MEASURING THE REGION-WIDE IMPACT OF TSUNAMI DISASTER ON OUTPUT AND INCOME DISTRIBUTION

By

THEINGI NYEIN

THESIS

Submitted to

KDI School of Public Policy and Management

in partial fulfillment of the requirements

for the degree of

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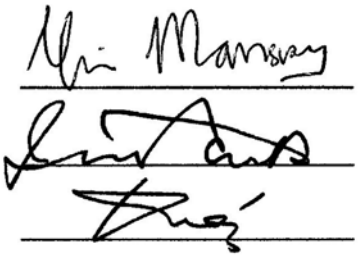

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ABSTRACT

MEASURING THE REGION-WIDE IMPACT OF TSUNAMI DISASTER ON OUTPUT AND INCOME DISTRIBUTION

By

Theingi Nyein

On December 24, 2006, a massive Indian Ocean earthquake triggered a series of Tsunamis that hit the coasts of a number of South Asian and East African countries. This study investigates the impact of Tsunami on Aceh regional economy, one of the Indonesian provinces, that was severely affected by this disaster. To quantify the regional economic impact, this study employs Social Accounting Matrix (SAM) framework as a technical tool. The study also employs Input-Output (I-O) method for comparison purposes.

The Input-Output analysis evaluates the impact on business activities through the I-O multipliers. Within this framework, there are two types of losses: direct and indirect. Direct losses are due to the exogenous shock generated outside the model, while indirect losses are due to inter-industry linkages within the model that are amplified through the multiplier process. The SAM model allows an additional effect, the induced effect, that is missing in the I-O model to be determined endogenously. The reason is that SAM model takes explicitly into considerations the feedbacks from households' income and consumption.

Using the SAM framework, this study examines the fall in incomes for each household group as well as the fall in sectoral output. The study finds that the expenditures on manufacturing sectors for both ‘public’ and ‘private’ are the largest one among the other sectors. Even though there is no direct impact on business activities, all household groups spend most of their income on commodities produced in the ‘domestic manufacturing sector’, which has indirect repercussions on local production. This study also compares the SAM multipliers with the I-O multipliers for production activities. The study shows that, in general, the magnitude of the SAM multipliers is greater than the I-O multipliers due to the household feedback effects.

ACKNOWLEDGEMENT

I would like to thank all the people who have given me the opportunity to finish this study. I thank profoundly the Central Bank of Myanmar, my working institution, Korean International Cooperation Agency (KOICA), all professors who teach me at the KDI School, all KDI staff, and my parents. Especially, I would like to express my gratitude to my supervisor, Professor Yuri Mansury, who never stopped encouraging me during the writing of this thesis. I alone am responsible for any mistake or omission in this paper.

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I. INTRODUCTION

A catastrophic event can severely disrupt a regional community's economic system and social fabric, thus highlighting people's vulnerability to a large-scale exogenous shock. Natural disaster is a naturally occurring event that has negative consequences on existing production capacity, livelihood sources, and social networks. There are different types of natural disaster, which include earthquake, wildfires, eruption, flooding, landslides, storms, and drought. In this study, the socioeconomic impact of 2004 Tsunami, which featured the deadly combination of earthquake, storm tides, and flooding, will be discussed. Social accounting matrix (SAM) framework will be used as a technical tool.

1.1Objective& Scope of the study

The main objective of this study is to investigate the region wide economic impact of the natural disaster as an external shock. External shock is the economic losses due to the 2004 tsunami. The region of interest is one of the Indonesian provinces, Aceh. Tsunami hit the Aceh region's social-economic losses seriously. Furthermore, the present study focuses on production sectors and households income distribution in Aceh province of the post disaster period.

The 1998 Indonesian social accounting matrix (SAM) transactions table will be utilized to estimate the direct and indirect impact of 2004 tsunami in Aceh province. The SAM data was obtained from the Central Board of Statistics (CBS), which is the Indonesian statistical organization. The tsunami occurred within a short period of time, which means the impact can be examined within a fixed-price framework, because it is reasonable to assume that prices remain constant (fixed) within the short term. The social accounting matrix method is such a fixed-price framework that is suitable to analyze the economic activities and

households income distribution in Aceh province through the multiplier process. Within the SAM framework, the distribution of value added from industries to factors of production, the distribution of income among households, and the consumption pattern of households are determined endogenously.[1]

The present study employs both input-output (I-O) and social accounting matrix (SAM) methods to compare the multiplier impact of the tsunami under different exogeneity assumptions. In the I-O model, only production activities are treated endogenously while household income and spending are assumed exogenous. I-O model can analyze both the direct and indirect impacts of the external shock. However, SAM can measure not only these two effects but also the induced effects of the shock propagated through household income and spending. Briefly, direct impact corresponds to the effect caused by an exogenous shock that, in the context of this study, occurs immediately after a natural hazard event. Indirect impacts by contrast are the subsequent (hence indirect) effects that occur through the various demand and supply linkages in the local economy due to the initial, direct impacts of a disaster. Finally, the induced impacts represent the additional contraction in regional output. Main reason is due to temporarily decreasing household income. Intuitively, less income generates less spending only.

1.2 Brief Description of the Tsunami Impact in Indonesia

Meaning of Tsunami is harbor and wave. It comes from the Japanese original word. A symptom of Tsunami has very large wave of water which rolls into the shore with a height of over 15 meter (50 feet). It can be caused by undersea earthquake as well as by landslides. In terms of the height, the highest tsunami along with the history took place in Ishigaki Island, Japan, on 24th April 1771. According to the record, it was 85 meter (over 200 ft.) high.

In this study, the focus is on the "December 26th 2004 tsunami". For this time, the

[1] Lecture Notes, Regional Policy and Economic Impact Analysis Class, KDI School of Public Policy and Management, Fall 2006.

tsunami was caused by an undersea earthquake only. This Indian Ocean Earthquake is recorded as the "Deadliest Tsunami." Thousands of people lost their lives and were displaced, and many children were orphaned. Tsunami struck along with the South Asian and East African countries namely: Sri Lanka, India, Thailand, Somalia, Maldives, Malaysia, Myanmar, Tanzania, Seychelles, Bangladesh and Kenya. Among them, Indonesian was the worst affected country in terms of both deaths and economic losses.

One of the disaster research centers says that the total amount of economic damage in Indonesia was U.S$ 4.5 billion. [2] The tsunami was a highly localized, and not a nationwide event in Indonesia. According to the United States Geological Survey, the earthquake strength is 9.0 Richter scale which directly affected two Indonesian provinces: Aceh and North Sumatra. The intensity of tsunami was remarkable and it shook along the east-west. The Aceh province geographically happened to be at the eastern tip of the epicenter of the earthquake.

As mentioned earlier, out of the total losses of US$4.5 billion, almost 100 percent of Aceh's GDP was devastated. Therefore, tsunami struck Aceh province severely. According to the "Selected Social-Economic Indicators of Indonesia" (July 2006 Edition), Aceh's GDP is Rupiah 47,923,449 million which is approximately US$ 5324.8 million in 2004. Compared to the country's population of 217.1 million people, Aceh's population, 4,104,187 was around 2 percent of the nation's population. The number of people who were affected by tsunami was 17.4 percent of the total population in Aceh.

The destruction was heavily affected to rural areas while it was not that much on the critical business area. Hence, the impact dragged thousands of people who were already poor, get poor more and more. Indeed, oil and gas sector is the major economic sector of the Aceh

[2] Prema-chandra Athukorala and Budy P. Resosudarmo. *The Indian Ocean Tsunami: Economic Impact, Disaster Management and Lessons*, Asian Economic Papers 4:1© 2006 The Earth Institute of Columbia University and the Massachusetts Institute of Technology.

region and was not hit by the disaster. In contrast, the hardest-hit sector is the non-oil and gas sector. One of the Indonesian advisory group reports that 32 percent of the workforce were employed in the Aceh non-oil and gas sector.[3] It brought about such a consequence that many people who worked in this sector lost their livelihood. Out of total losses, U.S$ 4.5 billion, the tsunami shock for household sector resulted in 40 percent (U.S$ 1.8 billion) losses of pre-disaster income level. This will be explained in Chapter four.

1.3 Structure of Thesis

This study has six chapters;

- Chapter one introduces the objective and scope of the study, and a brief description of 2004 tsunami impacts in Indonesia.
- The second chapter reviews the relevant literature. It includes two parts: first, previous studies that analyze the impact of a natural disaster using quantitative methods, and second, previous studies that analyze the transmission of an adverse shock to production and income distribution. Two quantitative methods will be discussed in the first part while five related papers will be presented in the second part of chapter two. These papers attempt to present the natural disaster impact on the related regional economy by using the economic model as well as engineering model.
- Chapter three describes the methodology. In this part, all conceptual frameworks which are adopted in the paper will be discussed, including I-O, SAM, the various concepts of economic impacts, the multiplier approach, and the conceptual measures of income distribution.
- Chapter four details the data. It is divided into five sections; namely 1) SAM accounts included in the 1998 Indonesian SAM transaction table, 2) the endogenous vs. exogenous

[3] The consultative Group on Indonesia (BAPPENAS), *Indonesia: Preliminary Damage and Loss Assessment (The December 26, 2004 Natural Disaster)*, January 19-20 2005.

variables, and aggregation and disaggregation schemes to compute SAM multipliers, 3) the distribution of income among Indonesian households groups, 4) the structure of sectoral production in the Indonesian economy, and 5) the final demand shocks due to the 2004 tsunami.

- In chapter five, the computational platform will be described. Using Microsoft Excel, I-O and SAM multipliers for Indonesia are calculated. In doing so, we could identify which multipliers are large and which ones are small for the Aceh regional economy. Then, the region's output contraction due to the external shock will be estimated using the multipliers. After that, the impacts of the2004 tsunami on sectoral production and household income distribution for Aceh province will be reported.

- The last chapter six closes with conclusions.

II. LITERATURE REVIEW

Literature review comprises two parts: 1) previous studies analyzing the natural disaster impact using quantitative methods, and 2) previous studies analyzing the transmission of an adverse shock to production and income distribution.

2.1 Previous Studies Analyzing the Impact of a Natural Disaster Using Quantitative Method

In this sub-section, 2.1, these two representative papers will be discussed: 1) "Linking Economic Model and Engineering Model: Application of Sequential Inter-industry Model (SIM)"[4], and 2) "Modeling Regional Economic Resilience to Disaster: A Computable General Equilibrium (CGE) Analysis of Water Service Disruptions".[5]

While the SIM is one of the engineering models, CGE is an economic model. The first paper presents the hypothetical scenarios to predict the impact of the catastrophic events by using the engineering model, SIM which has used as a technical tool. The second paper focuses on the direct and indirect effects only for the general equilibrium condition by using the CGE model, has applied to examine the economic losses. Those two papers attempt to access the potential losses and consider the production context due to the external shock. Hence, those studies discuss the supply shortages for production sector under the disaster circumstances and the regions economy condition after the disaster period. However, both studies are different from the current study. It is based on the many I-O transactions which is not only the production transaction but also the household activities.

