

# THE EITF WORLD ECONOMETRIC MODEL: A MULTISECTORAL APPROACH TO OUTPUT AND FOREIGN TRADE

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## Summary

A multisectoral global model was constructed on a 35 I-O sectoral basis in 1995 and has extensively been used for various policy analyses. The model, EITF, covers 29 countries and 7 regions with special reference to G7 and Asian countries. World trade can also be analyzed in the same sectoral categories, enabling the analysis of significant changes in foreign trade consistent with those for sectoral demand, output, factors such as labor and capital, and sectoral prices for each country. Major macroeconomic variables, exchange rates, price deflators, financial variables, and so on, are also endogenized in each country model.

Policy simulations are presented on a) US-Japan concerted action for world economic recovery, b) impact analysis of Japan's recession, c) Northeast Asia development cooperation, and d) the Asian currency crisis and the role of Japan contributing to the recovery of suffering Asian economies.

The EITF model is to be strengthened by expanding the number of countries to be disaggregated as their databases become available. Because the model addresses medium-range or long-range forecasts and policy analysis on a structural basis, such global issues as trade liberalization, new technologies, resource allocation for environmental purposes, and so on, will be analyzed with greater emphasis as the model improves.

## 1. Structure of the Model

A project to construct a multinational and multisectoral global model started in the late 1980s as a joint project among various Japanese institutions, including the International University of Japan, the Economic Research Institute for Northeast Asia (ERINA), and the University of Tsukuba, and various US institutions, especially the Project LINK research group. Most of the funding for the project has come from NIRA, MITI, and the Ministry of Education.

The global model presented here, the EITF, is one of two models, a less disaggregated version covering 36 countries and regions. A larger disaggregated version with 79 countries and regions, the NIRA-LINK model, been reported on several occasions and is under way in terms of trade and output for major countries other than Japan and the US. This larger global model, called the US-Japan-World Model, has been used for the analysis of US-Japan interdependence in the context of the global economy.

The EITF model covers 7 industrialized economies (G7), 9 Asian economies (A9), 13 other major countries, and 7 regions, as shown in Appendix 1 (see *Appendix 1: Countries in the EITF Model*).

Foreign trade flows are disaggregated on the basis of consistent input-output matrices with 35 sectors as specified in Appendix 2 (see *Appendix 2: Sectors Used in Foreign Trade Flows*).

For national models, sectoral disaggregation on a 35-sector basis was made for the G7 and the A9, while no such disaggregation was conducted for remaining economies except for exports and imports. The economic variables for the G7 and the A9 are sectoral output, investment, employment, producer prices, export and import, and conventional macroeconomic variables such as private and government consumption, government investment, disposable income, tax flows, deflators by categories, wage rates, interest rates, money supply, and international capital flows including foreign direct investment, and exchange rates. All the above variables are endogenized except government consumption and investment, and exchange rates for other industrial and developing economies. In other words, exchange rates are endogenized for the G7—except the US—with explanatory variables such as PPP (purchasing power parity), real interest rate, savings-investment ratio, and so on.

The model was constructed during the earlier period as a satellite system of the NIRA-LINK model and is called the EITF after the names of the four institutions engaged in its modeling: the ERINA, the International University of Japan (IUJ), the University of Tsukuba, and the Foundation for Advancement for International Science (FAIS). As an independent medium-size global model with disaggregated output and trade flows on a 35 sectoral basis, the EITF has been extensively used for various policy simulations (as described later) since 1995.

The theoretical framework of the model is of the Leontief-Keynesian type with price sensitive variables for both domestic and external markets. The model can be regarded in this sense as a general equilibrium type econometric model with a dynamic

adjustment property.

For each national model for the G7 and the A9 (Asian nine), common specifications were adopted for both macro and sectoral blocks. The macro block is of the conventional Keynesian type demand-oriented model with common monetary and fiscal equations. Fiscal and monetary blocks are interrelated through a deficit financing variable and interest payments by the government. For the sectoral (or input-output) block, the variables, whether related to volumes or prices, are determined within the framework of a Leontief type model as shown below.

$$DD_i = f((U_i + F_i), PX_i/PA) \quad (1)$$

$$U_i = \sum_j a_{ij} X_j \quad (i \neq j = 1, \dots, 35) \quad (2)$$

$$F_i = \sum_k b_{ik} (C + CG + IH + IP + IG + J) \quad (k=1, \dots, 5) \quad (3)$$

$$M_i = f(DD_i, PM_i/PX_i, M_{i-1}) \quad (4)$$

$$X_i = f((DD_i + E_i), PX_i/PA) \quad (5)$$

$$V_i = f(v_i X_i) \quad (6)$$

$$L_i = f(X_i, W/PX_i, L_{i-1}) \quad (7)$$

$$IP_i = f(X_i, PK/PX_i, \rho_i, IP_{i-1}) \quad (8)$$

$$PX_i = f(PU_i, W * L_i/X_i, \rho_i) \quad (9)$$

$$PU_i = \sum_j a'_{ij} PS_j \quad (10)$$

$$PS_i = (1 - \mu_i) PX_i + \mu_i PM_i \quad (11)$$

$$\mu_i = M_i / (DD_i + E_i) \quad (12)$$

$$\rho_i = X_i / X_i^c \quad (13)$$

where  $DD$  = domestic demand,  $U$  = intermediate demand,  $F$  = domestic final demand,  $PX$  = producer price,  $PA$  = absorption deflator,  $a$  = input-output coefficient of 1985,  $b$  = final expenditure component coefficient of 1985,  $X$  = output,  $C$  = private consumption,  $CG$  = government consumption,  $IH$  = housing investment,  $IP$  = business investment,  $IG$  = government investment,  $J$  = change in inventories,  $M$  = imports,  $PM$  = import price,  $E$

