TWO-LAYER FEEDBACK LOOP STRUCTURE OF THE REGIONAL ECONOMIES OF INDONESIA: AN INTERREGIONAL BLOCK STRUCTURAL PATH ANALYSIS

Nuzul Achjar, Geoffrey J.D. Hewings
Michael Sonis

REAL 03-T-17 May, 2003

Two-Layer Feedback Loop Structure of the Regional Economies of Indonesia: An Interregional Block Structural Path Analysis

Nuzul Achjar
LPEM, University of Indonesia, Jakarta

Geoffrey J. D. Hewings
Regional Economics Applications Laboratory, University of Illinois, Urbana

Michael Sonis
Department of Geography, Bar Ilan University, Ramat Gan, Israel and Regional Economics Applications Laboratory, University of Illinois, Urbana

Abstract

This paper examines the structure of interregional dependency in a five-region division of the Indonesian economy for 1995. An interregional social accounting matrix was constructed with direct interregional flows limited to those of the production accounts. An interregional version of Block Structural Path Analysis was applied to construct the chains of dependency resulting from injections in selected accounts in each region in turn. The results revealed once again the continuation of the asymmetry between the dependencies between Jawa and Sumatera on the one hand and these two regions and the remaining three regions in the country. While significant interregional leakages existed from changes in levels of activity in the eastern part of the country, the reverse was not the case when change was initiated in Jawa or Sumatera.

1 Introduction

Regional disparities have been one of major issues in the policy agenda of national development in Indonesia focusing especially on the dichotomy between Jawa and the rest of the country. During the last two decades, the debates on regional inequalities were focused on the differences in regional income per capita and the unbalanced budget allocation created tensions between rich resource regions and the rest of the country. Further, it has been observed that during the last three decades, the central government tended to favor Jawa, resulting in a core-periphery phenomenon that reflected the dependence of most of the regions on central government initiatives.

This paper will employ an interregional block structural path analysis to explore the nature of the interregional dependencies. Section 2 provides a brief overview of some of the important structural changes in Indonesia and its constituent regions over the last three decades. Section 3 introduces the analytical framework and the idea of network complication. The methodology is implemented with Indonesian data in section 4 while the final section provides some summary perspectives.

2 Changes in the Indonesian national and regional Economies, 1970-2000

As shown in table 1, during the last three decades, from 1971 to 2000, Indonesian population grew from nearly 120 million to 203 million. With decreasing average annual growth from 2.4% during 1971-1990 to 1.3% during 1990-2000, the largest population growth was contributed by Sumatera - once the largest receiver of transmigrants in the 1970s and 1980s. Kalimantan has the second largest average annual growth rate after Sumatera. Table 2 shows the increasing share of population in Sumatera and Kalimantan caused partly by the outflow of migrants from Jawa to these two regions. However, Jawa still accounts for more than 60% of Indonesian population in 2000. The largest concentration of small and medium industries value added by region provided more evidence of the domination of Jawa in economic activities (table 3). Between 1985 and 1997, almost 80% of manufacturing establishments were located in Jawa, contributing a similar percentage of manufacturing value added. Sumatera on contrast contributed 12-13% value added, leaving only a small percentage (<10%) for the remaining regions. A more detailed inspection of the manufacturing data will show that manufacturing value added was largely concentrated in North Sumatera where 50% of medium and large scale manufacturing value added is found. Large concentrations of economic activities in Jawa indicate the difficulty of implementing regional development policy to assist the rest of the country. From a spatial development perspective, some efforts to reduce spatial gap have been launched but there are still regional development problems. For example, Nazara *et al.* (2002) revealed a complementary among regions in the western part of Indonesia that implied simultaneous increasing relative share of income while there was evidence of increasing competition between the western and eastern part that occurred at the expense of the latter region.

The direction and magnitude of the push and pull factors between the core and periphery in a multiregional framework have been intensively explored. Using an aggregated interregional input-output, Hulu and Hewings (1993) provided an illustration on the dominant role of Jawa in controlling the national economy. On average, 80% of 1 million rupiah expenditure made in the eastern part of Indonesia returns to Jawa and Sumatera. Similar distortions, using a two-region 1985 interregional SAM by Hidayat (1991), dividing the country into Jawa and the Outer Islands, were found for the impact of agricultural policy on income.

Based on Hidayat's interregional SAM data, Temenggung (1995) constructed an interregional general equilibrium model to examine the consequences of national tax policies on the regions. Wuryanto (1996) provided another spatial dimension on the impact of central government policies on income distribution with his two-macro region, seven micro-region of Indonesia. Based on Wuryanto's framework, Resosudarmo *et al*. (1999) were able to analyze the income distribution through the instrument of central government policy (Block INPRES) in the decentralization of regional development of Indonesia. One of the essential results in Resosudarmo's work is that more funding allocation from central government to Outside-Jawa could not guarantee a more equal regional income distribution – contrary to the general premises held by many policy makers.

Since one of the advantages of Block Structural Path Analysis (BSPA), described in Sonis *et al*., (1997b) is the ability to measure feedback loop effects and to be able to separate the influence of each economic subsystem, from spatial perspective, this approach offers an opportunity to identify a two-layer feedback loop (see Sonis *et a*l., 1997a): the first layer comprises the economic subsystems in each region, while and the second layer accounts for the interregional feedback loops. Network complication in the system offers various interpretations in which economic subsystems behave in the interaction process and exert influence on other subsystems, distinguished by this two-layer approach (see Sonis and Hewings, 1998; Sonis *et al*., 2003).

3 Analytical Framework

Drawing on BSPA and the advantages of using an interregional SAM framework, the analytical framework in this paper will develop an interregional block structural path analysis (IRBSPA) - a hybrid method derived from typical block structural path analysis. This paper also introduces the a five-region interregional SAM table that has been constructed for the first time for Indonesia, covering five classifications of factors (four labor, one type of capital), five institutions (three households, and one type each of firms and government) and nine aggregated production activities. The analytical framework will develop and decompose a global matrix from the interregional SAM into two layers of feedback loops to address the nature of synergetic effects that involve three economic subsystems in each region and the five-region subsystems. The combination of a two-layer feedback loop will be expressed through the identification of the interregional network complication using the example of a two-region interregional SAM. In order to capture simultaneous effects through the linkages of all economic subsystems, this analytical framework will be elaborated in three parts. The first part of the presentation will introduce the general features of interregional network complication, followed by the intra and interregional feedback loops that represent the first and the second layer of feedback loop respectively.

3.1 Network Complication in Interregional Block Structural Path

The elaboration of network complication in the interregional block structural path is proposed to show a general comparison between interregional SPA and IRBSPA in tracing the path of an individual sector and a block of a sector respectively. This path may travel from an origin to a across sectors and space. Figure 1 illustrates a general comparison between the two methods. Suppose there are two regions, *r* and *R*, in an interregional framework. An initial injection of agricultural exports in region *r* directly influences the output of the agricultural sector in region *r*. The next path of influence traces agricultural exports from region *r* to agricultural output in region *R* and then generates labor incomes in the same region. Here, the influence of agricultural output in region *R* to agricultural labor and non-agricultural labor income in region *R*, will in turn, influence agricultural household income in the same region, *R*. In similar fashion, the magnitude of the influence of agricultural exports in region *r* to any other household income in region *R* that pass through the same path can be measured.

While interregional SPA offers a methodology to measure structural change that may occur in an individual sector, IRBSPA provides a methodology to reveal the influence of an economic subsystem on the whole economic system as a result of synergetic effects both from intra and interregional feedback loop effects. The two-dimensional structure of IRBSPA would make it possible to separate the influence of the initial injection in the production activities in region *r* and its influence to factorial and institutional income distribution in region *R*. The block path by sector and region in figure 1 illustrates an interregional network complication that links economic subsystems across sectors and regions.

