STRUCTURAL CHANGES IN THE INDONESIAN ECONOMY: A NETWORK COMPLICATION APPROACH

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Structural Changes in the Indonesian Economy: A Network Complication Approach

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Abstract: Using a time series of social accounting matrices (SAMs) for Indonesia, an exploratory analysis is conducted to explore some of the more important structural changes in that nation's economy. By adopting a block structural path analysis, attention was directed to the network complication engendered by gradually exploring links between one subsystem in the SAMs and the remaining systems. Important changes in the structure of production were revealed but the dominant changes appeared to lie in the distribution of income between factors, especially the growing importance of labor income and the concomitant change in consumption as incomes have risen. The effects of the 1997 financial crisis was discernible but the long-term implications remain to be explored.

1 Introduction

Earlier work of Sonis *et al*. (1997a,b) explored structural changes in the Indonesian economy by analyzing the change of output in each path and the change in the hierarchy of direct coefficients of production activities. Using a series of Indonesian social accounting matrices (SAM) for 1975-1985 consisting of five aggregated sectors, they found that block structural path analysis (BSPA) proved to be useful in contributing to the basic understanding of the processes of change within a social accounting framework. BSPA methodology was proposed as a complement, not as a replacement to the more familiar forms of structural path analysis (SPA) as suggested by Khan and Thorbecke (1988), Defourny and Thorbecke (1984) that focused on the micro level analysis of individual paths.

The present paper extends the analysis to explore the impact of the mid-1997 monetary crisis that resulted in the contraction of the economy from 4.7% growth in GDP in 1997 to a decline of 13.2% in 1998. Over the same time period, the construction sector declined 40.5%, financial services decreased 26.6%, trade, hotel & restaurant by 18.0%, and transportation by 15.1%. The manufacturing sector's decline was more modest, 11.9%, while agriculture sector maintained positive growth, even gaining 13.0% in the peak of the crisis. Over the period 1975-95 when average economic growth reached 6 to 7% annually, and income per capita rose by 4-5%, the economy experienced a declining share of the agricultural sector, the increasing contribution of manufacturing industries to GDP (see figure 1).

<<insert figure 1 here>>

Hence, the goal of this paper is to explore the observed changes in the Indonesian economy as a precursor to the development of more formal models that could simulate these changes. In the next section of the paper, some of the major issues are raised to guide the exploration of changes. Section 3 describes the methodology to be employed; section 4 presents the empirical applications with their interpretation documented in section 5.

2 Issues to be Addressed

Many tools of analysis have been developed to identify the changes of the structure, such as the *growth and size elasticity model* developed by Chenery and Syrquin (1975) using cross-section analysis of the countries. Hewings *et al.* (1998a, 1998b) noted that the progress of development might be associated with the deepening of the interaction among sectors. When the economy is in the early stage of maturity, the degree of intermediation of production will change; one might expect intra-economy flows to grow more rapidly than extra-economy transactions. It appears that at some points, the level of intermediation reaches an upper bound and then may decline.[1] Using a SAM framework, Defourny and Thorbecke (1984) proposed structural path analysis (SPA) as a methodology to identify structural changes by focusing on paths of influence between sectors that may be termed to be globally important.

This interpretation focuses at a very detailed level and reveals the connections that provide greater influence to other sectors of destination through the network of paths in the SAM. SPA emphasizes the role of the individual sector and path in an economic system. Using SPA in the SAM framework of Indonesia 1999, Azis (2000, 2001) studied the impact of the financial crisis on income distribution and extended the methodology into a computable general equilibrium analysis (CGE).

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[1] The decline is associated with a hollowing out process (see Okazaki, 1989; Hewings *et al*., 1998b)

This paper seeks to uncover the pattern of the structural changes in the Indonesian economy during the period 1975-1999, particularly on income distribution and the changes in the composition of production activities. Since no formal behavioral model will be developed, it will not be possible to provide the type of causal documentation that might be derived from a computable general equilibrium model; in essence, the search in this paper will attempt to document what happened and to try to trace potential causal links.

3 Analytical Framework

The hypotheses to be explored will require an evaluation of changes in the network structure of the Indonesian economy. The analysis will rest on the notion of network complication – essentially, an uncovering of the way in which interdependence between components of the economy can be "built up" as more loops of direct and indirect interaction are considered. To accomplish this task, the notion of internal, external multipliers and the notion of augmentation of a multiplier will be presented. The process of network complication will be evaluated by exploring the influence of changes in a subsystem on other subsystems and the whole system, using block structural path analysis (BSPA) developed by Sonis and Hewings (1997b, 1998). Prior to the elaboration of BSPA as the main tool of analysis, structural path analysis (SPA) will be summarized to discuss how this method can be used to explain the structural changes in an economy and how it differs from BSPA.

3.1 Structural Path Analysis (SPA)

The comprehensiveness of the SAM method as a data system that captures the circular interdependency of economic subsystems has made it an attractive tool to capture the global (direct and indirect) effects of injections from exogenous variables on endogenous variables can be measured. For example, the analyst might be interested in the magnitude of the effects that will be driven by food crops export (initial injection) on the income of urban and rural households respectively (destination, endogenous account), in which the initial injection travels through corresponding production activities and is then transmitted to various labor types, and then to the destination of interest (figure 2).

<<insert figures 2,3 here>>

While the analysis of the structural changes in the economy using SPA focuses the attention on individual sector with a highly disaggregated matrix, the BSPA offers a more macro perspective to trace the magnitude of the influence departing from an initial injection of an economic subsystem in a way such that the transfer of influence to other corresponding economic subsystems provides feedback loop effects on other corresponding subsystems – an augmentation process in the whole economic system. Figure 3 provides a conceptual overview of the main distinctions between the two complementary approaches to network analysis within a SAM.

3.2 Block Structural Path Analysis (BSPA)

To address the research questions, the elaboration of the BSPA will be organized into three sections that describe and trace the evolution of feedback loop effects from a simple two-region case to a more complex of synergetic effects. The first part focuses the attention on the notion of internal multiplier, external multiplier and augmented multiplier, combined with Schur (1917) and Banachiewics (1937) notion of the inversion of a 2 x 2 matrix. The decomposition of three economic subsystems will be discussed in the second part; in the third part, the partial Leontief inverse in a SAM framework will be discussed to separate the influence of an economic subsystem from other subsystems.

a) Two-Region Extended Leontief Multiplier[2]

The linkages between Miyazawa (1976), Yamada and Ihara (1969), Ihara (1999), Schur (1917) Banachiewics (1937), and Sonis *et al*. (1998a) on the idea of self influence, transfer of influence, and augmentation of influence can be explained in a 2 x 2 matrix that represents intra and interregional flows in a two-region (or two-fold division of a single economy) system in the following way:

$$A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \tag{1}$$

where, A_{11} and A_{22} are the square matrices of direct inputs within the first and second regions and A_{12} and A_{21} are the rectangular matrices showing the direct inputs purchased by the second region and vice versa. It is also possible to consider the case where the second region represents

[2] The methodology in this section is heavily drawn from Sonis (1999) with some change in notation.

the rest of the economy. The basic idea of interaction between the two regions can be developed into the interaction between the block sectors within a single region. The corresponding Leontief inverse matrix, $B = (I - A)^{-1}$, has the following block form (the superscripts II on the ***B***'s indicate the number of regions (2) in *B* or the cell that has been augmented from the interaction process). The matrix for two-region case is simplified as:

$$B = \begin{bmatrix} B_{11}^{II} & B_{12}^{II} \\ B_{21}^{II} & B_{22}^{II} \end{bmatrix} \quad (2)$$

The multiplier matrix (2) can be interpreted further with the help of the Schur-Banachiewicz formula (Schur, 1917; Banachiewicz, 1937; Miyazawa, 1966; Sonis and Hewings, 1993):

$$B = \begin{bmatrix} B_{11}^{II} & B_{11}^{II} A_{12} B_2 \\ B_{22}^{II} A_{21} B_1 & B_{22}^{II} \end{bmatrix} = \begin{bmatrix} B_{11}^{II} & B_1 A_{12} B_{22}^{II} \\ B_2 A_{21} B_{11}^{II} & B_{22}^{II} \end{bmatrix} \quad (3)$$

where, matrices $B_1 = (I - A_{11})^{-1}$ and $B_2 = (I - A_{22})^{-1}$ represent the Miyazawa internal matrix multipliers for the first and second regions (revealing the interindustry propagation effects within the region) while the matrices $A_{21}B_1, B_1A_{12}, A_{12}B_2$, and B_2A_{21} show the induced effects on output or input between the two regions (Miyazawa, 1966). The Schur-Banachiewicz procedure provides the notion of an augmented process received by a node in the process of interaction. For the two-region case as represented by previous 2 x 2 matrix, input A_{11} is augmented by the transfer of influence through $A_{12}B_2A_{21}$; and similarly A_{22} is augmented through $A_{21}B_1A_{12}$ such that:

$$\begin{aligned} S_1 &= A_{11} + A_{12}B_2A_{21} \\ S_2 &= A_{22} + A_{21}B_1A_{12} \end{aligned} \quad (4)$$

In equation (4), $A_{11,}A_{22}$ are the direct input for region 1 and 2 respectively that circulate within each region, and $A_{12}B_2A_{21}, A_{21}B_1A_{12}$ represents the *economic self-influence transactions* as the result of feedback effect of one region to other region and back to the first region. The Schur (1917) complements, S_1, S_2 may be considered as analogous to Yamada and Ihara's (1969) notion of augmented inputs. The inverse of Schur's augmented input (2.7) is termed as an *extended Leontief multiplier* in the form:

$$B_{11}^{II} = \left(I - A_{11} - A_{12}B_2A_{21}\right)^{-1}$$
$$B_{22}^{II} = \left(I - A_{22} - A_{21}B_1A_{12}\right)^{-1} \qquad (5)$$

The evolution of the Leontief extended multiplier provides an important basis for interpreting the notion of *economic direct influence*, *induced self-influence* and *augmented influence* that were proposed by Miyazawa (1966), Yamada and Ihara (1969), Sonis and Hewings (1998a). The linkage among those various types of influences is displayed in figure 4.

