Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/4733
DOI URL: http://dx.doi.org/10.21474/IJAR01/4733
ISSN NO. 2320-5407

RESEARCH ARTICLE

SPATIAL MULTIPLIERS AND LINKAGES IN INDONESIAN ECONOMY: AN INTER-ISLAND INPUT-OUTPUT ANALYSIS.

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Manuscript Info

Manuscript History

Received: 4 May 2017
Final Accepted: 6 June 2017
Published: July 2017

Key words:-
spatial multipliers; spatial flow-on; spatial linkages.

Abstract

This paper calculated spatial multipliers, flow-on effects and linkages in Indonesian economy that can be used for planning, evaluation and control purposes for both at national and regional development. Using hybrid procedure, inter-island input-output model for Indonesia has been constructed. Spatial multipliers, flow-on effects and spatial linkages were then calculated. The results show that, firstly, all measures of spatial-specific multipliers (output, income and output) indicated that the percentage of multipliers that occurred in the own-region is significantly high. For the island of Sumatra and Java the percentage of output, income and employment multipliers that occurred in the own region were about 90 per cent indicating that the two islands were relatively spatially independent. Only a small proportion of inputs from the rest of the country were required in producing goods and services in those islands. For other three groups of islands, the Kalimantan Island, the islands of Nusa Tenggara and Other islands, the percentage of multiplier effects in own-region ranged from 70 to 80 per cent of total multiplier effects. Secondly, the flow-on effects, by which the net-impact of change in final demand is measured, provides more accurate measures than that of total. On the lists of the ten largest ranking spatial sectors, the same sectors as those in output multipliers also emerged in output flow-on rank order. Finally, the spatial linkage analysis consistently confirms that the island of Sumatra and the island of Java were more independent with weak spatial linkages. A large proportion of multipliers or flow-on effects would occur in the own-region if the changes of final demand occurred in those islands. Focusing economic activities on these islands would increase the economic growth of the country, but at the same time would make the economic distribution among regions worse.

Introduction:-

Indonesia is one of the largest economies in Southeast Asia and is one of the emerging market economies of the world. The country is also a member of G-20 major economies and classified as a newly industrialized country. It is the sixteenth largest economy in the world by nominal GDP and is the eighth largest in terms of GDP (PPP). Indonesia still depends on domestic market, and government budget spending and its ownership of state-owned

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enterprises and the administration of prices of a range of basic goods including, rice, and electricity plays a significant role in Indonesia market economy, but since the 1990s, 80 percent of the economy has been controlled by private Indonesians and foreign companies. In the aftermath of the financial and economic crisis that began in mid1997 the government took custody of a significant portion of private sector assets through acquisition of nonperforming bank loans and corporate assets through the debt restructuring process and the companies in custody has been sold out by privatization several years later. Since 1999 the economy has recovered and growth has accelerated to over 4–6% in recent years; Indonesian economy grows on average at 5.06 per cent per year at period between 1967- 2011 (Prihawantoro, et al, 2013).

Modelling inter-island economy, Indonesia is divided into 5 big group of island: Sumatra, Java, Kalimantan, Bali-Nusa Tenggara Island and Other island (Muchdie, 1998). The island of Java is significantly important for the Indonesian economy as the national economy is highly concentrated in this island. Historically, the island of Java has dominated the Indonesian economy since the colonial era. More than 60 per cent output of the Indonesian economy resulted by the Island of Java (Muchdie, 2011).

Spatial multipliers measure multipliers occur in own region; own island and other region/other island, Meanwhile, spatial flow-on measure the flow-on effects occur in own-region and other region. DiPasquale & Polenske (1980) specify four types of multipliers, in which one of them is relevant in the context of the inter-island input-output model; spatial or region-specific multipliers.

Backward linkages are usually measured using output multipliers as based on the input matrix. Similarly, value-added and import multipliers are derived by additionally using the corresponding primary input coefficients. For measuring forward linkages, input multipliers have been frequently used. Within a 'supply-driven' input-output model, these multipliers are obtained from the output matrix (Dietzenbacher, E., 2002). Spatial feed-back effects of multipliers can easily be shown by the difference between the single-region multipliers and the intra-regional multipliers, those multipliers that occur in own-region, of the inter-regional model. Spatial spill-over effects are the multiplier effects that occur in other regions due to the change of final demand of own region. The spatial spill-over effects are calculated as the difference between the total multiplier and the multiplier effects that occurred in own-region.

Measures of inter-regional feed-back and spill-over linkages have been developed by Miller (1966; 1969; 1986), Guccione, et al., (1988), Miller & Blair (1985) and Cohrance (1990). Blair & Miller (1988) defined an inter-regional feed-back index (IFI) and a feed-back and spill-over index (FSI) to measure the importance of inter-regional connection for a region by calculating output forthcoming from sectors in a region in response to a change in that region's final demands. Similarly, the spatial feed-back of flow-on effects can easily be shown by the difference between the flow-on to the single-region model and the intra-regional flow-on of the inter-regional model. The spatial spill-over of flow-on is the flow-on that occurs in other regions due to the change of final demand of a certain region. The total feed-back and spill-over effects of flow-on are calculated as the difference between total flow-on of the inter-regional model and those of the single-regional model.

The objective of this paper is to analyze spatial multipliers, flow-on effects and spatial linkages through spill-over effects and feed-back effect in Indonesian economy.

Methods of Analysis:-

An inter-regional input-output model divides a national economy not only into sectors but also regions (Hulu, 1990). An industry in the Leontief model is split into as many regional sub-industries as there are regions. The table consists of two types of matrices representing the two types of economic interdependence. The first are the intra-regional matrices, which are on the main diagonal showing the inter-sectoral transactions which occur within each region. The second are the trade matrices, termed inter-regional matrices, representing inter-industry trade flows between each pair of regions. These matrices show the specific inter-industry linkages between regions, allowing each economic activity to be identified by industry as well as by location.