In the first paper, SIM has used to determine the ongoing region's economic changes through the catastrophic event, particularly for post-disaster period. Unlike the I-O model,

[4] Okuyama, Yasuhide and Lim, Hyunwoo, Conference Paper of the 49th North American Meeting, Regional Science Association International, Nov.14-16, 2002: *Linking Economic Model and Engineering Model: Application of Sequential Interindustry Model (SIM)*, San Juan, Puerto Rico.

[5] Rose, Adam and Liao, Shu-Yi, *Modeling Regional Economic Resilience to Disastesr: A Computable General Equilibrium Analysis of Water Service Disruptions*, Journal of Regional Science, Vol.45, No.1, 2005, pp. 75-112.

SIM has taken into account the time lagged: one is the time for ‘goods manufacturing’ and the other is ‘shipment delay period’. To become the efficient SIM, following issues should be considered: 1) classifying the manufacturing stages in order to make a response of the orders or receipts of invoice, 2) approaching the easy way to produce the goods.

In that paper, there are two methods to produce the goods. First one is expecting the volume which amount to be produced. It depends on the demand for goods of the primary and secondary sectors which is called “anticipatory mode”. The second one is determining by holding the invoices for a specific production which is called “responsive mode”. However, the expected demand method has used for the semi-finished goods. By doing so, the detail list for goods, “inventory” has to be considered. During the disaster period, it becomes the critical issue to predict the uncertainty which relates to build up the region’s economy after the disaster circumstance. To identify the level of uncertainty in post-disaster time, three scenarios have been assumed in that paper. After computing the data, different results show the different means and standard deviations for each scenario. The authors summarize these scenarios that minimum uncertainty can be resulted in the optimum mean and standard deviation.

In that study, there are some assumptions to estimate the potential impact of natural disaster within the SIM framework. After running the “programming software”, both output and consumption levels can be pre-determined. It also includes some ‘error terms’ for estimation which can be either less than or greater than zero. If there is overestimation, it can be positive. Similarly, if there is underestimation, it can be negative. Although the Sequential Inter industry Model is used for an engineering model to evaluate the heavy construction project, it develops the recovery processing situation, reflects the supply shortages, and adjusts the workforce. Notably, SIM cannot distinguish the disaster’s destruction of each industry due to much aggregation. While acknowledging the importance of uncertainty,

technology, and inventory, incorporating these advanced features is beyond the scope of the present study.

The second paper in this sub section is “Modeling Regional Economic Resilience to Disasters: A Computable General Equilibrium Analysis of Water Service Disruptions”. That study presents the major inputs shortages for the firms which has brought about by the disaster. In addition, the study estimates future economic losses by using the CGE economic model and it also concerns about the ‘quick response’ (which is called resilience in that paper) to disruption system through the attitudes of both producers and consumers. A typical resilience means that the capability technique to capture damages or back up against the losses. Among them, it also includes the replacement of inputs to produce the goods which based on the context of production theory such as cost minimizing, profit maximizing. That study shows the quick response to the production function parameters to the disaster event as two parts: “inherent” and “adaptive”. Key input shortage results in the initial new output level directly as a quick recover response. It is called “inherent”. If the parameters of the production functions change, it comes out as “adaptive” response.

Unlike the I-O model, CGE is non-linear model and it can examine only two impacts for general equilibrium analysis: direct and indirect. Initial shock is the direct effect and it can be analyzed as a partial equilibrium. And, the repercussion effect will be as an indirect effect. The paper uses ‘water service damages in Portland metropolis region’ as empirical evidence. Water service is the critical issue for that region and is also major supply for production and other community links. That study cannot distinguish the specific industry’s destruction precisely. Because of CGE data requirements, and because the present study focuses on the short-run impact immediately after disaster struck during which prices can be reasonably assume to remain unchanged, the present study does not employ the CGE approach.

2.2 Previous Studies Analyzing the Transmission of an Adverse Shock to Production and Income Distribution

As a second part of chapter two, the following papers with regards to this study will be discussed: 1) "Lifelines and Livelihood: a Social Accounting Matrix Approach to Calamity Preparedness"[6], 2) "The Regional Economic Impact of an Earthquake: Direct and Indirect Effects of Electricity Lifeline Disruptions"[7] 3) "Impact of Low-Intensity Hurricanes on Regional Economic Activity"[8] 4) "Modeling Spatial Economic Impacts of an Earthquake: Input-Output Approaches"[9], 5) "Measuring the impact of a catastrophic event: integrating geographic information system with social accounting matrix"[10].

The first paper for this sub-section is "Lifelines and Livelihood: a Social Accounting Matrix Approach to Calamity Preparedness". That paper presents the indirect impacts of disaster by using social accounting matrix (SAM) method. Selected region is one of the Caribbean small islands, Aruba and the concentration subject is the losses of Aruba's tourist industry due to the disruption of the water net work system under the disaster circumstance. Tourism industry plays the major role in its economy. Actually, Aruba's key economic sector has changed from oil refinery business to tourism industry. Tourism industry grew rapidly and Aruba's life depends upon this sector mainly.

Aruba has experienced a water supply problem in the past. After the water supply problem had been solved, the fuel supply lines were damaged by natural disaster. Because of the devastating natural disaster, there was huge amount of damages in tourism industry. In

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[6] Cole ,Sam, *Lifelines and Livelihood: a Social Accounting Matrix Approach to Calamity Preparedness*, Journal of Contingencies and Crisis Management, Vol.3, No.4,1995, pp.228-240.

[7] Rose, Adam and others, *The Regional Economic Impact of An Earthquake: Direct and Indirect Effects of Electricity Lifeline Disruptions*, Journal of Regional Science, Vol.37, No.3, 1997, pp.437-458.

[8] Burrus, Robert T. Jr. and others, *Impact of Low-Intensity Hurricanes on Regional Economic Activity*, Natural Hazards Review, August 2002, pp. 118-125.

[9] Okuyama, Yasuhide, *Modeling Spatial Economic Impacts of an Earthquake: Input-Output Approaches*, Journal of Disaster Prevention and Management, Vol.13, No.4, 2004, pp.297-306.

[10] Mansury, Yuri, *Measuring the Impact of the Catastrophic Event: Integrating Geographic Information System with Social Accounting Matrix*, KDI School Working Paper, December 2007, pp.07-17.

tourism industry, hotels are mainly affected by the fuel-electricity-water supply net work. Beyond the tourist industry, there is not only the hotel business but also the other tourism related businesses. These are heavily dependent on the water network system. On the other hand, the demographic is also a critical issue for that paper. In that small region, migration and expatriation issues have already existed. Hence, population, employment, division of labor and culture are related with each other for that region. To estimate the indirect losses, the SAM multipliers have to be computed. These multipliers can show the magnitude of the impact of the shock for all activities in SAM. If there is a hypothetical water supply shortage volume for three or four days, the total losses (i.e. direct and indirect losses) will be US$ 16 million approximately through the SAM multiplier process. Although the disruption of water supply network is the critical issue for Aruba's economy, some item should be considered. For example, firms can have their own spare water supply for few days. It can considerably solve the problem of water supplies shortages on the external shock. Similarly, household groups' income do not affected directly, it comes from wages, salaries and so on. If firms closed their business activities at the same time, it can avoid daily operating cost. It shows that there is no relationship between disruption of water loss and the business activities as well as households' income.

The overall impact for each business can be examined by not only the direct loss but also the indirect loss. However, time frame has also been taken into account in that study. Time can reduce the potential loss of disaster. One reason is that the construction business can grow along the reconstruction period. Likely, technology can vary from time to time to change the disaster loss. It consistent with the objective of the study is to reduce the Aruba's tourism business loss. Moreover, that study also observes the gain and loss of the disaster among the households and business activities. Nevertheless, that paper analyses indirect impact only. It is different from the present study. The reason is that this paper discusses all

impacts such as direct, indirect and induced on the natural disaster.

The second paper is “Regional Economic Impact of An Earthquake: Direct and Indirect Effects of Electricity Lifeline Disruptions”. The purpose of that study is to access the direct and indirect economic impact on the earthquake due to the devastation of the electricity system. Electricity disruption is one of the critical issues for the social network and business activities. The focal point in that study is Memphis economy in the Tennessee region. The Shelby county data set has been used to examine the sectoral distribution of the Memphis metropolis. Main assumptions in that study are: the ability of labor on production for each firm is the same, considering about the time frame for recovery and only the electric power transmission branches supply the electricity to the region. To evaluate the first round effect of the shock, resiliency factor is considered. It can reflect each industry’s electricity usage and adaptability characteristics. In addition, the most hit by the earthquake area suffers the largest volume of economic losses. Among all industries, petroleum refinery sector is the worst erupted by the disaster directly. After disaster, electric transmission substations are seriously damaged. However, industries display different capacities during both initial disruption and recovery.

Hence, the reduction of output for each firm has to be computed to measure the region’s total economic losses. There are two ways to measure the losses. The first assumption is that the input cannot flow freely to production after the disaster. As the second assumption, the input can flow freely after the disaster. The result in that study shows that the longer the period, the smaller the losses with freely input flow. The opposite view is that the longer the period, the larger the losses without freely input flow. The paper estimated the indirect impacts using input-output impact analysis. For this point on, there is no resiliency adjustment. That means electricity lifeline disruptions can translate into potential output reductions. Indirect effect is caused by the inputs flow freely during the post disaster period.

Although there are lots of buildings collapsed directly due to the earthquake, finance, insurance and real estate market has been distorted for overall economic impacts as a general equilibrium condition.

The third paper is “Impact of Low-Intensity Hurricanes on Regional Economic Activity”. That paper presents the regional economic impacts that struck by the real three hurricane storms in the Wilmington region, namely: Bertha, Fran, and Bonnie. Striking period of these storms is from 1996 to 1998. These storms windy speed are low and the range is between 74 and 110 mile per hour. Hence, it cannot heavily disrupt on the physical damages directly. As their estimation, physical damages of these storms are about US$ 550 million for the whole North Carolina State. According to their findings, the indirect economic losses are much higher than the direct losses for the cases of low degree storms. Indirect losses may occur through the distortion of business activities. To determine the business distortion duration, the disturbance times for firms’ response have set by percentage. The assumption for the percentage of a firm’s typical running condition range is 25%- 100%. Generally, the average duration for that running condition is ‘seven days’ (a week). That study presents that fourteen firms are more than a week to reach the typical running condition on business activities and mostly are the downstream industries for the tourism sector.