<<insert figure 4 here>>

At the meso-level of regions, the augmentation of inputs could be further interpreted as *the economic self-influence* and *the transfer of economic influence* from region to region (Sonis and Hewings, 1998); the extended Leontief inverse corresponds to a structural path of economic self-influence. In order to separate the influence of internal and external multiplier that represent direct and induced self-influences, the Leontief inverse can be decomposed by using Miyazawa decomposition.

$$B_{11}^{II} = B_1B_{11}^{IIR} = B_{11}^{IIL}B_1$$
$$B_{22}^{II} = B_2B_{22}^{IIR} = B_{22}^{IIL}B_2 \qquad (6)$$

where,

$$B_{11}^{IIL} = \left(I - B_1A_{12}B_2A_{21}\right)^{-1}; \quad B_{11}^{IIR} = \left(I - A_{12}B_2A_{21}B_1\right)^{-1}$$
$$B_{22}^{IIL} = \left(I - B_2A_{21}B_1A_{12}\right)^{-1}; \quad B_{22}^{IIR} = \left(I - A_{21}B_1A_{12}B_2\right)^{-1} \qquad (7)$$

are the left and right Miyazawa external self-influence multipliers for the first and second region. A structural path of self-influence corresponding to the analytical structure of the multipliers is shown in (8). The transfer of economic influence from one region to the other is presented by the block-components of the Leontief block inverse. The Miyazawa fundamental equations are:

$$B_{12}^{II} = B_{11}^{II}A_{12}B_2 = B_1A_{12}B_{22}^{II}$$
$$B_{21}^{II} = B_{22}^{II}A_{21}B_1 = B_2A_{21}B_{11}^{II} \qquad (8)$$

As shown in figure 4, the self-influence and transfer of influence augmentation process at the meso-level of regions represent the building blocks of the economic interactions between the economic subsystems. Each regional subsystem generates a decomposition of the Leontief block inverse into the product of partial Leontief inverses corresponding to the chosen regional subsystem. For example, the following formulae represent explicitly the separation of the direct and indirect self-influence and transfer of influence in the form of a triple decompositions that separates multiplicatively the effects of intra-regional economic relationships of isolated regional economies, $\begin{bmatrix} B_1 & 0 \\ 0 & B_2 \end{bmatrix}$, the intra/interregional feedback effects on the level of direct inputs, $\begin{bmatrix} I - A_{11} & A_{12} \\ A_{21} & I - A_{22} \end{bmatrix}$ and the intra-regional economic dependencies of interacting regions $\begin{bmatrix} B_{11}^{II} & 0 \\ 0 & B_{22}^{II} \end{bmatrix}$:

$$\begin{aligned} B &= \begin{bmatrix} B_{11}^{II} & 0 \\ 0 & B_{22}^{II} \end{bmatrix} \begin{bmatrix} I - A_{11} & A_{12} \\ A_{21} & I - A_{22} \end{bmatrix} \begin{bmatrix} B_1 & 0 \\ 0 & B_2 \end{bmatrix} = \\ &= \begin{bmatrix} B_1 & 0 \\ 0 & B_2 \end{bmatrix} \begin{bmatrix} I - A_{11} & A_{12} \\ A_{21} & I - A_{22} \end{bmatrix} \begin{bmatrix} B_{11}^{II} & 0 \\ 0 & B_{22}^{II} \end{bmatrix} \end{aligned} \tag{9}$$

Equation (9) provides the block matrix analog of the decompositions (8) of the transfer of economic influence. The application of the Miyazawa decompositions (6) of the extended Leontief inverses into the product of external/internal multipliers provides further possibilities for construction of another block matrix analog of (9).

$$\begin{aligned} B &= \begin{bmatrix} B_{11}^{L} & 0 \\ 0 & B_{22}^{L} \end{bmatrix} \begin{bmatrix} I & B_1 A_{12} \\ B_2 A_{21} & I \end{bmatrix} \begin{bmatrix} B_1 & 0 \\ 0 & B_2 \end{bmatrix} = \\ &= \begin{bmatrix} B_1 & 0 \\ 0 & B_2 \end{bmatrix} \begin{bmatrix} I & A_{12} B_2 \\ A_{21} B_1 & I \end{bmatrix} \begin{bmatrix} B_{11}^{R} & 0 \\ 0 & B_{22}^{R} \end{bmatrix} \end{aligned} \tag{10}$$

b) Decomposition of Three Economic Subsystems

Sonis and Hewings (1998a) extended the idea of self-influence and induced self-influence for a SAM in similar fashion to the decomposition of three regions into subsystems. A general form of direct coefficient A, exogenous demand d and total output x for SAM framework is given as:

$$A=\begin{bmatrix}0 & 0 & A_{13}\\ A_{21} & A_{22} & 0\\ 0 & A_{32} & A_{33}\end{bmatrix};\quad d=\begin{bmatrix}0\\ d_I\\ d_A\end{bmatrix};\quad x=\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} \tag{11}$$

The subscripts refer, respectively, to the usual tripartite division of a social accounting matrix into submatrices of (1) factors, (2) institutions and (3) activities. The following decomposition of A may be presented:

$$A=\begin{pmatrix}0 & 0 & 0\\ A_{21} & 0 & 0\\ 0 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & 0\\ 0 & A_{22} & 0\\ 0 & A_{32} & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & A_{13}\\ 0 & 0 & 0\\ 0 & 0 & A_{33}\end{pmatrix}= \\ = A_1+A_2+A_3 \tag{12}$$

where, matrices A_1, A_2, A_3 represent the direct inputs into factors, institutions and activities separately from which a decomposed inverse can be presented:

$$B=\left(I-A\right)^{-1}=G_3G_2G_1 \tag{13}$$

Decomposition (13) differs from multiplicative decomposition of Pyatt and Round (1979) that is primarily purposed to recognize own direct-effect, indirect self-influence and synergic cross effect by dividing matrix A into the diagonal and off-diagonal elements and exploiting the properties of permutation matrices.

$$\left(I-A\right)^{-1}=M_3M_2M_1 \tag{14}$$

where,

$M_1=\left(I-A_1\right)^{-1}$ own direct effect

$M_2=\left\{I-\left[(I-A_1)A_2\right]^3\right\}^{-1}$ indirect self influence

$M_3=I+(I-A_1)A_2+\left[(I-A_1)A_2\right]^2$ synergetic cross effects

Defourny and Thorbecke (1984) proposed an additive decomposition for tracing the influence of economic subsystem:

$$\left(I-A\right)^{-1}=I+\left(M_1-I\right)+\left(M_2-I\right)M_1+\left(M_3-I\right)M_2M_1 \tag{15}$$

Sonis and Hewings (1998a) converted the additive decomposition (10) into a multiplicative form of a block matrix of direct inputs for three-region or economic subsystems:

$$A = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \tag{16}$$

The corresponding Leontief inverse is shown as:

$$B = \left(I - A\right)^{-1} = \begin{bmatrix} B_{11}^{III} & B_{12}^{III} & B_{13}^{III} \\ B_{21}^{III} & B_{22}^{III} & B_{23}^{III} \\ B_{31}^{III} & B_{32}^{III} & B_{33}^{III} \end{bmatrix} \tag{17}$$

However matrix (17) does not separate the influence of economic subsystems from other sub-systems and economic system as the whole. The three-region case or three-block of economic subsystem should again refer to the basic concept of the Schur-Banachiewicz inverse for a pair of sub-systems.

Consider the row and column along A_{33} in equation (16) represent the domain of economic subsystem (3). The formation of the partial block matrix, for example, the pair of subsystems (1) and (2) is the domain of subsystem (3). Consider the Schur-Banachiewicz related form defined as (*S*). The direct inputs for the pair is written as:

$$A(S) = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \tag{18}$$

The corresponding partial Leontief inverse is written as:

$$\begin{aligned} B(S) = \left[I - A(S)\right]^{-1} &= \begin{bmatrix} B_{11}^{II}(S) & B_{12}^{II}(S) \\ B_{21}^{2}(S) & B_{22}^{2}(S) \end{bmatrix} = \\ &= \begin{bmatrix} B_{11}^{II}(S) & B_{11}^{II}(S)A_{12}B_{2} \\ B_{22}^{2}(S)A_{21}B_{1} & B_{22}^{II}(S) \end{bmatrix} = \begin{bmatrix} B_{11}^{II}(S) & B_{1}A_{12}B_{11}^{II}(S) \\ B_{2}A_{21}B_{22}^{II}(S) & B_{22}^{II}(S) \end{bmatrix} \end{aligned} \tag{19}$$

Based on the partial Leontief inverse for pair (1, 2), the element of the Schur-Banachiewincz inverse matrix in a three-region subsystem can be written as the following (see proofs, see Sonis and Hewings, 1998):

$$B = \begin{bmatrix} B_{11}^{III} & B_{11}^{III} A_{12}^{III} B_{22}^{II}(1) & B_{11}^{III} A_{13}^{III} B_{33}^{II}(1) \\ B_{22}^{III} A_{21}^{III} B_{11}^{II}(2) & B_{22}^{III} & B_{22}^{III} A_{23}^{III} B_{33}^{II}(2) \\ B_{33}^{III} A_{31}^{III} B_{11}^{II}(3) & B_{33}^{III} A_{32}^{III} B_{22}^{II}(3) & B_{33}^{III} \end{bmatrix} \quad (20)$$

with the Yamada and Ihara (1969) augmented inputs:

$$A_{ij}^{III} = A_{ij} + A_{is} B_s A_{sj} \qquad i \neq j, i \neq s, j \neq s; i, j, s = 1,2,3 \quad (21)$$

and the extended regional Leontief inverses:

$$B_{ii}^{III} = \left[I - A_{ii} - A_{ij} B_{jj}^{II}(i) A_{ji}^{III} - A_{is} B_{ss}^{II}(i) A_{si}^{III} \right]^{-1} \qquad i \neq j, i \neq s, j \neq s; i, j, s = 1,2,3 \quad (22)$$

The corresponding augmented Schur complement presents the trans-subsystem economic self-influence at the meso-level of subsystems:

$$S_i = A_{ii} + A_{ij} B_{jj}^{II}(i) A_{ji}^{III} + A_{is} B_{ss}^{II}(i) A_{si}^{III} \quad (23)$$

The augmentation of inputs (21) leads to the detailed structure of augmentation in the Schur complement (23):

$$\begin{aligned} S_i = {} & A_{ii} + A_{ij} B_{jj}^{II}(i) A_{ji} + A_{is} B_{ss}^{II}(i) A_{si} + \\ & + A_{ij} B_{jj}^{II}(i) A_{js} B_s A_{si} + A_{is} B_{ss}^{II}(i) A_{sj} B_j A_{ji} \qquad i \neq j, i \neq s, j \neq s; i, j, s = 1,2,3 \end{aligned} \quad (24)$$