The inter-regional model can be expressed similar to the equations for the national as well as the single region model. In the general case:

$$ {}^{r}X_i = \sum_j \sum_s {}^{rs}X_{ij} + \sum_s {}^{rs}Y_i; \ (i, j = 1,2,...,n) \text{ and } (r, s = 1,2,...,m) \qquad (1) $$

There are ($m \times n$) equations of this type for each sector in each region showing that the output of each sector is equal to the sales to all intermediate sectors in all regions plus sales to final demand in all regions. In matrix term, the model can be expressed as:

$$x = Ax + y \quad \text{or} \quad x = (I - A)^{-1} y \qquad (2)$$

where x is a vector of output, A is a matrix of input-output coefficients with elements of a_{ij}-s and y is a vector of final demand; $(I - A)^{-1}$ is Leontief inverse matrix with elements of b_{ij}-s. Basically, A matrix in equation (2) contains both technical and trade characteristics, Hartwick (1971) separated these input coefficients ($^{rs}a_{ij}$) into trade coefficients ($^{rs}t_{ij}$) and technical coefficients ($^{s}a_{ij}$). This separation is essentially the same as one that has been done for the single region model (Muchdie, 2011). Equation (2) can then be rewritten as:

$$x = T (A x + y) \quad \text{or} \quad x = (I - T A)^{-1} y \qquad (3)$$

Method employed for constructing Indonesian Inter-Island Input-Output model was hybrid method that specified for studying Island economy of Indonesia. In this model, the regions were disaggregated into 5 regions, namely 5 big-group of Island, namely SUM for Sumatera Island, JAV for Java Island, KAL for Kalimantan Island, NUS for Nusa Tenggara Island and OTH for Other Island which includes Sulawesi, Maluku and Papua Islands. Meanwhile, economic activities were disaggregated into 9 economic sectors, namely: Sec-1 for Agriculture, livestock, forestry and fishery, Sec-2 for Mining and quarrying, Sec-3 for Manufacturing, Sec-4 for Electricity, water and gas, Sec-5 for Construction, Sec-6 for Trade, hotels and restaurants, Sec-7 for Transportation and communication, Sec-8 for Banking and other finance, and Sec-9: Other services.

The GIRIOT (Generation Inter-Regional Input-Output Tables) procedures proposed and developed by Muchdie (1998) and have been applied using Indonesian data for the year 1990 (Muchdie, 1998; 2011). 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. These procedures have been revisited, evaluated and up-dated using Indonesian data for the year 2015 (Muchdie, 2017).

Multipliers: Total and Flow-on Effects:-

One of the major uses of input-output information is to assess the effect on an economy of changes in elements that are exogenous to the model of that economy. The capabilities and usefulness of the Leontief inverse matrix which is the source of analytical power of the model are well known. However, the meaning and interpretations are sometimes confusing. West and Jensen (1980) clarified the meaning of some of the components of the multipliers and suggested a multiplier format which is consistent and simpler to interpret but retains the essence of the conventional multipliers.

As a measurement of response to an economic stimulus, a multiplier expresses a cause and effect line of causality. In input-output analysis the stimulus is a change in sales to final demand. Similar to those in the single-region model, in the inter-regional model West et al., (1982; 1989) defined the major categories of response as: initial, first-round, industrial-support, consumption-induced, total and flow-on effects. Formula of such effects is provided in Table 1.

Table 1:- Formula for Calculation of Multipliers and Flow-on Effects

Effects	Output	Income	Employment
Initial	1	h_i	e_i
First-round	$\sum a_{ij}$	$\sum a_{ij} h_i$	$\sum a_{ij} e_i$
Industrial-support	$\sum b_{ij} - 1 - \sum a_{ij}$	$\sum b_{ij} h_i - h_i - \sum a_{ij} h_i$	$\sum b_{ij} e_i - e_i - \sum a_{ij} e_i$
Consumption-induced	$\sum (b^*_{ij} - b_{ij})$	$\sum (b^*_{ij} h_i - b_{ij} h_i)$	$\sum (b^*_{ij} e_i - b_{ij} e_i)$
Total	$\sum b^*_{ij}$	$\sum b^*_{ij} h_i$	$\sum b^*_{ij} e_i$
Flow-on	$\sum b^*_{ij} - 1$	$\sum b^*_{ij} h_i - h_j$	$\sum b^*_{ij} e_i - e_j$

Source: West, et al, 1982; 1989

Note: a_{ij} is direct input coefficients, b_{ij} is the element of open inverse of Leontief matrix, and b^*_{ij} is the element of closed inverse Leontief matrix, h_j is household income coefficient, e_j is employment output ratio.

DiPasquale & Polenske (1980) specify four types of multipliers, in which two of them are relevant in the context of the inter-regional input-output model; sector-specific and region-specific multipliers. Table 2 provides formula for the calculation of both sector-specific and region-specific multipliers for output, income and employment.

Tabel 2:- Formula for Calculation of Sector and Spatial Specific-Multipliers.

	Output	Income	Employment
Sector-Specific	$\sum {}^{rs}b^*_{ij;}$ r = 1,..m	$\sum {}^{rs}b^*_{ij}\ {}^{s}h_i$; r = 1,..m	$\sum {}^{rs}b^*_{ij}\ {}^{s}e_{i;}$ r = 1,..m
Region-Specific	$\sum {}^{rs}b^*_{ij;}$ i = 1,..n	$\sum {}^{rs}b^*_{ij}\ {}^{s}h_{i;}$ i = 1,..n	$\sum {}^{rs}b^*_{ij}\ {}^{s}e_{i;}$ I = 1,..n

Source: DiPasquale & Polenske, 1980

Note : *r* and *s* are the *m* origin and destination regions, *i* and *j* are the n producing and purchasing sectors, ${}^{rs}b^*_{ij}$ is the element of closed inverse of Leontief matrix, m is the number of regions and n is the number of sectors.