= exports,  $V$  = value added,  $v$  = value added ratio of 1985,  $L$  = number in employment,  $W$  = wage rate,  $PK$  = user cost of capital,  $\rho$  = the rate of capacity utilization,  $PU$  = unit input cost,  $a'$  = transposed matrix of  $a$ ,  $PS$  = supply price,  $\mu$  = import dependency,  $X'$  = capacity output.

The advantage of this type of multisectoral model is twofold: a) supply side constraints are more precisely specified, especially for primary sectors, energy producing sectors, transportation, and so on, and b) output prices and adjustment parameters for excess demand and supply in the commodity and factor markets are more easily modeled in an integrated system. The core parameters of this sectoral block are an  $a_{ij}$  matrix of the Leontief type in a benchmark year, 1985, which plays a dual role for linking a) demand and supply variables on one hand, and b) factor cost-price relationship on the other.

The above theoretical model based on integrated macro and sectoral blocks is a highly simplified version of a larger Japanese 64-sector model (JLM-G2) of the NIRA-LINK system, as mentioned earlier. As compared with the latter, the former model contains many fewer variables, but still has about 500 endogenous variables. Though not explicitly endogenized as in the latter model, the sectoral changes in productivity can be roughly analyzed, as shown later.

There have been many predecessors in sectoral modeling for single countries or multinational modeling. However, with the exception of Leontief and Carter in 1972, there has been no attempt to cover the whole world by a multisector model.

The feature of the EITF modeling in linking national models with world trade flows is to use the sectoral world trade matrix in 1985 on a 35-sector basis as a core for deriving proxy variables for bilateral exports, and then to estimate export share functions by country and commodity group. This submodel is specified below.

For simplicity, we take a specific sector or commodity group, say steel, for export and import functions of country  $j$ .

$$M_j = f(DD_j, PM_j/PX_j) \quad (i \neq j = 1, \dots, 36) \quad (14)$$

$$E_{ij}^* = m_{ij} M_j \quad (15)$$

$$E_i^* = \sum_j E_{ij}^* \quad (16)$$

$$E_i/E^w = f(E_i^*/E^w, PE_i/PE^w) \quad (17)$$

$$E^w = \sum_i E_i = \sum_j M_j = \sum_i E_i^{*w} \quad (18)$$

$$PM_j = f\left(\sum_i m_{ij} \cdot PE_i\right) \quad (19)$$

$$\sum_j PM_j \cdot M_j = \sum_i PE_i \cdot E_i \quad (20)$$

where  $m_{ij}$  = import share of country  $i$ 's product in the total imports of country  $j$  for a specific sector in 1985 ( $1 = \sum_i m_{ij}$ ),  $PE$  = export price,  $E^w$  = world exports,  $E^*$  = proxy of bilateral exports, and  $E^w$  = world exports.

If the steel sector of country  $i$  succeeds in cutting its costs as a result of technical progress, the share of country  $i$  in steel exports tends to rise, thus reducing the shares of competitors. In terms of macro variables, the rise in steel exports stimulates domestic production, employment, and investment in the same sector, thus increasing private consumption and business investment in steel-related sectors, and so on. A deflationary impact is likely to be felt in competitor countries from the fall in exports, output, and employment in the steel industry. This causal chain clearly indicates a strong interrelationship between a trade matrix of steel and a macroeconomic block.

Export share functions thus generate noticeable changes in the world export market, such as a rise in steel exports in NICs and its gradual fall in advanced industrial countries.

## 2. Policy Scenarios

The EITF model has been extensively used for policy scenarios since 1995—among which major ones are presented here to show the model's property and the policy simulations.

In the following we present several alternative policy scenarios in the context of the global economy.

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### Biographical Sketch

**Shuntaro Shishido** is Vice-President and Director General, Economic Research Institute for Northeast Asia (ERINA). He is also Emeritus Professor of the University of Tsukuba, Emeritus Professor of International University of Japan, Vice-Chairman Pan Pacific Association of Input-Output Study, and Chairman, Council of National Accounts, Economic Planning Agency. During the period from 1987 to 1995, he served as President, International University of Japan (IUJ). He served as Professor and Vice President of the University of Tsukuba for the period from 1974 to 1987, and was Special Advisor to the Minister, Economic Planning Agency, and the Japanese government during 1973–1974. He has held membership in the following academic societies: International Econometric Association, International

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