Thus, in the three-account system, the economic self-influence may be seen to comprise the superposition of (i) circulation (direct self-influence); (ii) self-influence generated through bilateral subsystem interdependencies and (iii) self-influence promoted by tri-lateral subsystem interdependencies. The expressions (23) and (24) reflect the existence of a nested hierarchy of different levels of augmentation represented in the recursive form in (20); in a sense, the process resembles the Matrioshka idea introduced by Sonis and Hewings (1991). Furthermore, the generalization of the Miyazawa fundamental equations (8) for the case of three subsystems also has a recursive form, with the transfer of influence from susbsystem j to i defined as:

$$B_{ij}^{II} = B_{ii}^{III} A_{ij}^{III} B_{jj}^{II}(i) = B_{ii}^{II}(j) A_{ij}^{III} B_{jj}^{III} \qquad i \neq j, i, j = 1,2,3 \quad (25)$$

Moreover, the augmented Schur complement (14) can also be written as:

$$S_i = A_{ii} + A_{ij}^{III} B_{jj}^{II}(i) A_{ji} + A_{is}^{III} B_{ss}^{II}(i) A_{si} \quad (26)$$

The expressions (25) and (26) offer the option of presenting the Leontief inverse for the three-account system in an alternative form:

$$B = \begin{bmatrix} B_{11}^{III} & B_{11}^{II}(2)A_{12}^{II}B_{22}^{II} & B_{11}^{II}(3)A_{13}^{III}B_{33}^{III} \\ B_{22}^{II}(1)A_{21}^{III}B_{11}^{III} & B_{22}^{III} & B_{22}^{II}(3)A_{23}^{III}B_{33}^{III} \\ B_{33}^{II}(1)A_{31}^{III}B_{11}^{III} & B_{33}^{II}(2)A_{32}^{III}B_{22}^{III} & B_{33}^{III} \end{bmatrix} \tag{27}$$

Thus, the following generalization of the Miyazawa external and internal multipliers holds:

$$B_{ii}^{III} = B_i B_{ii}^{IIIR} = B_{ii}^{IIIL} B_i \tag{28}$$

where,

B_{ii}^{IIIR} and B_{ii}^{IIIL} are the right and left external self-influence multipliers for subsystem i:

$$\begin{aligned} B_{ii}^{IIIR} &= \left[I - A_{ij}B_{jj}^{II}(i)A_{ji}^{III}B_i - A_{is}B_{ss}^{II}(i)A_{si}^{III}B_i \right]^{-1} \\ B_{ii}^{IIIL} &= \left[I - B_iA_{ij}B_{jj}^{II}(i)A_{ji}^{III} - B_iA_{is}B_{ss}^{II}(i)A_{si}^{III} \right]^{-1} \end{aligned} \tag{29}$$

The generalizations (28) and (29) can be transferred from the meso-level of subsystems to the higher macro-level of the inner and outer left and right block matrix multipliers. For example, for the left multipliers:

$$\begin{aligned} B &= \begin{bmatrix} B_{11}^{III} & 0 & 0 \\ 0 & B_{22}^{III} & 0 \\ 0 & 0 & B_{33}^{III} \end{bmatrix} \begin{bmatrix} I & A_{12}^{III}B_{22}^{II}(1) & A_{13}^{II}B_{33}^{II}(1) \\ A_{21}^{III}B_{11}^{II}(2) & I & A_{23}^{II}B_{33}^{II}(2) \\ A_{31}^{III}B_{11}^{II}(3) & A_{32}^{III}B_{22}^{II}(3) & I \end{bmatrix} = \\ &= \begin{bmatrix} B_{11}^{IIIL} & 0 & 0 \\ 0 & B_{22}^{IIIL} & 0 \\ 0 & 0 & B_{33}^{IIIL} \end{bmatrix} \begin{bmatrix} B_1 & 0 & 0 \\ 0 & B_2 & 0 \\ 0 & 0 & B_3 \end{bmatrix} \begin{bmatrix} I - A_{11} & A_{12}^{III}B_{22}^{IIL}(1) & A_{13}^{III}B_{33}^{IIL}(1) \\ A_{21}^{III}B_{11}^{IIL}(2) & I - A_{22} & A_{23}^{III}B_{33}^{IIL}(2) \\ A_{31}^{III}B_{11}^{2L}(3) & A_{32}^{III}B_{22}^{IIL}(3) & I - A_{33} \end{bmatrix} \begin{bmatrix} B_1 & 0 & 0 \\ 0 & B_2 & 0 \\ 0 & 0 & B_3 \end{bmatrix} \end{aligned} \tag{30}$$

c) Partial Leontief Inverse in the SAM framework

The purpose of partial block matrices of direct inputs for the three pairs of blocks (institution, activities), (activities, factors), (factors, institutions) is to separate their influence on other pairs of blocks. Consider the block pair, institutions, activities, as follows:

1) The pair institutions and production activities:

$$A_{I,A} = \begin{bmatrix} A_{22} & 0 \\ A_{32} & A_{33} \end{bmatrix} \quad (31)$$

The corresponding partial Leontief inverse is formulated as:

$$B_{I,A} = \left[I - A_{I,A} \right]^{-1} = \begin{bmatrix} B_2 & 0 \\ B_3 A_{32} B_2 & B_3 \end{bmatrix} \quad (32)$$

where, $B_2 = \left(I - A_{22} \right)^{-1}$ and $B_3 = \left(I - A_{33} \right)^{-1}$;

2) The pair, factors, activities:

$$A_{F,A} = \begin{bmatrix} 0 & A_{13} \\ 0 & A_{33} \end{bmatrix} \quad (33)$$

The corresponding partial Leontief inverse of the pair factors and activities is:

$$B_{F,A} = \left[I - A_{F,A} \right]^{-1} = \begin{bmatrix} I & A_{13} B_3 \\ 0 & B_3 \end{bmatrix} \quad (34)$$

3) The pair, factors, institutions:

$$A_{F,I} = \begin{bmatrix} 0 & 0 \\ A_{21} & A_{22} \end{bmatrix} \quad (35)$$

with the corresponding partial Leontief inverse:

$$B_{F,I} = \left[I - A_{F,I} \right]^{-1} = \begin{bmatrix} I & 0 \\ B_2 A_{21} & B_2 \end{bmatrix} \quad (36)$$

Define the augmented inputs proposed by Yamada and Ihara (1969):

$$A_{ij}^{III} = A_{ij} + A_{is} B_s A_{sj} \qquad i \neq j, i \neq s, j \neq s; i, j, s = 1, 2, 3 \quad (37)$$

and the extended regional Leontief inverses:

$$B_{ii}^{III} = \left[I - A_{ii} - A_{ij} B_{jj}^{II}(i) A_{ji}^{III} - A_{is} B_{ss}^{2}(i) A_{si}^{III} \right]^{-1} \qquad i \neq j, i \neq s, j \neq s; i, j, s = 1, 2, 3 \quad (38)$$

Augmented input of the blocks in the SAM are:

$$A_{12}^{III} = A_{13}B_3A_{32}; \quad A_{13}^{III} = A_{13};$$
$$A_{21}^{III} = A_{21} \quad ; \quad A_{23}^{III} = A_{21}A_{13}; \tag{39}$$
$$A_{31}^{III} = A_{32}B_2A_{21}; \quad A_{32}^{3} = A_{32}$$

The extended self-influence Leontief inverses at the meso level of the major divisions are:

$$B_{11}^{III} = \left[I - A_{13}B_3A_{32}B_2A_{21}\right]^{-1}$$
$$B_{22}^{III} = \left[I - A_{22} - A_{21}A_{13}B_3A_{32}\right]^{-1} \tag{40}$$
$$B_{33}^{III} = \left[I - A_{33} - A_{32}B_2A_{21}A_{13}\right]^{-1}$$

The corresponding augmented complements:

$$S_1 = A_{13}B_3A_{32}B_2A_{21}$$
$$S_3 = A_{22} + A_{21}A_{13}B_3A_{32} \tag{41}$$
$$S_3 = A_{33} + A_{32}B_2A_{21}A_{13}$$

have the economic network structure associated with the blocks A_{22}, A_{33} and with the components of the quasi-permutation matrix of direct inputs:

$$P = \begin{bmatrix} 0 & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & 0 \end{bmatrix} \tag{42}$$

This matrix represents the macro level feedback loop of the transfer of economic influence between factors, institutions and activities. Drawing on (39), the Leontief inverse for this SAM has a form:

$$B = \begin{bmatrix} B_{11}^{III} & A_{13}B_3A_{32}B_{22}^{III} & A_{13}B_{33}^{III} \\ B_2A_{21}B_{11}^{III} & B_{22}^{III} & B_2A_{21}A_{13}B_{33}^{III} \\ B_3A_{32}B_2A_{21}B_{11}^{III} & B_3A_{32}B_{22}^{III} & B_{33}^{III} \end{bmatrix} =$$
$$= \begin{bmatrix} I & A_{13}B_3A_{32} & A_{13} \\ B_2A_{21} & I & B_2A_{21}A_{13} \\ B_3A_{32}B_2A_{21} & B_3A_{32} & I \end{bmatrix} \begin{bmatrix} B_{11}^{III} & 0 & 0 \\ 0 & B_{22}^{III} & 0 \\ 0 & 0 & B_{33}^{3} \end{bmatrix} \tag{43}$$

Here, the diagonal matrix:

$$D_3 = \begin{bmatrix} B_{11}^{III} & 0 & 0 \\ 0 & B_{22}^{III} & 0 \\ 0 & 0 & B_{33}^{III} \end{bmatrix} \quad (44)$$

represents the macro level of economic self-influence within the factors, institutions and activities, and the block multiplier:

$$M = \begin{bmatrix} I & A_{13}B_3A_{32} & A_{13} \\ B_2A_{21} & I & B_2A_{21}A_{13} \\ B_3A_{32}B_2A_{21} & B_3A_{32} & I \end{bmatrix} \quad (45)$$

represents the macro level transfer of influence. It is important to stress that the quasi-permutation matrix *P* represents the building block of this macro level transfer of influence:

$$M = \begin{bmatrix} I & A_{13}B_3A_{32} & A_{13} \\ B_2A_{21} & I & B_2A_{21}A_{13} \\ B_3A_{32}B_2A_{21} & B_3A_{32} & I \end{bmatrix} = \begin{bmatrix} I & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & I \end{bmatrix} + \begin{bmatrix} I & 0 & 0 \\ 0 & B_2 & 0 \\ 0 & 0 & B_3 \end{bmatrix}\begin{bmatrix} 0 & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & 0 \end{bmatrix} + \\ + \begin{bmatrix} 0 & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & 0 \end{bmatrix}\begin{bmatrix} I & 0 & 0 \\ 0 & B_2 & 0 \\ 0 & 0 & B_3 \end{bmatrix}\begin{bmatrix} 0 & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & 0 \end{bmatrix} = I + D_2P + PD_2P \quad (46)$$

where,

$$D_2 = \begin{bmatrix} I & 0 & 0 \\ 0 & B_2 & 0 \\ 0 & 0 & B_3 \end{bmatrix} \quad (47)$$

is the diagonal block matrix of the direct self-influence of factors, institutions and activities. Thus, the SAM inverse has the following form, including the macro level direct and extended self-influence associated with the block diagonal matrices, D_2 and D_3 and the macro transfer of influence, *P*:

$$B = MD_3 = \left[I + D_2P + PD_2P \right] D_3 \quad (48)$$

At the meso level for the major divisions of the economy, the compacted form of endogenous block matrix B and final demand d can be shown as:

$$Bd = \begin{bmatrix} B_{11}^{III} & A_{13}B_3A_{32}B_{22}^{III} & A_{13}B_{33}^{III} \\ B_2A_{21}B_{11}^{III} & B_{22}^{III} & B_2A_{21}A_{13}B_{33}^{III} \\ B_3A_{32}B_2A_{21}B_{11}^{III} & B_3A_{32}B_{22}^{III} & B_{33}^{III} \end{bmatrix} \begin{bmatrix} 0 \\ d_I \\ d_A \end{bmatrix} = \\ = \begin{bmatrix} A_{13}B_3A_{32} \\ I \\ B_3A_{32} \end{bmatrix} B_{22}^{III} d_I + \begin{bmatrix} A_{13} \\ B_2A_{21}A_{13} \\ I \end{bmatrix} B_{33}^{III} d_A \quad (49)$$

The expression (49) reveals the major paths of influence in the transmission of economic impulses at the meso level of the SAM, rather than drawing attention to the individual path. Within the blocks, the individual paths are still preserved. In other words, the portraits of individual trees are still preserved in the forest picture of BSPA.