Spatial Feed-back and Spill-over Effects: Multipliers and Flow-on Effects:-

Measures of inter-regional feed-back and spill-over linkages have been developed by Miller (1966; 1969; 1986), Guccione, et al., (1988), Miller & Blair (1985) and Cohrance (1990). Blair & Miller (1988) defined an inter-regional feed-back index (IFI) and a feed-back and spill-over index (FSI) to measure the importance of inter-regional connection for a region by calculating output forthcoming from sectors in a region in response to a change in that region's final demands under two alternative assumptions: (1) that the region is a fully-connected part of an inter-regional input-output system, and (2) that the region is totally isolated from the remaining regions.

Using these two indices, the importance of inter-regional linkages among the islands of Indonesia will be analysed in this section. In this study, however, there are two principal differences with those of Miller. Firstly, the indices are measured by calculating the inter-regional feed-back index (IFI) and feed-back and spill-over index (FSI) of output, income and employment multipliers; rather than calculating output as in Miller studies. Secondly, to eliminate the initial effects of multipliers, the two indices of flow-on effects are also calculated and presented.

Spatial feed-back effects of multipliers can easily be shown by the difference between the single-region multipliers and the intra-regional multipliers, those multipliers that occur in own-region, of the inter-regional model. Spatial spill-over are the multiplier effects that occur in other regions due to the change of final demand of own region. The spatial spill-over effects are calculated as the difference between the total multiplier and the multiplier effects that occurred in own-region. The overall percentage error of ignoring the inter-regional linkages is measured using IFI and FSI. Formulation of IFI and FSI calculation for output, income and employment multipliers and flow-on effects is provided in Table 3.

Table 3:- Formula for Calculation of IFI and FSI of Multipliers.

	Output	Income	Employment
Inter-Regional Table o Total Multipliers o Intra-Reg Multipliers o Inter-Reg Multipliers	TOM= $\sum {}^{rr}b^*_{ij} + \sum {}^{sr}b^*_{ij}$ AOM= $\sum {}^{rr}b^*_{ij}$; i= 1,2,..n EOM= $\sum_{s=1} {}^{sr}b^*_{ij}$;i= 1,2,..n	TNM=$\sum {}^{rr}b^*_{ij}\ {}^{r}h_i + \sum {}^{sr}b^*_{ij}\ {}^{r}h_i$ ANM= $\sum {}^{rr}b^*_{ij}\ {}^{r}h_i$;i= 1,2,..n ENM= $\sum_{s=1} {}^{sr}b^*_{ij}\ {}^{r}h_i$;i= 1,2,..n	TEM=$\sum {}^{rr}b^*_{ij}\ {}^{r}e_i + \sum {}^{sr}b^*_{ij}\ {}^{r}e_i$ AEM= $\sum {}^{rr}b^*_{ij}\ {}^{r}e_i$;i= 1,2,..n EEM= $\sum_{s=1} {}^{sr}b^*_{ij}\ {}^{r}e_i$; i= 1,2,..n
Single-Region Table o Total Multipliers	SOM= $\sum {}^{rr}b^*_{ij}$	SNM= $\sum {}^{rr}b^*_{ij}\ {}^{r}h_i$	SEM= $\sum {}^{rr}b^*_{ij}\ {}^{r}e_i$
Feed-back Effects	FBOM = AOM – SOM	FBNM = ANM – SNM	FBEM = AEM – SEM
Spill-over Effects	SOOM = TOM – AOM	SONM = TNM – ANM	SOME = TEM – AEM
Feed-back + Spill-over	FSOM = TOM - SOM	FSNM = TNM - SNM	FSEM = TEM - SEM
IFI	(FBOM/AOM)100	(FBNM/ANM)100	(FBEM/AEM)100
FSI	(FSOM/TOM)100	(FSNM/TNM)100	(FSEM/TEM)100

Source: Blair and Miller (1988); Cochrane (1990).

Similar to those of multipliers, the spatial feed-back of flow-on effects can easily be shown by the difference between the flow-on to the single-region model and the intra-regional flow-on of the inter-regional model. The spatial spill-over of flow-on is the flow-on that occurs in other regions due to the change of final demand of a certain region. The total feed-back and spill-over effects of flow-on are calculated as the difference between total flow-on of the inter-regional model and those of the single-regional model. The advantage of using this measure in analysing the spatial feed-back and spill-over effects is that the initial effects of multipliers have been excluded, so that "the

net-impacts" of changes in final demand can be provided. Table 4 provides the formula of IFI and FSI calculation for output, income and employment flow-on effects.

Table 4:- Formula for Calculation of IFI and FSI of Flow-on Effects

	Output	Income	Employment
Inter-regional Table o Total Flow-on o Intra-Reg Flow-on o Inter-Reg Flow-on	TOF= $(\sum {}^{rr}b^*_{ij} + \sum {}^{sr}b^*_{ij}) - 1$ AOF= $(\sum {}^{rr}b^*_{ij}) - 1$ EOF= $\sum_{s=1} {}^{sr}b^*_{ij}$; for i= 1,2,..n	TNF=$(\sum {}^{rr}b^*_{ij}\, {}^{r}h_i + \sum {}^{sr}b^*_{ij}\, {}^{r}h_i) - {}^{r}h_i$ ANF= $(\sum {}^{rr}b^*_{ij}\, {}^{r}h_i) - {}^{r}h_i$ ENF= $\sum_{s=1} {}^{sr}b^*_{ij}\, {}^{r}h_i$; for i= 1,2,..n	TEF=$(\sum {}^{rr}b^*_{ij}\, {}^{r}e_i + \sum {}^{sr}b^*_{ij}\, {}^{r}e_i) - {}^{r}e_i$ AEF= $(\sum {}^{rr}b^*_{ij}\, {}^{r}e_i) - {}^{r}e_i$ EEF= $\sum_{s=1} {}^{sr}b^*_{ij}\, {}^{r}e_i$;for i= 1,2,..n
Single-region Table o Total Flow-on	SOF= $(\sum {}^{rr}b^*_{ij}) - 1$	SNF= $(\sum {}^{rr}b^*_{ij}\, {}^{r}h_i) - {}^{r}h_i$	SEF= $(\sum {}^{rr}b^*_{ij}\, {}^{r}e_i) - {}^{r}e_i$
Feed-back Effects	FBOF = AOF – SOF	FBNF = ANF – SNF	FBEF = AEF – SEF
Spill-over Effects	SOOF = TOF – AOF	SONF = TNF – ANF	SOEF = TEF – AEF
Feed-back + Spill-over	FSOF = TOF - SOF	FSNF = TNF - SNF	FSEF = TEF - SEF
IFI	(FBOF/AOF)100	(FBNF/ANF)100	(FBEF/AEF)100
FSI	(FSOF/TOF)100	(FSNF/TNF)100	(FSEF/TEF)100