That study evaluates three types of impacts on products, labor force, and indirect taxes on each firm. It is based on the distortion to the firms’ running condition which is called “Business Interruption Losses to Output” in short as “BILO”. In that study, BILO addresses two options. As the first option, the business running condition supposes that the ability to do the typical business performance. With this presumption, the direct, indirect, and induced effects of these hurricanes can be determined. To estimate the indirect impact (ripple effect) and induced impacts (household spending feedback), 1995 the IMPLAN I-O modeling software has to be applied for Wilmington, N.C. Hence, each type of impact on output, labor

force and indirect taxes can be examined as an average for three hurricanes. As a result, while the estimation of output for direct effect is US$ 79.6 million, indirect and induced effects are US$ 19.5 million, and US$ 23.2 million, respectively. For the workforce, 1416 jobs for direct effect, 286 for indirect and 381 for induced. For the indirect business tax, US$ 5.9 million is for direct effect, US$ 1.2 million for indirect, and US$ 1.8 million for induced effect.

Comparing the indirect and induced effects for these three types of impact, indirect effects are larger than the induced effects. The reason is that there is an income flow through the business transactions in the induced effect. As the second option, the typical firm's running condition is assumed that the ability to produce goods and services as well as concerning the demand level which is to reach before storms striking. For that time, the typical firm's running condition can have lower limit and upper limit of the economic losses for the above each types of impact. That study also presents the likely happen for the low degree and high degree storm for the comparison purposes in the last part. Nevertheless, that paper approach is similar with this thesis which based on the I-O framework.

The forth paper is "Modeling spatial economic impacts of an earthquake: input-output approaches". That paper evaluates the initial and repercussion effects of the earthquake by using the input-output model and considers the time lagged by using the sequential inter-industry model (SIM). The subject to analyze the disaster's impact is "the Great Hanshin Earthquake in 1995". That study develops the I-O model with some extent to the format of income flow. It regards with the inter link between manufacturing and consumption within the region. The 'Great Hanshin Earthquake' was the worst disaster for Japan after the Japan War period. It struck the Japan's second largest region, Kinki region. That earthquake strikes severely to the region with the direct losses of US$ 100 billion approximately which is 2.1 percent of the country's GDP and 11 percent of the region's GDP. In direct losses, the disruption of buildings, transports and communication, and electricity

system are included. To study the consequences, there are two parts can be divided for the "Kinki" region as well as the other regions of Japan. Because of the disaster impacts spread not only the striking local area, but also the other regions. For both regions, there are two assumptions that with and without the recovery assistance action for the next three years after the disaster period. It can be negative impacts only without the recovery action for these two regions. In contrast, it also can be positive when the recovery action has taken into account. That study shows that demand was driven by the recovery action to the Kinki regional economy. However, considering the force for demand source is absent in that study. In practice, funds can move from spending the future long-term program to the emergency recovery action.

As mention before, the sequential inter-industry model (SIM) has been used to measure the manufacturing stages and to determine the one industry to another industry's activities for production purposes. To determine the production of inter firm's, there are two methods to produce the goods. Firstly, it is expected volume to produce the goods which is called "anticipatory mode". It relies on expected potential invoices regarding with the primary and many secondary sectors. Firm's input quantity, technology changes, and duration of production have been considered to get an output. Secondly, there is a receipt to produce the specific volume of output which is called "responsive mode". It can be seen in some manufacturing sectors and mainly in the services sectors. In that second mode, output price has been already determined by the invoices. Electric power line disruption has supposed to study the impacts of the Chicago region's economic sectors by applying the SIM. Hence, the initial shock is only on the electric power line disruption directly. In accordance with the assumptions in that study, there are four parts in a year and it is three months for each part. In the first period, it has direct effect and the indirect effects in the remaining parts. For that case, the direct loss is smaller than the indirect losses. It is different from the

previous earthquake disaster. While that study has based on the input-output analysis for the earthquake disaster and the sequential inter industry model for the life line destruction, this thesis focus on both the production activities as well as the household income flow by using the social accounting matrix as a technical tool.

The fifth paper is “Measuring the impact of a catastrophic event: integrating geographic information system with social accounting matrix”. As in this thesis, the impacts on low income groups, specifically of the two regions: Orleans Parish and Jefferson Parish, were analyzed. The hurricane storm, Katrina struck along with the coastal area of Louisiana, Mississippi, and Alabama in 2006. Around the coastal area and the Gulf cities were flooded as a result of the storm striking. That study interesting issue is in the New Orleans. The focal point in that paper is on the small scale firms as well as the low income households. As the paper presented, these household groups have already poor since the pre-disaster period.

On the other hand, business activities were seriously hit by the hurricane. Among them, 90 percent are the small scale firms. They cannot exist without the assistance such as the insurance claims, loans for small businesses. The objective of that study is to mitigate the economic losses by making the structure of quick recovery plans for the authorities after the disaster. Notably, that paper develops the “integrated approach” which is merged the geographic information system (GIS) and the social accounting matrix (SAM) model to analyze the direct impact and indirect impact respectively. GIS has used to access the direct effects of the Orleans and Jefferson areas as a result of Katrina storm. Due to this reason, it can be under estimate. Hence, that study has to apply the SAM to evaluate the second and highly ordered impacts.

As the paper findings, the unemployment rate is 5.5 percent of the New Orleans. The major workforce in that area is in the tourism industry which is the crucial industry of that region. On the other hand, the mining sector is also the major sector of the region’s economy.

In GIS technology, there is highly aggregated. According to these presumptions, the accommodation sector and mining sector are disaggregated to estimate the output reduction in both sectors for that study. These two sectors are destructed 50 percent of their output. For household groups, the income is divided into three groups: a) less than US$ 10000 per year for low income, b) between US$ 40000 – 100000 per year for middle income, and c) above US$ 100000 per year for high income.

Among them, low income is 21 percent of the total households in Orleans Parish. Comparing the other region, Jefferson Parish, low income rate in Orleans Parish is larger than that one. In addition, 23.7 percent households have to live under the poverty line. While the impact on low income household distribution of New Orleans is falling by US$ 2068, the Jefferson is declining by US$ 1482 only.

III. METHODOLOGY

As a conceptual framework, Input-Output (I-O) approach will be discussed in the first section, (3.1) with the comparison purpose. SAM approach has to be explained in the next section (3.2). Then, the concepts of the initial/direct impact, the second round impact which is called "indirect impact" and the household income flow feedback which is called "induced impact" will be discussed. After that, the conceptual measures of income distribution will be explained.

3.1 Conceptual framework for the Inter-Industry Approach

Wassily Leontief (1905-1999) originally developed the Input-Output model.[11] In 1973, he became the Nobel Prize winner for his attempt in the field of economic science. The basic intention of this approach is to analyze the inter-dependence of industries in a particular economy. Basic Leontief I-O model is building a comprehensive economic data set for a geographically indicated area.

I-O model can examine the movement of business activities from one industry to another. For example, the industry 'A' produce commodity 'X'. At the same time, industry 'A' can also be a consumer for commodity 'Y'. This basic information is contained in an inter-industry transactions table. In the I-O transactions table, rows represent the partition of products for the whole region's economy. Similarly, all columns in that table show the corresponding share of input needs for a specific industry to get each output. The business activities have to specify for production. The required data can shift from a sector to another in the I-O transactions table. These can be quantified by the monetary unit for a specific time frame. The exchanging goods between sectors are sales and purchases of physical goods. The demands of these units are generally determined by the amount being produced in each of the units. The demands of these are only for consumption, and do not intend to

[11] Millar and Blair, Chapter 1 in *Input-Output Analysis*, 1985.

use as an intermediate goods any more. It can describe as the "final demand". Final demand represents mostly households and government as a domestic final demand for consumption and investment purposes while exports as a foreign final demand. When the economy has "m" sectors, then equation can be written as follows:

$$X_i = z_{i1} + z_{i2} + ...+ z_{ii} + …….. + z_{im} + Y_i$$

where X_i: Sum amount of the output for sector 'i'.

Y_i: Sum amount of the demands of goods for the output of sector 'i'.

The component parts of the payment sectors include payments by one sector to another for labor services and for other all value-added items. In addition, columns in I-O table represent **outlays** (i.e. the cost of input required by an industry to produce its output). Similarly, rows represent **incomes** (i.e. an industry's revenue from the sales of its output).[12] In short, the input-output transactions table includes two main items: the business's buying and the unit of demand for consumption only. Similarly, and the row also consists two major parts: industry's sales and value-added. Hence, that table can view input for vertically as well as output from horizontally. Therefore, it has named **input-output table**. Moreover, the figures which include in the I-O table are the core data for I-O analysis. I-O transaction table maintains the exact amount of the receipts and payments for all business activities. Hence, the sum amount of the outlay has to be same as the amount of revenues. For example, consider an economy that consists of eight sectors, namely Agriculture, Mining, Construction, Manufacturing, Trade, Transportation, Services, and Others. Then, following 'Miller & Blair', a typical I-O transaction table is shown in Table (1).

[12] Lecture Notes, Regional Policy and Economic Impact Analysis Class, KDI School of Public Policy and Management, Fall 2006.

Table (1) Input-Output Transaction Table

		PPODUCERS								FINAL DEMAND			
		Agri	Mining	Construc.	Manuf.	Trade	Transport	Services	Other	Personal Consumption Expenditure	Gross Private Domestic Investment	Net Export of Goods & Services	Govt. Purchases of Goods& Services
PRODUCERS	Agri												
	Mining												
	Construc.												
	Manuf.												
	Trade												
	Transport												
	Services												
	Other												
VALUE ADDED	Employees	Employee compensation								GROSS NATIONAL PRODUCT			
	Owners of Business and Capital	Profit-type income and capital consumption allowance											
	Government	Indirect business taxes											

Source: Millar & Blair, Input-Output Analysis, Chapter One, pp.3

The input-output transactions table demonstrates the data descriptive framework. It has not yet become a model. To analyze the regional economic disruption, it has to convert the I-O data into an I-O model. Then, **technical coefficients** have to be computed at first. The "technical coefficients" are also called input-output coefficients. The technical coefficient is determined as $\mathbf{a_{ij}}$ which is the ratio of input to output. $a_{ij} = z_{ij}/x_j$

where, z_{ij}: from the input of 'i' sector to the output of 'j' sector

X_j: Sum amount of output in 'j' sector

The economic interpretation of a_{ij} is that for every one currency unit's worth of goods 'j' produced (the output), it requires a_{ij} currency unit's worth of input 'i'. The technical coefficient is calculated for all business transactions within the table. By construction, it should be greater than 'zero' and less than 'one'. Intuitively, the spending on input goods unable to larger than the sum amount expenditures on the whole output produced. After computing all technical coefficients for all business transactions in that I-O table, it can be constructed as matrix 'A'. By using table (1), the above mentioned eight sectors can be expressed in the simultaneous method:

Agriculture: $x_1 = a_{11} * x_1 + a_{12} * x_2 + a_{13} * x_3 + \ldots + a_{18} * x_8 + d_1$
Mining : $x_2 = a_{21} * x_2 + a_{22} * x_2 + a_{23} * x_3 + \ldots + a_{28} * x_8 + d_2$
. .
. .
Other : $x_8 = a_{81} * x_8 + a_{82} * x_2 + a_{83} * x_3 + \ldots + a_{88} * x_8 + d_8$

The system of equations can be represented in an array format:

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} & \ldots. & a_{18} \\ a_{21} & a_{22} & a_{23} & \ldots. & a_{28} \\ . & . & . & \ldots. & \\ . & . & . & \ldots. & \\ . & . & . & \ldots. & \\ a_{81} & a_{82} & a_{83} & \ldots. & a_{88} \end{pmatrix} \quad X = \begin{pmatrix} x_1 \\ x_2 \\ . \\ . \\ . \\ x_8 \end{pmatrix} \quad d = \begin{pmatrix} d_1 \\ d_2 \\ . \\ . \\ . \\ d_8 \end{pmatrix}$$

Each of these arrays constitutes a matrix. Therefore, it can rearrange as a matrix structure.

$$X = A * X + d$$

Final demand has supposed to become an exogenous variable within the input-output framework. Hence, final demand has to be computed outside the model. The objective of the impact analysis is that to indicate the relationship between the changes in exogenous variables due to changes in endogenous variables. For economic impact analysis, I-O multiplier has to be computed using the ‘A’, ’x’, and ‘d’ matrix and vectors. The computation will be discussed in section (3.4).