Similarly, an initial injection from production activities in region *r* will directly change the output of production activities in region *r*. In the first layer of feedback loop process, the intra-regional feedback loop effect is analogous to the effect within the BSPA framework, such that the change in the output of production activities in region *r* will affect the change of factorial income in the same region, *r*, and then affect institutional income in the same region. In an ideal full-fledged interregional SAM table in which all related economic systems are linked, the transformation of an economic system in region r will affect the associated subsystem in region R. In a way, the second layer feedback loop that represents interregional feedback loop process might be analogous to that in a standard interregional input-output system with the exception that each region has experienced internal transformation and each regional economic subsystem will influence the associated subsystem in other regions and vice versa. In addition, a change in production activities in region *r* will not only influence factor and household income in the same region, but also region *R*, so that there will be another augmentation of output in the second layer. Thus the augmentation effect on the outputs received by each economic system will be greater than that of partially related networks.

3.2 Intraregional Network Complication

The decomposition of an IRBSPA matrix requires two steps to separate the influence of the two feedback loops: one is the intra-regional feedback loop, and the other is the interregional feedback loop. Assume that there are two regions, *r* and *R*, and each region consists of three economic subsystems: production activities, factors, and institutions, the intra-regional network complication is simplified as follows:

$$A^* = \begin{bmatrix} 0 & 0 & A_{13}^* \\ A_{21}^* & A_{22}^* & 0 \\ 0 & A_{32}^* & A_{33}^* \end{bmatrix} \tag{1}$$

where, A^* represents block matrix of average expenditure propensities (A), superscripts denote region, and subscripts refer to the linkages of each element in the matrix in which (1) are factors of production, (2) are institutions and (3) production activities. The interregional network complication matrix A^{**} can be shown as:

$$A^{**} = \begin{pmatrix} 0 & 0 & A_{13}^{rr} & \vdots & 0 & 0 & A_{13}^{rR} \\ A_{21}^{rr} & A_{22}^{rr} & 0 & \vdots & A_{21}^{rR} & A_{22}^{rR} & 0 \\ 0 & A_{32}^{rr} & A_{33}^{rr} & \vdots & 0 & A_{32}^{rR} & A_{33}^{rR} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ 0 & 0 & A_{13}^{Rr} & \vdots & 0 & 0 & A_{13}^{RR} \\ A_{21}^{Rr} & A_{22}^{Rr} & 0 & \vdots & A_{21}^{RR} & A_{22}^{RR} & 0 \\ 0 & A_{32}^{Rr} & A_{33}^{Rr} & \vdots & 0 & A_{32}^{RR} & A_{33}^{RR} \end{pmatrix} \tag{2}$$

Using a similar decomposition approach to that employed in BSPA, the partial block matrices of direct inputs for the three pairs of blocks and their partial Leontief inverses in each region have the form:[1]

1) for the pair (institutions, activities):

$$A^{*}(1) = \begin{bmatrix} A_{22}^{*} & 0 \\ A_{23}^{*} & A_{33}^{*} \end{bmatrix} \tag{3}$$

Augmented inputs in the first layer feedback loop within the interregional SAM framework are given as:

$$\begin{aligned} &A_{12}^{*} = A_{13}^{*} B_{3}^{*} A_{32}^{*}; \quad A_{13}^{*} = A_{13}^{*}; \\ &A_{21}^{*} = A_{21}^{*} \qquad ; \quad A_{23}^{*} = A_{21} A_{13}; \\ &A_{31}^{*} = A_{32}^{*} B_{2}^{*} A_{21}^{*}; \quad A_{32}^{*} = A_{32}^{*} \end{aligned} \tag{4}$$

with the corresponding partial Leontief inverse as:

$$B^{*}(1) = \left[I - A^{*}(1) \right]^{-1} = \begin{bmatrix} B_{3}^{*} & 0 \\ B_{3}^{*} A_{32}^{*} B_{2}^{*} & B_{3}^{*} \end{bmatrix} \tag{5}$$

where, $B_{2}^{*} = \left(I - A_{22}^{*} \right)^{-1}$ and $B_{33}^{*} = \left(I - A_{33}^{*} \right)^{-1}$;

[1] This section draws on theoretical analysis presented in Sonis *et al*., (1997a, b, 1998, 2003).

2) for the pair (factors, activities)

$$A^*(2) = \begin{bmatrix} 0 & A_{13}^* \\ 0 & A_{33}^* \end{bmatrix} \tag{6}$$

with the corresponding partial Leontief inverse:

$$B^*(2) = \left[I - A^*(2)\right]^{-1} = \begin{bmatrix} I & A_{13}^* B_3^* \\ 0 & B_3^* \end{bmatrix} \tag{7}$$

3) for the pair (factors, institutions):

$$A^*(3) = \begin{bmatrix} 0 & 0 \\ A_{21}^* & A_{22}^* \end{bmatrix} \tag{8}$$

with the corresponding partial Leontief inverse:

$$B^*(3) = \left[I - A^*(3)\right]^{-1} = \begin{bmatrix} I & 0 \\ B_{21}^* A_{21}^* & B_2^* \end{bmatrix} \tag{9}$$

Using the same decomposition method as BSPA, the extended Leontief inverse for the first layer feedback loop of in the interregional block structural path analysis (IRBSPA) is given as:

$$\begin{aligned} B_{11}^* &= \left[I - A_{13}^* B_3^* A_{32}^* B_2^* A_{21}^*\right]^{-1} \\ B_{22}^* &= \left[I - A_{22}^* - A_{21}^* A_{13}^* B_3^* A_{32}^*\right]^{-1} \\ B_{33}^* &= \left[I - A_{33}^* - A_{32}^* B_2^* A_{21}^* A_{13}^*\right]^{-1} \end{aligned} \tag{10}$$

3.3 Interregional Network Complication

Interregional network complication is proposed to transform the influence of economic systems in region r on the associated economic subsystems in region R. For this purpose, an extended Leontief inverse of a region as shown in (10) is considered as the second layer economic subsystem. Using this approach, the influence of all economic subsystems on the whole economic system can be captured by incorporating the first layer of the extended Leontief inverse into the second layer.

Consider the interregional sub-block matrix A_{ij}^{**} to be used for constructing the partial interregional direct inputs of the pair of block matrix, e.g. the pair of production activities *i* and factors *j* in intra or interregional framework such as:

$$A_{ij}^{**} = \begin{bmatrix} A_{ij}^{rr} & A_{ij}^{rR} \\ A_{ij}^{Rr} & A_{ij}^{RR} \end{bmatrix} \tag{11}$$

Using the same matrix decomposition used to derive the partial Leontief inverse in the first layer from (3) to (9), for a two-region interregional SAM, each region consisting of three economic subsystems, there will be four clusters of the second layer of extended Leontief inverses. Each cluster consists of three blocks, so twelve block of the second layer extended Leontief inverses are found; these are shown in (12) through (15)

Intraregional rr

$$\begin{aligned} B_{11}^{rr} &= \left[I - A_{13}^{rr} B_3^{rr} A_{32}^{rr} B_2^{rr} A_{21}^{rr} \right]^{-1} \\ B_{22}^{rr} &= \left[I - A_{22}^{rr} - A_{21}^{rr} A_{13}^{rr} B_3^{rr} A_{32}^{rr} \right]^{-1} \\ B_{33}^{rr} &= \left[I - A_{33}^{rr} - A_{32}^{rr} B_2^{rr} A_{21}^{rr} A_{13}^{rr} \right]^{-1} \end{aligned} \tag{12}$$