Source: Blair and Miller (1988); Cochrane (1990)

Results and Discussions:--

Total Multipliers:-

Table 5 provides the ten sectors with the largest total multipliers. The top ten sectors with total output multipliers were JAV-5: Construction industry in the island of Java (2.866), NUS-3: Manufacturing industry in the islands of Nusa Tenggara (2.837), KAL-4: Electricity, water and gas services in the Kalimantan island (2.829), NUS-4: Electricity, water and gas services in the islands of Nusa Tenggara (2.819) and KAL-9: Other services in the Kalimantan island (2.808), SUM-4: Electricity, water and gas services in the island of Sumatra (2.761), OTH-4: Electricity, water and gas services in Other islands (2.647), JAV-4: Electricity, water and gas services in the island of Java (2.568), JAV-9: Other services in the island of Java (2.564) and KAL-5: Construction industry in the Kalimantan island (2.561).

Tabel 5:- Rank of Ten Largest Total Multipliers in Indonesian Economy: Output, Income and Employment.

Multipliers	Total Output		Total Income		Total Employment	
Rank	SECTOR	Value	SECTOR	Value	SECTOR	Value
1	JAV-5	2.866	KAL-9	0.928	NUS-2	2.316
2	NUS-3	2.837	OTH-9	0.883	NUS-1	1.241
3	KAL-4	2.829	SUM-9	0.815	NUS-3	1.170
4	NUS-4	2.819	NUS-9	0.799	NUS-4	0.916
5	KAL-9	2.808	JAV-9	0.772	NUS-7	0.906
6	SUM-4	2.761	NUS-2	0.583	NUS-9	0.903
7	OTH-4	2.647	KAL-8	0.489	NUS-5	0.887
8	JAV-4	2.568	NUS-7	0.474	OTH-5	0.773
9	JAV-9	2.564	JAV-5	0.462	JAV-1	0.740
10	KAL-5	2.561	OTH-5	0.457	NUS-8	0.738

Source: Data Processed using IO7 software

Table 5 also presents total income multipliers where the ten top sectors in generating total income are ranked. Most of them were Sector-9: Other services. They were KAL-9: Other services in the Kalimantan island (0.928), OTH-9: Other services in Other islands (0.883), SUM-9: Other services in the island of Sumatra (0.815), NUS-9: Other services in the islands of Nusa Tenggara (0.799) and JAV-9: Other services in the island of Java (0.772), NUS-2: Mining and quarrying industry in the islands of Nusa Tenggara (0.583), KAL-8: Bank and other finance services in the Kalimantan island (0.489), NUS-7: Transportation and communication in the islands of Nusa Tenggara (0.474), JAV-5: Construction industry in the island of Java (0.462) and OTH-5: Construction industry in Other island (0.457).

Total employment multipliers are also ranked in Table 5. Most of the ten sectors with the highest total employment multipliers were in the islands of Nusa Tenggara; only one was in the island of Java and the other was in Other

islands. They were NUS-2: Mining and quarrying industry in the islands of Nusa Tenggara (2.316), NUS-1: Agriculture, livestock, forestry and fishery in the islands of Nusa Tenggara (1.241), NUS-3: Manufacturing industry in the island of Nusa Tenggara (1.170), NUS-4: Electricity, water and gas services in the island of Nusa Tenggara (0.916) and NUS-7: Transportation and communication in the island of Nusa Tenggara (0.906), NUS-9: Other services in the islands of Nusa Tenggara (0.903), NUS-5: Construction industry in the islands of Nusa Tenggara (0.887), OTH-5: Construction industry in Other islands (0.773), JAV-1: Agriculture, livestock, forestry and fishery in the island of Java (0.740) and NUS-8: Bank and other finance services in the island of Nusa Tenggara (0.738).

One reason for high total employment multipliers in the islands of Nusa Tenggara, the less developed region in the country, is the existence of low wage-rates. This makes the employment-output ratio high and further contributes the high of initial employment effects. For NUS-2: Mining and quarrying industry and NUS-1: Agriculture, livestock, forestry and fishery can be explained as follow: NUS-2: Mining and quarrying industry where small amount of output were produced; all were from quarrying sector, many people were involved. An increase in Rp. 1 million of final demand of this sector would increase total employment by 2,316 persons. Out of this, 1,923 persons were the result of initial employment effects since the direct coefficient of employment of this sector is 1, 923 persons per Rp. 1 million of output. Other effects were first round effects (43 persons), industrial-support effects (22 persons) and consumption-induced effects (328 persons). A similar explanation could be applied to NUS-1: Agriculture, livestock, forestry and fishery where the employment direct coefficient is 981 persons per Rp 1 million of output.

Spatial-Specific Multipliers:-

Table 6 presents a form of spatial-specific multipliers, it only specifies own-region and other regions. From Table 6, one can see that output multiplier effects occurring in own-region are generally much larger than those which occurred in other regions. This is simply because the intial effects occurred in own-region and weak inter-regional linkages.

Table 6:- Spatial-Specific Multiplier in Indonesian Economy: Output, Income and Employment

Region	Own	Other	Total	Region	Own	Other	Total	Region	Own	Other	Total
SUM	1.863	0.116	1.979	SUM	0.282	0.022	0.304	SUM	0.326	0.025	0.351
JAV	2.112	0.251	2.363	JAV	0.378	0.045	0.423	JAV	0.415	0.052	0.467
KAL	1.631	0.447	2.078	KAL	0.323	0.084	0.407	KAL	0.236	0.101	0.337
NUS	1.657	0.554	2.211	NUS	0.362	0.103	0.465	NUS	0.865	0.107	0.972
OTH	1.736	0.511	2.247	OTH	0.393	0.093	0.486	OTH	0.442	0.106	0.548

Source: Data Processed using IO7 software.

