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GIRIOT REVISITED: UP-DATED AND EVALUATED

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ABSTRACT

This paper reported an evaluated of a hybrid procedure in GIRIOT (Generation Inter-Regional Input-Output Table) applied for an Island economy of Indonesia. The model was then up-dated using Indonesian data for the year 2015. GIRlOT combines and modifies the GRIT II and GRIT III procedures developed at The University of Queensland. At least three aspects of the new procedure are different to GRIT; the hybrid procedure designed for a mainland economy in a developed country. GRIT uses national technical coefficients. GIRlOT adjusts regional technology differences since in an island country like Indonesia; regional diversity exists in its ecology, economy and culture. GRIT uses LQ (Location Quotient) techniques. GIRIOT estimates the intra-regional input coefficients by employing the generalised RSP (Regional Supply Percentage) and uses column-only as well as row-only approaches. The two approaches are then reconciled. GIRlOT also estimates the inter-regional input coefficients using the inter-island transport pattern of commodity groups for primary and secondary sectors and the pattern of population distribution for the non-zero imports of service sectors. The GIRIOT procedure consists of three stages, seven phases and twenty four steps. Stage I: Estimation of Regional Technical Coefficients, consists of two phases, namely Phase 1: Derivation of National Technical Coefficients and Phase 2: Adjustment for Regional Technology. Stage II: Estimation of Regional Input Coefficients, consists of two phases, namely Phase 3: Estimation of Intra-regional Input Coefficients, and Phase 4: Estimation of Inter-regional Input Coefficients, and Stage III: Derivation Transaction Tables, consists of three phases, namely Phase 5: Derivation of Initial Transaction Tables, Phase 6: Sectoral Aggregation, and Phase 7: Derivation of Final Transaction Tables. The results were two 5 region-9 sector models; row only table and column only table. The validity of the two tables was tested using professional judgment as well as sensitivity test of multipliers resulted yang the models.

Keywords: Hybrid procedure; Inter-Regional Input-Output Tables; Validity test; Sensitivity analysis.

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INTRODUCTION

The increased concern with regional aspects of economic development has been almost universal. Economists, planners, regional analysts and politicians as well as many others are all interested in socio-economic evaluation and the potential impacts of development programs and plans. This interest has created demands for two major kinds of information, namely structural relationships among economic activities and direct, indirect and induced impacts of planned economic activities. The input-output model, originally developed by Leontief in 1930s, is one very useful tool in looking at an economy. It is an excellent descriptive device and a powerful analytical technique (Jensen et.al., 1979). It not only identifies the structural interdependence among industries or sectors as well as among regions of an economy but also it can be used to predict the impacts of new planned economic activities. Batten (1983) states that a great deal of theoretical and empirical attention has been devoted to input-output analysis for several reasons. Firstly, input-output analysis is a theoretically simple technique for recognizing the interdependent nature of an economic system. Secondly, input-output tables provide a practical means of representing economic interdependencies. Thirdly, input-output models are being adopted more frequently for short to medium term economic forecasting. More technically, as stated by Lewis (1971), the purposes of input-output models are (1) to provide a detailed description of a national or regional economy by quantifying linkages among sectors of the economy and the sources and origin of exports and imports, (2) given a set of final demands (exogenous), total output in each industry and requirements for primary factors and resources can be determined, (3) the effects of changes in final demands, arising in either the private or public sector, can be traced and predicted in detail, (4) changes in production technology or relative prices can be incorporated by changing the technical coefficients of production.

The development of the inter-regional input-output model has enabled the regional analyst to incorporate spatial interdependence into empirical analysis, and for many purposes this is an important contribution to analytical methods. Although it can be argued that the general spatial implications of an event, or action or policy are less important, many economic impact and forecasting studies can be significantly improved if the spatial implication can be provided in detail (West, et. al., 1982; 1989). Many, including:, Richardson (1972), Polenske (1969; 1980; 1995), Miller & Blair (1985), Ngo et al (1986), West et al (1982;1989), Hulu et al (1992) and Dewhurst (1994) argued that inter-regional models have significant advantages and uses over single-region model. Firstly, an operational inter-regional model provides consistency checks on its data. For instance, total inter-regional imports must equal total inter-regional exports. Secondly, the data requirements of inter-regional models are, with the aid of acceptable methods recently developed, not disproportionately heavy, particularly if government were to collect some of the necessary information as part of its normal statistical service. Thirdly, inter-regional models have wider application than the single region model, especially through their ability to

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compare and contrast the various regions which comprise the table and to represent the differential effects of an action or policy on each region. West et al., (1982; 1989) gives a good example that the regional economic effects of migration of population and industry can be represented in more meaningful detail if the compensating effects on the migration on all regions can be studied. Polenske (1969) lists the following potential uses for an inter-regional input-output model: studies of shifts in the location of industrial activity and employment; estimation of regional and industrial differences in production techniques; establishment of regional accounts; regional impact studies; regional economic development programs; transportation planning; and civil defense planning. Richardson (1972) points out more specific applications of inter-regional input-output models that includes calculation of the effects on different regions of changes in central government, evaluating the effects of inter-regional shifts in industrial location, measurement and forecasts of export markets for a region, estimation of the effects of freight rate changes on regional production and trade, calculation of spill-over effects of expanded development in rich regions on poorer regions and of inter-regional feedbacks.