Intraregional RR

$$\begin{aligned} B_{11}^{RR} &= \left[I - A_{13}^{RR} B_3^{RR} A_{32}^{RR} B_2^{RR} A_{21}^{RR} \right]^{-1} \\ B_{22}^{RR} &= \left[I - A_{22}^{RR} - A_{21}^{RR} A_{13}^{RR} B_3^{RR} A_{32}^{RR} \right]^{-1} \\ B_{33}^{RR} &= \left[I - A_{33}^{RR} - A_{32}^{RR} B_2^{RR} A_{21}^{RR} A_{13}^{RR} \right]^{-1} \end{aligned} \tag{13}$$

Interregional rR

$$\begin{aligned} B_{11}^{rR} &= \left[I - A_{13}^{rR} B_3^{rR} A_{32}^{rR} B_2^{rR} A_{21}^{rR} \right]^{-1} \\ B_{22}^{rR} &= \left[I - A_{22}^{rR} - A_{21}^{rR} A_{13}^{rR} B_3^{rR} A_{32}^{rR} \right]^{-1} \\ B_{33}^{rR} &= \left[I - A_{33}^{rR} - A_{32}^{rR} B_2^{rR} A_{21}^{rR} A_{13}^{rR} \right]^{-1} \end{aligned} \tag{14}$$

Interregional Rr

$$\begin{aligned} B_{11}^{Rr} &= \left[I - A_{13}^{Rr} B_3^{Rr} A_{32}^{Rr} B_2^{Rr} A_{21}^{Rr} \right]^{-1} \\ B_{22}^{Rr} &= \left[I - A_{22}^{Rr} - A_{21}^{Rr} A_{13}^{Rr} B_3^{Rr} A_{32}^{Rr} \right]^{-1} \\ B_{33}^{Rr} &= \left[I - A_{33}^{Rr} - A_{32}^{Rr} B_2^{Rr} A_{21}^{Rr} A_{13}^{Rr} \right]^{-1} \end{aligned} \tag{15}$$

With the set of interregional network complications A^{**} revealed in (2), final demand d^* and total output X^*, the system may be presented as:

$$A^{**} = \begin{pmatrix} 0 & 0 & A_{13}^{rr} & 0 & 0 & A_{13}^{rR} \\ A_{21}^{rr} & A_{22}^{rr} & 0 & A_{21}^{rR} & A_{22}^{rR} & 0 \\ 0 & A_{32}^{rr} & A_{33}^{rr} & 0 & A_{32}^{rR} & A_{33}^{rR} \\ 0 & 0 & A_{13}^{Rr} & 0 & 0 & A_{13}^{RR} \\ A_{21}^{Rr} & A_{22}^{Rr} & 0 & A_{21}^{RR} & A_{22}^{RR} & 0 \\ 0 & A_{32}^{Rr} & A_{33}^{Rr} & 0 & A_{32}^{RR} & A_{33}^{RR} \end{pmatrix}; d^* = \begin{pmatrix} 0 \\ d_I^r \\ d_A^r \\ 0 \\ d_I^R \\ d_A^R \end{pmatrix} \quad X^* = \begin{pmatrix} 0 \\ X_I^r \\ X_A^r \\ 0 \\ X_I^R \\ X_A^R \end{pmatrix} \tag{16}$$

Following Sonis and Hewings (1998), a nested feedback loop hierarchy that captures the feedback loop effects received by the whole economic system in an interregional system is developed as as:

$$\begin{aligned} B^{**}d^* &= \begin{bmatrix} B_{11}^{**} & A_{13}^{**}B_3^{**}A_{32}^{**}B_{22}^{**} & A_{13}^{**}B_{33}^{**} \\ B_2^{**}A_{21}^{**}B_{11}^{**} & B_{22}^{**} & B_2^{**}A_{21}^{**}A_{13}^{**}B_{33}^{**} \\ B_3^{**}A_{32}^{**}B_2^{**}A_{21}^{**}B_{11}^{**} & B_3^{**}A_{32}^{**}B_{22}^{**} & B_{33}^{**} \end{bmatrix} \begin{bmatrix} 0 \\ d_I^* \\ d_A^* \end{bmatrix} \\ &= \begin{bmatrix} A_{13}^{**}B_3^{**}A_{32}^{**} \\ I \\ B_3^{**}A_{32}^{**} \end{bmatrix} B_{22}^{**}d_I^* + \begin{bmatrix} A_{13}^{**} \\ B_2^{**}A_{21}^{**}A_{13}^{**} \\ I \end{bmatrix} B_{33}^{**}d_A^{**} \end{aligned} \tag{17}$$

The general Leontief inverse for the interregional system is written as:

$$\begin{aligned} B^{**} &= \begin{bmatrix} B_{11}^{**} & A_{13}^{**}B_3^{**}A_{32}^{**}B_{22}^{**} & A_{13}^{**}B_{33}^{**} \\ B_2^{**}A_{21}^{**}B_{11}^{**} & B_{22}^{**} & B_2^{**}A_{21}^{**}A_{13}^{**}B_{33}^{**} \\ B_3^{**}A_{32}^{**}B_2^{**}A_2^{**}B_{11}^{**} & B_3^{**}A_{32}^{**}B_{22}^{**} & B_{33}^{**} \end{bmatrix} \\ &= \begin{bmatrix} I & A_{13}^{**}B_3^{**}A_{32}^{**} & A_{13}^{**} \\ B_2^{**}A_{21}^{**} & I & B_2^{**}A_{21}^{**}A_{13}^{**} \\ B_3^{**}A_{32}^{**}B_2^{**}A_{21}^{**} & B_3^{**}A_{32}^{**} & I \end{bmatrix} \begin{bmatrix} B_{11}^{**} & 0 & 0 \\ 0 & B_{22}^{**} & 0 \\ 0 & 0 & B_{33}^{**} \end{bmatrix} \end{aligned} \tag{18}$$

The interregional network complication chain that starts from the self-influence, $B_{22}^{**}d_I^*$, of the institution expenditure, d_I^*, on the institutional income and the influence of the institutional expenditures on factorial income, $A_{13}^{**}B_3^{**}A_{32}^{**}B_{22}^{**}d_I^*$, and the activities output, $B_3^{**}A_{32}^{**}B_{22}^{**}d_I^*$, can be represented as follows:

$$d_I^* \to B_{22}^{**}d_I^* \to B_3^{**}A_{32}^{**}B_{22}^{**}d_I^* \to A_{13}^{**}B_3^{**}A_{32}^{**}B_{22}^{**}d_I^{**} \tag{19}$$

The self-influence, $B_{33}^{**}d_A^*$, of the injections into the production activities, d_A^*, and the influence of these injections on factorial incomes, $A_{13}^{**}B_{33}^{**}d_A^*$, and the institutional income, $B_2^{**}A_{21}^{**}A_{13}^{**}B_{33}^{**}d_A^*$ is reflected by the following complication chain:

$$d_A^* \to B_{33}^{**}d_A^* \to A_{13}^{**}B_{33}^{**}d_A^{**} \to B_2^{**}A_{21}^{**}A_{13}^{**}B_{33}^{**}d_A^* \tag{20}$$

Although network complications (19) and (20) have included feedback loop effects of all activities, factors and institutions across regions, however, those network complication chains are not decomposed to trace the influence of the injection derived from an individual region. In order to trace the influence of individual region that is nested with the rest of the regions within national economic system, network complication chains (19) and (20) can be constructed as follows:

1. Network complication of institutional injection from region *r*

$$\begin{aligned}
&\begin{pmatrix} d_I^r \\ 0 \end{pmatrix} \to \begin{pmatrix} B_{22}^{rr} & B_{22}^{rR} \\ B_{22}^{Rr} & B_{22}^{RR} \end{pmatrix}\begin{pmatrix} d_I^r \\ 0 \end{pmatrix} \to \begin{pmatrix} B_3^{rr} & B_3^{rR} \\ B_3^{Rr} & A_3^{RR} \end{pmatrix}\begin{pmatrix} A_{32}^{rr} & B_{32}^{rR} \\ A_{32}^{Rr} & B_{32}^{RR} \end{pmatrix}. \\
&\begin{pmatrix} B_{22}^{rr} & B_{22}^{rR} \\ B_{22}^{Rr} & B_{22}^{RR} \end{pmatrix}\begin{pmatrix} d_A^r \\ 0 \end{pmatrix} \to \begin{pmatrix} A_{13}^{rr} & A_{13}^{rR} \\ A_{13}^{Rr} & A_{13}^{RR} \end{pmatrix}\begin{pmatrix} B_3^{rr} & B_3^{rR} \\ B_3^{Rr} & A_3^{RR} \end{pmatrix}\begin{pmatrix} A_{32}^{rr} & B_{32}^{rR} \\ A_{32}^{Rr} & B_{32}^{RR} \end{pmatrix}. \\
&\begin{pmatrix} B_{22}^{rr} & B_{22}^{rR} \\ B_{22}^{Rr} & B_{22}^{RR} \end{pmatrix}\begin{pmatrix} d_A^r \\ 0 \end{pmatrix}
\end{aligned} \tag{21}$$

Feedback loops effects from the injection of institutions by individual region *r* in interregional SAM framework may be simplified by the following format:

$$\begin{array}{ccccc}
d_I^r & \to & B_{22}^{rr}d_I^r & \to & B_{22}^{Rr}d_I^r \\
 & & \downarrow & & \downarrow \\
 & & B_3^{rr}A_{32}^{rr}B_{22}^{rr}d_I^r & & B_3^{Rr}A_{32}^{Rr}B_{22}^{Rr}d_I^r \\
 & & \downarrow & & \downarrow \\
 & & A_{13}^{rr}B_3^{rr}A_{32}^{rr}B_{22}^{rr}d_I^r & & A_{13}^{Rr}B_3^{Rr}A_{32}^{Rr}B_{22}^{Rr}d_I^r
\end{array} \tag{22}$$

where, d_I^r is the injection of institutions from region *r*, $B_{22}^{rr} d_I^r$ is generated institutional income in regions *r* (self-influence income), $B_3^{rr} A_{32}^{rr} B_{22}^{rr} d_I^r$ is the activities output of region *r*, and $A_{13}^{rr} B_3^{rr} A_{32}^{rr} B_{22}^{rr} d_I^r$ is the generated factorial income in region *r*. The external impact on institutional income in region *R* is shown by $B_{22}^{Rr} d_I^r$, then the demand for activities in region *R* as $B_3^{Rr} A_{32}^{Rr} B_{22}^{Rr} d_I^r$, and the impact on factorial income in region *R* as $A_{13}^{Rr} B_3^{Rr} A_{32}^{Rr} B_{22}^{Rr} d_I^r$.

2. Network complication of activities injection from region *r*

$$\begin{pmatrix} d_A^r \\ 0 \end{pmatrix} \rightarrow \begin{pmatrix} B_{33}^{rr} & B_{33}^{rR} \\ B_{33}^{Rr} & B_{33}^{RR} \end{pmatrix} \begin{pmatrix} d_A^r \\ 0 \end{pmatrix} \rightarrow \begin{pmatrix} A_{13}^{rr} & A_{13}^{rR} \\ A_{13}^{Rr} & A_{13}^{RR} \end{pmatrix} \begin{pmatrix} B_{33}^{rr} & B_{33}^{rR} \\ B_{33}^{Rr} & B_{33}^{RR} \end{pmatrix} \begin{pmatrix} d_A^r \\ 0 \end{pmatrix} \rightarrow$$
$$\begin{pmatrix} B_2^{rr} & B_2^{rR} \\ B_2^{Rr} & B_2^{RR} \end{pmatrix} \begin{pmatrix} A_{13}^{rr} & A_{13}^{rR} \\ A_{13}^{Rr} & A_{13}^{RR} \end{pmatrix} \begin{pmatrix} B_{33}^{rr} & B_{33}^{rR} \\ B_{33}^{Rr} & B_{33}^{RR} \end{pmatrix} \begin{pmatrix} d_A^r \\ 0 \end{pmatrix} \tag{23}$$

Using a similar decomposition as for institutions (21), the influence of the injection of production activities from region *r* and its impact to the economic subsystems in both region *r* and *R* may be chosen for simplification as the following:

$$\begin{array}{ccccc} d_A^r & \rightarrow & B_{33}^{rr} d_A^r & \rightarrow & B_{33}^{Rr} d_A^r \\ & & \downarrow & & \downarrow \\ & & A_{13}^{rr} B_{33}^{rr} d_A^r & & A_{13}^{Rr} B_{33}^{Rr} d_A^r \\ & & \downarrow & & \downarrow \\ & & B_{22}^{rr} A_{13}^{rr} B_{33}^{rr} d_A^r & & B_{22}^{Rr} A_{13}^{Rr} B_{33}^{Rr} d_A^r \end{array} \tag{24}$$

where, d_A^r is the injection of activities from region *r*, $B_{33}^{rr} d_A^r$ and $B_{33}^{Rr} d_A^r$ are generated outputs of activities in regions *r* and *R* respectively (self-influence output), $A_{13}^{rr} B_{33}^{rr} d_A^r$ and $A_{13}^{Rr} B_{33}^{Rr} d_A^r$ are generated factorial income in region *r* and *R*. The external impact on institutional transfer of income in region *r* and *R* are shown as $B_{22}^{rr} A_{13}^{rr} B_{33}^{rr} d_A^r$ and $B_{22}^{Rr} A_{13}^{Rr} B_{33}^{Rr} d_A^r$.

Given this system, the next section provides results from an application to Indonesia.

4 Empirical Application

The empirical application will use the interregional SAM to evaluate two examples of injection generated by exogenous accounts (final demand). The first example traces the injection of institutions and activities to analyze the global influence resulted from the transformation of associated activities, factors and institutions in the whole region simultaneously. The second example separates the influence of an injection generated by institutions and activities by an individual region and its external influence on the other region's economic subsystems.

4.1 The Sources of the Data

The application of interregional block structural path analysis will use a five-region 1995 interregional SAM. The construction a five-region 1995 interregional SAM is made possible with the availability of interregional trade transaction in the 1995 interregional input-output tables,[2] and the availability of wage, salary, profit, export, import, investments, household and government consumption by region. In the 1995 five-region interregional SAM framework, no interregional household transfers and interregional factorial income from other regions were included because of lack of data. An example of simplified two-region interregional SAM framework and related entries in the cells as the basis for the construction of the 1995 interregional SAM is presented in figure 2. The classification of factors, institutions, and production activities in each region is shown in table 4.

4.2 Global Output and Income

The first stage in the empirical application of using interregional block structural path analysis (IRBSPA) is to compute the injection of institutions and production activities in both regions simultaneously and then to trace their influences on associated activities, institutions, and factors of production. As elaborated earlier, the block matrix of each economic subsystem in each region is grouped into one large block matrix for the ease of computation. This arrangement of the block matrix is analogous to the block matrix for the economic subsystem for the whole region. Using the same approach as BSPA, a global matrix of interregional SAM is decomposed to explicitly specify the influence of production activities and institutions in generating associated outputs in the economic system.