Using equation (49), the injection of institution d_I will transform the composition of changes in institution in the form of $B_{22}^{III} d_I$. The change in institutional income distribution will further influence factorial incomes, $A_{13}B_3A_{32}B_{22}^{III} d_2$, and output of production activities, $B_3A_{32}B_{22}^{III} d_2$. This series of processes follows a complication chain in the form:

$$d_I \rightarrow B_{22}^{III} d_I \rightarrow B_3A_{32}B_{22}^{III} d_I \rightarrow A_{13}B_3A_{32}B_{22}^{III} d_I \quad (50)$$

A similar complication chain can be observed from the injection of activities d_A to the transformation activities $B_{33}^{III} d_A$, factorial incomes, $A_{13}B_{33}^{III} d_A$, and the institutional income, $B_2A_{21}A_{13}B_{33}^{III} d_A$ such that:

$$d_A \rightarrow B_{33}^{III} d_A \rightarrow A_{13}B_{33}^{III} d_A \rightarrow B_2A_{21}A_{13}B_{33}^{III} d_A \quad (51)$$

3.3 Macro Decomposition

Finally, the pattern of structural changes in the Indonesian economy will be analyzed by decomposing changes of income and output into three components: first, change of output generated by the influence of final demand; second, change in technology (intersectoral linkages); and third, synergetic effects between change in final demand and technology. Using this decomposition, the indication of hollowing out process can be evaluated. Following *Sonis et al.*, (1997b), the decomposition of changes of output generated by institutions and activities are drawn as the following:

$$\Delta X = X_t - X_0$$
$$\Delta B = B_t - B_0 \quad (52)$$
$$\Delta d = d_t - d_0$$

where, $\Delta X, \Delta B, \Delta d$ are changes of total output, change of Leontief multiplier, and change of final demand between two different times respectively. Analogous to standard input-output model to derive output as the multiplication between Leontief inverse and final demand, change in income or output can be written as:

$$\Delta X = X_t - X_0 = B_t d_t - B_0 d_0 \quad (53)$$

The above change of output (53) can be decomposed into three components that capture the value of changes:

$$\begin{aligned} \Delta X &= (B_0 + \Delta B) + (d_0 + \Delta d) - B_0 d_0 \\ &= B_0 \Delta d + \Delta d_0 + \Delta B \Delta d \end{aligned} \quad (54)$$

where, $B_0 \Delta d$ is a change in the value of final demand, Δd_0 is a change in technology, and $\Delta B \Delta d$ is a change as a result of synergetic interaction between changes in value of final demand and changes in technology. Percentage changes in the income and output of institutions and activities in two- time periods from t_0 to t_1 derived by changes in final demand, technology, and both final demand and technology are gives as:

(a) Percentage change in final demand of economic subsystem *i*: $\Delta_i^{t_0} \delta(d_i)^{t_1 - t_0}$

(b) Percentage change in technology of economic subsystem *i*: $\delta(\Delta_i)^{t_1 - t_0} d_i^{t_0}$

(c) Percentage change in final demand and technology of economic subsystem *i* as a result of synergetic interaction: $\delta(\Delta_i)^{t_1 - t_0} \delta(d_i)^{t_1 - t_0}$.

4 Empirical Applications

The analysis of the pattern of the structural changes uses a set of six aggregated Indonesian SAMs for 1975, 1980, 1985, 1990, 1995 and 1999. The elements of the SAM are aggregated into two types of factors (labor and capital), three groups of institutions (household, company and government), and five sectors of production activities (see table 1). With this SAM data set, any indication of hollowing-out in the Indonesian economy can be analyzed based on changes in the input linkages over time. The linkage between service and goods sector will be explored using a more disaggregated SAM for 1995 and 1998 to gain a sense of the impact of the economic crises of mid-1997.

<<insert table 1 here>>

The structural changes in Indonesian economy are analyzed from two different approaches. Considered first is the influence of an initial injection from final demand of both institutions and production activities. Feedback loop effects that work in an economic system through economic subsystems, such as from institutions and activities are identified to separate the influence of other subsystems in transforming the economic system. The impact of an initial injection from institutions to the transformation of institutional income, output of activities, and factorial income are presented in table 2a and 2b. Table 3a and 3b show the injection of activities and its influence on the transformation of activities, factorial, and institutional income[3].

<<insert tables 2 and 3 here>>

4.1 The Injection of Institutions

Table 3a shows the value of institutional income, the demand for production activities, and factorial income generated by the injection of institutions during 1975-1990; table 3b displays the percentage of the composition of the elements of such economic subsystems. The final demand of institutions in the SAM framework might partially or completely be derived from the transfer of income from abroad to Indonesian households. In 1975, income from abroad received by households was virtually non-existent; and was too small to be included in the table. Significant income transfers received by Indonesian households from abroad were recorded in the 1980 SAM table. They increased consistently from Rp. 67.0 million to Rp. 9,930 million between 1980 and 1999, as more Indonesian workers were employed abroad, many of them as unskilled as well as illegal laborers. The share of government receipts from abroad in

[3] It should be noted that the series of 1975-1999 SAM data use current market prices. Thus, the analysis emphasizes on changes in the composition of elements within each three economic subsystem as a proxy to analyze structural changes in the Indonesian economy. In addition, the analysis uses direct coefficient multiplier $(I - A_n)^{-1}$ instead of a constrained multiplier $(I - C_n)^{-1}$ to capture the marginal propensity to consume, where $A_{23} \neq C_{23}$.

institutional income was still dominant from 1975 to 1999, although it tended to decrease. While firms' receipts from abroad ranked second in institutional income in 1990 and 1995, no firm receipts were available in the 1999 SAM data.

The injection of institutions has transformed the pattern of institutional income distribution. In 1975 for example, an institutional injection generated 45.3%, 17% and 37.7% of the income of households, firms and government respectively. This distribution pattern was almost the same until 1995, but changed significantly in 1999. Further transformation from institutional income to production activities revealed that the largest part of institutional demand went to food crops during the whole period from 1975 to 1985, between 36-43% of the output of production activities. The demand for food crops dropped from 36.8% to 28% in 1990 and 1999 respectively. Compared to other production sectors, institutional demand for estate crops from 1975 to 1985 was not strongly related.

The transformation of production activities from the injection of institutional income showed the declining share of food crops from 1975 to 1999; they were substituted by manufacturing. This pattern indicated the increasing impact of institutional consumption and spending toward manufacturing products. In the period of financial crisis, the share of food crops rose slightly from 27.4% in 1995 to 28.3% in 1999. The share of financial (including the government sector) outputs declined significantly after 1985 from 23-24% during 1975-85 to 2.6% and 4.6% respectively in 1995. In 1999, the share was down to only 2%. This result is interpreted as the declining influence of household consumption, firm investment and government expenditure in the financial and government sector. The financial sector was badly hit by the crisis in which many commercial banks collapsed. Figures 6a, b and c provide the pattern of the changes in the structure of economic subsystems from 1975-1999 as the result of the injection of institutions.

<<insert figure 6 here>>

The changing pattern of production activities on factorial income indicates the increasing share of labor compared to capital. During 1975-1980, the share of capital income was larger than labor income. In the next periods, the share of labor income increased to dominate capital income. The transformations of the influence from institutions to production activities and to factors provided positive effects on income distribution during the whole period. Given the aggregate nature of the system, nothing can be concluded about the impact on the distribution of income across income groups.

4.2 The Injection of Production Activities

In the final demand of production activities, the share of manufacturing remained the highest over the years from 1975 to 1999. It increased from 68% in 1975 to 73.3% in 1980; by 1990, it was 90% of total final demand of production activities. Although the share of manufacturing sector in final demand in 1999 decreased to 59.1%, this sector still plays a dominant role in the formation of final demand, particularly exports.

Table 3a and 3b exhibit the influence of initial injection from production activities and its subsequent transformation of the output of production activities, factorial, and institutional income distribution. Here, the output of manufacturing sector played a dominant role over the years, from 34.1% of total activities' output in 1975 to 46.9% in 1990 – the largest share over 1975-1999. The decreasing share of manufacturing from 46.9%, 43.5%, and 33.7% in 1990, 1995, and 1999, respectively, followed the increasing share of demand for food crops. The injection of production activities generally increased the share of factorial and labor income between 1975-1999. The distribution of labor income in factors of production changed from 38.9% in 1975 to become 51.7% in 1990. Over the period from 1990 to 1999, labor has received the lion's share in the factor incomes.

4.3 The Hierarchy of Direct Coefficients

Analysis in the change in the hierarchy of direct coefficients of production activities in the SAM framework was analyzed. The use of food crops as an input to food crops (1,1) ranked highest in the hierarchy from 1975 to 1985, then it fell down to second rank during 1990-95, and returned to the highest rank in 1999. During 1975-1980 and 1990, the use of food crops as an input by financial, real estate and government sector (1,5) was ranked second and third respectively; but then fell down to rank 21st during 1990-95 and rank 16th in 1999. The group of the inputs that had the highest rank between 1975-1990 was dominated by food-crops as an input into other sectors (figure 8). The use of food crops as the inputs for financial, real estate, and government (1,5) in the SAM table was dominated by the government sector. Food-crops were distributed as part of the compensation paid to civil servants. It should be noted that between 1975 and 1980, the government still played an important role in controlling economic activities. It is not difficult to understand the importance of (1,3), the use of food crops by manufacturing sectors, and by restaurants (1,4) (see figure 7).