A further advantage of inter-regional models is that they can compare the effect on the whole economy of increases in demand for the output of one region with the effect of increases in demand for the output of a different region. As a government, for instance, can affect the spatial allocation of final demand it would be able to use this as a means to improve the growth of the economy as a whole (Dewhurst, 1994). If employment data are available, one could estimate the employment effects of such stimuli to the economy. Suppose then the government increased its demand for a product. The inter-regional model could not only measure the number of job created and where they are located, but also provide a measure of the relative costs of creating jobs using different sectoral and spatial patterns of increased demand.

For developing country, like Indonesia, the need for spatial analysis would appear to be increasing (Hulu & Hewings, 1993) since the process of national development is very often accompanied by a sharp increase in the disparities in welfare across regions (Williamson, 1965). The identification of optimum development strategies must include consideration of location. Attempts to reduce welfare disparities are often hampered by substantial inter-regional leakages as regional economies in developing countries are very open. Without a reliable accounting system, it is difficult to make informed judgments about appropriate project selection, to monitor projects or to provide ex post evaluation. One of the most important aspects in the process of model development for Indonesia has been to provide a strong link between national and regional systems (Hulu & Hewings, 1993) through an inter-regional input-output model.

GIRIOT (Generation Inter-Regional Input-Output Tables) have been proposed and applied by Muchdie (1998) using Indonesian data 1995. Two models have been resulted and the validity of

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the model has been tested. The problem was the models have already been 20 year old. To analyze the current condition, the model is needed to be up-dated and evaluated.

The objective of this paper is to report the result of up-dating data of GIRIOT procedure to Indonesian data of the year 2015. The results are then evaluated using sensitivity analysis of multipliers resulted by the model.

REVIEW OF LITERATURES

Survey and Non-Survey

Methodology for constructing regional and inter-regional input-output tables can be broadly grouped into three categories; survey-based, non-survey and hybrid. Although the survey-based method is considered as the most comprehensive and accurate technique, the compilation process requires enormous resources in terms of time and money (Richardson, 1972; West & Jensen, 1988). A survey-based table may cost ten times as much and need eight to ten times as long to prepare as a non-survey table (Richardson, 1972; West & Jensen, 1988). It is agreed that "full-surveys are no longer feasible" (Miernyk, 1987) means of estimating the regional trade flows (Lahr, 1992).

In contrast, non-survey techniques attempt to estimate regional trade flows without undertaking primary data collection, using procedures which are largely mechanical in nature (West, 1986; West & Jensen, 1988; Bayne & West, 1989; West, 1990). These techniques can produce regional input-output tables with a minimum time; effort and monetary cost (Brucker, S.M., et al, 1987; 1990). Unfortunately, most analysts now agree that pure non-survey or ready-made model can only provide tables of dubious accuracy. Jensen, R.C., (1980; 1990) clearly states that as it has been revealed by a large amount of research, the non-survey tables are inappropriate substitutes for survey-based tables because the non-survey methods are incapable of producing input-output tables with acceptable level of accuracy.

"The survey-non-survey debate is over" (Jensen, 1980; 1990). Both survey and non-survey techniques are no longer considered as the most cost-effective means of constructing sufficiently accurate regional (Lahr, 1993) and inter-regional input-output models. The argument appears to be that "complete survey-based tables are almost prohibitively expensive to construct and that non-survey methods may be too inaccurate for many purpose" (Dewhurst, 1991). This has led to the development of hybrid methods which attempt to combine the best features of both survey and non-survey techniques (Hewings & Jensen, 1986; West 1986; West & Jensen, 1988, Bayne & West, 1989; West, 1990).

Hybrid Methods

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Basically, hybrid methods combine non-survey techniques with superior data which are obtained from experts, surveys and other reliable sources and are inserted at any stage of model construction. The more superior data inserted, the closer the model is to the full survey-based table (West, 1990). The philosophy behind the hybrid method is based on the concept of holistic accuracy; the accuracy with which "the table represents the main features of the economy in a descriptive sense and preserves the importance of these features in an analytical sense" (Jensen, 1980). There are three important categories of hybrid methods that can be distinguished, namely the top-down, the bottom-up, and the horizontal approaches. Lahr (1993) provided an excellent review of literature supporting the hybrid approach to constructing regional input-output models.

The top-down approach is the most common hybrid technique for constructing regional input-output tables, in which various non-survey techniques are applied to the national table or other higher-order table to produce a non-survey regionalised matrix of intra-regional trade coefficients. In order to improve the accuracy of the table, superior data are then inserted into the table (West, 1986). Among the few techniques which satisfy the definition of hybrid are the Georgia Inter-industry System (GIS) and the Generation of Regional Input-Output Tables (GRIT).