In the island of Sumatra and Java, the two most developed islands in the country, the percentage of multiplier effects that occurred in own region were consistently high. In the island of Sumatra, 94.2 per cent of output multiplier effects occurred in own-region and only 5.8 per cent occurred in other regions. The percentage of multiplier effects that occurred in own-region were 92.9 per cent and 93.1 per cent for income and employment. In the island of Java the percentage of multiplier effects that occurred in own region were 89.4, 89.1 and 89.0 per cent for output, income and employment respectively. The high percentage of multiplier effects occurring in own-region indicates that the regions are highly independent. Spatial linkages to other regions are weak.

For other three groups of islands -the Kalimantan Island, the islands of Nusa Tenggara and Other islands- the percentage of multiplier effects occurring in own-region were about 10 - 15 per cent lower. In the Kalimantan island, for instance, the percentage of multiplier effects occurring in own-region were 78.5, 79.4 and 70.2 per cent for output, income and employment respectively. In the islands of Nusa Tenggara, the percentages were 75.0, 77.8, and 89.0 per cent for output, income and employment. In Other island the percentages were 77.3, 80.8 and 80.6 per cent for output, income and multipliers.

Total Flow-on Effects:-

The ten largest ranking sectors for output, income and employment flow-on effects are provided in Table 7. Compared to Table 5 in which sectors were ranked based on total multipliers, one can see that the ten largest sectors based on output flow-on (Table 8) are the same sectors as those for in total multipliers. This is simply because, for total output, the initial effect is unity for all of the spatial-sectors. Since primary input coefficients for income (h_j) and employment (e_j) are different for each spatial-sector, so that each spatial-sector has different intial income and

employment effects, one can then expect that different sectors would appear as the ten sectors with largest flow-on effects for income and employment.

Based on the income flow-on effects, the ten largest sectors were KAL-9: Other services in the Kalimantan island (0.335), NUS-3: Manufacturing industry in the islands of Nusa Tenggara (0.328), NUS-9:Other services in the islands of Nusa Tenggara (0.314), OTH-3: Manufacturing industry in Other islands (0.308), NUS-4: Electricity, water and gas services in the islands of Nusa Tenggara (0.305), OTH-9: Other services in Other islands (0.303), JAV-5: Construction industry in the island of Java (0.297), KAL-4: Electricity, water and gas in the Kalimantan island (0.296), OTH-5: Construction industry in Other islands (0.292) and NUS-7: Transportation and communication in the islands of Nusa Tenggara (0.292). This means than an increase of Rp. 1,000 final demand of KAL-9: Other services in the Kalimantan Island, for example, would generate income flown-on effects into the national economy of Rp. 328. The same sectors as those on total multipliers were KAL-9: Other services in the Kalimantan island, NUS-9: Other services in the islands of Nusa Tenggara, OTH-9: Other services in Other islands, JAV-5: Construction industry in the island of Java and OTH-5: Construction industry in Other island.

Table 7:- Ten Largest Total Flow-on Effects in Indonesian Economy: Output, Income and Employment

Multipliers	Total Output		Total Income		Total Employment	
Rank	SECTOR	Value	SECTOR	Value	SECTOR	Value
1	JAV-5	1.866	KAL-9	0.335	NUS-3	0.784
2	NUS-3	1.837	NUS-3	0.328	NUS-9	0.596
3	KAL-4	1.829	NUS-9	0.314	OTH-3	0.515
4	NUS-4	1.819	OTH-3	0.308	NUS-4	0.494
5	KAL-9	1.808	NUS-4	0.305	NUS-7	0.484
6	SUM-4	1.761	OTH-9	0.303	NUS-5	0.465
7	OTH-4	1.647	JAV-5	0.297	NUS-6	0.441
8	JAV-4	1.568	KAL-4	0.296	KAL-9	0.402
9	JAV-9	1.564	OTH-5	0.292	NUS-2	0.393
10	KAL-5	1.561	NUS-7	0.292	OTH-9	0.390

Source: Data Processed using IO7 software**.**

The ten sectors with the largest employment flow-on effects were NUS-3: Manufacturing industry in the islands of Nusa Tenggara (0.784), NUS-9: Other services in the island of Nusa Tenggara (0.596), OTH-3: Manufacturing industry in Other islands (0.515), NUS-4: Electricity, water and gas services in the island of Nusa Tenggara (0.494), NUS-7: Transportation and communication in the island of Nusa Tenggara (0.484), NUS-5: Construction industry in the island of Nusa Tenggara (0.465), NUS-6: Trade, hotel and restaurant industry in the islands of Nusa Tenggara (0.441), KAL-9: Other services in the Kalimantan island (0.402), NUS-2: Mining and quarrying industry in the island of Nusa Tenggara (0.393) and OTH-9: Other services in Other islands (0.390).

The same sectors as those for total multipliers were NUS-3: Manufacturing industry in the islands of Nusa Tenggara, NUS-9: Other services in the islands of Nusa Tenggara, NUS-4: Electricity, water and gas services in the islands of Nusa Tenggara, NUS-7: Transportation and communication industry in the islands of Nusa Tenggara, NUS-5: Construction industry in the islands Nusa Tenggara and NUS-2: Mining and quarrying industry in the islands of Nusa Tenggara.

Spatial Distribution of Flow-on Effects:-

Table 8 provides the spatial distribution of output, income and employment flow-on effects. The patterns to what extend the output, income and employment flow-on effects are spatially distributed were similar. If final demand changes in the islands of Sumatra and Java, about 80 per cent of total flow-on effects occurred in own-region. For output, the percentage of flow-on effects that occurred in own-region was 88.8 per cent if final demand changes in the island of Sumatra and 79.5 per cent in the island of Java. For income, 89.7 per cent in the island of Sumatra and 81.9 per cent in the island of Java; and for employment, 84.5 per cent in the island of Sumatra and 80.3 per cent in the island of Java. This is, again, due to weak inter-regional linkages in an island country.