3.2 Concepts of the Social Accounting Matrix Approach

This approach was developed by Professor Richard Stone (1913-1991). He published 'A System of National Accounts' as a U.N report in 1952. In 1984, he received a noble prize for his effort to improve the national accounts method. As a consequence, it is really developed for the observation in economic analysis.[13] SAM is the series of accounts in each of which incomings and outgoings (or income and expenditure). An incoming transaction of one account must be an outgoing transaction for another account. Therefore, each account consists of one row across the board and one column down it; the amount should be the same for both. Rows represent incomings and the columns are outgoings. In practice, incomings and outgoings may be divided into many different categories in the accounts for the whole economy.

As a conceptual framework, SAM contains not only the Input-Output structure for each industry, but also the consumption patterns of households as well as of other institutions. Like the input-output model, SAM is also a *demand driven model*. In addition, SAM has two core objectives. Firstly, it is concerned with the format of socio-economic of a national as well as regional within a certain period. Secondly, unlike the input-output method, SAM emphasizes income distribution among households differentiated by occupation, income levels, gender, ethically. Size of the matrix is depends on the limitations of the available data and the interesting one has for constructing it. Poverty has become a contentious topic, and SAM provides a framework to examine 'poverty' implications. SAM treats final consumption as an endogenous variable. Thus, it can determine household income endogenously.

The structure of a SAM contains:

- I-O structure for each industry;

[13] Lecture Notes, Regional Policy and Economic Impact Analysis Class, KDI School of Public Policy and Management, Fall 2006.

- Distribution of value-added from industries to factors of production;

- Distribution of income among households;

- Consumption patterns of households and other institutions;

- Other items: exports, imports, government transfers to households (i.e. welfare programs), investments, taxes.

A typical SAM transaction table is shown in table (2).

Table (2) SAM Transaction Table

SAM	Factors	Households	Production Activities	Exogenous Accounts
Factors			T_{13}	T_{14}
Households	T_{21}	T_{22}		T_{24}
Production Activities		T_{32}	T_{33}	T_{34}
Exogenous Accounts		T_{42}	T_{43}	

Source: Lecture Notes, Regional Policy & Economic Impact Analysis Class, KDI School of Public Policy and Management, Fall 2006.

Table (2) exhibits a typical partitioning of a social accounting matrix into three types of endogenous accounts. Among these accounts, one can affect to another account likely vice versa and it also affects the exogenous accounts. Unlike these endogenous accounts, exogenous accounts are determined independently. Exogenous accounts typically include the government, capital account, indirect taxes, and the accounts which are remaining and dealing with the global, is known as "rest of the world" (R.O.W). Table (2) shows that all transaction matrices may be identified as follows:

T_{13}: the value-added generated by production activities into income of the factors

T_{21}: factorial income distribution into the household income distribution

T_{22}: the income transfer within the household groups

T_{32}: the expenditures of institutions on the goods and services for their consumption

T_{33}: the goods and services which are utilized for the inter-industry transactions purpose only

T_{14}: exports vs. imports payment for services

T_{24}: household receives income from transfer, grant, and technical assistant

T_{34}: production sectors receive subsidy from government

T_{42}: imports of household for their final consumption

T_{43}: government imports for the purpose of the intermediate input requirements

Due to the circular flow of demand in SAM, production/activities, factor income and household income are inter-related. From the activities to factor, money flows as the factor income. From factor to household, money flows as household receipts such as wages for labor, rent for capital and so on. From household to activities, some parts of household income flow to finance consumptions. In SAM, household plays a very important role in both the demand and supply sides. On the demand side, household spending is the largest component of final consumption expenditures. On the supply side, household is the providers of labor and capital to production. There are two main parts in the factors of production: labor and capital. Households supply labor and capital to production process. In turn, household receives wages and rents. In developing economies, wealthy households derive high share from the capital. And, low-income households rely on labor income. However, there are exceptions. For example, the professional works can earn high income without high share of capital.

SAM has been presented like the organizer of the facts. By examining the endogenous and exogenous accounts, these matrices have become the design to evaluate the economic impact analysis. Then, SAM coefficients (a_{ij}) have to be computed.

$$a_{ij} = z_{ij}/x_j$$

where z_{ij}: the payments of account j to account i

x_j: the total outgoings (or incomings) of account j

After computing SAM coefficients, the matrix 'A' will be built.

$$\mathbf{(I - A) * X = d}$$

Where ‘I’ denotes the identity matrix and the number of sectors will be expressed in the simultaneous method which has put in the following forms.

$$A = \begin{pmatrix} a_{11} \ldots\ldots\ldots\ldots\ldots a_{1n} \\ a_{21} \ldots\ldots\ldots\ldots\ldots a_{2n} \\ . \\ . \\ a_{n1} \ldots\ldots\ldots\ldots\ldots a_{nn} \end{pmatrix} \qquad X = \begin{pmatrix} x_1 \\ x_2 \\ . \\ . \\ x_n \end{pmatrix} \qquad d = \begin{pmatrix} d_1 \\ d_2 \\ . \\ . \\ d_n \end{pmatrix}$$

where n is the number of production sectors.

Based on these data and format, SAM multiplier can be calculated for impact analysis. The multiplier concept is discussed next.

3.3 The Multiplier Approach

Using the I-O/SAM transactions data, the multipliers can be computed. As mentioned earlier, final consumption (or final demand) drives the input-output models. Producing goods and services for every sector creates the demands for other sectors. For instance, if there is an external shock affecting the agriculture sector, it will have repercussions on factors of production. The impact is then transmitted to household groups through the factors of production as labor wages. However, it takes time for the completion of the whole multiplier process. In other words, multiplier describes the general-equilibrium response of the economy to a stimulus (an exogenous change in demand or production).

For multiplier calculation, the technical coefficient ‘A’ matrix has to be computed at first. It has introduced in section (3.1) for I-O approach and section (3.2) for SAM approach. Then, I-O and SAM multipliers can have from the ‘A’ matrix as follows:

$$\mathbf{X = (I - A)^{-1} * d}$$

Where: X = Sum of the product

I = The identity matrix

A= Matrix "A"

d = Final consumption

The inverse matrix $(I - A)^{-1}$ is the matrix of I-O/SAM multipliers. If final demand changes, then total output will respond. Thus, the equation can be re-written as follows to capture the general-equilibrium impact:

$$\triangle \mathbf{X} = \mathbf{(I - A)}^{-1} * \triangle \mathbf{d}$$

According to the IMPLAN PRO, there are three different characteristics of multiplier.[14] These are as follow.

- The first one can evaluate the initial impact and the repercussion impact for the changes of business activities which is called "Type I multiplier". It shows inter-industry effects only. That means industries purchase goods and services from the firms which are the same region. The Type I multipliers are therefore the I-O multipliers.

- The second type can also captures the initial and repercussion effects. However, this type of multiplier concerns about the income flow of household groups. This type is called as "Type II multiplier". For this multiplier, household incomes expenditures are treated endogenously.

- Type SAM multiplier applies all information about the institutions selected to be endogenously included in the model. Therefore, if only households are included, the SAM multipliers are identical to Type II multipliers.

3.4 The Concept of Direct, Indirect and Induced Impacts

Being the natural disaster, damages have occurred. It can evaluate the size of the destructions on buildings, death of lives and, vulnerabilities or hurtful people. If these damages have changed into the monetary unit, then the initial damages represent direct losses.

[14] Lecture Notes, Regional Policy and Economic Impact Analysis Class, KDI School of Public Policy and Management, Fall 2006.

Therefore, direct impact means the effect is caused by a natural disaster that occurs during or immediately after a natural hazard event. On the other hand, any changes in demand for goods and services produced by a region will have further effects on the local economy overtime through indirect effects on the other sectors and induced effects through households. Hence, indirect impacts are the flow of effects that occur through the various demand and supply linkages in the local economy and are caused by the direct impacts of a disaster. Furthermore, the induced impacts represent the regional economy declining which is the result of decreased spending of the household groups caused by falling in the household income.

The essence of the regional economic models is that there is an internal feedback through input-output linkages between economic agents such as firms and households. Firms are linked to other firms through the goods and services what they buy from each other. This concept is in I-O model as well as in SAM model. However, as mentioned in section (3.2), households sell their services as labor to firms and buy goods what they need from firms. These linkages can be seen in SAM only, not in I-O model. SAM model can capture not only the direct impact, but the indirect and induced impacts as well, which are generated by the SAM multipliers. The induced impact is also known as 'the household feedback effect'. For example, when government injects $1 million to the Agriculture sector for a given region, we can then calculate the general equilibrium impact (i.e. the total effect) of the government's injection using the SAM multipliers. Let the SAM multiplier for the Agriculture sector be $2.5million. It can be broken-down for each impact as follows.

Total losses: $2.5million

Initial losses: $1million

Indirect losses: $0.5million ($1.5million - $1million)

Household feedback losses: $1million ($2.5million - $0.5million - $1million)

Table (3) All impacts in SAM framework ($ in million)

Initial losses	Indirect losses	Household feedback losses	Total losses
$ 1(40%)	$ 0.5(20%)	$ 1(40%)	$ 2.5(100%)

In this case, the contributions of initial losses, indirect losses and the household feedback losses as the percentage of total are 40 percent, 20 percent and 40 percent respectively. The conceptual measures of income distribution are presented next.

