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RESEARCH ARTICLE

SPATIAL DIMENSIONS OF MULTIPLIERS IN SUMATRA ISLAND ECONOMY: AN INTER-REGIONAL INPUT-OUTPUT ANALYSIS.

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Abstract

This paper provides the results of analysis of total, sectoral-specific, and spatial-specific multipliers and flow-on effects in Sumatera Island economy. The model employed was Inter-Regional Input-Output Model (IRIOM) developed using new hybrid procedures with special attention on Island economy. Data used for model were updated Indonesian data for the year of 2015. The results show that firstly, the important sectors of Sumatera Island economy could be based on total multipliers and flow-on effects of output, income and employment. Secondly, important economic sectors could be based on sector-specific multipliers effects; multipliers that occurred in own sector and other sectors. Thirdly, important economic sectors could be based on spatial-specific multipliers; multipliers that occurred both in own region and other regions. Fourthly, important economic sectors could be based on spatial distribution of flow-on; flow-on effects that occurred in own region as well as in other regions.

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Introduction:-

Sumatra (Indonesian: *Sumatera*) is one of large island in Indonesia and the sixth-largest island in the world at 473,481 km², including adjacent islands such as the Riau Islands and Bangka Belitung Islands. Sumatra is an elongated landmass spanning a diagonal northwest-southeast axis. The Indian Ocean borders the west, northwest, and southwest sides of Sumatra with the island chain of Simeulue, Nias and Mentawai bordering the southwestern coast. On the northeast side the narrow Strait of Malacca separates the island from the Malay Peninsula, an extension of the Eurasian continent. On the southeast the narrow Sunda Strait separates Sumatra from Java. The northern tip of Sumatra borders the Andaman Islands, while on the lower eastern side are the islands of Bangka and Belitung, Karimata Strait and the Java Sea (Wikipedia, 2016, <https://en.wikipedia.org/wiki/Sumatra>)

The ten administrative Provinces of Sumatra – including the smaller islands nearby – are: Nangroe Aceh Darussalam, a special province with Capital City Banda Aceh, North Sumatra with Capital City Medan, West Sumatra with Capital City Padang, Riau with Capital City Pekanbaru, Jambi with Capital City Jambi, South Sumatra with Capital City Palembang, Bengkulu with Capital City Bengkulu, Lampung with Capital City Bandar Lampung, Bangka-Belitung with Capital City Pangkal Pinang, and Riau Islands with Capital City Tanjung Pinang. Note some 4 million of these residents of Sumatra do not live on the island itself—but on nearby islands administered

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collectively as "Sumatra". The final two of the provinces below do not have territory on the actual island (Anonymous, 2015).

According to Prihawantoro, S., *etal* (2013), the main economic activities in Sumatra Island were Sector-1 Agriculture, livestock and fishery (Nangroe Aceh Darussalam, North Sumatra, West Sumatra, Jambi, Bengkulu, Lampung), Sector-2 Mining and quarrying (Riau Mainland, Riau Island, South Sumatra), Sector-3 Manufacturing (North Sumatra, Riau Mainland, South Sumatra, Bangka-Belitung), and Sector-6 Trade, hotel and restaurant (North Sumatra, Riau Island). Based on the statistical data by the year of 2013 which is released by Badan Pusat Statistik, Sumatra Island itself contributes at about 20% of Indonesia's Gross Domestic Product (Anonymous, 2015).

In macroeconomics, a multiplier is a factor of proportionality that measures how much an endogenous variable changes in response to a change in some exogenous variable (see among others: Dornbusch, R., & Stanley, F., 1994; McConnell, C., *et. al*, 2011; Pindyck, R & Rubinfeld, D., 2012). In monetary microeconomics and banking, the money multiplier measures how much the money supply increases in response to a change in the monetary base (see among others: Krugman & Wells 2009; Mankiw, 2008). Multipliers can be calculated to analyze the effects of fiscal policy, or other exogenous changes in spending, on aggregate output. Other types of fiscal multipliers can also be calculated, like multipliers that describe the effects of changing taxes (such as lump-sum taxes or proportional taxes).

Literature on the calculation of Keynesian multipliers traces back to Richard Kahn's (1931) description of an employment multiplier for government expenditure during a period of high unemployment. At this early stage, Kahn's calculations recognize the importance of supply constraints and possible increases in the general price level resulting from additional spending in the national economy (Ahiakpor, J.C.W., 2000). Hall (2009) discusses the way that behavioral assumptions about employment and spending affect econometrically estimated Keynesian multipliers.