The injection of activities, institutions and the aggregated influence on the associated block matrix of activities and institutions is presented in table 5 for the impact of an injection of

2 In the 1995 interregional input-output, the Indonesian Central Bureau of Statistic also estimated interregional private and government consumption, and interregional investment as well.

institutions and table 6 for activities. The injection of institutions generates Rp.107.7 billion value of institutional income, equal to 17.7% of total institutional income in the system. For comparison, note that, in the same table, the injection of activities in the system creates Rp. 488,311 billion value of institutional income, equal to 81.2% of total institutional income in the whole economic system. While the injection of institutions only generates demand for activities of Rp.188,832 or 8.2% of total output of activities, the injection of activities generates 91.3% of total output. On average, the injection of institutions and activities together generate almost 99% of total output and income of Indonesia; the remaining 1% was contributed by factorial income.

The above injection from block matrix of institutions and production activities simultaneously in the whole system simultaneously only provides a global picture of the share of institutions and production activities in generating global outputs in a big economic system. This result is again identical with the way in which BSPA offers the method to decompose the global matrix. In the interregional framework, one of the advantages of using IRBSPA is in its ability to trace the influence of the transformation from one region's economic subsystem to the other region's subsystem. Using the new decomposition to separate the influence of institution and production from each macro region, the paths of feedback loop and the magnitude of the influence from one region to other regions can be traced.

4.3 Injection of Institutions by Macro Regions

Further investigation of the aggregated impact of the injection of institutions and activities from an individual region can be seen in table 7. The injection of institutions in Sumatera, for example, generates 79.7% of total institutional income derived by Sumatera. Although no direct linkage between institutions in Sumatera and Jawa is specified, however, the injection of institutions in Sumatera generates Rp.3,719 billion value (18%) of institutional income in Jawa as a result of direct linkage between production activities of the two regions. Compared to the four other regions, the self-generating income of Jawa is higher, accounting for 94.2% of total income, more than 10% higher than those of Sumatera (79.7%), Kalimantan (74.9%), Sulawesi (75.5%), and Other (72.2%). Further observation of table 7 shows that the injection from each of those four other regions has more linkages with Jawa compared to the rest of the three other regions. It can be seen that changes in institutional income will change the consumption, and changes in consumption will generate demand for production activities from Jawa. This can be shown from the transformation of activities as the result of change in institutional income. For example, the injection of institutional income in Sumatera generates 88.8% of production activities in Sumatera, and the rest is derived from Jawa. Similar patterns can be observed in Kalimantan where almost 17% of total demand for production comes from Jawa. The linkage between Other and Jawa is even stronger than other neighboring regions such as between Other and Sulawesi or between Other with Kalimantan. The injection of institutional income in Other generates 21% of institutional income in Jawa, while income generation from Sulawesi and Kalimantan is less than 3%.

Closer observation of the impact of the chained reaction from the injection of institutions by individual region provides complimentary profiles of the regional economies. Table 8 illustrates one example to reveal more detailed linkages by sector for Sulawesi. The injection of institutions from Sumatera generates 27.3% of agricultural household income from Jawa, much higher than that of from Kalimantan and Sulawesi with less than 2% of income generation. Overall, table 8 indicates the moderate to strong linkages between Jawa and Sumatera. The injection of institutional income in Sumatera generates 17.9% of manufacturing output from Jawa. In addition, Sumatera also generates around 17% of financial services, and trade, hotel & restaurant of Jawa respectively.

For the other regions, the patterns reinforce the findings of Hulu and Hewings (1993) with an asymmetrical relationship between Jawa and Sumatera with the rest of the country. This is reinforced by the role played by injections of economic activities, described in the next section.

4.4 Injection of Activities by Macro Regions

Table 9 provides aggregated outputs as the result of the injection of production activities in each macro region and the influence to other regions. At the aggregate level, the injection of production activities in Sumatera generates 60.3% of total output (self-generating output), while 35.8% comes from Jawa, with the rest of the country contributing much smaller amounts. In contrast, Kalimatan generates as much as 39% of its activities from Jawa, while self-generating activities only contribute 49% of the output. Detailed analysis in table 10 indicates a strong linkage between Sumatera and Jawa compared to three other macro regions because of geographical proximity and sufficient transport infrastructure linking the two regions. For example, the injection of activities in Jawa generates 16.3% agricultural output from Sumatera, followed by Kalimantan (7%), Sulawesi (7%) and Other (3.64%). Again, the injection of production activities in Other generates more output from Jawa compared from Sulawesi and Kalimantan – the neighbor regions.

The transformation of manufacturing activities in Sumatera only generates around 55% of total manufacturing outputs internally, while more than 40% is generated in Jawa, and a very small proportion from the rest of the other three regions. This result again indicates a strong dependence of Sumatera on Jawa - the focal point of almost all economic activities. As in the case of the injection of institutions, Other's regional economy is more depended on Jawa compared to Sulawesi – the nearest region. Internal production of Other can only produce 57.2% of agricultural output that was generated by the injection of activities, while 27% is imported from Jawa. The nearest region, Sulawesi only provides 7.2% of the agricultural production.

The mining sector is the only production activity that has the largest self-influence (92.4%) among regions, followed by construction (75.4%). Other production activities, such as manufacturing, electricity, gas and water (EGW), trade, hotel & restaurant, and financial sectors are mostly generated by Jawa (more than 50%). This result indicates a weak linkage between Other and the regions within eastern part of Indonesia. This weak trade linkage is partly caused by the non-existence of input resources that can be supplied by Sulawesi or Kalimantan to Other. The fragmented location of the provinces that are grouped into Other (West Papua, Maluku, Nusa Tenggara Barat and Nusa Tenggara Timur) is one of the reasons to explain the weak linkages between Other and the nearest region, particularly Sulawesi and Kalimantan. Nusa Tenggara Timur and Nusa Tenggara Barat tended to be oriented to Jawa instead of Sulawesi or Kalimantan.

Some other features (not presented in tabular form) that can be observed from the direct and indirect influence from the transformation of production activities in each macro region are the differences in the magnitude of self-influence. Sumatera and Jawa have a similar composition of the output of production activities but the magnitude of self-influence is different. The internal structure of Jawa, for example, generates around 88% manufacturing output; the percentage for Sumatera is smaller, 83% and Kalimantan, Sulawesi and Other generates less than 80% of its total output respectively. As far as factor incomes are concerned, the transformation of production activities in Sumatera generates 71.3% of total income of agricultural labor income in

Sumatera, while 23% received accrues to Jawa, and three other regions receive less than 3%. Overall, Sumatera receives 62% of the factorial income generated by the injection of activities in Sumatera. Again, in terms of the percentage, factorial income received by Jawa is higher than other regions; given the higher degree of internal dependence, Jawa generates a higher percentage of its own factorial income (82.9%). In contrast again, Kalimantan can only generate 49.9% - the lowest rate in the system. The pattern of self-generating institutional income in each of macro regions is almost the same as factorial income because of linear transfer from factors to institutions.

5 Conclusions

Using two variations in the decomposition of 1995 five-region interregional SAM of Indonesia, one of the important results is that the injection of institutions and production activities in Jawa alone does not necessarily induce a higher percentage of the change in other regional economies. On contrary, the injection of institution or production activities in Outer-Jawa region could generate the associated institution, activities, and factorial income in Jawa through trade linkages. This asymmetry poses a major problem for any regional development strategy that attempts to reduce disparities in welfare across regions. One of the important findings of this analysis is that the structure of the regional economy of Jawa contains a high degree of self-generation, particularly in manufacturing and some services. Change in institutional income and final demand of Jawa will not necessarily generate concomitant demand in the economies of other macro regions to any significant degree. With higher self-influence in manufacturing industries and most of the production activities of Jawa, the demand from Jawa is not very sensitive to changes in the output of other regions, with the possible exception of the mining sector. Further analysis revealed that the self-influence of the goods sector is higher than services sector; in fact, a much higher percentage of each goods sector is generated within each macro region, while expansion of service demands result in significant leakage to Jawa.