3.5 Conceptual Measure of Income Distribution

People who live in a country can earn their money from the various places. Income levels are different which depend on their different qualities. Some people are competent and master of their specific field. On the other hand, some are doing as blue collar workers. In make sense, people who have high quality can get good job and they can earn large amount of money. In contrast, people who have low quality can earn small piece of money. These unequal opportunities create the inequalities of income. There are different income distributed patterns can be seen in many countries and they all want to reach the stable and equal income distribution level. Most of the developing countries have such income inequality problem and still try to make a great effort to fight this problem. They endeavor to upgrade both income level and stable income distribution situation likely the main objective of the growth.

According to Harvey S. Rosen, income is defined as "the sum of the amount consumed during that period and the amount saved."[15] Income distribution can be classified by different types: by size of income, by demographic composition, by age, by region, by gender, and so on. It depends on different purposes. Normally, people have low income when they are young, higher when they are middle-aged, and less again when they become old and

[15] Rosen, Harvey S., Chapter 7 in *Public Finance*, 7th Edition, Mc Graw-Hill, 2005.

in the retired stage. Therefore, even among people who have the same lifetime incomes, their different stages of the life cycle can result in income inequality. At the same time, income inequality can occur more and more when share accruing to rich persons is greater than that accruing to poor persons. Here, one thing should be noticed that income inequality is different from poverty. Generally, poverty and income inequality are closely linked particularly in developing economies. In developing countries, income inequality is associated with the problem of 'extreme poverty'. Developing economies typically has rising poverty co-existing together with growth and polarization. There is strong correlation between inequality and rebellion throughout the history: (1776) American Revolution, (1789-1799) French Revolution, (1917) Bolshevik Revolution. According to the World Bank report (2005), "equity is essential for not only eradicating in poverty but also in accelerating growth." There are 'three' axioms to satisfy the income inequality: 1) Symmetry, 2) Scale Independence Axiom, and 3) Transfers Axiom.

- ***Symmetry*** - The inequality measure be independent of any characteristic of individuals other than their income. Hence, inequality is regardless of the differences such as ethic, age, education, etc. In addition, inequality measuring is independent of 'wealth'. Because of the income is a *'flow'* concept, while wealth is a *'stock'* concept.

- ***Scale Independence*** **–** Inequality measuring should not be affected by *'proportional'* change. For example, if each person's income increases by 100%, then inequality should not change. Hence, inequality concerns about only *'relative'* differences matter, not *'absolute'* differences matter.

- ***Transfers Axiom*** **–** Transfers axiom is satisfied if the chosen inequality measure 'decreases' after the transfer is completed. For example, there are two persons, one is poor man with income y, while the other is a rich man with income y+δ where δ is strictly positive. Then, *'transfer'* a positive amount of income, change in y ($\triangle$ y) from the richer to the poor man,

where $\triangle y$ is strictly less than ½. δ is avoid rank reversal. Inversely, if the transfers go from the poor to the rich, then the inequality measure should 'increase'.

For example, some measures that do not satisfy these three inequality axioms, include:

i. *Variance of income violates the scale independence axiom***.** The variance is depends on the 'mean income' level. var (λ . y) = λ^2 . var (y)

ii. In the utilitarian framework, the form of the social welfare function plays a crucial role. The social welfare depends on the utility of the person only who has the lowest utility. This social objective is called the *maximin criterion* because the objective is that person to get the highest level of the utility with minimum utility. It can be shown as equation:

$$W = \text{Minimum } (U_1, U_2, \ldots, U_n)$$

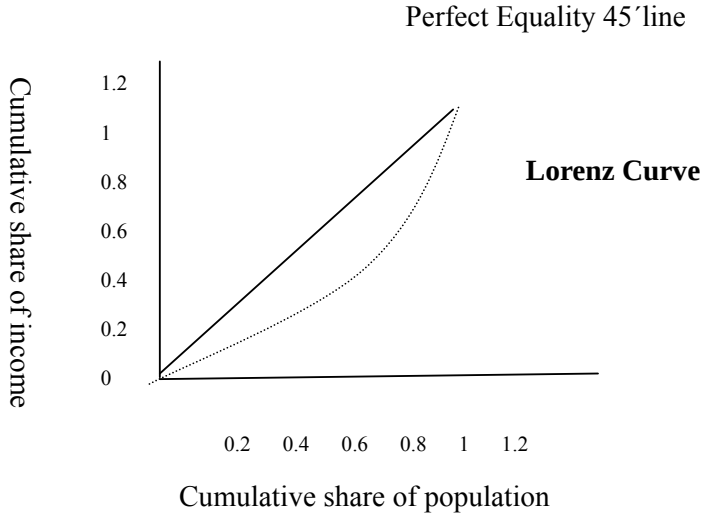
The maximin criterion has originally received by the philosopher, John Rawls. Rawls believes in the original position, people's concerning distributional goals are impartial and fair. Hence, the maximin criterion concerns only the welfare of the poorest. Therefore, the *maximin criterion violates the transfers axiom.*

By contrast, some measures satisfy the three inequality axioms such as coefficient of variations (CV) and Gini coefficient.

i. *Coefficient of variation* is sort of like the variance, but CV satisfies the scale independence axiom. Let the number of households is 'n' which is from one to i, income is 'y', and the average income is 'ŷ', then use this formula:

$$CV = \frac{1}{\hat{y} \cdot n} \sum_{i=1}^{n} (y_i - \hat{y})^2$$

ii. Common indicator for inequalities is “Gini coefficient” which is obtained from the “Lorenz Curve”. In this curve, the vertical axis shows cumulative households’ income share while the horizontal axis represents cumulative share of population. There is a 45´diagonal line from left to right in the curve which can determine the equality. As far as the income distribution tends to be unequal, it will deviate from the original 45´ line. Furthermore, it means that there is imperfect income inequality in the economy. For example, there are (10) people in the economy with total income, US$10. If the income distribution is perfectly equal, then everybody gets US$1. In other words, everybody gets 10 percent of the total income, US$10. But, for the other example, there are (10) people in the economy with total income US$10. For this time, the income distribution is highly concentrated (i.e., more unequal). Six people do not get any income while other four people get US$1, US$2, US$3 and US$4 of the total income respectively. As a percentage, the first six people have ‘zero’ percent and the other people have 1%, 2%, 3% and 4% respectively. For the first example, it relates the cumulative share of population top to cumulative share of income bottom. Hence, the curve marks the household group’s income shares by cumulatively. However, for the second example, the income distribution is uneven. So, the curve falls below the 45´ line.



IV. DATA

4.1 SAM Data for Indonesia

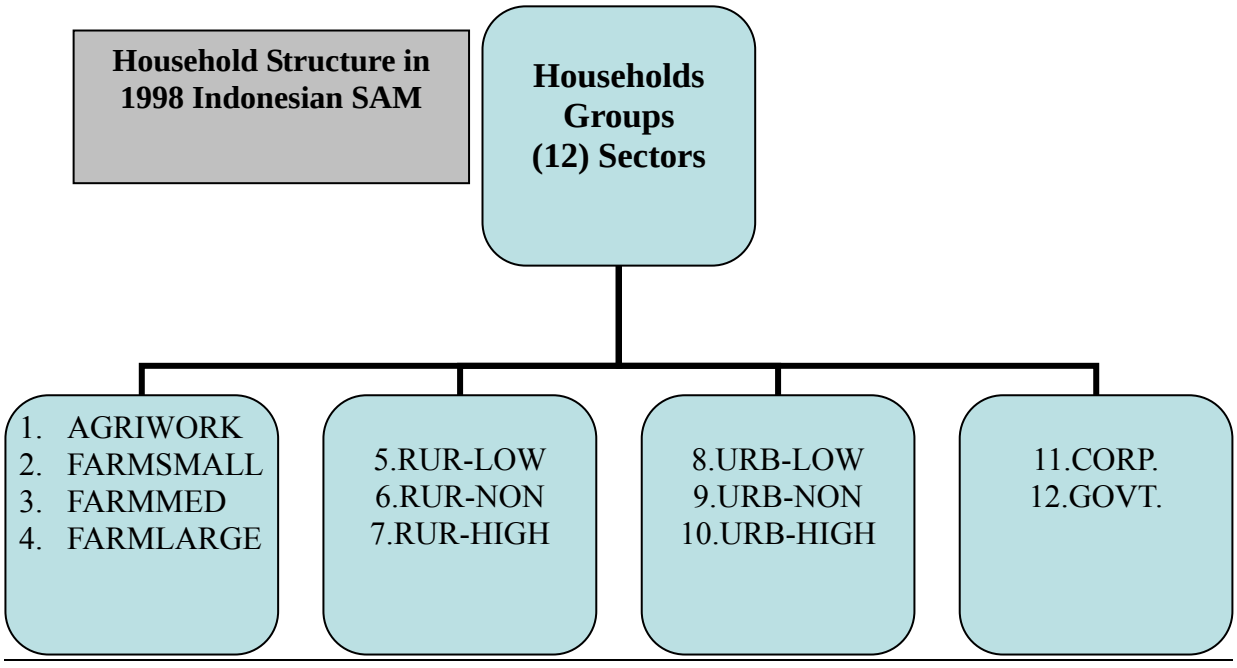
This thesis employs the Indonesian 1998 social accounting matrix (SAM) table, available from the Indonesian statistical organization, Central Bureau of Statistics (CBS). This chapter discusses four parts: 1) classifying the SAM data, 2) distribution of income among Indonesian households and other institutions, 3) structure of sectoral production in the Indonesian economy, and 4) capturing the final demand shocks due to 2004 tsunami. The Indonesia 1998 SAM data reflects the entire country's socio-economic structure. Lacking regional data, this thesis assumes that the Aceh province (this thesis' focus region) has the same structure as the national economy.