The literature on the calculation of I-O multipliers traces back to Leontief (1951), who developed a set of national-level multipliers that could be used to estimate the economy-wide effect that an initial change in final demand has on an economy. Isard (1951) then applied input-output analysis to a regional economy. According to Richardson (1985), the first attempt to create regional multipliers by adjusting national data with regional data was Moore & Peterson (1955) for the state of Utah. In a parallel development, Tiebout (1956) specified a model of regional economic growth that focuses on regional exports. His economic base multipliers are based on a model that separates production sold to consumers from outside the region to production sold to consumers in the region. The magnitude of his multiplier is based on the regional supply chain and local consumer spending.

In a survey of input-output and economic base multipliers, Richardson (1985) notes the difficulty inherent in specifying the local share of spending. He notes the growth of survey-based regional input-output models in the 1960s and 1970s that allowed for more accurate estimation of local spending, though at a large cost in terms of resources. To bridge the gap between resource intensive survey-based multipliers and "off-the-shelf" multipliers, Beemiller (1990) of the BEA describes the use of primary data to improve the accuracy of regional multipliers. The literature on the use and misuse of regional multipliers and models is extensive. Coughlin & Mandelbaum (1991) provide an accessible introduction to regional I-O multipliers. They note that key limitations of regional I-O multipliers include the accuracy of leakage measures, the emphasis on short-term effects, the absence of supply constraints, and the inability to fully capture interregional feedback effects.

Three other papers on the general topic of the use and misuse of regional multipliers are briefly noted. Grady & Muller (1988) argued that regional I-O models that include household spending should not be used and argue that cost-benefit analysis is the most appropriate tool for analyzing the benefits of particular programs. Mills (1993) noted the lack of budget constraints for governments and no role for government debt in regional IO models. As a result, in less than careful hands, regional I-O models can be interpreted to over-estimate the economic benefit of government spending projects. Hughes (2003) discussed the limitations of the application of multipliers and provides a checklist to consider when conducting regional impact studies. Additional papers focus on the uses and misuse of regional multipliers for particular types of studies. Harris (1997) discussed the application of regional multipliers in the context of tourism impact studies, one area where the multipliers are commonly misused. Siegfried, *et al*(2006) discussed the application of regional multipliers in the context of college and university impact studies, another area where the multipliers are commonly misused. Input-output analysis, also known as the

inter-industry analysis, is the name given to an analytical work conducted by Leontief in the late 1930's. The fundamental purpose of the input-output framework is to analyze the interdependence of industries in an economy through market based transactions. Input-output analysis can provide important and timely information on the interrelationships in a regional economy and the impacts of changes on that economy.

The notion of multipliers rests upon the difference between the initial effect of an exogenous change (final demand) and the total effects of a change. Direct effects measure the response for a given industry given a change in final demand for that same industry. Indirect effects represent the response by all local industries from a change in final demand for a specific industry. Induced effects represent the response by all local industries caused by increased (decreased) expenditures of new household income and inter-institutional transfers generated (lost) from the direct and indirect effects of the change in final demand for a specific industry. Total effects are the sum of direct, indirect, and induced 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 & 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.

The objective of this paper is to report the research in developing and applying a model that provides information on multipliers: total, flow-on, sectoral-specific and spatial-specific, so they can further be used for planning and evaluating regional economic development in Sumatera Island.

Method of Analysis:-

An inter-regional input-output model divides a national economy not only into sectors but also regions (Hulu, 1990 and West et.al, 1982; 1989). 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:

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

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.

The spatial input coefficients are derived in the same way as the direct input coefficients in the national or the single-region model. For region s , the spatial input coefficients are expressed as:

$${}^{rs}a_{ij} = {}^{rs}X_{ij} / {}^sX_j \quad (2)$$

Substituting (2) into (1):

$${}^rX_i = \sum_j \sum_s {}^{rs}a_{ij} {}^sX_j + \sum_s {}^{rs}Y_i; (i, j = 1, 2, \dots, n) \text{ and } (r, s = 1, 2, \dots, m) \quad (3)$$

Since equations (1) to (3) refer to general case, it is more convenient to refer specifically to each of the intra-regional and the inter-regional matrices:

$${}^rX_i = \sum_j {}^{rr}X_{ij} + \sum_j {}^{rs}X_{ij} + {}^rY_i; (i, j = 1, 2, \dots, n) \quad (4)$$

and

$${}^sX_i = \sum_j {}^{sr}X_{ij} + \sum_j {}^{ss}X_{ij} + {}^sY_i; (i, j = 1, 2, \dots, n) \quad (5)$$

From (4) and (5), it is possible to determine regionally defined input coefficients, according to the relevant intra-regional and inter-regional trade matrices:

$${}^{rr}a_{ij} = {}^{rr}X_{ij} / {}^rX_j \quad (6)$$

$${}^{rs}a_{ij} = {}^{rs}X_{ij} / {}^sX_j \quad (7)$$

$${}^{sr}a_{ij} = {}^{sr}X_{ij} / {}^rX_j \quad (8)$$

$${}^{ss}a_{ij} = {}^{ss}X_{ij} / {}^sX_j \quad (9)$$

Equations (6) and (9) present the familiar intra-regional direct input coefficients, while equations (7) and (8) represent inter-regional trade coefficients.