In the Kalimantan island, the percentage of flow-on effects that occurred in own-region was about 60 per cent or less. More than 20 per cent of flow-on effects generated by changes in final demand of Kalimantan's economy went

to the island of Java. The percentages were 21.5, 20.7, and 23.8 per cent for output, income and employment respectively. Flow-on effects occurred in own-region for final demand changes in the island of Nusa Tenggara were about 50 per cent for output and income; 52.9 per cent for output and 53.9 per cent for income. For employment, the percentage of own-region flow-on effect was 74.3 per cent. Finally, if final demand changes in Other islands, the flow-on effects that occurred in own-region were about 55 per cent; 55.6 per cent for output, 55.3 per cent for income, and 55.2 per cent for employment.

Table 8:- Spatial Distribution of Low-on Effects (%) Output.

Island \ Island	Sumatra	Java	Kalimantan	Nusa Tenggara	Other Islands	Total
Sumatra	88.8	7.9	1.4	0.5	1.3	100.0
Java	11.5	79.5	4.1	1.2	3.7	100.0
Kalimantan	8.5	21.5	57.4	2.5	10.1	100.0
Nusa Tenggara	15.0	16.7	8.4	52.9	7.0	100.0
Other Island	14.4	11.9	13.4	4.6	55.6	100.0

Income

Island \ Island	Sumatra	Java	Kalimantan	Nusa Tenggara	Other Islands	Total
Sumatra	89.7	7.9	1.1	0.2	1.2	100.0
Java	9.9	81.9	4.0	0.9	3.4	100.0
Kalimantan	6.5	20.7	61.2	1.9	9.7	100.0
Nusa Tenggara	12.8	14.8	8.6	53.9	9.9	100.0
Other Island	18.5	10.3	13.0	2.9	55.3	100.0

Employment

Island \ Island	Sumatra	Java	Kalimantan	Nusa Tenggara	Other Islands	Total
Sumatra	84.5	12.5	0.8	0.9	1.3	100.0
Java	9.6	80.3	2.7	2.8	4.5	100.0
Kalimantan	7.3	23.8	49.6	5.7	13.5	100.0
Nusa Tenggara	7.5	9.4	3.9	74.3	5.0	100.0
Other Island	10.4	16.3	8.6	9.4	55.2	100.0

Source: Data Processed using IO7 software.

The extent to which the percentage of flow-on effects occurred in own-region is mainly determined by the size of inter-regional linkages through the spill-over and feed-back effects. The larger the spill-over effects, the larger the percentage of flow-on effects which occur in other regions, making a smaller percentage of flow-on effects in own-region. The larger the feed-back effect, the larger the percentage of flow-on effects which occur in own-region. In the following section, these two effects are discussed in more detail in turn.

Spatial Feed-back and Spill-over Effects of Multipliers:-

Tabel 9 provides total feed-back and spill-over effect indexes for output, income and employment multipliers. From the table, it is evident that at national average IFI were small for all output, income and employment multipliers. The FSI, however, were quite significant due to large spill-over effects of multipliers. Ignoring inter-regional feed-back and spill-over effects would underestimate multipliers by 24.2 per cent for output, 22 per cent for income and 23.0 per cent for employment. Using IFI alone to measure inter-regional linkages could be underestimate because the spill-over effects have not been taken account for analysing the linkages, so that the error of not using inter-regional model in estimating multipliers were relatively small, namely 6.5 per cent for output multipliers, 7.2 per cent for income multipliers and 8.1 per cent for employment multipliers. FSI measure would be more relevant for linkage analysis as it provides more complete analysis that includes not only the feed-back effects but also the spill-over effects.

Table 9:- Total Feed-Back and Spill-Over Effects Indexes in Indonesian Economy: Output, Income and Employment Multipliers

	Output	Income	Employment
IFI	6.5	7.2	8.1
FSI	24.2	22.5	23.0

Source: Data Processed using IO7 software.

Disaggregated by island; one can see the indices of feed-back and spill-over effects (FSI) for output, income and employment multipliers that is provided in Table 14. The values of FSI for the island of Sumatra and Java were relatively small compared to other three groups of islands. For the island of Sumatra the values of FSI were 11.3, 11.2 and 16.3 for output, income and employment multipliers respectively. For the island of Java the values of FSI were 12.2, 10.5 and 11.3 for output, income and employment multipliers respectively. The reasons might be that the two regions were the most independent regions in the country's economy. The index of spatial independence, calculated as a ratio between the intra-regional multipliers and total multipliers (see Cochrane, 1990), for Sumatra was 0.942 and Java was 0.894.

The three other less developed regions, the Kalimantan island, the islands of Nusa Tenggara and Other islands, were less independent. Their indices of the spatial independence were 0.785, 0.750 and 0.773 for the Kalimantan island, the islands of Nusa Tenggara and Other islands respectively. They were more dependent on the rest of the country, especially the island of Java and to less extend on the island of Sumatra. The Kalimantan island, for instance, was strongly dependent on the island of Java in providing inputs for producing goods and services; about 50 per cent of its inputs came from the island of Java. Changes in final demand of Kalimantan would generate a significant amount of spilled-over effects that went to the island of Java. The values of FSI for Kalimantan were 30.0, 26.8 and 40.6 for output, income and employment multipliers consecutively. For the islands of Nusa Tenggara, the values of FSI were 36.9, 34.6 and 21.6 for output, income and employment multipliers. For Other islands, the values of FSI were 29.1, 25.1, and 27.1 for output, income and employment multipliers.

Table 10:- Spatial Feed-Back and Spill-over Index (FSI) in Indonesian Economy: Output, Income and Employment Multipliers

FSI	Output	Income	Employment
Sumatra	11.3	11.2	16.3
Java	12.2	10.5	11.3
Kalimantan	30.0	26.8	40.6
Nusa Tenggara	36.9	34.6	21.6
Other Island	29.1	25.1	27.1
National	24.2	22.5	23.0

Source: Data Processed using IO7 software.