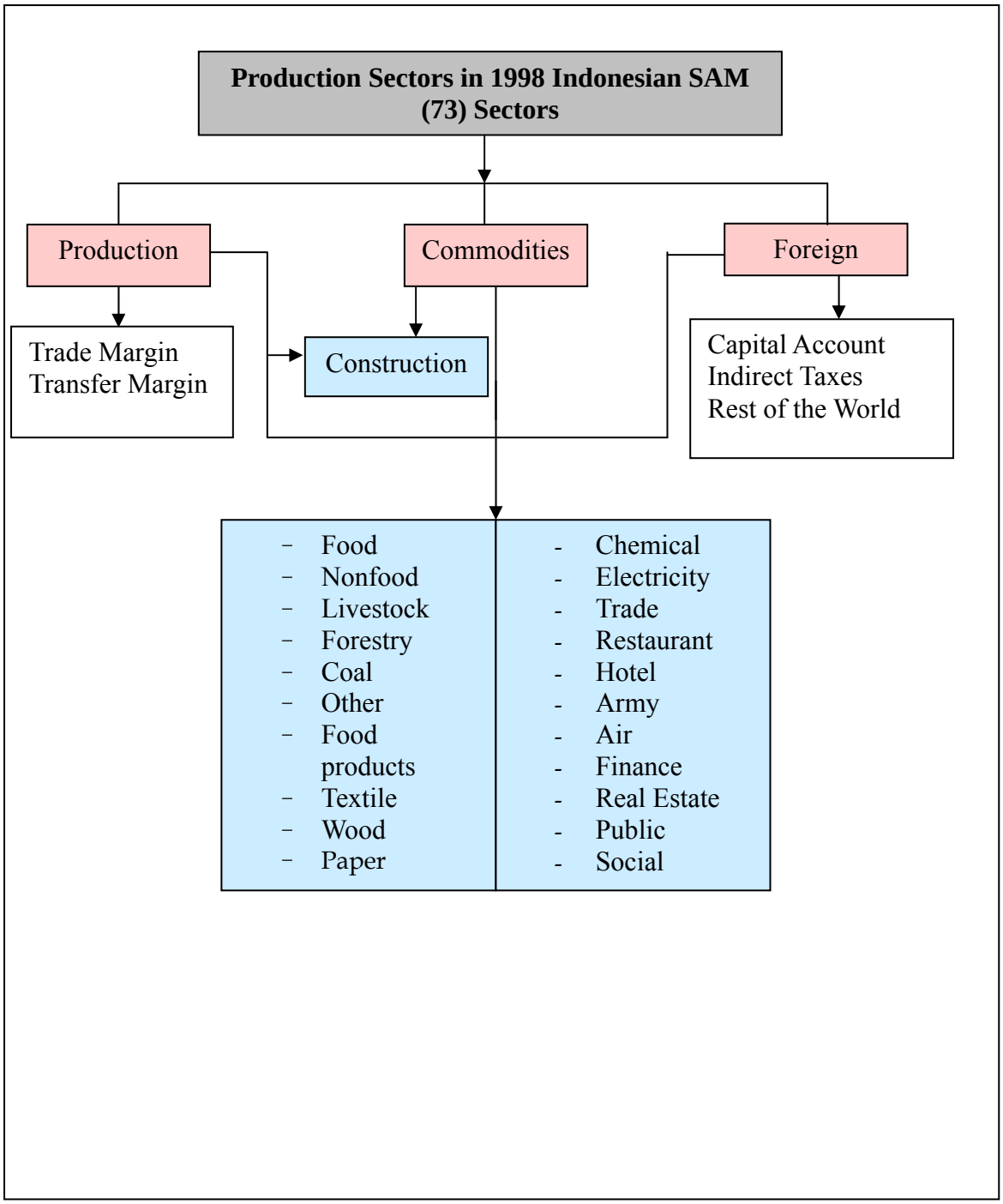
Some characteristics that are specific to Aceh must be acknowledged, however. In particular, the Aceh province mainly produces oil & gas, although Agriculture is the primary source occupation employing almost half of the people in Aceh. The two sectors, oil & gas sector and agriculture sector dominate that region's economic structure. They represent 43%in oil & gas sector and 32.2% in agriculture sector. At the same time, Aceh's regional GDP represents only 2.3% as the percentage of the whole nation's GDP. The original 1998 SAM matrix contains 108×108 entries. In that matrix, the rows represent the receipts of each sector while columns show the expenditures. All revenues and expenditures are the same amount. All data entries are in 1998 current Indonesian rupiah in billion. In the SAM table, it includes three major parts: factor accounts, production accounts, and households & other institutions accounts.

- Land, labor and capital are the factors of production. Labor is divided between rural and urban for agriculture, manual, clerical and professional with paid and unpaid. Capital accounts include government, private and foreign capital accounts. The total number of factor accounts is 23.

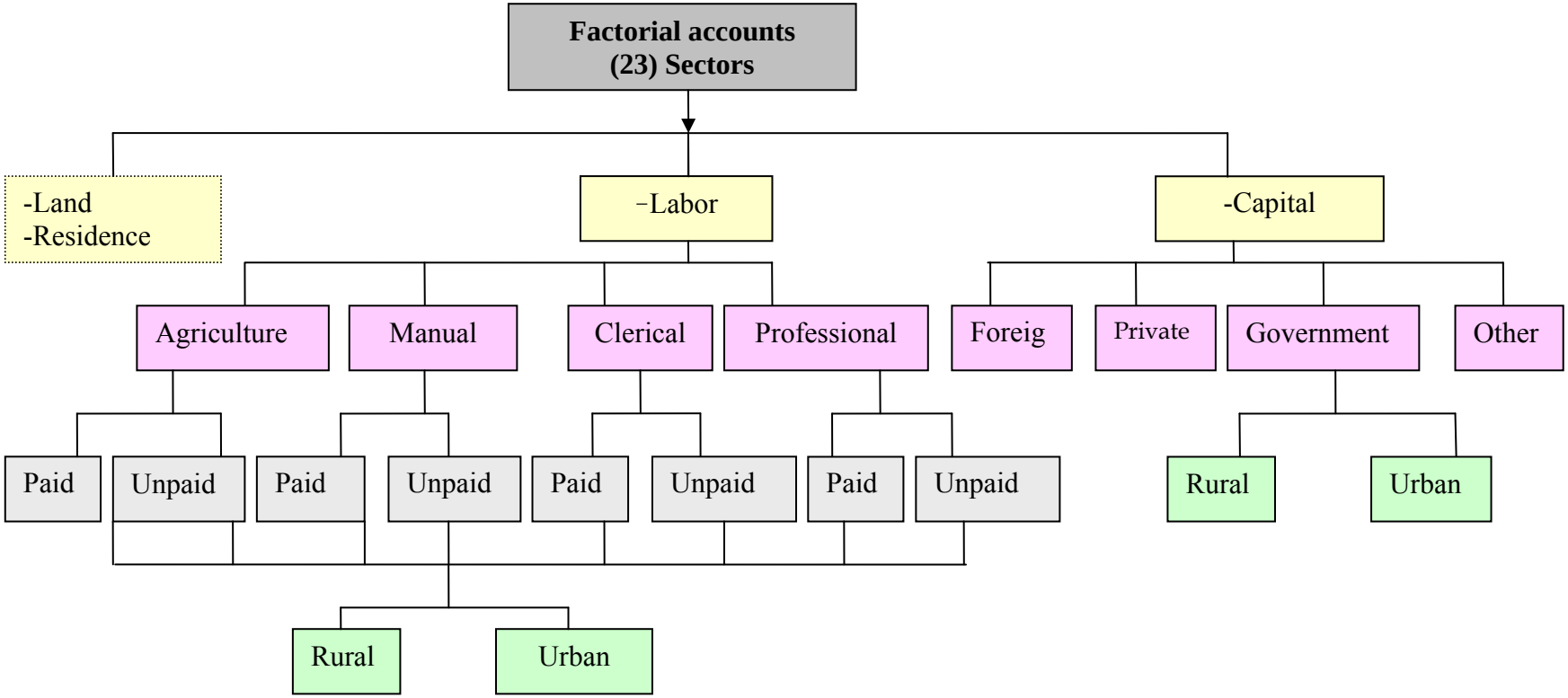
- Households are classified as non-income, low income, medium income and high income among farms, rural and urban. In the non-income group, it can contain the retired persons, students and disabled persons. Number of household account is 12 in 1998 SAM table.
- In production, activities and commodities accounts have been divided to local and foreign. Except for construction sector, other activities and commodities accounts are represented in both local and foreign accounts. There are 73 accounts in production.
- Finally, the exogenous accounts are the capital accounts, indirect taxes accounts, and rest of the world.

In this thesis, some household groups are aggregated while some are treated exogenously. It will be explained in the classifying data part, section 4.2. To sum up the overall accounts in SAM, out of 108 accounts, twenty three are factorial accounts, twelve are households group which is including other institutions, and seventy-three are production accounts for both activities and commodities. Structure of the Indonesian households group, production sector accounts, and factors accounts in SAM can be seen in three charts.




Production Sectors in 1998 Indonesian SAM
(73) Sectors
Production
Commodities
Foreign
Trade Margin
Transfer Margin
Construction
Capital Account
Indirect Taxes
Rest of the World
- Food
- Nonfood
- Livestock
- Forestry
- Coal
- Other
- Food products
- Textile
- Wood
- Paper
- Chemical
- Electricity
- Trade
- Restaurant
- Hotel
- Army
- Air
- Finance
- Real Estate
- Public
- Social

Factors Accounts in 1998 Indonesian SAM



After describing (108) accounts with their corresponding groups, SAM table can be simplified as in table (4). It shows the Indonesian SAM transactions in the monetary unit with the corresponding sectors. As mentioned earlier, total receipts, Rupiah 6907317.11 billion <which is about US$ 767.48 billion> is identical with total payment. The corresponding transactions have been partitioned into sub-matrices. Specifically, sub-matrix T_{13} represents the production sector's expenditure on the factors accounts for production. In addition, sub matrix T_{13} shows the factor accounts receipts from production sector, which is Rupiah 1030675.07 billion, <US$ 114.52 billion>. In turn, sub matrix T_{21} exhibits the income of household and institutions, while sub-matrix T_{32} is for household expenditure on their consumption purposes. Therefore, households & other institutions income, rupiah 960409.74 billion, <US$ 106.71 billion> comes from the factor account through wages and rent. In turn, households spend Rupiah 846230.24 billion, <US$ 94.02 billion> on consumption, 88 percent of their wages and rent.

The flows reflect the circular flows of demand in the 1998 Indonesian SAM. Actually, households have other income source, which is from both indirect taxes account and the remittance/transfer (rest of the world account). However, the diagonal entry, which represents transfers from one household/institution to other households/ institutions is Rupiah 152469.23 billion <US$ 16.94 billion> only. Looking at the sub matrix T_{33}, it contains the inter industry transactions, which can be employed for I-O transactions study in detail. For all I-O transaction value is Rupiah 2571683.71 billion <US$ 285.74 billion>. Among all sub transactions tables, this sub matrix, T_{33} volume is the largest one due to production purposes.

Table (4) 1998 Indonesian SAM Transaction Table (Billions in Rupiah)

	Factors 1-23	Institutions 24-35	Production 36-105	Capital a/c 106	Indirect 107	R.O.W 108	**Total**
Factors 1-23	__	__	1030,675.07	__	__	14,125.43	**1044,800.50**
Institutions 24-35	960,409.74	152,469.23	__	__	76,616.11	15,392.23	**1204,887.31**
Production 36-105	__	846,230.24	2571,683.71	139,315.94	__	419,369.59	**3976,599.48**
Capital a/c 106	__	123,105.42	__	__	__	16,210.52	**139,315.94**
Indirect 107	__	__	76,616.11	__	__	__	**76,616.11**
R.O.W 108	84,390.76	83,082.42	297,624.59	__	__	__	**465,097.77**
Total	**1044,800.50**	**1204,887.31**	**3976,599.48**	**139,315.94**	**76,616.11**	**465,097.77**	**6907,317.11**

4.2 Data Classification for SAM

To compute the multiplier, first it is required to assume which accounts were endogenous and which ones were exogenous. In this thesis, there are 40 endogenous variables which include 11 factorial, 8 households and 21 activities. Then, there are 30 exogenous variables namely: private capital, government capital, foreign capital, corporation, government, capital account, indirect taxes, rest of the world and the others are 22 foreign activities. Among the endogenous accounts, it must be decided which accounts should be aggregated for parsimonious reasons.

