSFB) economy.

---

1/ There are 91 entries in the SAM and 3 cells defined as residuals hence $91 - 3 = 88$. 

---

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Take another analyst who would not believe that capital services are in perfectly elastic supply at the going rates of return. His view would rather be that capital services are a constraint on production implying increasing marginal costs. Then he would view the economy as a Labor Surplus Free to Borrow (LSFB) one. He would replace the exogenous rates of returns by exogenous capital services: \( q_2, q_3 \) and \( q_5 \).

Now assume that the supply of labor is limited; the economy is labor constrained and the wage clears the labor market. Then the price \( p_1 \) (the wage) becomes endogenous and the constraint is imposed through an exogenous determination of \( q_1 \) (labor supply). Such an economy can be described as Factor Constrained and Free to Borrow (FCFB).

Another view can be that: (i) the economy is not free to borrow abroad as much as it needs: foreign capital inflow is fixed in dollars; (ii) investment is savings determined (national and foreign); (iii) the exchange rate adjusts to equalize outflows and inflows of foreign exchange and (iv) the general price level is exogenously determined. Such an economy would be more neoclassical and can be described as Factor Constrained Borrowing Constrained (FCBC). The exogeneity of foreign capital inflow in dollars can be captured by changing in table three the specification of \( t_{15,37} \) from 2 to 8. In this case table 3 would imply 103 equations and not 132 as previously. It becomes thus necessary to determine only five additional constraints. In this FCBC economy, these will be:

\[
\begin{align*}
&- q_1 \quad \text{labor supply,} \\
&- q_2, q_3, q_5 \quad \text{supply of capital services.}
\end{align*}
\]

\[1/\text{ A residual is not an equation whereas } t_{1j} = t^0_{1j} f_{ij}(\theta) p_j x_i \text{ is one.}\]
the consumer price index.\(^1\)

All other variables, in particular investment and the exchange rate are now endogenous.

As may be clear from the foregoing, the TV approach limits the discussion of the choice of a model to two types of questions: (i) are the prices, quantities and (or) values associated with each account exogenous or endogenous and (ii) are there residuals in the specifications of the transaction values. In practice these questions have a definite economic content which facilitates the correspondence between the model and the views of the analyst. Furthermore the implementation of the model with the TV software will require a file of TV specifications (table 3) and a file of account types. This latter file will contain information on the endogeneity or exogeneity of the prices, quantities and values associated to each account. Thus moving from one model in the class to another will simply imply changing input data on these two files.

7. **The Taxation of Agricultural Exports in Three Models of the MENES Class**

In the last section four models are identified depending on the constraints the economy faces. In the following we illustrate the flexibility of the TV approach by analysing the effects of an increase of the tax rate on agricultural exports in three of the models outlined: (i) the LSFB - Labor Surplus Free to Borrow Economy; (ii) the FCFB - Factors Constrained Free to Borrow economy, and (iii) the FCBC - Factors Constrained Borrowing Constrained Economy.\(^2\) Table 7 presents the comparative statics of a 1% increase in the tax rate of agricultural exports.

---

\(^1\) One can choose to fix another price index.

\(^2\) Results corresponding to the FSFB economy can be found in Drud and Grais and Vujovic (1982).
### Table 7

Effects of an Increase in the Taxation of Agricultural Exports

<table>
<thead>
<tr>
<th>A 1% Increase in the Tax Rate on Agricultural Exports in a</th>
<th>LSFB Economy</th>
<th>FCFB Economy</th>
<th>FCBC Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP at Current Market Prices</td>
<td>-.0358</td>
<td>-.0185</td>
<td>.0004</td>
</tr>
<tr>
<td>GDP at Constant Market Prices</td>
<td>-.0288</td>
<td>-.0002</td>
<td>.0006</td>
</tr>
<tr>
<td>Employment</td>
<td>-.0410</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>Wage</td>
<td>.0</td>
<td>-.0268</td>
<td>-.0085</td>
</tr>
<tr>
<td>Investment</td>
<td>.0</td>
<td>.0</td>
<td>.0171</td>
</tr>
<tr>
<td>Household Income</td>
<td>-.0431</td>
<td>-.0264</td>
<td>-.0082</td>
</tr>
<tr>
<td>Household Savings</td>
<td>-.0433</td>
<td>-.0261</td>
<td>-.0084</td>
</tr>
<tr>
<td>Net Indirect Taxes</td>
<td>.0117</td>
<td>.0226</td>
<td>.0455</td>
</tr>
<tr>
<td>Government Revenue</td>
<td>-.0000</td>
<td>.0134</td>
<td>.0351</td>
</tr>
<tr>
<td>Imports:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>-.0289</td>
<td>-.0235</td>
<td>-.0178</td>
</tr>
<tr>
<td>Industry</td>
<td>-.0279</td>
<td>-.0158</td>
<td>.00094</td>
</tr>
<tr>
<td>Services</td>
<td>-.0531</td>
<td>-.0568</td>
<td>-.0611</td>
</tr>
<tr>
<td>Exports:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>-.1698</td>
<td>-.0910</td>
<td>-.0925</td>
</tr>
<tr>
<td>Industry</td>
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<td>.0391</td>
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<td>Services</td>
<td>.0195</td>
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<td>-.0281</td>
<td>.0178</td>
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<td>Gross Output:</td>
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<tr>
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<td>-.0213</td>
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<tr>
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<td>.0149</td>
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<tr>
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<td>.0076</td>
<td>.0065</td>
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<td>Prices of Domestically Produced:</td>
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<tr>
<td>Agriculture</td>
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<td>-.0265</td>
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<tr>
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<td>.0035</td>
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<td>Consumer Price Index</td>
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<tr>
<td>Exchange Rate</td>
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The first effect in the three economies is to depress agricultural exports. The final reduction in agricultural exports however varies according to the mechanisms contained in each model. In the LSFB economy, lower agricultural exports lead to lower agricultural activity which depresses directly agricultural employment and indirectly employment in the other sectors—the wage is fixed. The lower level of general activity leads to a drop in GDP and incomes. However these drops are not sufficient to compensate the negative effect on the current account deficit of the drop in exports.

In the FCFB economy the wage flexibility dampens the effects of the increase in the export tax rate. In particular it allows an increased competitiveness of the industrial sector which sees an expansion in its exports. The contraction of the agricultural sector is to a certain extent compensated by increases in non-agricultural exports. The current account deficit improves.

When foreign exchange is limited (the FCBG economy), the effect of an increase in the tax rate on agricultural exports is to depreciate the exchange rate which cuts in imports and helps exports. It also increases the domestic currency value of foreign savings, which in a savings driven model contributes to an increase in investment. The over-all level of activity does not vary significantly.

The comparison of the results of the three models shows how crucial for policy conclusions is the choice of the few additional constraints which will close the model. Alternative constraints at practically no cost, the TV approach and software introduce some discipline and objectivity in what can become interminable debates.

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1/ This is by now a generally well known fact which has been stressed by L. Taylor (1979). See also F. Lysy (1983).
8. Conclusions

The TV approach is seemingly an unusual way of looking at, formulating and implementing economywide models. Its strength is the systematic use of an accounting framework in the form of a SAD. The identification of accounting and modeling flows allows a clear explicitation of the magnitudes to be modelled and of their interrelationships. The TV approach introduces flexibility in the choice of a model; it makes models more transparent and easier to document and replicate; it facilitates the comparison of model results and actual data; it reduces the time and financial resources needed to develop an economywide model. These features should be attractive for any model builder and user.
References