The above values of FSI indicate the importance of inter-regional linkages in the island economy of Indonesia. Ignoring the spatial linkages would certainly underestimate the impacts occurring in the regional economy. As the single-region model excludes the feed-back and spill-over effects in respond to changes in a region's final demand, it is important to employ an inter-regional model.

Disaggregated measures of FSI describe the sectoral nature of the linkage indices. The ten highest ranking spatial-sectors based on FSI of output, income and employment multipliers are presented in Table 11.

Table 11:- Ten Largest Spatial Sector Feed-back and Spill-over Index (FSI): Output, Income and Employment Multipliers

Output	Income	Employment
NUS-4 (50.8)	NUS-4 (59.0)	KAL-8 (54.3)
OTH-4 (50.6)	OTH-4 (57.8)	KAL-5 (53.1)
KAL-9 (44.9)	NUS-5 (48.1)	KAL-9 (50.5)
NUS-5 (44.7)	NUS-3 (46.9)	OTH-4 (47.3)
OTH-5 (42.5)	OTH-5 (44.0)	KAL-4 (42.6)
NUS-3 (41.0)	KAL-5 (34.4)	KAL-2 (39.9)
NUS-2 (40.6)	KAL-8 (32.2)	KAL-7 (37.7)
KAL-8 (37.6)	KAL-4 (31.0)	KAL-6 (36.4)
NUS-9 (36.7)	NUS-2 (30.9)	NUS-9 (35.2)
KAL-5 (33.0)	NUS-6 (29.5)	OTH-9 (34.2)

Source: Data Processed using IO7 software.

As mentioned, the most relevant for impact analysis are the FSI. Among the highest ten sectors for FSI of output multipliers were five sectors of economy in the islands of Nusa Tenggara, namely NUS-4: Electricity, water and gas, NUS-5: Construction, NUS-3: Manufacturing, NUS-2: Mining and quarrying and NUS-9: Other services. For income multipliers, there were also five sectors in the islands of Nusa Tenggara among the highest ten spatial-sector of FSI, namely NUS-4: Electricity, water and gas, NUS-5: Construction, NUS-3: Manufacturing, NUS-2: Mining and quarrying and NUS-6: Trade, hotel and restaurant.

For employment multipliers, seven sectors in the Kalimantan island were among the highest ten spatial-sectors for FSI, namely KAL-8: Bank and other finance services, KAL-5: Construction, KAL-9: Other services, KAL-4: Electricity, water and gas, KAL-2: Mining and quarrying, KAL-7: Transportation and communication and KAL-6: Trade, hotel and restaurant. Identified by sector, three Other services, namely KAL-9, NUS-9 and OTH-9 included in the ten largest spatial-sectors for FSI of employment multipliers. Since the FSI measure is based on elements of the Leontief inverse, these results indicate that, in term of production of output and generation of income, strong linkages occurred between the islands of Nusa Tenggara and the rest of the country mostly through input purchases by utility, construction, manufacturing and service sectors. Agriculture, livestock, forestry and fishery sector relied on local inputs in the island.

In term of employment creation, almost all of the economic sectors in the Kalimantan island had strong employment linkages with the rest of Indonesia, especially the island of Java. Local employment was mainly supplied for agriculture, livestock, forestry and fishery sectors. As mentioned earlier, the use of multipliers in analysing the spatial structure of economy can be misleading due to the existence of intial effects in multiplier calculation. The net-effects of stimuli where the intial effects have been eliminated, the flow-on effects, would be preferred. In the following section, the spatial feed-back and spill-over flow-on effects will be presented.

Spatial Feed-back and Spill-over Effects of Flow-on:-

Table 12 provides spatial FSI for output, income and employment flow-on effects. Compared to Table 11, one can see that the pattern of spatial linkages is similar to those of total multipliers. The sizes of linkages, however, are larger due to the elimination of the initial effects. Ignoring the spatial linkages in estimating flow-on effects that occurred due to changes in final demand in the island of Sumatra and Java would result in an error of about 20 per cent. The values of FSI of output, income and employment flow-on effects for the island of Sumatra were 21.1, 23.3, and 27.7 respectively. For the island of Java, the values of FSI were 22.9, 21.0 and 20.7 for output, income and employment flow-on effects respectively.

Table 12:- Spatial Feed-back and Spill-over Index (FSI):Output, Income and Employment Flow-on Effects

FSI	Output	Income	Employment
Sumatra	21.1	23.3	27.7
Java	22.9	21.0	20.7
Kalimantan	53.5	51.7	63.0
Nusa Tenggara	65.5	66.7	49.9
Other Island	54.8	59.2	50.4
National	44.3	47.3	44.2

Source: Data Processed using IO7 software.

The error of ignoring the spatial linkages was even higher if the final demand changes occurred in the other three groups of islands. The values of FSI of output, income and employment flow-on effects were 53.5, 51.7 and 63.0 if final demand changes occurred in the Kalimantan island. If final demand changes in the islands of Nusa Tenggara, the values of FSI were 65.5, 66.7 and 49.9 for output, income and employment flow-on effects. In Other island, the values of FSI were 54.8, 59.2 and 50.4 for output, income and employment flow-on effects.

Again, these results confirmed that the three groups of islands, the Kalimantan island, the islands of Nusa Tenggara and Other islands, had very strong spatial linkages with the rest of the country mainly through input purchases in producing goods and services in the region. In more disaggregated form, Table 13 lists the ten highest ranking spatial-sectors based on FSI of output, income and employment flow-on effects.

Similar to the results of analysing the values of FSI for multiplier effects, among the highest ten spatial-sectors for FSI of output flow-on effects were five sectors of the economy in the islands of Nusa Tenggara, namely NUS-4:

Electricity, water and gas, NUS-2: Mining and quarrying, NUS-5: Construction, NUS-8: Bank and other finance services, and NUS-1: Agriculture, livestock, forestry and fishery. With slightly different rank order, three sectors were the same as those in multiplier effects analysis. Another two new spatial-sectors, however, emerged in the flow-on analysis.