Even though the macro economic structure of the Indonesian economy is changing, manufacturing (25%), agriculture (17%) and mining (10%) still contribute significant portions of national gross value added. As the contributions of these sectors begin to decline and non-manufacturing increases, there is some cause for concern about the way in which this process will exacerbate the concentration of wealth within Jawa. Since the analytical framework used in this paper contained only a partial representation of the interregional connections, there is a distinct possibility that the results overstate the intraregional dependencies for regions other than Jawa and Sumatera.

References

Hidayat, Tirta. 1991. *The Construction of Two- region Social Accounting Matrix for Indonesia and its Application to Some Equities Issues*. Unpublished Ph.D. Dissertation, Cornell University.

Hulu, E and G.J.D Hewings. 1993. "The development and use of interregional input-output models for Indonesia under conditions of limited information." *Review of Regional Development Studies* 5, 135-153.

Nazara, S., M. Sonis and Geoffrey J.D Hewings. 2002. "Regional competition and complementarity in Indonesia." *Discussion Paper* 01-T-02, Regional Economics Applications Laboratory, University of Illinois, Urbana. (www.uiuc.edu/unit/real).

Resosudarmo, Budy P., L.E. Wuryanto, G.J.D. Hewings, and L. Saunders. 1999. "Decentralization and income distribution in the inter-regional Indonesian economy." in Hewings, G.J.D., M. Sonis, M. Madden, and Y. Kimura. *Understanding and Interpreting Economic Structure*. Berlin: Springer.

Sonis, M., G.J.D. Hewings, J. Guo, and E. Hulu. 1997a. "Interpreting spatial economic structure: feedback loops in the Indonesian Interregional economy, 1980, 1985." *Regional Science and Urban Economics* 27, 325-42.

Sonis, M., G.J.D. Hewings, and S. Sulistyowati. 1997b. "Block structural path analysis: applications to structural changes in the Indonesian economy." *Economic Systems Research* 9, 265-80.

Sonis, M., Geoffrey J.D. Hewings. 1998. "Economic complexity as network complication: multiregional input-output structural path analysis." *Annals of Regional Science 32, 407-36.*

Sonis, M., G.J.D. Hewings and N. Achjar. 2003. "Hierarchical fields of influence of spatial exchange." In B. Johansson (ed.) *The Economics of Disappearing Distance* (forthcoming).

Temenggung, Y.A. 1995. *An Inter-Regional Computable General Equilibrium for Indonesia: Measuring the Regional Consequences of National Tax Policy*. Unpublished Dissertation, Cornell University.

Wuryanto, Luki. E. 1996. *Fiscal Decentralization and Economic Performance in Indonesia: An Interregional Computable General Equilibrium Approach*. Unpublished Ph.D. Dissertation, Cornell University.

Table 1 Population and growth rate by region, 1971-2000

Region	Population (in thousand people)					Av. Growth per year (%)		
	1971	1980	1990	1995	2000	1971-80	1980-90	1990-00
Sumatera	20,809	28,017	36,507	40,984	42,666	3.4	2.7	1.6
Jawa+Bali	78,206	93,740	110,359	117,880	123,554	2.0	1.6	1.1
Kalimantan	5,155	6,723	9,100	10,520	10,948	3.0	3.1	1.9
Sulawesi	8,528	10,409	12,521	13,775	14,446	2.2	1.9	1.4
Other	6,510	8,602	10,894	12,135	11,841	3.1	2.4	0.8
Indonesia	119,208	146,935	178,631	195,294	203,455	2.4	2.0	1.3

Source: CBS

Table 2 Distribution of population by region, 1971-2000 (%)

Region	1971	1980	1990	1995	2000
Sumatra	17.5	19.1	20.4	21.0	21.0
Jawa+Bali	65.6	63.8	61.8	60.4	60.7
Kalimantan	4.3	4.6	5.1	5.4	5.4
Sulawesi	7.2	7.1	7.0	7.1	7.1
Other	5.5	5.9	6.1	6.2	5.8
Indonesia	100	100	100	100	100

Source: CBS

Table 3 Distribution of medium and large-scale manufacturing by region, 1985-1997

Region	Establishments (%)			Value Added (%.)			Employment (%)		
	1985	1990	1997	1985	1990	1997	1985	1990	1997
Sumatera	11.1	11.4	10.8	13.4	12.5	13.1	12.2	13	11.7
Jawa	80.1	79.9	80.5	77.9	78.8	79.9	78.6	78	80.9
Kalimantan	3.1	2.8	2.4	6.7	6.1	4.9	5.6	5.3	4.1
Sulawesi	2.5	2.3	2.9	1.2	1.2	1.2	1.8	1.5	1.5
Other*	3.2	3.6	3.4	0.8	1.4	0.8	1.9	2.2	1.8
Indonesia	100	100	100	100	100	100	100	100	100

Sources: CBS, Medium and Large Manufacturing Statistics, 1985, 1990 and 1997; and Dhanani (2000).
* Bali was included in Other region as a part of Nusa Tenggara.

Table 4 Classification of 1995 interregional SAM by sectors in each region

	Code	Sector	Abbreviation
FACTOR OF PRODUCTION	1	Agricultural Labor	AgLab.
	2	Production Labor	ProdLab
	3	Administrative Labor	AdmLab.
	4	Professional Labor	ProfLab.
	5	Capital	Cap.
INSTITUTIONS	6	Agricultural Household	AgHH
	7	Non-agricultural Household Urban	NagUrban
	8	Non-agricultural Household Rural	NagUrban
	9	Firms	Firm
	10	Government	Gov.
PRODUCTION ACTIVITIES	11	Agriculture	Agri.
	12	Mining	Mining
	13	Manufacturing	Man.
	14	Electricity, Gas, and Water	EGW
	15	Construction	Const.
	16	Trades, Hotels, restaurants	Trade
	17	Transportation	Trans.
	18	Finance, House-rent	Fin.
	19	Other services	Other
EXOGENOUS ACCOUNT	20	Capital Account	CapAcc.
	21	Indirect Tax	IndTax
	22	Foreign	Foreign

Table 5 Aggregated global income and output generated by the injection of institutions, 1995 (Rp. billion)

Region	Institutions			Production Activities			Factors		
	Total Income	Generated Income	% Total Income	Total Output	Generated Output	% Total Output	Total Income	Generated Income	% Total Income
Sumatera	127,139	19,037	15.0	469,097	33,639	7.2	109,910	7,937	7.2
Jawa	374,211	74,226	19.8	1,467,484	129,502	8.8	311,487	28,879	9.3
Kalimantan	51,534	6,885	13.4	190,055	11,996	6.3	45,038	2,900	6.4
Sulawesi	28,271	4,339	15.3	93,629	8,228	8.8	24,596	2,209	9.0
Other	26,111	3,221	12.3	86,460	5,467	6.3	22,875	1,446	6.3
TOTAL	607,267	107,707	17.7	2,306,726	188,832	8.2	513,906	43,371	8.4

Table 6 Aggregated global income and output generated by the injection of activities, 1995 (Rp. billion)