Equations (6) to (9) can be substituted into equation (4) and (5) resulting the traditional input-output equations:

$${}^rX_i = \sum_j {}^{rr}a_{ij} {}^rX_j + \sum_j {}^{rs}a_{ij} {}^sX_j + {}^rY_i; (i, j = 1, 2, \dots, n) \quad (10)$$

and

$${}^sX_i = \sum_j {}^{sr}a_{ij} {}^rX_j + \sum_j {}^{ss}a_{ij} {}^sX_j + {}^sY_i; (i, j = 1, 2, \dots, n) \quad (11)$$

The equations outlined above can be extended in parallel to the national or single region input-output system. In matrix terms they can be expressed as:

$${}^r x = {}^r A {}^r x + {}^r y \quad \text{or} \quad {}^r x = (I - {}^r A)^{-1} {}^r y \quad (12)$$

and

$${}^s x = {}^{ss} A {}^s x + {}^s y \quad \text{or} \quad {}^s x = (I - {}^{ss} A)^{-1} {}^s y \quad (13)$$

where $(I - {}^r A)^{-1}$ and $(I - {}^{ss} A)^{-1}$ are the inverse of the open inter-regional model. In general term, equation (12) and (13) can be written as:

$$x = Ax + y \quad \text{or} \quad x = (I - A)^{-1} y \quad (14)$$

Since the regional input coefficients of equations (6) to (9) or the A matrix in equation (13) contains both technical and trade characteristics, Hartwick (1971) separated these input coefficients (${}^{rs}a_{ij}$) into trade coefficients (${}^{rt}a_{ij}$) and technical coefficients (${}^{st}a_{ij}$). This separation is essentially the same as one that has been done for the single region model. Equation (13) can then be rewritten as:

$$x = T(Ax + y) \quad \text{or} \quad x = (I - TA)^{-1} y \quad (15)$$

Method employed for constructing Indonesian Inter-regional 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.

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 & 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 (increase or decrease) 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. Formulas of such effects are provided in Table 1.

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. The inter-regional sector-specific multiplier expresses the inputs required from the whole economy to satisfy a unit expansion

of a named sector’s exogenously determined final demand. The inter-regional region-specific multiplier quantifies the inputs required from all sectors in a specified region to satisfy the unit demand expansion in a given region.

Table 1:-Component Effects of Output, Income and Employment Multipliers

Effects	Output	Income	Employment
Initial	1	h_j	e_j
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	$\sum b^*_{ij} - 1$	$\sum b^*_{ij} h_i - h_i$	$\sum b^*_{ij} e_i - e_i$

Source: West, *et, al* (1982; 1989).

Note: h_j is household income coefficient, e_j is employment output ratio, 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.

Table 2:-Inter-regional Sector-Specific and Region-Specific Multipliers

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

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.

Formula provided in Table 1 and Table 2 were used to calculate total and flow-on multipliers, sector-specific multipliers and spatial-specific multipliers.

Results and Discussion:-

Total Multipliers and Flow-on:-

Table 3 present total output, income and employment multipliers and flow-on effects in Sumatra Island. In term of output, the highest output multipliers was SUM-4 (Electricity, water and gas), 2.761. It means that an increase of final demand of the sector by 1.000 would increase total output by 2.761 including the initial increase of 1.000. It was followed by SUM-9 (Other services), 2.542 meaning that an increase of final demand of that sector by 1.000 would increase total output by 2.542 including the initial increase of 1.000. The lowest total multipliers was in SUM-2 (Mining and quarrying), 1.241. An increase of final demand of that sector by 1.000 units would increase total output by 1.241 including the initial increase of 1.000. The flow-on effects of output were the difference between total increase and initial increase. Flow-on effect is summation of direct, indirect and induced effects of an economic activity. In case of highest total multipliers (SUM-4) the flow-on effect was 1.761, meaning the impact of increase of final demand of SUM-4 (Electricity, water and gas) to total output was 1.761 as the initial effect was not included. The rank of total output multipliers might be different than that of output flow-on effects. The evidence from Sumatra Island economy showed that the rank of total multipliers were the same as flow-on effects where SUM-4 (Electricity, water and gas) had the highest output flow-on effects, followed by SUM-9 (Other services) and the lowest value of output flow-on effects was SUM-2 (Mining and quarrying).