Tabel 13:- Ten Largest Spatial-Sector Feed-Back and Spill-Over Index (FSI): Output, Income and Employment Flow-on Effects

Output	Income	Employment
OTH-4 (436.5)	NUS-4 (83.8)	KAL-9 (76.1)
NUS-4 (370.0)	OTH-8 (82.3)	KAL-8 (75.3)
NUS-2 (319.2)	OTH-4 (78.7)	OTH-4 (74.4)
NUS-5 (283.7)	NUS-2 (76.9)	KAL-5 (67.7)
OTH-5 (232.0)	NUS-5 (75.5)	OTH-5 (65.5)
KAL-9 (230.5)	NUS-1 (69.1)	KAL-2 (65.5)
NUS-8 (210.5)	OTH-5 (68.8)	NUS-2 (64.5)
KAL-8 (209.5)	NUS-8 (68.1)	KAL-6 (63.3)
NUS-1 (208.6)	KAL-9 (68.0)	OTH-2 (61.1)
NUS-3 (172.1)	KAL-8 (64.7)	NUS-5 (60.1)

Source: Data Processed using IO7 software.

For income flow-on effects, there were also five sectors in the islands of Nusa Tenggara among the highest ten spatial-sector of FSI, namely NUS-4: Electricity, water and gas, NUS-2: Mining and quarrying, NUS-5: Construction, NUS-1: Agriculture, livestock, forestry and fishery, and NUS-8: Bank and other finance services. As in output flow-on, three sectors were the same as those in multipliers analysis. The two new spatial-sectors were also the same, but different in rank order.

For employment flow-on, compared to seven sectors in multipliers analysis, only five sectors in the Kalimantan island were among the highest ten spatial-sectors for FSI. These sectors were KAL-9: Other services, KAL-8: Bank and other finance services, KAL-5: Construction, KAL-2: Mining and quarrying, and KAL-6: Trade, hotel and restaurant.

The results of the analysis, especially on the spatial feed-back and spill-over effects of multipliers and flow-on, discussed in this section justify the notion that development activities should be focused on the eastern parts of Indonesia that include the Kalimantan island, the islands of Nusa Tenggara (not include Bali) and Other islands. This reinforces the Indonesian government policies, highlighted in the 1990 presidential address, to list the eastern parts of Indonesia as a priority in Indonesia's development (Soegijoko, 1995). Not only will the eastern parts of Indonesia get benefits from the government policy, but also the rest of the country will improve their economic performance through the spill-over effects and the spatial linkages.

Concentrating economic activities in the island of Java and Sumatra would worsen the inequity problems in the Indonesian economy. It has been showed that, by any measure, Java and Sumatra have dominated the Indonesian economy and in this chapter, it is showed that the spill-over effects of the two islands were small. This shows the net impact of economic development on the two islands would not spread-out into the rest of the country. Conversely, the spill-over effects from development in the eastern parts of Indonesia will flow to the two islands, especially the island of Java.

Conclusion:-

In this chapter, the spatial structure of the island economy of Indonesia was presented in a more predictive manner by analysing the multipliers, flow-on and the spatial linkages.

All spatial-sector of Sector 9: Other services (KAL-9, OTH-9, SUM-9, NUS-9 and JAV-9) were among the ten largest ranking spatial-sectors for income multipliers. Two spatial-sectors of Sector-5: Construction industry (JAV-5 and OTH-5) were also included, as two sectors in the islands of Nusa Tenggara (NUS-2: Mining and quarrying industry, and NUS-7: Transportation and communication industry).

Among the ten largest ranking spatial-sectors in employment multipliers, there were eight sectors of the islands of Nusa Tenggara, namely NUS-2, NUS-1, NUS-3, NUS-4, NUS-7, NUS-9 and NUS-5. The other sectors were Sector-1: Agriculture, livestock, forestry and fishery in the island of Java (JAV-1), and Sector-5: Construction industry in Other islands (OTH-5).

All measures of spatial-specific multipliers (output, income and output) showed that, for an island economy, the percentage of multipliers that occurred in the own-region is significantly high. For the island of Sumatra and Java, the two most developed islands in the country, the percentage of output, income and employment multipliers that occurred in the own region were about 90 per cent indicating that the two islands were relatively spatially independent. Only a small proportion of inputs from the rest of the country were required in producing goods and services. For other three groups of islands, the Kalimantan island, the islands of Nusa Tenggara and Other islands, the percentage of multiplier effects in own-region ranged from 70 to 80 per cent of total multiplier effects. This indicated that the three groups of islands were more dependent to the rest of the country. The spatial linkage analysis using the feed-back and spill-over index confirmed that the island of Java and Sumatra were more independent, while the other three groups of islands were less independent. The spatial linkages in the latter were stronger due to the significant size of spill-over and feed-back effects.

The flow-on effects, by which the net-impact of change in final demand is measured, provides more accurate measures than that of total. Based on the flow-on effects of output, income and multipliers, the spatial-sectors were also ranked. On the lists of the ten largest ranking spatial sectors, the same sectors as those in output multipliers also emerged in output flow-on rank order. This is simply because of the same initial unit impact. For income and employment flow-on effects, some different sectors were among the ten largest spatial sectors. Three Sector-9 (rather than five in multiplier effects), two of Sector-3 and two of Sector-4 were among the ten largest spatial sectors of income flow-on, and another Sector-3 on the rank of employment multipliers.

The spatial linkage analysis consistently confirms that the island of Sumatra and the island of Java were more independent with weak spatial linkages. A large proportion of multipliers or flow-on effects would occur in the own-region if the changes of final demand occurred in those islands. This would worsen the spatial inequity problems that have already been the nature of the island economy. Focusing economic activities on these islands would increase the economic growth of the country, but at the same time would make the economic distribution among regions worse.

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