Over the period from 1990 to 1999, the pattern of inter-industry relationships changed significantly in comparison to previous periods. The pair of sectors in the five highest ranks was dominated by intra-industry replacing inter-industry. During 1990-95 for example, the first rank was achieved by (3,3) indicates the use of more the same manufacturing sector as the input. This finding is obviously sensitive to the level of aggregation but does indicate a strengthening and deepening of the level of interactions between firms within a broad sector. The pattern of the hierarchy for the top five was stable over the period 1990-1995 that placed mining, non-food manufacturing, utilities and communication as the highest rank (3,3), followed by food crops (1,1), then financial, real estates, and government (5,5), trade, hotel & restaurant, transport, communication (4,4), and the pair of estate crops, forestry and hunting (2,2). In 1999, the pattern of the hierarchy has changed. The pair of food sector (1,1) returned to its position in the first rank, followed by estate crops (2,2), mining, manufacturing, utilities and construction in the third rank; pair of trades (5,5) and financial, real estate, and government (4,4) was in the fourth and fifth rank respectively.

On one hand, the pair of intra-industries of (1,1), (2,2), (3,3), (4,4) and (5,5) converge to form the top hierarchy from 1990 to 1999, while, on the other hand the use of food crops dropped significantly to a lower hierarchy such as (1,3) drop from rank 6th to 11th, 23rd and 24th in 1975, 1980, 1990 and 1999 respectively. As noted previously, the use of food crops as the inputs by financial, real estate and government declined sharply (1,5), replaced by its own sector (5,5), and by mining, non-food manufacturing, utilities and construction (3,5). The lowest hierarchy was the pair of (2,4) and (2,5) during the whole period; while (2,3) increased significantly since 1990 to become rank 14th, 5th, and 13th in 1990, 1995 and 1999 respectively.

4.4 The Influence of Final Demand and Technology

The analysis on decomposition of income and output change is focused on two periods of time: 1975-1985 (see previous work of *Sonis et al*., 1997) and 1990-1999 that may be considered to represent the state-led development stage of Indonesia and the period of market-led economy respectively. Four sub-periods: 1975-1980, 1980-1985 (represent 1975-1990 period), 1990-1995 and 1995-1990 (represent 1990-1990 period) are compared to reveal the pattern of the effect of changes in final demand, technology, and the combined (synergetic) effects. The patterns of the percentage change in institutional income during those sub-periods are varied. Table 4a shows the dominant role of final demand in changing households and firm incomes (more than 95%), compared to government income (56.1%) during the period from 1975 to 1980. From 1980-1985, the pattern was reversed for households and government income; change in final demand was dominant (97.7%) in changing government income, while the greater change in technology affected household income (29.5%). Closer observations for the 1990-1995 and 1995-1999 time periods show that final demand still played a dominant role, however, there has been an increasing role for changes in technology and synergetic effects accounted for changing institutional income.

Comparing to the 1980-1985 period, the pattern of change in the output of activities during 1995-1999 is quite different. The value of final demand increased during 1990-1995 while technological and synergetic effect declined compared to the 1980-1985 period (table 4b). During 1990-1995, there has been a clear decline in the role of technology and synergetic effects (negative sign) that indicate the decline in intermediate input.

5 Interpretation of the Results

Using a set of 1975-1999 aggregated SAM data, at the macro scale, the results from two initial injections of institutions and production activities provide some general features of the structural change in the Indonesia economy over the years from 1975 to 1999. The most important feature of the impact from injection of both institutions and activities is the increasing consumption of food crops during the financial crisis in 1999 with the decline in the share of trade, estate crops and financial & government services, compared to 1995. However, whether this represents a cyclical rather than a more permanent, longer-run structural change in Indonesian economy should be confirmed through the analysis of the hierarchy of direct coefficient of production activity in the SAM framework with a more detailed level of aggregation and with further explorations of future SAMs.

An important interpretation from the impact of institutional income to the transformation of production activities is the declining share of food crops consumption, substituted by the increasing share on manufacturing consumption during 1975-1995. The impact of initial injection of production activities to factorial income and its subsequent influence on institutional income was varied. The share of household income was still the largest compared to capital during 1975-1999, and the share of companies dropped significantly from 30.5% in 1980 to 18.6% in 1999 – the lowest level during the whole period. This consumption pattern follows an Engel's curve that shows declining portion of income spent on food consumption when income per capita rises. In the midst of the crisis in 1999, the share of consumption of food crops rose again due to the decline of real income. In this situation, the influence of the declining institutional income from households, companies and government to production activities provided a significant impact on the financial sector. In 1999, the demand for financial services declined dramatically.

The results from the hierarchy of direct coefficients might have been influenced by the changes in real income, trade linkages, the adoption of technology, and government policies, both directly and indirectly. Until 1975, the role of private sector participation in the implementation of long-term development strategy was still limited. Government played major roles in initiating development, particularly in the agricultural sector to achieve rice self-sufficiency. In the same period, the output of commercial estate-crops was not as extensive as food crops as a result of significant government intervention. The hierarchy of the intra-sectoral use of estate crops is in rank 7th and 6th respectively in 1975 and 1980, and moves down to rank (15th) in 1985. In the next periods, the increasing role of estate crops as the input for sector 3 indicates the emergence of the output of non-foods manufacturing industries that require estate crops as the raw materials, such as palm oil, and other related industries after 1985. The hierarchy of intra-industry transaction for estate crops increases after 1985 from rank 15th to become rank 5th in 1990 and 1995, and then at the second rank in 1999. The requirement of estate crops by restaurants (2,4) and by service sector (2,5) is low, hence, placing these pairs at lower level.

The changes in the structure of production activities, labor and capital efficiencies in many ways might have been driven by external factors as well as government intervention. The changes in the structure of Indonesian economy that place food crops as the highest rank in the hierarchy of intermediate input was partly influenced by government policy at the earlier stage of the new order regime under President Soeharto to achieve rice self-sufficiency The declining role of food crops replaced by manufacturing activities since 1980 were not only influenced by the changes of income that generate more manufacturing demand, but also induced by government policies such as import substitution, market-driven, export oriented, and outward looking strategy .

In Achjar *et al*. (2003), the decomposition of production activities into goods and services into disaggregated SAM documents evidence of the dominant role of the goods sector in shaping the Indonesian economy. Obviously, at more disaggregated levels, it will be possible to explore the changing role of specific sectors in a variety of ways – in terms of industrial interdependence, and in income formation for example.

6 Summary and Conclusions

Using block structural path analysis, the mechanism of direct, direct transfer and augmentation of the influence that work in each economic subsystem has been explored. The influence of economic subsystems in the SAM framework cannot be detected by conventional structural path analysis that emphasizes individual sectors and path. It has been shown in the empirical application that the injection from both block matrices of institutions and activities has created an increasing share of labor income compared to its associated capital from 1975-1999. This indicates the change in economic structure has contributed to the improvement of labor income through government policies such as subsidies for the poor and a labor-intensive industrialization strategy. However, the conclusion should be tempered carefully by considering that recently, more high-tech manufacturing industries that absorb highly educated labor have been developed. Without a more detailed break down of income by level across households, it is difficult to assess the impact of these changes in income distribution within the household sector. Further, the one advantage of the SAM framework is the ability to estimate institutional (household) income and not just income derived by labor as a factor.

The hierarchy of direct coefficients in the SAM framework shows a tendency of intra-industry linkages to replace inter-industry. This pattern reveals preliminary evidence from the hypothesis that the maturity of an economy may be characterized by the deepening of the intra-industry transactions due to the changes in technology, reducing transport cost, innovation process, and other external factors. However, the decomposition of the change of output into three elements: internal, direct, and synergetic influences cannot confirm any indication of hollowing out processes. The change in the output of activities and change in income were more influenced by changes in final demand. The role of technology was almost negligible.

The analysis conducted in this paper may be considered as an exploratory analysis of the Indonesian economy viewed through the lens of a series of social accounting matrices. While there is evidence of some important structural changes, the analysis could not formally link the changes to policy initiatives, changes in Indonesia's terms of trade or other macro policy instruments. The next challenge would be to craft a transparent computable general equilibrium model that would enable analysis of these changes to be linked to more formal policy instruments.

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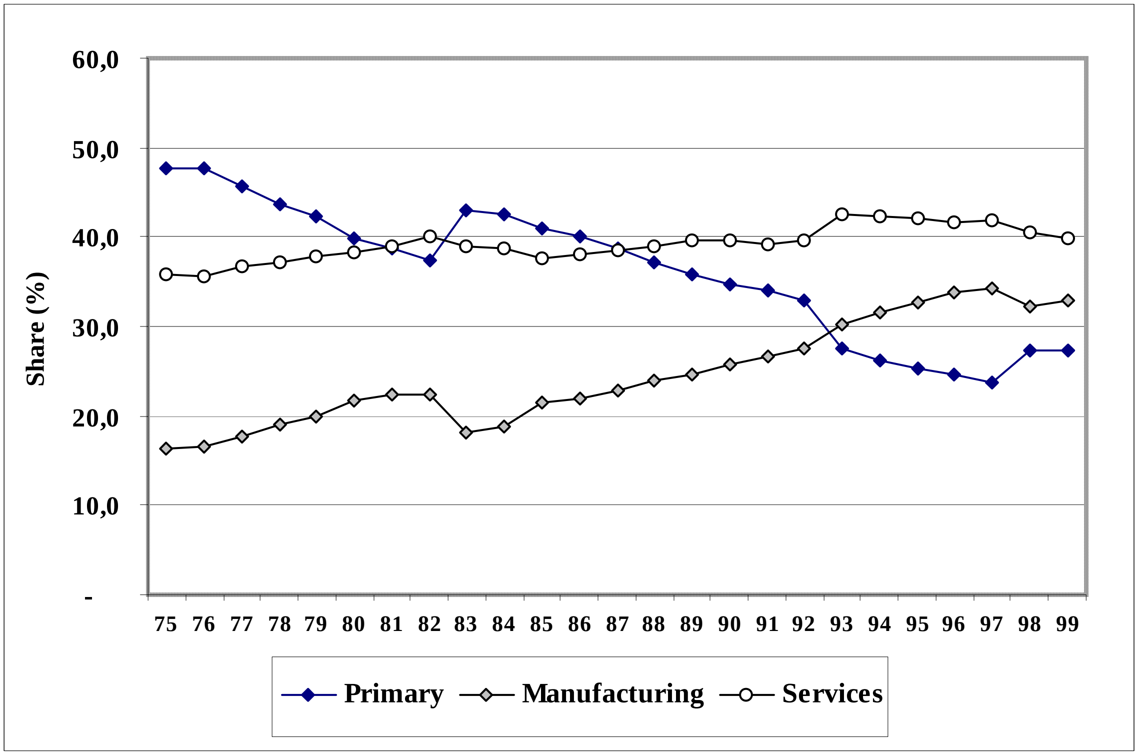