In term of household income, the highest total income multiplier was in SUM-9 (Other services), 0.815. It means that an increase of final demand of SUM-9 (Other services) by 1.000 units would increase initial household income by 0.553 and then would increase total income by 0.815. It was followed by SUM-8 (Banking and other finance) with total income multipliers of 0.445. The lowest total income multiplier was, again, in SUM-2 (Mining and quarrying) with total income multipliers of 0.082. Income flow-on effects were the difference between total income multipliers and initial income effects from the increase of final demand in that sector. It is the summation of direct, indirect and induced effects of an economic activity. For instance, in SUM-9 (Other services), the increase of final demand by 1.000 would have initial income effects by 0.553, resulting total income of 0.815. The income flow-on effect of SUM-9 (Other services) was 0.336. The highest income flow-on effect was in SUM-9 (Other services), followed by SUM-5 (Construction). The lowest income flow-on effect was in, again, SUM-2 (Mining and quarrying).

In term of employment, the highest total employment multiplier was in SUM-1 (Agriculture, livestock and fishery), 0.670. It means that an increase of final demand of SUM-1 (Agriculture, livestock and fishery) by 1.000 units would increase initial employment of SUM-1 (Agriculture, livestock and fishery) by 0.496 and then would increase total employment by 0.670. It was followed by SUM-9 (Other services) with total employment multipliers of 0.553. The lowest total employment multiplier was, again, in SUM-2 (Mining and quarrying) with total employment multipliers of 0.160. Employment flow-on effects were the difference between total employment multipliers and initial employment effects from the increase of final demand in that sector. It is the summation of direct, indirect and induced effects on employment from an economic activity. The highest employment flow-on was in SUM-9 (Other services), followed by SUM-5 (Construction). The lowest income flow-on effect was in, again, SUM-2 (Mining and quarrying).

Table 3:-Multipliers and Flow-on Effects: Output, Income and Employment

SECTOR	Output			Income			Employment		
	Initial	Flow-on	Total	Initial	Flow-on	Total	Initial	Flow-on	Total
SUM-1	1.000	0.804	1.804	0.203	0.174	0.331	0.496	0.174	0.670
SUM-2	1.000	0.241	1.241	0.039	0.044	0.082	0.116	0.044	0.160
SUM-3	1.000	1.088	2.088	0.087	0.256	0.237	0.113	0.256	0.369
SUM-4	1.000	1.761	2.761	0.091	0.290	0.310	0.116	0.290	0.406
SUM-5	1.000	1.515	2.515	0.165	0.293	0.383	0.063	0.293	0.356
SUM-6	1.000	0.939	1.939	0.176	0.204	0.335	0.106	0.204	0.310
SUM-7	1.000	1.395	2.395	0.182	0.260	0.433	0.092	0.260	0.352
SUM-8	1.000	1.108	2.108	0.243	0.211	0.445	0.116	0.211	0.327
SUM-9	1.000	1.542	2.542	0.553	0.336	0.815	0.217	0.336	0.553