Region	Production Activities			Production Activities			Factors		
	Total Income	Generated Income	% Total Income	Total Output	Generated Output	% Total Output	Total Income	Generated Income	% Total Income
Sumatera	127,139	106,667	83.9	469,097	432,725	92.2	109,910	100,644	91.6
Jawa	374,211	296,481	79.2	1,467,484	1,330,656	90.7	311,487	279,379	89.7
Kalimantan	51,534	44,063	85.5	190,055	177,003	93.1	45,038	41,595	92.4
Sulawesi	28,271	23,559	83.3	93,629	84,670	90.4	24,596	22,047	89.6
Other	26,111	22,577	86.5	86,460	80,467	93.1	22,875	21,142	92.4
TOTAL	607,267	488,311	81.2	2,306,726	2,105,521	91.3	513,906	464,806	90.4

Table 7 Aggregated income and output generated by the injection of institutions by region, 1995 (Rp. billion)

Injection	Region	Institutions	%	Activities	%	Factors	%
SUMATERA Injection of Institutions	Sumatera	16,504	79.7	22,802	88.8	5,451	90.3
	Jawa	3,719	18.0	2,855	11.1	585	9.7
	Kalimantan	217	1.0	7	0.0	2	0.0
	Sulawesi	167	0.8	3	0.0	1	0.0
	Other	93	0.4	1	0.0	0	0.0
	TOTAL	20,700	100	25,668	100	6,039	100
JAWA Injection of Institutions	Sumatera	2,161	3.0	253	0.3	61	0.3
	Jawa	67,738	94.2	97,200	99.7	22,012	99.6
	Kalimantan	1,022	1.4	57	0.1	14	0.1
	Sulawesi	608	0.8	14	0.0	4	0.0
	Other	415	0.6	7	0.0	2	0.0
	TOTAL	71,944	100	97,531	100	22,093	100
KALIMANTAN Injection of Institutions	Sumatera	207	2.9	20	0.3	5	0.3
	Jawa	1,379	19.0	1,220	16.5	259	14.6
	Kalimantan	5,436	74.9	6,119	83.0	1,507	84.9
	Sulawesi	155	2.1	12	0.2	3	0.2
	Other	80	1.1	3	0.0	1	0.0
	TOTAL	7,257	100	7,374	100	1,774	100
SULAWESI Injection of Institutions	Sumatera	87	2.0	4	0.1	1	0.1
	Jawa	676	15.3	359	7.2	78	5.8
	Kalimantan	147	3.3	22	0.4	5	0.4
	Sulawesi	3,332	75.5	4,597	91.8	1,256	93.3
	Other	171	3.9	25	0.5	6	0.5
	TOTAL	4,413	100	5,007	100	1,346	100
OTHERS Injection of Institutions	Sumatera	77	2.3	4	0.1	1	0.1
	Jawa	714	21.0	625	18.7	134	15.5
	Kalimantan	63	1.8	4	0.1	1	0.1
	Sulawesi	77	2.3	5	0.2	1	0.2
	Other	2,462	72.6	2,704	80.9	726	84.2
	TOTAL	3,392	100	3,342	100	863	100

Table 8 Injection of institutions from Sumatera and interregional influence, 1995 (%)

S	INSTITUTIONS	Sumatera	Jawa	Kalimantan	Sulawesi	Other	TOTAL
U	AgHH	68.7	27.3	1.9	1.3	0.7	100
M	NAgRural	65.6	30.1	2.0	1.5	0.8	100
A	NAgUrban	65.6	30.2	1.9	1.5	0.8	100
T	Firm	78.7	20.1	0.6	0.4	0.2	100
E	Government	96.0	3.2	0.3	0.3	0.2	100
R	TOTAL	79.7	18.0	1.0	0.8	0.4	100
A							

ACTIVITIES	Sumatera	Jawa	Kalimantan	Sulawesi	Other	TOTAL
Agriculture	95.3	4.7	0.0	0.0	0.0	100
Mining	96.2	3.7	0.0	0.0	0.0	100
Manufact.	82.0	17.9	0.0	0.0	0.0	100
EGW	86.5	13.4	0.0	0.0	0.0	100
Construction	92.6	7.4	0.0	0.0	0.0	100
Trade	82.5	17.4	0.0	0.0	0.0	100
Transport	88.2	11.7	0.1	0.0	0.0	100
Finance	82.9	17.1	0.0	0.0	0.0	100
Other Services	96.6	3.3	0.0	0.0	0.0	100
TOTAL	88.8	11.1	0.0	0.0	0.0	100

FACTORS	Sumatera	Jawa	Kalimantan	Sulawesi	Other	TOTAL
AgLab	95.3	4.7	0.0	0.0	0.0	100
ProdLab	89.4	10.5	0.0	0.0	0.0	100
AdmLab	88.6	11.3	0.0	0.0	0.0	100
ProfLab	95.3	4.7	0.0	0.0	0.0	100
Capital	89.0	11.0	0.0	0.0	0.0	100
TOTAL	90.3	9.7	0.0	0.0	0.0	100

Table 9 Aggregated output and income generated by the injection of activities by region, 1995 (Rp. billion)

Injection	Region	Activities	%	Factors	%	Institutions	%
SUMATERA Injection of Activities	Sumatera	326,701	60.3	76,191	62.0	80,773	61.9
	Jawa	194,293	35.8	41,456	33.7	44,047	33.8
	Kalimantan	10,390	1.9	2,470	2.0	2,613	2.0
	Sulawesi	6,934	1.3	1,810	1.5	1,933	1.5
	Other	3,902	0.7	1,024	0.8	1,090	0.8
	TOTAL	542,220	100	122,951	100	130,454	100
JAWA Injection of Activities	Sumatera	85,238	7.4	21,150	8.5	22,479	8.6
	Jawa	983,032	85.6	204,983	82.9	217,469	82.8
	Kalimantan	42,642	3.7	10,591	4.3	11,280	4.3
	Sulawesi	19,593	1.7	5,168	2.1	5,463	2.1
	Other	18,418	1.6	5,475	2.2	5,837	2.2
	TOTAL	1,148,923	100	247,367	100	262,528	100
KALIMANTAN Injection of Activities	Sumatera	14,087	5.9	3,363	6.2	3,553	6.2
	Jawa	92,507	39.0	20,279	37.3	21,412	37.2
	Kalimantan	116,297	49.0	27,129	49.9	28,749	50.0
	Sulawesi	8,925	3.8	2,200	4.0	2,312	4.0
	Other	5,293	2.2	1,443	2.7	1,525	2.7
	TOTAL	237,109	100	54,414	100	57,552	100
SULAWESI Injection of Activities	Sumatera	2,928	3.5	717	3.5	771	3.5
	Jawa	23,758	28.8	5,354	26.2	5,748	26.3
	Kalimantan	4,642	5.6	1,096	5.4	1,180	5.4
	Sulawesi	45,967	55.6	11,871	58.1	12,694	58.1
	Other	5,319	6.4	1,379	6.8	1,474	6.7
	TOTAL	82,614	100	20,418	100	21,866	100
OTHERS Injection of Activities	Sumatera	3,772	4.0	888	3.8	946	3.8
	Jawa	37,065	39.2	8,235	35.7	8,764	35.6
	Kalimantan	3,033	3.2	700	3.0	748	3.0
	Sulawesi	3,250	3.4	853	3.7	903	3.7
	Other	47,534	50.2	12,416	53.8	13,270	53.9
	TOTAL	94,654	100	23,092	100	24,631	100

Table 10 Injection of activities from Sumatera and interregional influence, 1995 (%)