Figure 1 The share of primary, manufacturing and services to GDP, 1975-99 (%)

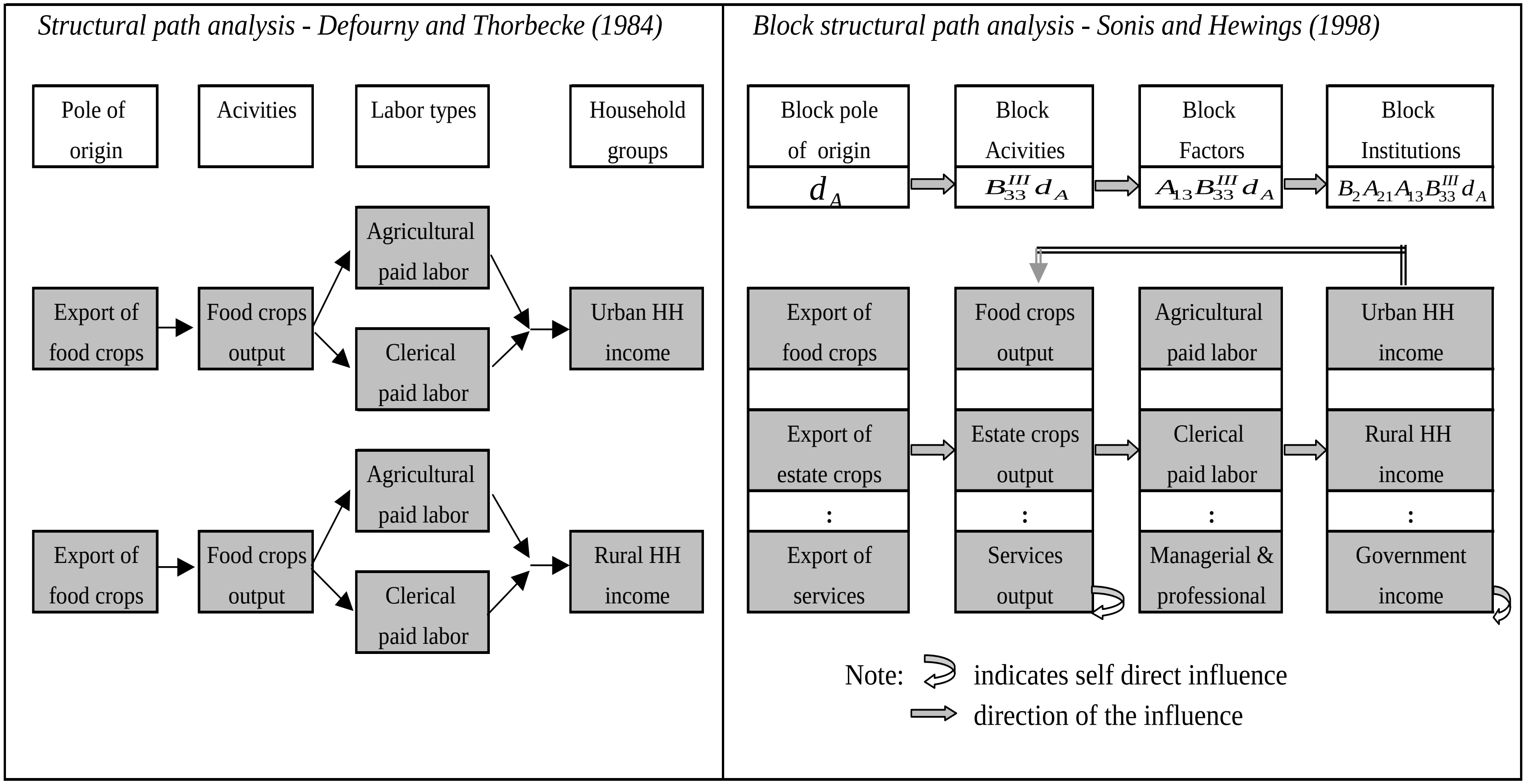

Figure 2 Injection from activities and the paths in SPA and BSPA framework

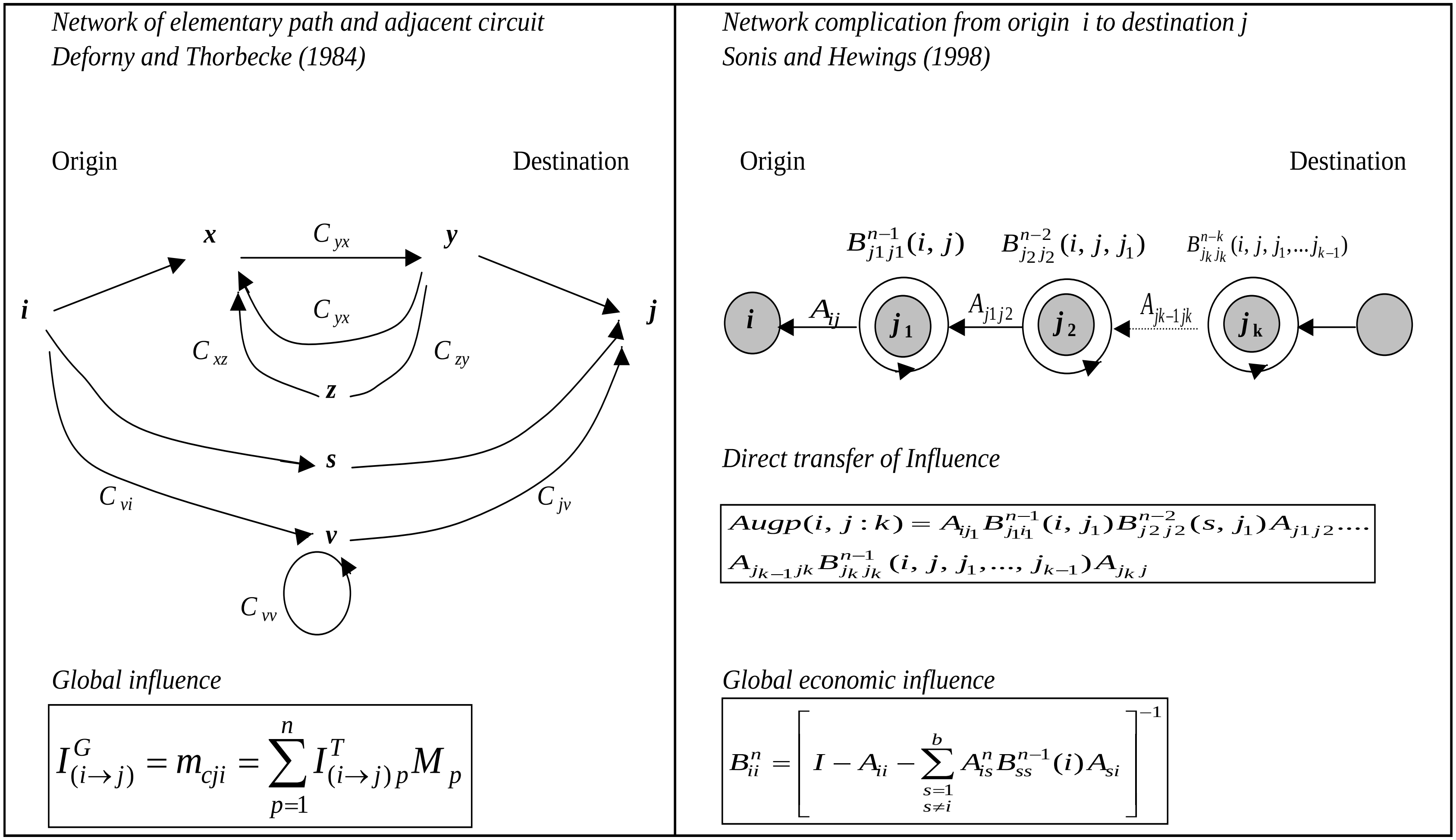

Figure 3 Network of elementary path and network complication

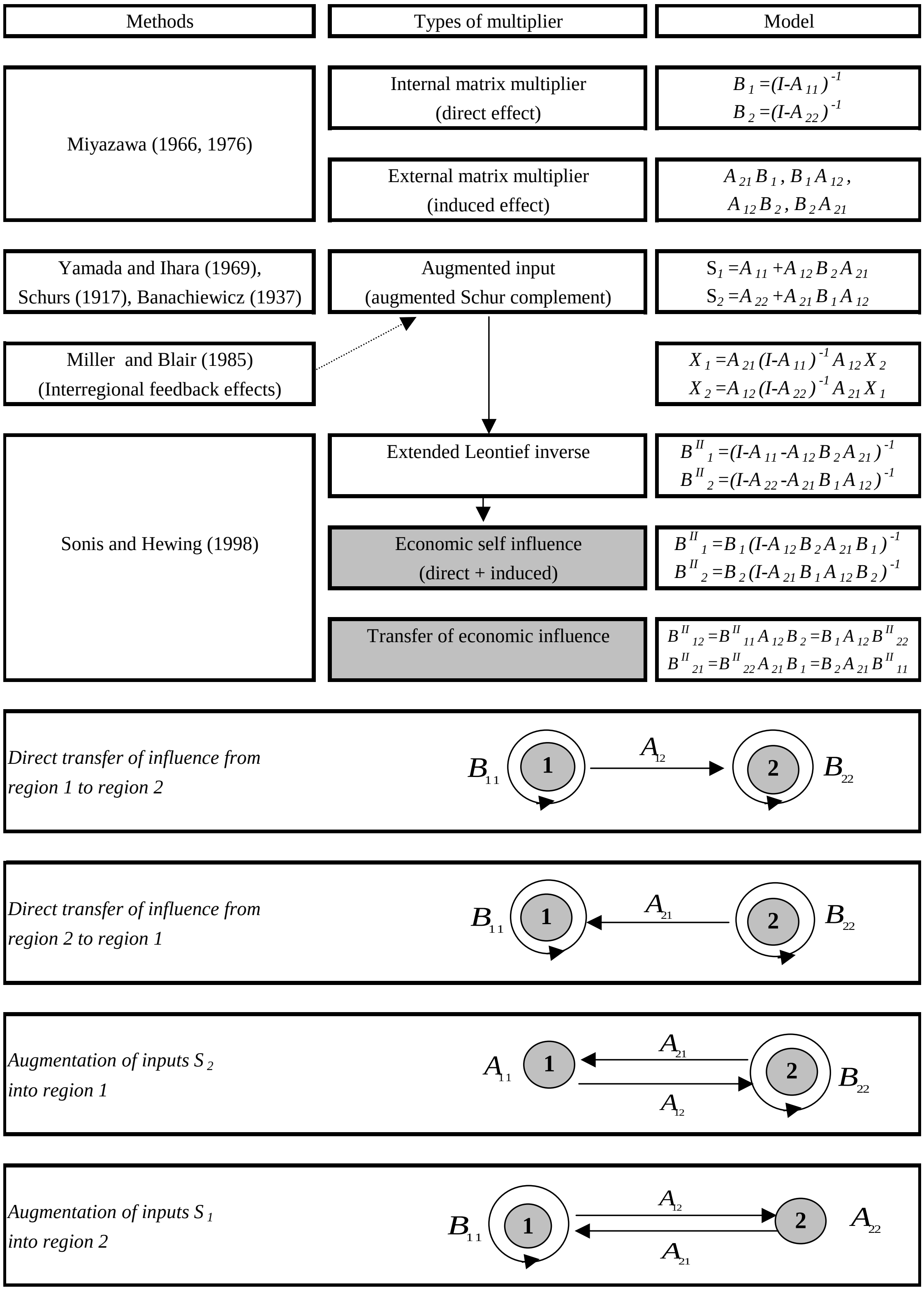

Figure 4 The evolution of two-region case of self-influence and transfer of influence