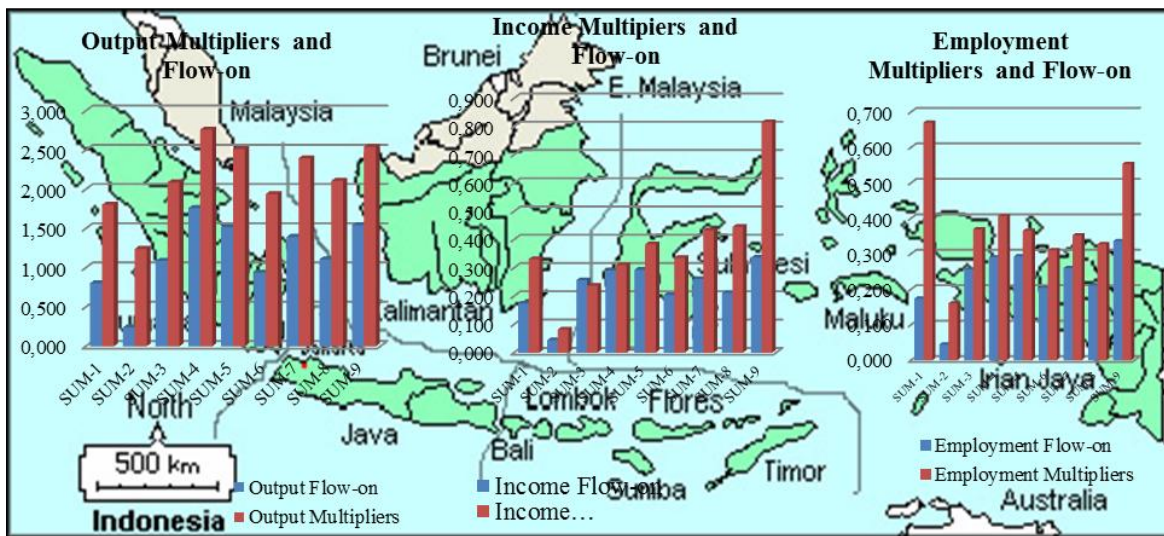


Figure 1:-Multipliers and Flow-on Effects: Output, Income and Employment

Sector-Specific Multipliers:-

Table 4 and also Figure 2 provide sector-specific multipliers for output, income and employment in Sumatra Island economy. In term of output, there were 4 sectors in which multipliers occurred in own sector were less than 50 per cent, namely SUM-4 (Electricity, water and gas), SUM-5 (Construction), SUM-7 (Transportation and communication) and SUM-9 (Other services). Meanwhile, other 5 sectors in which multipliers occurred in own region were more than 50 per cent. These were: SUM-1 (Agriculture, livestock, forestry and fishery), SUM-2 (Mining and quarrying), SUM-3 (Manufacturing), SUM-6 (Trade, hotel and restaurant), and SUM-8 (Banking and other finance).

In term of income, there were 6 sectors in which multipliers occurred in own region were less than 50 per cent, namely SUM-1 (Agriculture, livestock and fishery), SUM-2 (Mining and Quarrying), SUM-3 (Manufacturing),

SUM-4 (Electricity, water and gas), SUM-5 (Construction) and SUM-7 (Transportation and communication). Meanwhile, other 3 sectors in which multipliers occurred in own region were more than 50 per cent. These sectors were: SUM-6 (Trade, hotel and restaurant), SUM-8 (Banking and other finance) and SUM-9 (Other services).

Table 4:-Sector-Specific Multipliers: Output, Income and Employment

SECTOR	Output			Income			Employment		
	Own Sector	Other Sector	Total	Own Sector	Other Sector	Total	Own Sector	Other Sector	Total
SUM-1	1.202	0.602	1.804	0.243	0.088	0.331	0.599	0.071	0.670
SUM-2	1.018	0.223	1.241	0.039	0.043	0.082	0.118	0.042	0.160
SUM-3	1.237	0.851	2.088	0.107	0.130	0.237	0.140	0.229	0.369
SUM-4	1.228	1.533	2.761	0.111	0.199	0.310	0.142	0.264	0.406
SUM-5	1.012	1.503	2.515	0.167	0.216	0.383	0.064	0.292	0.356
SUM-6	1.108	0.831	1.939	0.194	0.141	0.335	0.064	0.246	0.310
SUM-7	1.192	1.203	2.395	0.217	0.216	0.433	0.110	0.242	0.352
SUM-8	1.169	0.939	2.108	0.284	0.161	0.445	0.136	0.191	0.327
SUM-9	1.088	1.454	2.542	0.601	0.214	0.815	0.236	0.317	0.553

In term of employment, there were 7 sectors in which multipliers occurred in own sector were less than 50 per cent, namely SUM-3 (Manufacturing), SUM-4 (Electricity, water and gas), SUM-5 (Construction), SUM-6, SUM-7 (Transportation and communication), SUM-8 and SUM-9 (Other services). Meanwhile, only 2 sectors in which multipliers occurred in own sectors were more 50 per cent multipliers. These sectors were: SUM-1 (Agriculture, livestock, forestry and fishery), and SUM-2 (Mining and quarrying).