The GIS system, devised by Schaffer (1976), is the first attempt to combine survey and non-survey techniques into a formal sequence of steps to produce a regional table (Hewings & Jensen, 1986). It consists of two phases, namely the development of regional technology coefficients and the derivation of regional transaction tables. The first phase in the GIS system is the development of regional technology matrix, irrespective of the regional origin of inputs. This matrix is constructed from several sources such as secondary data, primary data, survey data, and national coefficients. There are several stages in this phase, namely (1) the distinction between direct allocation and transfer items associated with secondary products, (2) adjustment for price changes between the time of construction of the national and the proposed regional table, (3) identification of sectors as local or non-local, (4) accounting for transfers in the process of aggregation, and (5) calculation of regional technology coefficients. The second phase is the derivation of a regional transaction table from the regional technology matrix. There are three steps in this phase, namely (1) estimating regional exports and imports, using the supply-demand pool technique, (2) comparing and adjusting initial estimates to those derived by the export-only technique, and (3) inserting of known values as a substitute for less reliable data in the transaction matrix, and re-balancing with the supply-demand pool technique.

The GRIT system, initially developed by Jensen et al. (1979) and modified by West et al, (1979; 1980), is a multiphase technique for constructing regional input-output tables based on a combination of non-survey and survey techniques. Using conventional non-survey techniques, it begins with the national table to estimate an initial regional transactions table. Superior or more

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reliable data obtained from surveys, other primary data sources or reliable secondary data are then inserted to improve the accuracy of the table. The insertion of superior data can be done at several stages, depending on the availability of the data. It is designed to produce regional tables which are consistent in accounting terms with each other as well as the national table, capable of calculation to a reasonable degree of holistic accuracy, and capable of updating with minimum effort as new data become available.

According to West (1990), the GRIT methodological sequence consists of fourteen steps which are arranged in five phases. Phases 1 and 2 create the non-survey aspects and phases 3 through 5 accommodate the opportunities for insertion of region-specific data and professional assessment of the quality of the resulted table. The procedure focuses on the conversion of national or other higher order coefficients into regional coefficients and the calculation of regional transactions by use of the gross output values. West (1990) denotes that one of the fundamental differences which differentiate GRIT from other models is the final objective. GRIT attempts to produce the best general purpose tables, given limited resources available. This is contrast to a number of ready-made models which are directed toward a special purpose application.

The GRIT system has been intensively used in Australia since its initial introduction in 1977. Of course, the procedure and the usage of the tables have been improved. West et al. (1979; 1980), for instance, use a revised procedure, termed GRIT II, to compile regional tables commissioned by the Northern Territory and South Australian Government. In 1980, the Western Australian Government derived an input-output table using the GRIT II procedures (Western Australian Department of Resource Development, 1980). The tables for Victoria (Powel et al., 1981) and later for New South Wales (Powel et al., 1985) have also been constructed using the technique. Edward et al. (1981) derived a state table for the Tasmanian Government. In total, some 100 tables based on GRIT procedures had been constructed by various research groups for Australian regions (West, 1990). In UK, it was reported that the GRIT-like technique has been widely used to produce local area input-output tables (Willis, 1987).

The opposite approach of constructing intra-regional trade coefficients is the bottom-up approach in the sense that the technique is seen as working from the bottom (firms) which differs than the usual approach which works from the national table down to derive regional tables. Smith & Jensen (1984) experimentally use a system, called ASSET (A System for Small Economy Tables) to produce sub-regional tables. The approach is intended to estimate tables for small regions, with a population of 10,000 or less. The technique, born in the GRIT philosophy, has three phases, namely (1) the assembly of representative firm data relating to the cost structures of those types of firms or community organisation and the conversion of these data to regional input-output coefficients and an initial transaction matrix; (2) the adjustment for regional imports

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and accounting prices and the preparation of a transaction table which is mechanical in nature; and (3) the insertion of superior data and table verification in the context of holistic accuracy.

There are two important assumptions behind this approach. Firstly is that the cost structure of firms with similar functions in rural areas are not unacceptably dissimilar and any differences and unusual features of the small economy can easily be recognised by analysts and can be incorporated through superior data. Secondly, the structure of small rural region economies will tend to be more similar than different. Although the application of it is not without difficulties, West (1986) predicted that the ASSET-type will play an important role in the estimation of small region input-output tables (Smith & Jensen, 1984).

The third approach of hybrid methods in constructing regional input-output tables is the horizontal approach, which derives a table from a previous table of the same region. The adjusted RAS technique, which is basically the simple RAS technique in which superior data are inserted and "locked" in can be included in this category. Although the technique is questionable in a top-down context when applied using the national table as the base matrix, the approach seem to have potential as a hybrid updating methodology. Morison & West (1984) compared the RAS technique with the GRIT procedure for constructing Northern Territory tables and concluded that strong similarities exist between adjusted RAS and final GRIT tables. The approach is similar to the GRIT procedure in which the same superior data are collected and inserted into the base matrix and then "locked in". However, the remaining insignificant cells are not being estimated by the location quotient technique. They are estimated by applying a RAS procedure to the base matrix, in which the only non-pre-determined cells being allowed to vary.