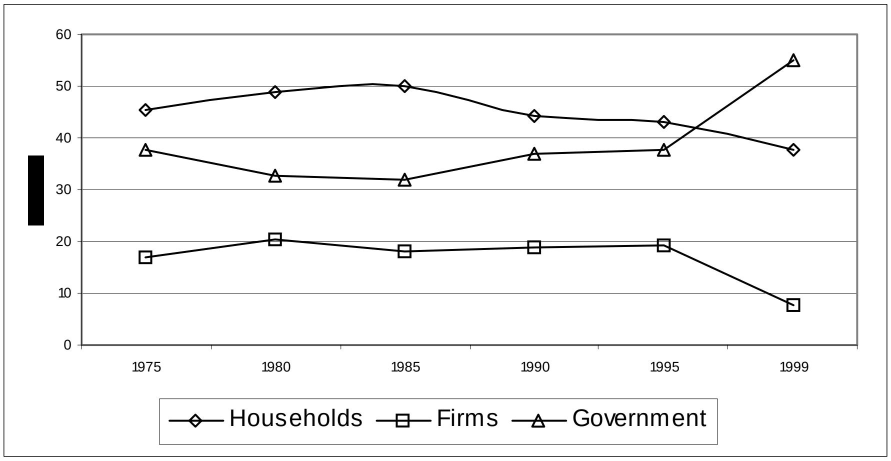

Figure 5a Injection of institutions and the transformation of institutional income.

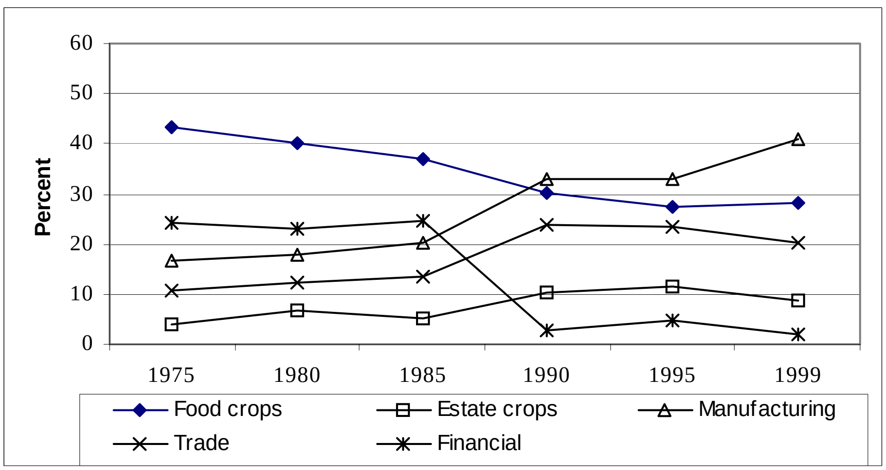

Figure 5b Injection of institutions and the transformation of activities

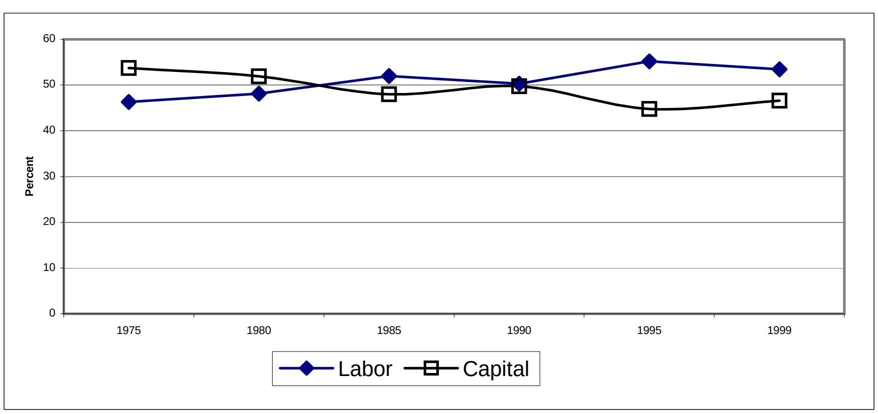

Figure 5c Injection of institutions and the transformation of factorial income

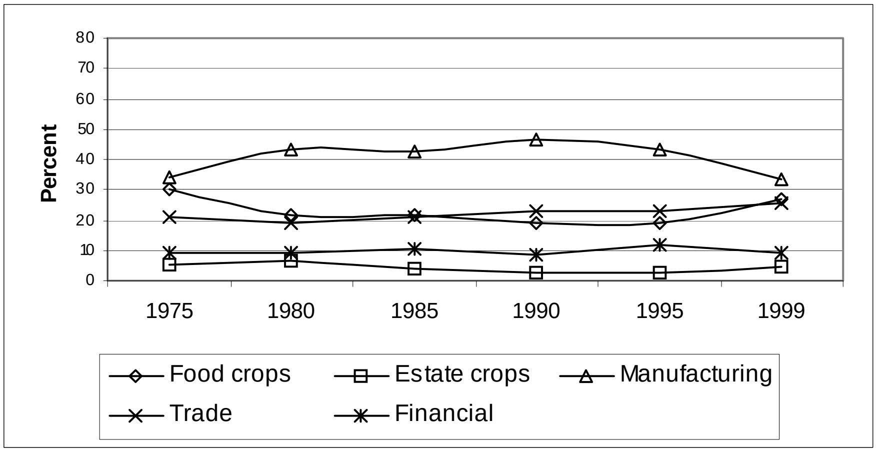

Figure 6a Injection of activities and the transformation of activities

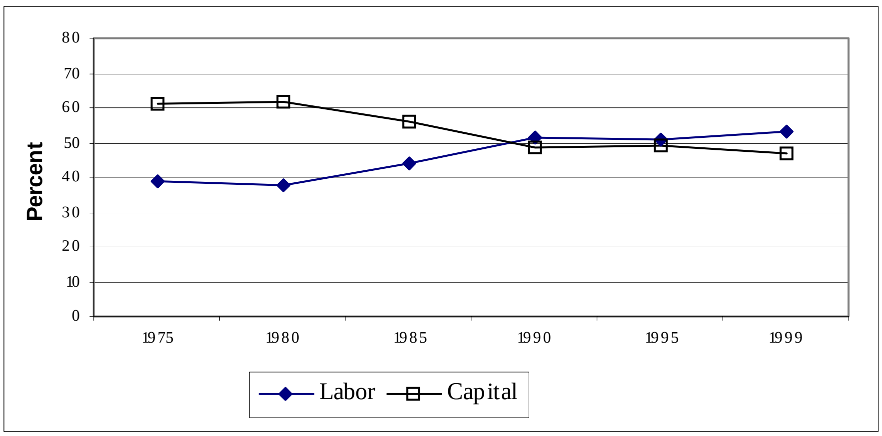

Figure 6b Injection of activities and the transformation of factorial income

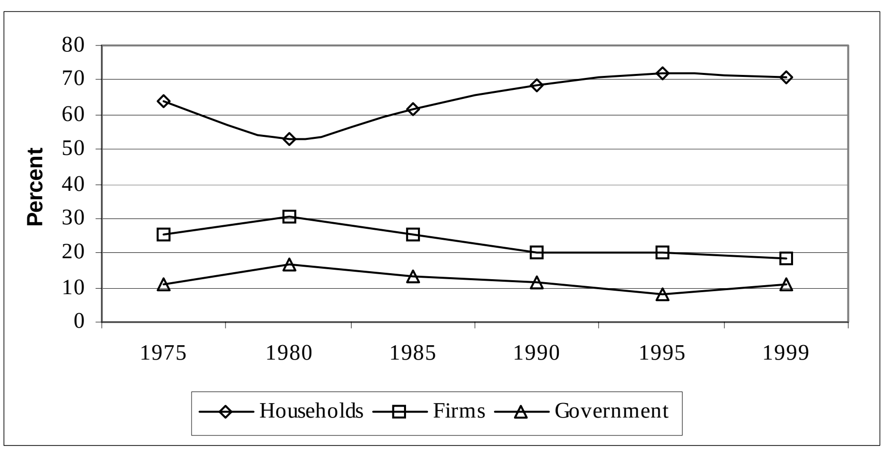

Figure 6c Injection of activities and the transformation of institutional income

Figure 7 The hierarchy of direct coefficients in the Indonesian SAM 1975-1999

Rank	Cell 1975	Cell 1980	Cell 1985	Cell 1990	Cell 1995	Cell 1999
1	1,1	1,1	1,1	4,4	4,4	1,1
2	1,5	1,5	3,3	3,3	3,3	4,4
3	1,4	1,4	1,5	1,1	1,1	3,3
4	1,2	3,3	1,4	5,5	5,5	2,2
5	3,3	1,2	1,2	2,2	2,2	5,5
6	1,3	2,2	3,4	4,2	4,2	4,3
7	2,2	3,5	4,4	4,3	4,1	4,1
8	3,5	4,4	5,5	4,1	4,3	3,5
9	3,4	3,4	3,5	3,4	3,5	3,1
10	5,4	5,5	3,2	3,2	3,2	3,4
11	4,4	1,3	4,5	3,5	2,1	4,2
12	5,5	5,4	1,3	1,4	5,4	3,2
13	3,2	5,2	5,4	3,1	1,4	4,5
14	5,2	3,2	5,2	2,1	3,4	1,4
15	4,5	4,5	2,2	5,4	3,1	5,4
16	5,3	5,3	4,2	4,5	5,3	2,1
17	4,2	4,2	3,1	2,3	2,3	2,3
18	3,1	2,1	5,3	5,3	5,1	5,2
19	5,1	3,1	5,1	5,2	5,2	1,5
20	4,3	5,1	2,1	5,1	4,5	5,1
21	4,1	4,1	4,1	1,5	1,2	5,3
22	2,1	4,3	4,3	2,4	1,5	1,2
23	2,3	2,3	2,3	1,2	2,4	1,3
24	2,4	2,5	2,4	1,3	1,3	2,4
25	2,5	2,4	2,5	2,5	2,5	2,5