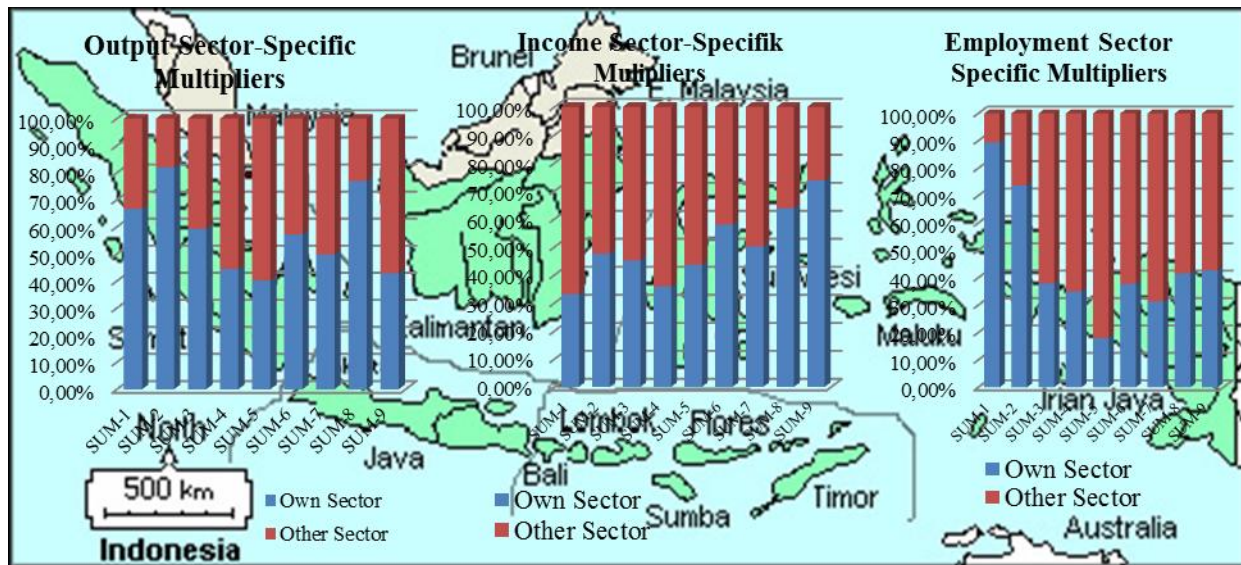


Figure 2:-Sector-Specific Multipliers: Output, Income and Employment

Spatial-Specific Multipliers:-

Table 5 and Figure 3 provide spatial-specific multipliers of output, income and employment multipliers in Sumatra. In term of output, all sectors had more than 50 per cent of multipliers that occurred in own region; in Sumatra Island. All sectors had less than 50 per cent of multipliers that occurred in other regions; other Islands. It applied for income. All sectors had more than 50 per cent of multipliers that occurred in own region; Sumatra Island. All sectors had less than 50 per cent of multipliers occurred in other regions; the rest of Indonesia. In term of employment, all sectors had more than 50 per cent of multipliers that occurred in own region; Sumatra Island. Again, all sectors had less than 50 per cent of multipliers that occurred in other regions; the rest of Indonesia.

Table 5:-Spatial-Specific Multipliers: Output, Income and Employment

SECTOR	Output			Income			Employment		
	Own Region	Other Region	Total	Own Region	Other Region	Total	Own Region	Other Region	Total
SUM-1	1.723	0.081	1.804	0.317	0.014	0.331	0.644	0.026	0.670
SUM-2	1.217	0.024	1.241	0.078	0.004	0.082	0.154	0.006	0.160
SUM-3	2.021	0.067	2.088	0.226	0.011	0.237	0.347	0.022	0.369
SUM-4	2.613	0.148	2.761	0.282	0.028	0.310	0.366	0.040	0.406
SUM-5	2.333	0.182	2.515	0.351	0.032	0.383	0.305	0.051	0.356
SUM-6	1.832	0.107	1.939	0.316	0.019	0.335	0.277	0.033	0.310
SUM-7	2.279	0.116	2.395	0.412	0.021	0.433	0.315	0.037	0.352
SUM-8	1.914	0.194	2.108	0.409	0.036	0.445	0.275	0.052	0.327
SUM-9	2.284	0.258	2.542	0.769	0.046	0.815	0.473	0.80	0.553