The principle of hybrid techniques in constructing the regional input-output table has been widely accepted and there is no reason that this technique is less appropriate in constructing inter-regional input-output tables (West, 1990). There are at least two hybrid procedures that have been developed for constructing inter-regional input-output tables. One method has been developed at the University of Queensland (West et.al. 1982; 1989) and termed as GRIT III. The other technique developed by Boomsma and Oosterhaven (1992) is termed DEBRIOT, an acronym for Double Entry Bi-Regional Input-output Tables.

One of the main weaknesses of this technique, unfortunately, is that it can only dealt with a two region models. Neither GRIT III nor DEBRIOT are appropriate for constructing inter-regional input-output tables for Indonesia. This is because the GRIT III was designed for the derivation of inter-regional tables given the existence of the appropriate single-region tables. DEBRIOT can deal only with two regions since it was designed for constructing two-region input-output tables. To construct a hybrid many-region input-output table where no single-region tables are available, GRIT II and GRIT III procedures should be combined and some modifications on the procedure are, of course, required.

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The GIRIOT procedure developed by Muchdie (1998) based upon four important considerations. The first is that the procedure can be applied for constructing either the single-region input-output tables or the inter-regional input-output tables or both. A combination of GRIT II and GRIT III procedures is more appropriate since the combination of the procedures will provide a facility in which either the single-region or the many-region input-output tables can be constructed. The second consideration is that the non-survey techniques employed in the procedure should provide the most accurate initial estimates for the reasons that the cells or sectors that do not receive superior data are as accurate possible. For this purpose, the procedure should provide three important facilities in which (1) the difference in regional technology can be taken into account, (2) more accurate techniques can be employed to estimate the intra-regional input coefficients, (3) more appropriate techniques can be provided to estimate the inter-regional input coefficients for an island economy in developing country. The third consideration is that superior data can be inserted at any stage of table construction. This is important since it is anticipated that superior data could be available at any level of disaggregation –from highly disaggregated to highly aggregated and at any form; in coefficients or in flows. Finally, professional judgment will be a very important consideration in ensuring that the procedure produces a model which represents the structure of the economy being studied and the results, in the form of multipliers, represent reality within acceptable professional norms.

Based on these basic considerations, a hybrid procedure in generation the inter-regional input-output tables (GIRIOT) for an island economy in developing country, with special reference to Indonesia, was proposed, developed and applied.

METHODS

GIRlOT combines and modifies the GRIT II and GRIT III procedures developed at The University of Queensland. At least three aspects of the new procedure are different to GRIT; the hybrid procedure designed for a mainland economy in a developed country. GRIT uses national technical coefficients. GIRlOT adjusts regional technology differences since in an island country like Indonesia; regional diversity exists in its ecology, economy and culture. GRIT uses LQ (Location Quotient) techniques. GIRIOT estimates the intra-regional input coefficients by employing the generalised RSP (Regional Supply Percentage) and uses column-only as well as row-only approaches. The two approaches are then reconciled. GIRlOT also estimates the inter-regional input coefficients using the inter-island transport pattern of commodity groups for primary and secondary sectors and the pattern of population distribution for the non-zero imports of service sectors.

The GIRIOT procedure consists of three stages, seven phases and twenty four steps. Stage I: Estimation of Regional Technical Coefficients, consists of two phases, namely Phase 1: Derivation of National Technical Coefficients and Phase 2: Adjustment for Regional

Technology. Stage II: Estimation of Regional Input Coefficients, consists of two phases, namely Phase 3: Estimation of Intra-regional Input Coefficients, and Phase 4: Estimation of Inter-regional Input Coefficients, and Stage III: Derivation Transaction Tables, consists of three phases, namely Phase 5: Derivation of Initial Transaction Tables, Phase 6: Sectoral Aggregation, and Phase 7: Derivation of Final Transaction Tables.

Muchdie (1998) has applied the procedure using Indonesian data for the year 1995. The results were two inter-regional input-output tables; the row only and the column only tables. The model was up-dated using Indonesian data for the year 2015. The main principle of up-dating was the third consideration that superior data can be inserted at any stage of table construction. Data on Gross Domestic Product for every regions/islands (5 regions) and every sector (9 sectors) were inserted and locked. Data on final demand were also inserted and locked. Then intermediate sectors were also inserted with another superior data such as data on regional imports and exports. Tables were then balanced. The two tables then were up-dated and validity of the model was tested.

RESULTS

Model validation is one of the most important aspects of creating a model. According to Jensen et al. (1989) and Jensen (1991), the process of model validation could contribute significantly to the understanding of economic analysis by improving model credibility. Model validation provides some general evidence of the usefulness and applicability of theory and modelling methods. It also provides insight into the relevance of preconceived notions regarding event impact. In broad terms, the process of model validation is to establish how closely the model represents the perceived reality (Gass, 1983). Since a model can neither represent all of perceived reality nor mirror the perceived reality perfectly, McCarl (1984) suggested that attention should be focused only on that part of reality in that the model is intended to represent.

To evaluate the procedure designed to generate an inter-regional input-output table for studying the spatial structure of the Indonesian economy; the questions were: (1) Does the procedure produce inter-regional input-output tables that reflect the spatial characteristics of the Indonesian economy? (2) Do the results, in the form of multipliers, represent reality within acceptable professional norms?