-The first one is factorial account. As mentioned before, originally there are 23 factor accounts in SAM. Five groups can be aggregated for both rural and urban: agriculture, manual, clerical, professional and other capital. Land and residence are disaggregated. Hence, the total endogenous accounts for factorial are 11. Apart from these accounts, private capital, government capital and foreign capital are treated as exogenous.

- The second one is households account. Total number of accounts are originally 12 for households. Rural low and rural-non as well as urban low and urban non are aggregated. The other accounts such as agriculture worker, small farmer, medium farmer, large farmer, rural high and urban high are disaggregated. After aggregation, there are eight endogenous accounts representing various household groups. Other institutions: corporation and government accounts are assumed exogenous.

-The third one is the production/activities account which has three parts: public, domestic and foreign sectors. Endogenous variables will be treated as 11 accounts in public sector and 10 accounts in domestic sector respectively. Among them, some accounts such as electricity/utilities, construction and trade are disaggregated. The foreign sectors were unlikely to be endogenous during the disaster period. Therefore, 21 sectors are assumed endogenous in the production/ activities accounts. Capital account, indirect sales tax, rest of the world accounts and all foreign accounts are treated as exogenous.

-To sum up, 11 accounts for factors, 8 for households, and 21 for production, bringing total endogenous accounts to 40 in this study, while there are 30 exogenous accounts. The complete list of accounts is shown in Table (5).

Table (5) Aggregated & Disaggregated on Endogenous vs. Exogenous Variables

Sectors	Original Account Name	Aggregated/ disaggregated	Rename	Endogenous/ Exogenous
Factorial	AGPRUR AGURUR	Aggregated	F_AGRUR	Endogenous
	AGPURB AGUURB	Aggregated	F_AGURB	Endogenous
	MANPRUR MANURUR	Aggregated	F_MANRUR	Endogenous
	MANPURB MANUURB	Aggregated	F_MANURB	Endogenous
	CLERPRUR CLERURUR	Aggregated	F_CLERRUR	Endogenous
	CLERPURB CLERUURB	Aggregated	F_CLERURB	Endogenous
	PROPRUR PROURUR	Aggregated	F_PRORUR	Endogenous
	PROPURB PROUURB	Aggregated	F_PROURB	Endogenous
	LAND	Disaggregated	F_LAND	Endogenous
	RESIDENCE	Disaggregated	F_RESDI	Endogenous
	OTCAPRUR OTCAPURB	Aggregated	F_OTCAP	Endogenous
	PRICAP	-	-	Exogenous
	GOVCAP	-	-	Exogenous
	FORCAP	-	-	Exogenous
Households	AGRIWORK	Disaggregated	H_AGW	Endogenous
	FARMSMALL	Disaggregated	H_FARM.S	Endogenous
	FARMMED	Disaggregated	H_FARM.M	Endogenous
	FARMLARGE	Disaggregated	H_FARM.L	Endogenous
	RURLOW RURNON	Aggregated	H_RUR.L	Endogenous
	RURHIGH	Disaggregated	H_RUR.H	Endogenous
	URBLOW URBNON	Aggregated	H_URB.L	Endogenous
	URBHIGH	Disaggregated	H_URB.H	Endogenous
	CORP	-	-	Exogenous
	GOVT	-	-	Exogenous

(Cont'd)

Production -Public	PFOOD PNONFOOD PLIV PFOR PFISH	Aggregated	P_PAG	Endogenous
	PCOAL POTHER	Aggregated	P_PMIN	Endogenous
	PFPROD PTEX PWOOD PPAP PCHEM	Aggregated	P_PMANF	Endogenous
	PELEC	Disaggregated	P_PULT	Endogenous
	PCONSTRUC	Disaggregated	P_PCONS	Endogenous
	PTRADE	Disaggregated	P_PTRD	Endogenous
	PRES PHOT	Aggregated	P_PRES.HOT	Endogenous
	PARMY PAIR	Aggregated	P_PTRANS	Endogenous
	PFIN PREAL	Aggregated	P_PFIN.REAL	Endogenous
	PPUBLIC PSOC	Aggregated	P_PPUB	Endogenous
	TRADMAR TRANSMAR	Aggregated	P_PTRD.TRAN	Endogenous
Production -Domestic	DFOOD DNONFOOD DLIV DFOR DFISH	Aggregated	P_DAG	Endogenous
	DCOAL DOTHER	Aggregated	P_DMIN	Endogenous
	DFPROD DTEX DWOOD DPAP DCHEM	Aggregated	P_DMANF	Endogenous
	DELEC	Disaggregated	P_DUTL	Endogenous
	DCONSTRUC	Disaggregated	P_DCONS	Endogenous
	DTRADE	Disaggregated	P_DTRD	Endogenous
	DRES DHOT	Aggregated	P_DRES.HOT	Endogenous
	DARMY DAIR	Aggregated	P_DTRANS	Endogenous
	DFIN DREAL	Aggregated	P_DFIN.REAL	Endogenous
	DPUBLIC DSOC	Aggregated	P_DPUB	Endogenous

(Cont'd)

Production -Foreign	FFOOD	-	-	Exogenous
	FNONFOOD	-	-	Exogenous
	FLIV	-	-	Exogenous
	FFOR	-	-	Exogenous
	FFISH	-	-	Exogenous
	FCOAL	-	-	Exogenous
	FOTHER	-	-	Exogenous
	FFPROD	-	-	Exogenous
	FTEX	-	-	Exogenous
	FWOOD	-	-	Exogenous
	FPAP	-	-	Exogenous
	FCHEM	-	-	Exogenous
	FELEC	-	-	Exogenous
	FTRADE	-	-	Exogenous
	FRES	-	-	Exogenous
	FHOT	-	-	Exogenous
	FFIN	-	-	Exogenous
	FREAL	-	-	Exogenous
	FARMY	-	-	Exogenous
	FAIR	-	-	Exogenous
	FPUBLIC	-	-	Exogenous
	FSOC	-	-	Exogenous
	CAPACC	-	-	Exogenous
	INDIRECT	-	-	Exogenous
	R.O.W	-	-	Exogenous

-After doing the aggregation, SAM coefficients have to be computed by transforming the monetary transactions. A SAM coefficient is defined as : $a_{ij} = z_{ij}/x_j$.

Where, z_{ij} = the payment of account j to account i,

x_j = the total outgoings of account j

The SAM coefficients are then computed for every entry in the endogenous sub-matrix (40*40). Then, the 'A' matrix of SAM coefficients can be constructed.

-The 'A' matrix represents as the mathematically equal expressions form.

$$(I – A) * X = Y$$

4.3 Income Distribution among Indonesian Households and other institutions

The Indonesian Gross Domestic Product (GDP) was rupiah 2729710 billion, <US$ 303.30> billion in 2005.[16] Population is estimated to be 219.9 million in 2005. Out of 219.9 million people, the labor force is 105.8 million. Out of 105.8 million of labor force, 89.7 percent, 94.9 million of the labor force is employed and 41.8 millions are working in the agriculture sector. According to the Selected Social-Economic indicators of BPS, people who live in the rural area are mostly below the poverty line. Among the provinces, Jawa Timur has the largest poor population (as percent of total) who lived below the poverty line. By contrast, Bangka Belitung province has the smallest share of poor population who lived below the poverty line.

If one takes a look at 'income inequality', it is typically higher than consumption inequality. One of the previous findings provides that the Indonesian rural as well as urban "Gini" proportional earnings vs. final demand.[17] Table (6) shows the proportion for both areas during 2002~2004 period. Comparing inequality, the rural to the urban areas, it is more than that within the remote area. In 2002, the Gini ratio is 0.4 for urban while 0.3 for rural. Similarly, 0.4 is for urban, and 0.3 for rural in 2004.

Table (6) Gini Proportional earning vs. final demand for Indonesian Rural & Urban areas in 2002~2004

	2002		2004	
	Earning	**Final Demand**	**Earning**	**Final Demand**
Urban	0.4	0.3	0.4	0.3
Rural	0.3	0.2	0.3	0.2

Source: SMERU working paper (May 2006)

[16] Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries, Updated December 21, 2006, pp.210-pp.216.

[17] Suryadarma, Daniel and others, *From Access to Income: Regional and Ethnic Inequality in Indonesia*, SMERU Working Paper, May 2006.

Table (7) describes the Indonesian income distribution for both rural and urban areas during 2002~2004 period. Although 57 percent of the total population lived in rural area, 59 percent of total income was generated in the urban areas. It also shows similar pattern in the income to population ratio. The ratio is 1.25 for urban, and 0.79 for rural for rural. However, 2004 income to population ratio indicates the worse condition, 1.36 for urban and 0.73 for rural area.

Table (7) Income Distribution in Indonesia during 2002~2004

Region:	**Income Share**		**Population Share**		**Income to Population Ratio**	
	2002	**2004**	**2002**	**2004**	**2002**	**2004**
Urban	0.57	0.59	0.46	0.43	1.25	1.36
Rural	0.43	0.41	0.54	0.57	0.79	0.73

Source: SMERU working paper (May 2006)

As mentioned before, there are 12 household groups and institutions in the 1998 SAM. Households whose heads work in the agriculture sector are classified into agriculture workers, small farmers, medium farmers, and large farmers. Households who live in rural as well as urban area have been classified according to their income level. The remaining; namely corporation and government are the other institutions. This study focuses on households.

Household per capita monthly expenditure on food is, on average, 58 percent of their expenditure.[18] Major food item is 'prepared food and beverages'. The second most spending is on non food item i.e. 'housing and household facility'. As the structure of demand, private consumption is 65.4% of GDP while government consumption is only 8.2% of GDP. Agriculture sector has the largest employee, rather than the others. And, mentioned in the previous section (4.1), the Indonesian household groups' income and expenditure can also be analyzed through the 1998 Indonesian SAM table. Household receiving vs. the factorial

[18] Statistics Indonesia (BPS), Selected Social-Economic of Indonesia, July 2006.

accounts which maps from the column 1-23 to row 24-35 in original SAM table. In turn, for household expenditure on consumption, which map from column 24-35 to row 61-105.