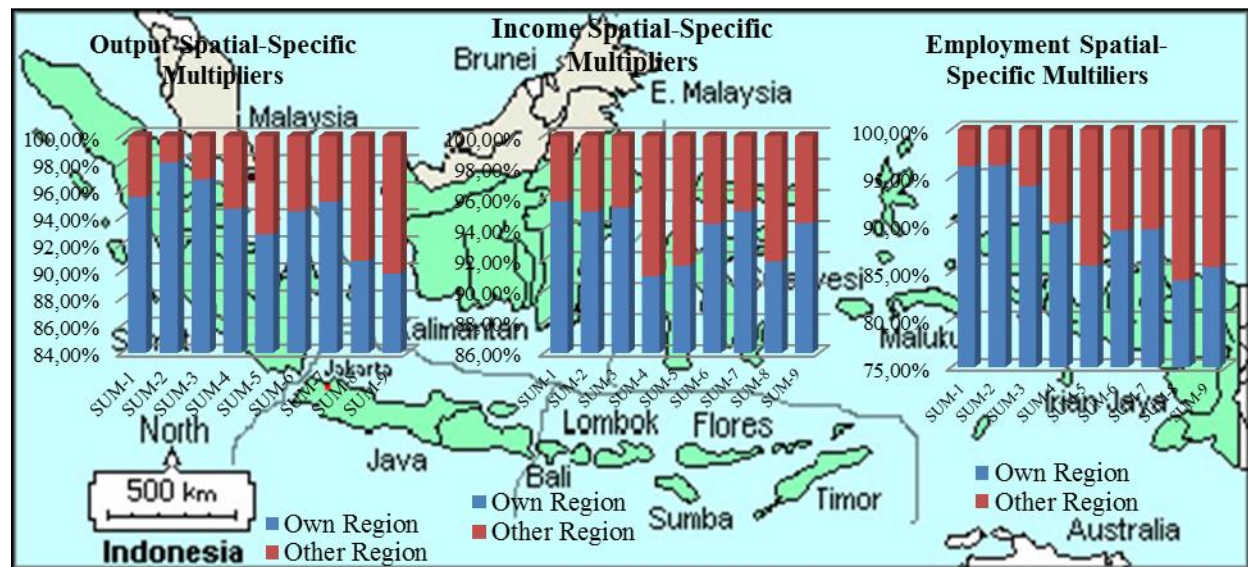


Figure 3:-Spatial-Specific Multipliers: Output, Income and Employment

Spatial Distribution of Flow-on:-

Flow-on effects are the difference between total effects (total multipliers) and initial effect. It consists of direct effects, indirect effect and induced effects of a change in final demand. As Table 3 and Figure 1 provided the total flow-on effects for every spatial sector in Sumatra Island, Table 6 and Figure 4 presents spatial distribution of flow-on effects in Sumatra Island economy. In term of output, all sectors had more than 50 per cent of flow-on occurred in own region. It means that, in all sectors, flow-on effects that occurred in other regions were less than 50 per cent. The highest output flow-on effect that occurred in other regions was in SUM-8 (Banking and other finance), followed by SUM-9 (Other services) and SUM-5 (Construction). The lowest output flow-on effect that occurred in other regions was in SUM-3 (Manufacturing).

The same case also applies in income flow-on effects. All sectors had flow-on effects that more than 50 per cent of the flow-on occurred in own region. The flow-on effects that occurred in other regions were less than 50 per cent. The highest income flow-on effect that occurred in other regions was in SUM-9 (Other services), SUM-8 (Banking and other finance) and SUM-5 (Construction). The lowest income flow-on that occurred in other regions was in SUM-2 (Mining and quarrying).

In term of employment, again, all sector had employment flow-on that occurred in own region more than 50 per cent. All sectors had the flow-on effects that occurred in other regions were less than 50 per cent. The highest employment flow-on effect that occurred in other regions were in SUM-9 (Other services), SUM-8 (Banking and other finance) SUM-5 (Construction) and the lowest employment flow-on that occurred in other regions was in SUM-3 (Manufacturing).

Table 6:-Spatial Distribution of Flow-on: Output, Income and Employment

SECTOR	Output			Income			Employment		
	Own Region	Other Region	Total	Own Region	Other Region	Total	Own Region	Other Region	Total
SUM-1	90,00%	10,00%	0.804	90,50%	9,50%	0.128	85,50%	14,50%	0.174
SUM-2	90,00%	10,00%	0.241	97,50%	2,50%	0.043	88,40%	11,60%	0.044
SUM-3	93,80%	6,20%	1.088	93,30%	6,70%	0.150	92,50%	7,50%	0.256
SUM-4	91,60%	8,40%	1.761	88,80%	11,20%	0.219	87,40%	12,60%	0.290
SUM-5	88,00%	12,00%	1.515	85,70%	14,30%	0.218	82,90%	17,10%	0.293
SUM-6	88,60%	11,40%	0.939	90,90%	9,10%	0.159	84,20%	15,80%	0.204
SUM-7	91,70%	8,30%	1.395	93,50%	6,50%	0.251	86,40%	13,60%	0.260
SUM-8	82,50%	17,50%	1.108	83,80%	16,20%	0.202	76,10%	23,90%	0.211
SUM-9	83,30%	16,70%	1.542	83,10%	16,90%	0.262	76,90%	23,10%	0.336