The first question might be answered by inspecting the structure of inter-regional input-output tables in the most aggregate form. More specifically, it will be answered by inspecting the proportion of regional imports and the pattern of inter-regional trade flows. Two versions of very similar tables resulted when the procedure was applied to Indonesia. One version originated from a column-only estimation and the other resulted from a row-only estimation. These two tables were aggregated into a 5-region-1-sector model. The question arises at to which table is more likely to represent the spatial structure of the island economy of Indonesia.

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The two tables differ the value of the cells in the intermediate sector, even though the total intermediate input and total intermediate demand were made equal. Inspection therefore, should focus on the intermediate quadrant of the two tables.

Table 1: Direct coefficients: 5-region-1-sector model (Column estimation)

SECTOR	SUM	JAV	KAL	NUS	OTH	TOT	H-SUM	H-JAV	H-KAL	H-NUS	H-OTH	OFD	EXPRT	TOT
SUM	0.3358	0.0216	0.0205	0.0131	0.0152	0.4061	0.8308	0.0340	0.0142	0.0840	0.0683	0.1461	0.3533	1.9367
JAV	0.0047	0.3731	0.0206	0.0323	0.0099	0.4406	0.1089	0.8319	0.2053	0.0872	0.1358	0.7218	0.4164	2.9473
KAL	0.0015	0.0150	0.2539	0.0273	0.0419	0.3396	0.0095	0.0155	0.6394	0.0434	0.0560	0.0211	0.1614	1.2860
NUS	0.0007	0.0013	0.0034	0.2240	0.0027	0.2320	0.0038	0.0134	0.0198	0.7793	0.0635	0.0443	0.0041	1.1610
OTH	0.0022	0.0097	0.0194	0.0343	0.2812	0.3468	0.0043	0.0194	0.0846	0.0032	0.6046	0.0418	0.0648	1.1694
TOTAL	0.3449	0.4207	0.3177	0.3309	0.3509	1.7651	0.9572	0.9141	0.9633	0.9972	0.9283	0.9751	1.0000	8.5004
HH-SUM	0.1515	0.0000	0.0000	0.0000	0.0000	0.1515	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1515
HH-JAV	0.0000	0.1789	0.0000	0.0000	0.0000	0.1789	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1789
HH-KAL	0.0000	0.0000	0.1977	0.0000	0.0000	0.1977	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1977
HH-NUS	0.0000	0.0000	0.0000	0.2184	0.0000	0.2184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2184
HH-OTH	0.0000	0.0000	0.0000	0.0000	0.2264	0.2264	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2264
OVA	0.4336	0.2344	0.4215	0.4335	0.3881	1.9111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.9111
IMPORT	0.0700	0.1659	0.0623	0.0134	0.0334	0.3450	0.0428	0.0859	0.0367	0.0028	0.0717	0.0249	0.0000	0.6098
TOTAL	1.0000	1.0000	1.0000	1.0000	1.0000	5.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	12.0000
EMPLOY	0.1752	0.1967	0.1444	0.5220	0.2544	1.2927	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.2927

Table 2: Direct coefficients: 5-region-1-sector model (Row estimation)

SECTOR	SUM	JAV	KAL	NUS	OTH	TOT	H-SUM	H-JAV	H-KAL	H-NUS	H-OTH	OFD	EXPRT	TOT
SUM	0.3098	0.0330	0.0130	0.0106	0.0029	0.3693	0.8308	0.0340	0.0142	0.0840	0.0683	0.1461	0.3533	1.8999
JAV	0.0223	0.3578	0.0404	0.0710	0.0599	0.5513	0.1089	0.8319	0.2053	0.0872	0.1358	0.7218	0.4164	3.0579
KAL	0.0044	0.0170	0.2389	0.0141	0.0367	0.3111	0.0095	0.0155	0.6394	0.0434	0.0560	0.0211	0.1614	1.2574
NUS	0.0015	0.0017	0.0032	0.2145	0.0004	0.2213	0.0038	0.0134	0.0198	0.7793	0.0635	0.0443	0.0041	1.1504
OTH	0.0069	0.0113	0.0222	0.0207	0.2510	0.3121	0.0043	0.0194	0.0846	0.0032	0.6046	0.0418	0.0648	1.1347
TOTAL	0.3449	0.4207	0.3177	0.3309	0.3509	1.7651	0.9572	0.9141	0.9633	0.9972	0.9283	0.9751	1.0000	8.5004
HH-SUM	0.1515	0.0000	0.0000	0.0000	0.0000	0.1515	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1515
HH-JAV	0.0000	0.1789	0.0000	0.0000	0.0000	0.1789	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1789
HH-KAL	0.0000	0.0000	0.1977	0.0000	0.0000	0.1977	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1977
HH-NUS	0.0000	0.0000	0.0000	0.2184	0.0000	0.2184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2184
HH-OTH	0.0000	0.0000	0.0000	0.0000	0.2264	0.2264	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2264
OVA	0.4336	0.2344	0.4215	0.4335	0.3881	1.9111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.9111
IMPORT	0.0700	0.1659	0.0623	0.0134	0.0334	0.3450	0.0428	0.0859	0.0367	0.0028	0.0717	0.0249	0.0000	0.6098
TOTAL	1.0000	1.0000	1.0000	1.0000	1.0000	5.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	12.0000
EMPLY	0.1752	0.1967	0.1444	0.5220	0.2544	1.2927	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.2927