Sector codes:

1. **Farm food crops, livestock, and food manufacturing**
2. **Estate crops, forestry, hunting**
3. **Mining, non-food manufacture, utilities and construction**
4. **Trade, restaurants, hotels, transport, and communication**
5. **Financial, real estate, and government**

Table 1 Classification of main sectors in the Indonesian SAM, 1975-1999

Main Sector	Elements of Main Sectors
1. Factors	1.1. Labor
	1.2. Capital
2. Institutions	2.1. Households
	2.2. Companies
	2.3. Government
3. Activities	3.1 Farm Food Crops, Livestock, Food Manufacturing.
	3.2. Estate crops, forestry, hunting.
	3.3. Mining, Non-food Manufacturing, Utilities, and Construction.
	3.4. Trade, Restaurants, Hotels, Transport, and Communication.
	3.5. Financial Services, Real Estate, Government.

Table 2a Injection of institutions and the transformation of institutions, activities and factors, 1975-1999(Rp. billion)

EXOGENOUS ACCOUNT	1975	1980	1985	1990	1995	1999
Households	-	167	401	3,613	6,022	9,928
Firms	18	75	313	5,343	11,467	-
Government	363	425	2,820	12,734	32,229	82,081
TOTAL	381	666	3,534	21,690	49,717	92,008

↓

INSTITUTIONS	1975	1980	1985	1990	1995	1999
Households	448	748	5,348	22,769	50,086	66,152
Firms	167	324	1,912	9,587	22,157	13,286
Government	373	524	3,434	18,964	43,860	96,967
TOTAL	987	1,596	10,694	51,320	116,103	176,405

↓

ACTIVITIES	1975	1980	1985	1990	1995	1999
Food crops	384	492	3,650	36,159	78,411	94,696
Estate Crops	36	81	496	12,545	32,566	28,821
Manufacturing	149	220	2,009	39,810	95,064	137,236
Trade	97	153	1,332	28,495	67,382	67,731
Other Service	223	284	2,445	3,136	13,137	6,651
TOTAL	889	1,230	9,932	120,145	286,560	335,135

↓

FACTORS	1975	1980	1985	1990	1995	1999
Labor	272	392	3,230	14,410	35,128	44,108
Capital	317	423	2,980	14,259	30,629	41,861
TOTAL	589	815	6,210	28,669	65,757	85,969

Table 2b Injection of institutions and the transformation of institutions, activities and factors 1975-1999 (%)

EXOGENOUS ACCOUNT	1975	1980	1985	1990	1995	1999
Households	0	25.0	11.3	16.7	12.1	10.8
Firms	4.7	11.3	8.9	24.6	23.1	0.0
Government	95.3	63.7	79.8	58.7	64.8	89.2
TOTAL	100	100	100	100	100	100

↓

INSTITUTIONS	1975	1980	1985	1990	1995	1999
Households	45.3	48.9	50	44.4	43.1	37.5
Firms	17	20.3	17.9	18.7	19.1	7.5
Government	37.7	32.8	32.1	37.0	37.8	55.0
TOTAL	100	100	100	100	100	100

↓

ACTIVITIES	1975	1980	1985	1990	1995	1999
Food crops	43.2	40	36.8	30.1	27.4	28.3
Estate Crops	4.1	6.6	5	10.4	11.4	8.6
Manufacturing	16.8	17.9	20.2	33.1	33.2	40.9
Trade	10.9	12.4	13.4	23.7	23.5	20.2
Other Service	24.1	23.1	24.6	2.6	4.6	2.0
TOTAL	100	100	100	100	100	100

↓

FACTORS	1975	1980	1985	1990	1995	1999
Labor	46.3	48.1	52.0	50.3	53.4	51.3
Capital	53.7	51.9	48.0	49.7	46.6	48.7
TOTAL	100	100	100	100	100	100

Table 3a Injection of activities and the transformation of activities, factors, and institutions, 1975-1999 (Rp. billion)

EXOGENOUS ACCOUNT	1975	1980	1985	1990	1995	1999
Food crops	(948)	(2,456)	(6,469)	4,879	13,702	114,721
Estate crops	173	968	(129)	1,374	2,302	27,848
Manufacturing	3,842	19,545	30,778	106,321	237,710	329,987
Trade	2,619	8,661	17,772	3,377	13,338	75,823
Other Service	1	(59)	314	2,127	6,915	10,306
TOTAL	5,687	26,659	42,266	118,078	273,967	558,685

↓

ACTIVITIES	1975	1980	1985	1990	1995	1999
Food crops	6,143	16,272	33,665	148,296	401,117	982,860
Estate Crops	1,019	4,954	6,399	21,289	60,664	160,403
Manufacturing	6,913	32,584	65,981	363,934	905,724	1,232,651
Trade	4,315	14,415	32,379	177,588	473,962	937,548
Other Service	1,864	7,030	16,036	65,210	241,751	348,093
Total	20,254	75,255	154,160	776,317	2,083,218	3,661,555

↓

FACTORS	1975	1980	1985	1990	1995	1999
Labor	4,953	18,143	39,211	82,292	233,203	499,945
Capital	7,780	29,554	50,196	94,284	223,004	445,592
TOTAL	12,733	47,696	89,407	176,576	456,207	945,537

↓

INSTITUTIONS	1975	1980	1985	1990	1995	1999
Households	9,278	30,387	52,612	134,305	348,843	704,781
Firms	3,690	17,563	21,593	39,560	96,650	185,531
Government	1,554	9,577	11,482	22,171	39,177	108,587
TOTAL	14,522	57,527	85,687	196,036	484,670	998,899

Table 3b Injection of activities and the transformation of activities, factors, and institutions 1975-1999 (%)

ACTIVITIES	1975	1980	1985	1990	1995	1999
Food crops	-16.7	-9.2	-15.3	4.1	5.0	20.5
Estate Crops	3.0	3.6	-0.3	1.2	0.8	5.0
Manufacturing	67.6	73.3	72.8	90.0	86.8	59.1
Trade	46.1	32.5	42.1	2.9	4.9	13.6
Other Service	0	-0.2	0.7	1.8	2.5	1.8
TOTAL	100	100	100	100	100	100

↓

ACTIVITIES	1975	1980	1985	1990	1995	1999
Food crops	30.3	21.6	21.8	19.1	19.3	26.8
Estate Crops	5.0	6.6	4.1	2.7	2.9	4.4
Manufacturing	34.1	43.3	42.7	46.9	43.5	33.7
Trade	21.3	19.2	21	22.9	22.8	25.6
Other Service	9.2	9.3	10.4	8.4	11.6	9.5
TOTAL	100	100	100	100	100	100

↓

FACTORS	1975	1980	1985	1990	1995	1999
Labor	38.9	38.0	43.9	46.6	51.1	52.9
Capital	61.1	62.0	56.1	53.4	48.9	47.1
TOTAL	100.0	100	100	100	100	100

↓

INSTITUTIONS	1975	1980	1985	1990	1995	1999
Households	63.9	52.8	61.4	68.5	72.0	70.6
Firms	25.4	30.5	25.2	20.2	19.9	18.6
Government	10.7	16.7	13.4	11.3	8.1	10.9
TOTAL	100	100	100	100	100	100

Note: numbers in parantheses are negative

Table 4a Decomposition of changes in institutional income 1975-1985 and 1990-1999 (%)

Period	Sector	Change in final demand $\Delta_I^{t_0}\delta(d_I)^{t_1-t_0}$	Change in technology $\delta(\Delta_I)^{t_1-t_0}\,d_I{}^{t_0}$	Change in final demand & technology $\delta(\Delta_I)^{t_1-t_0}\,\delta(d_I)^{t_1-t_0}$	Total change
1975-1980	Households	95.1	-1.6	-3.3	100
	Firms	99.1	0.2	0.7	100
	Government	56.1	32.6	11.4	100
1980-1985	Households	64.6	5.9	29.5	100
	Firms	99.6	-0.1	-0.3	100
	Government	97.6	0.3	2.1	100
1990-1995	Households	86.2	6.0	7.8	100
	Firms	91.9	3.4	4.7	100
	Government	79.1	-9.1	-11.8	100
1995-1999	Households	80.8	-7.6	-11.6	100
	Firms	78.5	-6.1	-15.3	100
	Government	82.8	12.1	5.2	100

Note: negative changes were calculated as the absolute number of changes.

Table 4b Decomposition of changes in output of production activities 1975-1985 and 1990-1999 (%)

Period	Sector	Change in final demand $\Delta_I^{t_0}\delta(d_I)^{t_1-t_0}$	Change in technology $\delta(\Delta_I)^{t_1-t_0}\, d_I{}^{t_0}$	Change in final demand & technology $\delta(\Delta_I)^{t_1-t_0}\,\delta(d_I)^{t_1-t_0}$	Total change
1975-1980	Food crops	63.9	-8.0	-28.1	100
	Estate crops	99.2	-0.1	-0.8	100
	Manufacturing	96.7	-0.8	-2.5	100
	Trade	94.1	-1.2	-4.8	100
	Financial	85.2	-3.4	-11.4	100
1980-1985	Food crops	36.9	40.4	22.7	100
	Estate crops	51.6	26.7	21.7	100
	Manufacturing	57.0	26.9	16.1	100
	Trade	71.1	18.2	10.7	100
	Financial	51.3	30.7	18.1	100
1990-1995	Food crops	82.7	7.5	9.8	100
	Estate crops	67.9	13.9	18.3	100
	Manufacturing	84.5	6.7	8.8	100
	Trade	84.6	6.6	8.7	100
	Financial	53.2	20.0	26.8	100
1995-1999	Food crops	81.8	-7.1	-11.1	100
	Estate crops	84.3	-6.3	-9.5	100
	Manufacturing	65.8	-18.5	-15.7	100
	Trade	74.7	-10.2	-15.1	100
	Financial	62.1	-17.0	-20.9	100

Note: negative changes were calculated as the absolute number of changes.