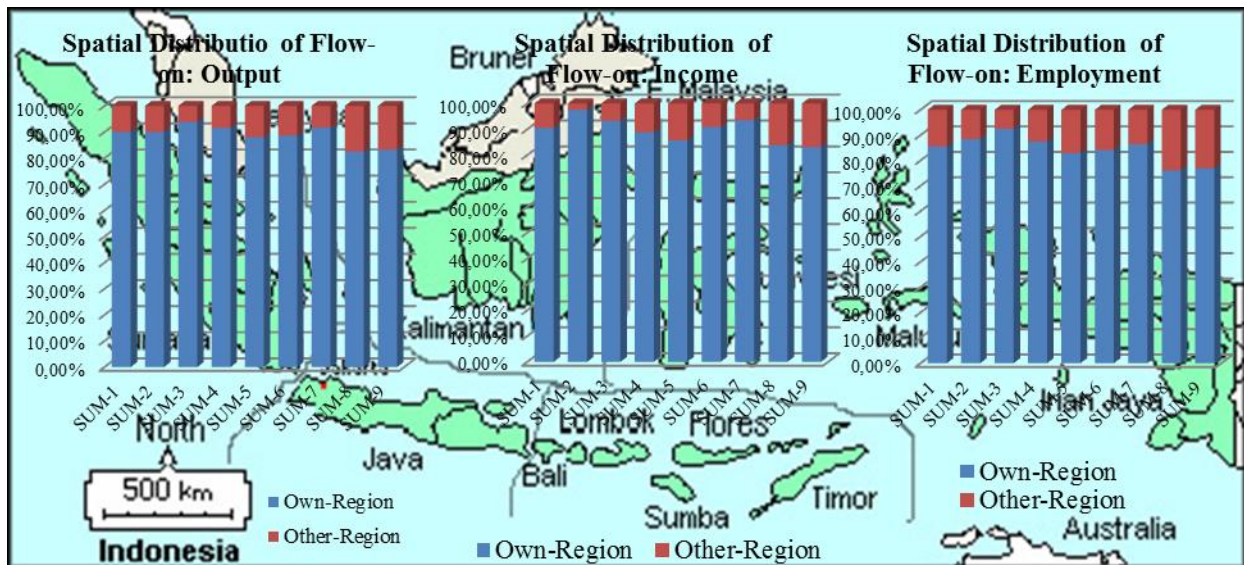


Figure 4:-Spatial Distribution of Flow-on: Output, Income and Employment

Conclusion:-

The conclusions could be drawn were: firstly, the important sectors of Sumatra Island economy could be based on total multipliers of output, income and employment. Based on total output multipliers, three important sectors in Sumatra Island economy were SUM-4 (Electricity, water and gas), SUM-9 (Other services) and SUM-5 (Construction). Based on total income multipliers, three important sectors in Sumatra Island economy were SUM-9 (Other services), SUM-8 (Banking and other finance) and SUM-7 (Transportation and communication). Based on total employment multipliers, three important sectors in Sumatra Island economy were SUM-1 (Agriculture, livestock, forestry and fishery), SUM-9 (Other services) and SUM-4 (Electricity, water and gas). Based on output flow-on effects, three important sectors in Sumatra Island economy were SUM-4 (Electricity, water and gas), SUM-9 (Other services), and SUM-5 (Construction). Based on income flow-on effects, three important sectors in Sumatra Island economy were SUM-9 (Other services), SUM-5 (Construction), and SUM-4 (Electricity, water and gas). Based on employment flow-on effects, three important sectors were SUM-9 (Other services), SUM-5 (Construction), and SUM-4 (Manufacturing).

Secondly, important economic sectors could be based on sector-specific multipliers effects. It could be based on the highest multipliers that occurred in own sectors. Based on output sector-specific multipliers that occurred in own sector, three important sectors were SUM-2 (Mining and quarrying), SUM-1 (Agriculture, livestock, and fishery) and SUM-3 (Manufacturing). Based on income sector-specific multipliers that occurred in own sectors, three important sectors were SUM-9 (Other services), SUM-1 (Agriculture, livestock and fishery) and SUM-8 (Banking and other finance). Based on employment sector-specific multipliers that occurred in own sector, three important sectors were

SUM-1 (Agriculture, livestock and fishery), SUM-2 (Mining and quarrying) and SUM-6 (Trade, hotel and restaurant).

Thirdly, important economic sectors could be based on spatial-specific multipliers. It could be based on the highest multipliers that occurred in own regions; in Sumatra Island. Based on output spatial-specific multipliers that occurred in own region, three important sectors were SUM-2 (Mining and quarrying), SUM-8 (Banking and other finance) and SUM-6 (Trade, hotel and restaurant). Based on income sector-specific multipliers that occurred in own region, three important sectors were SUM-9 (Other services), SUM-8 (Banking and other finance) and SUM-6 (Trade, hotel and restaurant). Based on employment spatial-specific multipliers that occurred in own region, three important sectors were SUM-1 (Agriculture, livestock and fishery), SUM-6 (Trade, hotel and restaurant) and SUM-8 (Banking and other finance).

Fourthly, important economic sectors could be based on spatial distribution of flow-on. It could be based on the highest flow-on that occurred in own regions; in Sumatra Island. Based on output spatial distribution of low-on that occurred in own region, three important sectors were SUM-8 (Banking and other finance), SUM-9 (Other services) and SUM-6 (Trade, hotel and restaurant). Based on income spatial distribution of low-on that occurred in own region, three important sectors were SUM-8 (Banking and other finance), SUM-9 (Other service) and SUM-6 (Trade, hotel and restaurant). Based on employment spatial distribution of flow-on that occurred in own region, three important sectors were SUM-3 (Manufacturing), SUM-8 (Banking and other finance) and SUM-6 (Trade, hotel and restaurant).

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