Table 1 and Table 2 show that the intra-regional coefficients of the table that originated from the column-only estimation are larger than those of the table derived from row-only estimation. Consequently, given that each table received the same amount of total intermediate input, the inter-regional import proportions of the first table are smaller (Table 3). In comparison, the intra-regional coefficients for Sumatra (0.3358), Java (0.3731), Kalimantan (0.2539), Nusa Tenggara (0.2277) and Other Islands (0.2812) of Table 1 are all higher than those of Table 7.4, the proportion of imports in the column-only table for Sumatra (total : 7.9 %, inter-regional: 0.9%), Java (total: 21.3%, inter-regional:4.7%), Kalimantan (total 12.7%, inter-regional: 6.5%), Nusa

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Tenggara (total: 12.0%, inter-regional: 10.7%) and Other Islands (total: 10.4%, inter-regional : 7.1%) are all smaller than those of the row-only table. For an island economy where every island tends to be self-sufficient because of difficulties associated with inter-regional trade, it seems reasonable to expect that the intra-regional input coefficients (the coefficients of input that are supplied locally) would be higher. The same reason could explain why the proportions of inter-regional imports are smaller. As the size of the region and the stage of economic development determines the size of regional imports, Table 3 shows that Nusa Tenggara, the less-developed region in the country, with an area just 4.6 per cent of the nation total areas, has the largest import proportion. Other islands, at about the same stage of economic progress as Nusa Tenggara but with a larger area (35.7 % of the national total), is the second-highest region in regard to inter-regional imports. The proportion of domestic imports for Java is higher than Sumatra, mainly because the area of Java is only one-fifth that of Sumatra. The inter-regional input-output table whose initial estimations were based on the column average could reflect the spatial structure of an island economy more properly.

Table 3: Regional import proportion by island (% of total input)

Column Estimation	SUM	JAV	KAL	NUS	OTH
Total Import	7.9	21.3	12.7	12.0	10.4
Inter-regional	0.9	4.7	6.5	10.7	7.1
Foreign	7.0	16.6	6.2	1.3	3.3
Row Estimation	SUM	JAV	KAL	NUS	OTH
Total Import	10.5	22.8	14.2	13.3	13.4
Inter-regional	3.5	6.3	8.0	12.0	10.1
Foreign	7.0	16.6	6.2	1.3	3.3

To inspect the structure of inter-regional trade flows more closely, Table 4 and Table 5 provide bi-region and inter-regional trade flows among the islands. As expected, Java, Sumatra and Kalimantan dominate the inter-regional transactions in Indonesia's economy. The trade flow between Java and the rest of Indonesia accounts for 77 per cent of the nation's inter-regional trade flows. The highest percentage trade flow occurred between Java and Sumatra (33 %), followed by Java and Kalimantan (25 %), Java and Other Islands (15 %), and Java and Nusa Tenggara (4 %). The trade flow between Sumatra and the rest of Indonesia accounted for more than 42 per cent of the total inter-regional trade whereas the trade flow between Sumatra and Java accounted for 33 per cent, and trade flows between Sumatra and Kalimantan, Nusa Tenggara and Other Islands was less than 10 per cent of total inter-regional transactions.

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Table 4: Bi-region transaction flows, Indonesia 1990

Two-region flows	Per cent	Two-region flows	Per cent
S-J, J-S	32.83	J-S,S-J	32.83
J-K,K-J	24.74	K-J,J-K	24.74
J-O,O-J	15.02	O-J,J-O	15.02
K-O,O-K	9.01	O-K,K-O	9.01
S-K,K-S	4.23	K-S,S-K	4.23
J-N,N-J	4.19	N-J,J-N	4.19
S-O,O-S	3.18	O-S,S-O	3.18
N-O,O-N	2.92	O-N,N-O	2.92
K-N.N-K	2.62	N-K,K-N	2.62
S-N,N-S	1.25	N-S,S-N	1.25
Total	100.00	Total	100.00

Table 5: Inter-region transactions between island and the rest of Indonesia

Inter-regional flows	Per cent	Dominant two-region trade flows
J-the rest of Indonesia	76.78	(J-S,S-J; J-K,K-J; J-O,O-J: J-N,N-J)
S-the rest of Indonesia	41.49	(S-J,J-S; S-K,K-S; S-O,O-S; S-N,N-S)
K-the rest of Indonesia	40.60	(K-J,J-K; K-O,O-K; K-S,S-K; K-N,N-K)
O-the rest of Indonesia	30.14	(O-J,J-O; O-K,K-O; O-N,N-O;O-S,S-O)
N-the rest of Indonesia	10.99	(N-J, J-N; N-O,O-N; N-K,K-N; N-S,S-N;)