	ACTIVITIES	Sumatera	Jawa	Kalimantan	Sulawesi	Other	TOTAL
S	Agriculture	75.3	19.2	2.2	2.2	1.1	100
U	Mining	88.1	8.2	2.2	0.3	1.1	100
M	Manufacturing	55.1	42.1	1.7	0.7	0.4	100
A	EGW	42.0	55.1	1.3	1.2	0.3	100
T	Construction	74.8	21.2	1.5	1.7	0.8	100
E	Trade	49.3	46.5	2.2	1.3	0.7	100
R	Transport	56.3	36.0	3.9	2.6	1.2	100
A	Finance	45.6	51.1	1.3	1.4	0.6	100
	Other Services	52.7	42.9	1.1	2.2	1.1	100
	TOTAL	60.3	35.8	1.9	1.3	0.7	100
	FACTORS						
	AgLab	71.3	23.0	2.2	2.4	1.2	100
	ProdLab	62.3	33.9	2.0	1.1	0.7	100
	AdmLab	54.1	41.5	2.0	1.6	0.8	100
	ProfLab	54.1	41.4	1.4	2.0	1.1	100
	Capital	63.1	32.8	2.0	1.2	0.8	100
	TOTAL	62.0	33.7	2.0	1.5	0.8	100
	INSTITUTIONS						
	AgHH	65.0	30.6	2.2	1.5	0.8	100
	NAgRural	64.8	30.8	2.1	1.5	0.8	100
	NAgUrban	63.8	31.8	2.1	1.5	0.8	100
	Firm	48.8	48.3	1.4	1.0	0.6	100
	Government	68.0	25.8	2.3	2.3	1.5	100
	TOTAL	61.9	33.8	2.0	1.5	0.8	100

Note: two-way arrows indicate direct influence of production activities across all regions

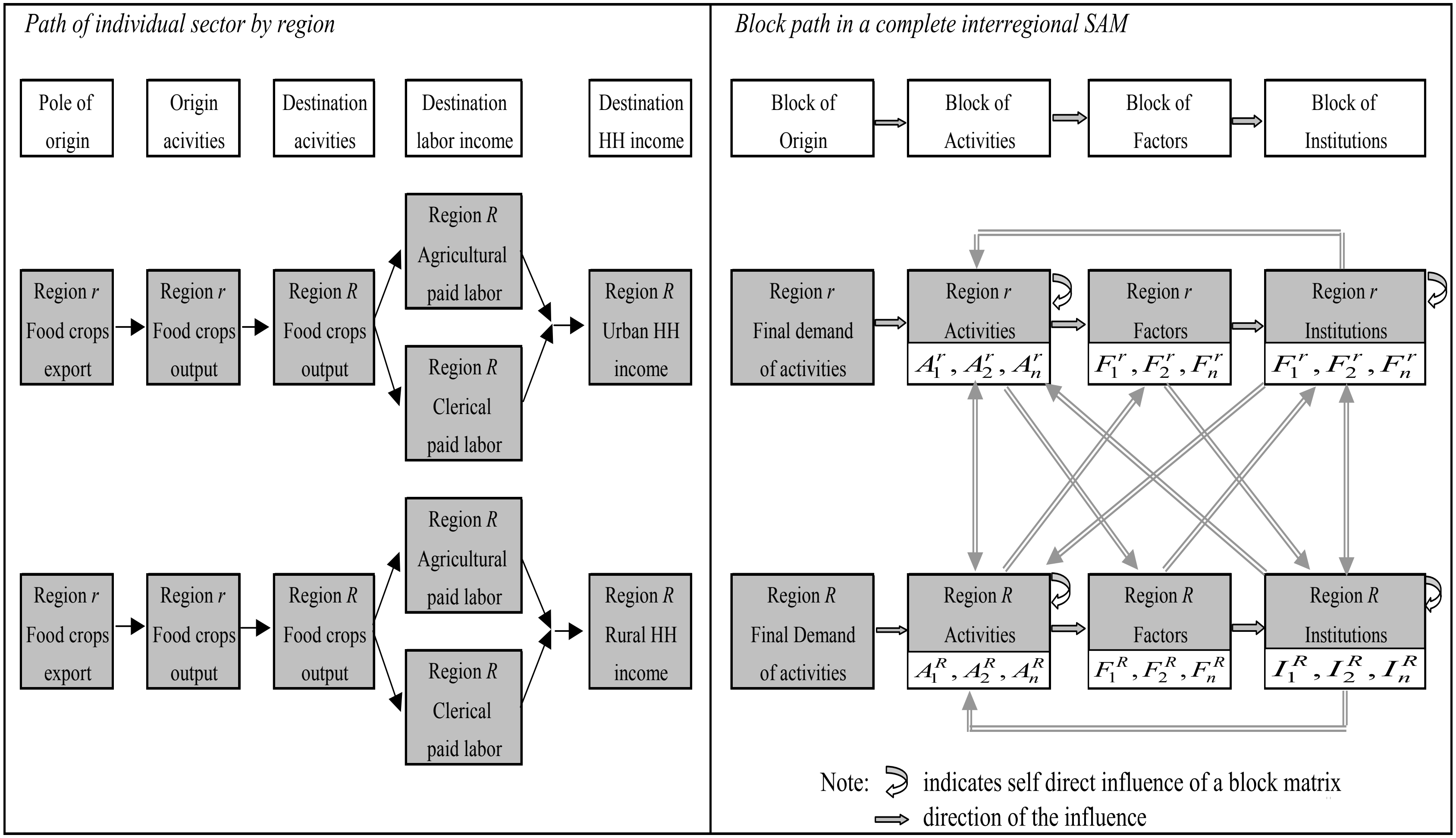

Figure 1 The framework of paths in a two-region interregional SAM

<table>
<tr><td colspan="3" rowspan="3"></td><td colspan="4">FACTORS</td><td colspan="4">INSTITUTIONS</td><td colspan="4">ACTIVITIES</td></tr>
<tr><td colspan="2">*r*</td><td colspan="2">*R*</td><td colspan="2">*r*</td><td colspan="2">*R*</td><td colspan="2">*r*</td><td colspan="2">*R*</td></tr>
<tr><td>F_1</td><td>F_2</td><td>F_1</td><td>F_2</td><td>I_1</td><td>I_2</td><td>I_1</td><td>I_2</td><td>A_1</td><td>A_2</td><td>A_1</td><td>A_2</td></tr>
<tr><td rowspan="4">FACTORS</td><td rowspan="2">*r*</td><td>F_1</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">A_{31}^{rr}</td><td colspan="2" rowspan="2">0</td></tr>
<tr><td>F_2</td></tr>
<tr><td rowspan="2">*R*</td><td>F_1</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">A_{31}^{RR}</td></tr>
<tr><td>F_2</td></tr>
<tr><td rowspan="4">INSTITUTIONS</td><td rowspan="2">*r*</td><td>I_1</td><td colspan="2" rowspan="2">A_{21}^{rr}</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">A_{22}^{rr}</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td></tr>
<tr><td>I_2</td></tr>
<tr><td rowspan="2">*R*</td><td>I_1</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">A_{21}^{RR}</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">A_{22}^{RR}</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td></tr>
<tr><td>I_2</td></tr>
<tr><td rowspan="4">ACTIVITIES</td><td rowspan="2">*r*</td><td>A_1</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">A_{32}^{rr}</td><td colspan="2" rowspan="2">A_{32}^{rR}</td><td colspan="2" rowspan="2">A_{33}^{rr}</td><td colspan="2" rowspan="2">A_{33}^{rR}</td></tr>
<tr><td>A_2</td></tr>
<tr><td rowspan="2">*R*</td><td>A_1</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">0</td><td colspan="2" rowspan="2">A_{32}^{Rr}</td><td colspan="2" rowspan="2">A_{32}^{RR}</td><td colspan="2" rowspan="2">A_{33}^{Rr}</td><td colspan="2" rowspan="2">A_{33}^{RR}</td></tr>
<tr><td>A_2</td></tr>
</table>

Figure 2 Block of cell entries in a simplified two-region interregional SAM without interregional factors and transfer of institutions