The trade flow between Kalimantan and the rest of Indonesia accounted for 40 per cent, with the general trade flow dominated by Java (25%). The rest of Kalimantan's trade was with Sumatra (4%), Nusa Tenggara (3%) and Other Islands (9%). The trade flow between the Other Islands and the rest of Indonesia accounted for 30 per cent of the total inter-regional trade while the trade flows with Java accounted for 15 per cent of the total, with Nusa Tenggara 3 per cent; Kalimantan 9 per cent; and Sumatra 3 per cent. Finally, the trade flow between Nusa Tenggara and the rest of Indonesia amounted 11 per cent of the total inter-regional trade: 4 per cent of the trade flow between Nusa Tenggara and Java; 3 per cent trade between Nusa Tenggara and Other Islands; 3 per cent trade between Nusa Tenggara and Kalimantan; and 1 per cent trade between Nusa Tenggara and Sumatra.

To answer the second question (Do the results, in the form of multipliers, represent reality within acceptable professional norm?), the stability of the multipliers could be examined by inspecting the indicative parameters of the total multipliers as well as by conducting sensitivity analysis to determine the cells and sectors that are critical to the accuracy of the model.

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Table 6: Indicative parameters of total multipliers

Total output multipliers

Region	Observed Value	Expected Value	Standard Error	95% Confidence Interval Lower	Upper
SUM	1.979	1.99	0.145	1.734	2.31
JAV	2.363	2.384	0.221	2.006	2.887
KAL	2.082	2.091	0.123	1.873	2.362
NUS	2.224	2.235	0.138	1.991	2.542
OTH	2.253	2.265	0.152	1.997	2.602

Total income multipliers

Region	Observed Value	Expected Value	Standard Error	95% Confidence Interval Lower	Upper
SUM	0.304	0.306	0.022	0.266	0.355
JAV	0.424	0.428	0.040	0.360	0.518
KAL	0.407	0.409	0.024	0.366	0.461
NUS	0.468	0.470	0.028	0.420	0.533
OTH	0.488	0.490	0.032	0.433	0.561

Total employment multipliers

Region	Observed Value	Expected Value	Standard Error	95% Confidence Interval Lower	Upper
SUM	0.351	0.353	0.026	0.307	0.410
JAV	0.467	0.471	0.044	0.396	0.571
KAL	0.337	0.339	0.021	0.301	0.386
NUS	0.978	0.981	0.056	0.880	1.104
OTH	0.551	0.553	0.037	0.488	0.634

Table 6 provides the indicative parameters of total output, income and employment multipliers at a 95 per cent confidence interval. The highest standard error for the total output multipliers is for Java (0.221) while the lowest is for Kalimantan (0.123). For total income multipliers, the highest standard error is Java (0.040) and the lowest is for Sumatra (0.022). For the total employment multipliers, Nusa Tenggara has the highest standard error (0.056) while Kalimantan has the lowest (0.021). All observed values total multipliers for output, income and employment lie between the lower and upper bound of the 95 per cent confidence interval, indicating that the total multipliers of the model are stable.

Finally, to identify which coefficients are critical to the accuracy of the model, sensitivity analysis was performed. Using GRIMP Input-Output software, a shock of 10 per cent changes was applied to all direct coefficients. The changes of the total multipliers are ranked. For the inter-regional model with 5 regions and 9 sectors, the closed inverse of the Leontief matrix consisted of 2500 cells. The sensitivity analysis ranked 361 cells in total output, 362 cells in total income, and 334 cells in total employment. Those were the cells that experienced changes of

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more than 0.01 per cent in multipliers due to 10 per cent changes in direct coefficients. When this value was used as the criterion for critical cells generating multipliers, only 14.4, 14.4 and 13.4 per cent of the cells of direct coefficients are important for creating total output, income, and employment multipliers respectively. The rest of the cells are not important and can be ignored.

The results of the tests were summarised in a matrix, called Boolean or Adjacency matrix. This is a matrix that contains unity and zero cells (Cochrane, 1990). A zero cell denotes an element of direct coefficients considered not critical in the sense that 10 per cent change in direct coefficients generates less than 0.01 per cent changes in multipliers. A cell with a value of 1 denotes a critical cell. Rather than specifying coefficients as critical, it would be equally useful to determine which sectors are critical for accuracy of the table. This information is very important for designing surveys for updating table where data for all inputs are gathered, not just a few types of inputs. The sums of rows plus the sums of columns of the Boolean matrix are calculated to indicate which sectors contain the greatest number of critical cells. If a sector comprises 15 or more critical cells it is considered a critical sector.

Table 7: The most critical sectors in generating multipliers

Rank	Output	Income	Employment
1	HH-SUM	HH-SUM	HH-SUM
2	JAV-3	JAV-3	JAV-3
3	HH-NUS	HH-NUS	HH-NUS
4	KAL-3	SUM-3	HH-KAL
5	SUM-3	JAV-7	KAL-3
6	JAV-7	NUS-3	NUS-3
7	HH-KAL	HH-JAV	SUM-3
8	NUS-3	KAL-3	OTH-3
9	HH-JAV	HH-KAL	HH-JAV
10	OTH-3	SUM-6	JAV-1
11	SUM-6	OTH-3	NUS-6
12	KAL-7	JAV-6	SUM-6
13	JAV-6	KAL-7	JAV-6
14	NUS-6	OTH-6	JAV-7
15	SUM-7	SUM-7	KAL-1
16	SUM-8	SUM-8	KAL-7
17	OTH-6	JAV-8	NUS-7
18	KAL-1	KAL-1	OTH-6
19	JAV-8	NUS-6	
20	OTH-8	OTH-8	
21		SUM-9	
22		OTH-7	

Table 7 highlights three significant results. First, the number of sectors that are crucial in generating multipliers varies: 20 sectors for output multipliers; 22 sectors for income multipliers;

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and 18 sectors for employment multipliers. Second, except in Other Islands, the household sectors are consistently critical. This confirms the suggestion that household sectors might be the most important feature of at region's economy. Third, the manufacturing sectors in all regions are the next significant critical sectors for generating output, income and employment multipliers. Transport and communication sectors are crucial for Sumatra, Java and Kalimantan. Trade sectors in Sumatra, Java, Nusa Tenggara and Other Islands are also critical for generating output, income and employment multipliers. Financial sectors are critical only in Sumatra and Java. Except in Kalimantan, no agricultural sectors are identified as critical sectors.

Inspecting the structure of contructed inter-regional input-output tables in the most aggregate form (5 region-1 sector), it can be expected for an island economy that the proportion of inter-regional import would be small because of difficulties associated with inter-regional trade. Applying the feed-back loop analysis introduced by Sonis & Hewings (1991), Sonis, et al, (1993), Sonis, et al (1995) it was showed that inter-regional flows in the Indonesian economy was only 11 per cent. This was smaller that that of mainland economy of the USA reported by Hewing and Gazel (1993) but higher than that of small island economies in the South Pacific reported by Fairbairn (1985). Inspecting bi-regional transaction flows, the contructed model, as expected, showed that Java dominated the inter-island transactions in the Indonesia's economy in which the trade flow between Java and the rest of Indonesia accounted for 77 per cent of the nation's inter-regional trade flows.

The stability of the multipliers resulted by the model was tested by inspecting the indicative parameters of the total multipliers. It was showed that all observed values of the total multipliers lie between the lower and upper bound of the 95 per cent confidence interval, indicating that the total multipliers of the model are stable. To identify which sectors are critical to the accuracy of the model, sensitivity analysis was also performed.

In conclusion, although it is difficult to validate constructed inter-regional input-output model for Indonesia, it can be justified that the GIRIOT procedure would produce inter-regional input-output tables that reflect the spatial characteristics of the Indonesian economy and the result, in the form of multipliers, represent reeality within acceptable profesional norms.

CONCLUSION

GIRIOT as a hybrid procedure in constructing inter-regional input-output tables for Island economy has been up-dated and evaluated. Basically, GIRIOT combines and modifies the GRIT II and GRIT III procedures developed at The University of Queensland. At least three aspects of the new procedure are different to GRIT; the hybrid procedure designed for a mainland economy in a developed country. GRIT uses national technical coefficients. GIRlOT adjusts regional technology differences since in an island country like Indonesia; regional diversity exists in its ecology, economy and culture. GRIT uses LQ (Location Quotient) techniques. GIRIOT

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estimates the intra-regional input coefficients by employing the generalised RSP (Regional Supply Percentage) and uses column-only as well as row-only approaches. The two approaches are then reconciled. GIRlOT also estimates the inter-regional input coefficients using the inter-island transport pattern of commodity groups for primary and secondary sectors and the pattern of population distribution for the non-zero imports of service sectors.

Two other advantages of the GIRIOT procedure are important. First, it can provide the facilities for generating single-region input-output tables. Second, it can be expanded to generate inter-national input-output tables (GINIOT) if the appropriate data are available. Initially, inter-regional input-output tables were constructed for this research using 1990 data from Indonesia, and then updated using 2015 data. Plausible validity testing showed that the GIRIOT procedure could produce inter-regional input-output tables that satisfactorily reflect the spatial characteristics of the Indonesia economy, provided sufficient resources are available. The results also showed the stability of multipliers when all observed values of total multipliers for output, income and employment fell between the lower and upper boundary of the 95 per cent confident interval. Sensitivity analysis also showed that less than 15 per cent of direct coefficients are important for creating total output, income and employment multipliers.

Households proved to be the most critical sectors, confirming the suggestion that household sectors may be the most important feature of regional economies. The manufacturing sector in all regions was the next critical sectors for generating output, income and employment multipliers. Transport and communication sectors were crucial for Sumatera. Java and Kalimantan islands. Trade sectors in Sumatra, Java, Nusa Tenggara and Other Islands were also critical. The financial sector is critical only for the Sumatra and Java Islands. Except for Kalimantan Island, no agricultural sectors are identified as critical sectors.

The model proved useful for analyzing the spatial structure of the island economy of Indonesia as well as the impact of policy simulations. The results of the procedure are claimed to represent reality within acceptable professional norms.

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