The first household group is 'AGRIWORK' (agriculture workers). Total income of this group is rupiah 50062.27 billion <US$ 5.56 billion>. Major source of income, rupiah 11500.77 billion <US$ 1.28 billion> comes from the first factorial account, 'AGPRUR' (agriculture paid rural). For spending, this group spends the most rupiah 17027.35 billion <US$ 1.89 billion> on 'DFPROD' sector for final consumption. The second most spending sector is on 'DFOOD' sector. But, the diagonal entry is only rupiah 9.41 billion <US$ 0.001 billion approximately>. The diagonal entry represents the receipt and payment transactions among households in the same income group. The 'agriculture worker' group earned income also from remittances abroad, which can be seen from the intersection with the rest of the world (ROW) account. However, the amount is not that significant, rupiah 328.79 billion <US$ 0.04 billion> only.

The second household group is 'FARMSMALL'. Total income is rupiah 67600.27 billion <US$ 7.51 billion>. Major source of income is from 'AGURUR' (agriculture unpaid rural) account. This household group spends much on 'DFPROD' sector for consumption with rupiah 17457.05 billion<US$ 1.94 billion>. 'Farm small' group spends on 'DFOOD' sector as a second one, with rupiah 7311.08 billion <US$ 0.81 billion>. The other factors of production: 'CLERURUR', 'MANPRUR', 'MANURUR' also generate receipts for 'FARMSMALL' group.

The third group, 'FARMMED' earned the lowest income among all household groups, rupiah 36590.08 billion <US$ 4.07 billion>. One factorial account, 'AGURUR' (agriculture unpaid rural) represents the largest source of income with rupiah 15326.89 billion <US$ 1.70 billion>. It is 42 percent of total income. Like the above two groups, 'DFPROD' sector is the largest consumption item, while 'DFOOD' is the second largest.

The forth one is ‘FARMLARGE’ with receipts amounting to rupiah 36735.33 billion <US$ 4.08 billion>, which is almost the same as the above group. Key factorial account is also ‘AGURUR’ (agriculture unpaid rural). The distinguishing characteristic is ‘FARMLARGE’ expenditure on ‘CAPACC’ (Capital Account), which represents significant savings. It also received remittances from abroad as shown by the intersection with ‘ROW’ (rest of the world). The ‘FARMLARGE’ remittances are the second largest among all household groups with rupiah 1370.70 billion <US$ 0.15 billion>. It represents 3.7 percent of the group’s total income.

Fifth group is ‘RURLOW’ (rural low). Income of this group is higher than the previous three agriculture groups. The major source of income is ‘MANPRUR’ (manual paid rural) account, amounting to rupiah 24464.77 billion <US$ 2.72 billion>. For this group, contribution is not from manual paid account only, but also from other factors of production such as ‘OTCAPRUR’ (other capital rural), ‘AGURUR’ (agriculture unpaid rural), ‘CLERURUR’ (clerical unpaid rural), ‘LAND’ also contribute somewhat to the income of ‘RURLOW’ group.

Sixth household group is ‘RURNON’. ‘MANPRUR’ is the core factor for this group. Rupiah 14305.38 billion <US$ 1.59 billion> or 31.2 percent of total income comes from that factor. Total income is rupiah 39559.78 billion, which is equivalent to US$ 4.4 billion. Consumption is mainly on ‘DFPROD’ sector and ‘DFOOD’ sector, 26 percent and 9.4 percent of total expenditures, respectively.

Seventh group is ‘RURHIGH’. Total revenue of this group is rupiah 102205.78 billion <US$ 11.35 billion>. Unlike the previous groups, the major source of income is from ‘OTCAPRUR’ with rupiah 31243.09 billion <US$ 3.47 billion>, or 30.56 percent of total income. This group has other sources of income, namely ‘CLERPRUR’, ‘AGURUR’, and ‘LAND’. For consumption, 23.1 percent of total income or rupiah 23603.49 billion

<US$ 2.62 billion> was spent on ‘DFPROD’ sector, while 8.15 percent or rupiah 8331.14 billion <US$ 0.93 billion> on ‘DREAL’.

‘URBLOW’ is the eighth group and its total income is rupiah 146961.42 billion <US$ 16.33 billion>. ‘MANPURB’ is the biggest factors account for this group generating rupiah 40968.56 billion <US$ 4.55 billion>, or 28 percent of total income. ‘CLERPURB’, ‘LAND’, and ‘OTCAPURB’ accounts also generated revenues for ‘URBLOW’ group. ‘DFPROD’ sector remains the first priority for consumption, with rupiah 28184.04 billion <US$ 3.13 billion>, or 19.2 percent of total spending. ‘DRES’ is the second priority spending sector for ‘URBLOW’ group with rupiah 12456.10 billion <US$ 1.38 billion>.

‘URBNON’ is the ninth group. Its total income is rupiah 43138.97 billion <US$ 4.79 billion>. ’CLERPURB’ sector creates huge amount of income for this group with rupiah 17995.74 billion <US$ 1.99 billion> (42 percent of total income). The second factor is ‘MANPURB’. Meanwhile, ‘DFPROD’ and ‘DRES’ are the two largest spending items for consumption.

‘URBHIGH’ is the tenth household group and the biggest one apart from the other institutions such as ‘CORP’ and ‘GOVT’. Total income is rupiah 168832.47 billion <US$ 18.76 billion>. Major factorial accounts are ‘OTCAPURB’, ‘CLERPURB’, ‘PROPURB’, and ‘CLERUURB’, all contribute to total revenues. For consumption, ‘DFPROD’ is the largest one, with rupiah 39610.51 billion <US$ 4.40 billion>, or 23.5 percent of total expenditures. After ‘DFPROD’ sector, ‘DRES’ and ‘DFOOD’ sectors are followed. Further, this group receives remittances income from ‘ROW’ (rest of the world), while also investing in ‘CAPACC’ (Capital Account).

Besides the household groups, there are two other institutions: corporation (CORP) and government (GOVT) sectors. In the corporation sector, revenue mainly comes from three capital accounts: ‘PRIVCAP’, ‘FORCAP’, ‘GOVCAP’ accounts. Total revenues are rupiah

207144.42 billion <US$ 23.01 billion>. Private capital, 'PRIVCAP' is key for the income of corporation sector with rupiah 90369.01 billion <US$ 10.04 billion>, 43.6 percent of total revenues. Corporation sector spends a large sum on the government sector, amounting to rupiah 98561.36 billion <US$ 10.95 billion>. On the other hand, it also is the largest investor in the capital account. In addition, it also has large internal transactions, between one corporation and another. Hence, the corporate sector spends rupiah 21351.20 billion <US$ 2.37 billion> on other corporation.

Government account is the last one for the whole group. Its total revenue is rupiah 210251.8 billion <US$ 23.36 billion>. Taxes of the corporation sector are the main source of government revenues, which is rupiah 98561.36 billion <US$ 10.95 billion>, or 47 percent of total revenue. The second source of income is indirect taxes, rupiah 76616.11 billion <US$ 8.51 billion>, or 36.4 percent. For spending, capital account is the largest item with rupiah 99495.85 billion <US$ 11.06 billion>, representing 47 percent of total expenditure, while the second largest account is 'DPUBLIC' with rupiah 59477.22 billion <US$ 6.61 billion>, 28.3 percent. It has large government to government transactions (representing transfers from central to local governments), amounting to, rupiah 16364.11 billion <US$ 1.82 billion>. From the ROW, government purchases commodities and activities in the amount of rupiah 20800.50 billion <US$ 2.31 billion>, while exports rupiah 5464.72 billion <US$ 0.61 billion>.

According to the above all information, Indonesian household/ institutions income distribution and their spending can be designed roughly. Depends on their works, major source of income from the factors accounts are different. For the first group, 'AGRIWORK', **agriculture paid rural** is the main factor account. For 'FARMSMALL', 'FARMMED', and 'FARMLARGE', main income source is **agriculture unpaid rural** account. For 'RURLOW' and 'RURNON', **manual paid rural** account is the major factor account while **manual paid**

urban is the main source of income for 'URBLOW'. **Clerical paid urban** is the main factor for 'URBNON'. For 'RURHIGH' and 'URBHIGH', **other capital rural** and **other capital urban** are important. For corporations and the government sector, corporation sector's largest expenditure goes to the government, while government's largest revenue source is taxes from corporation. However, corporation's major revenue source is private capital. On the consumption pattern, except for corporations and the government, all household groups spend on 'DFPROD' (domestic food production) sector as the largest item. However, the second largest item differs across groups. 'DFOOD' is the second largest item for 'AGRIWORK', 'FARMSMALL', 'FARMMED', 'FARMLARGE', 'RURLOW', and 'RURNON' household groups. By contrast, 'DREAL' is second for 'RURHIGH', while 'DRES' is the second choice for the other three groups: 'URBLOW', 'URBNON', and 'URBHIGH'.

4.4 The Structure of Sectoral Production in the Indonesian Economy

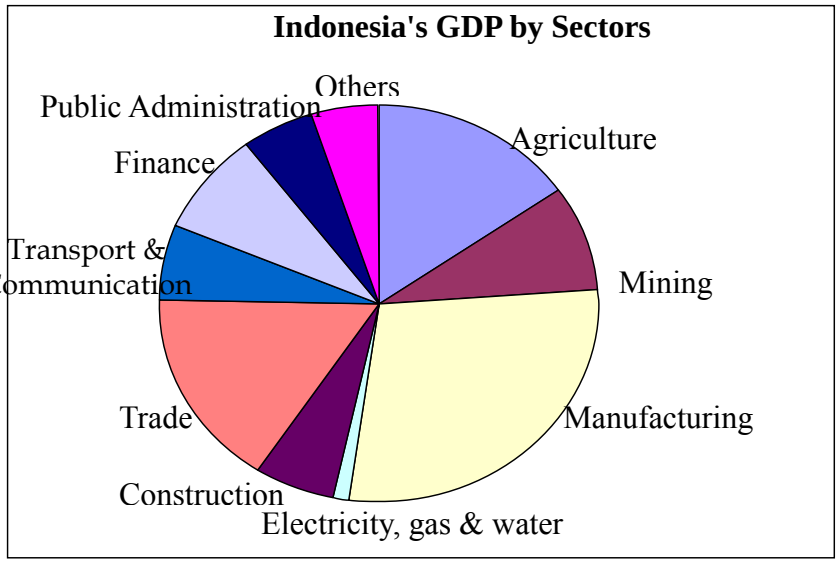
The Indonesian economy contracted in 1998 due to the 1997 Asian Financial Crisis. As one response, policy makers re-built in economic structure as an initial step with the recommendation and financial support from the IMF. Although 2004 tsunami disaster struck in Indonesia, the economy has been growing rapidly. The growth has reached up to almost 5 percent in 2004 from about 3 percent in 2001.

An Asian Development Bank report (2006) breaks down Indonesian production into 'ten' sectors. Table (8) has been constructed to show sectoral production in the Indonesian economy. The table shows each production sector's contribution to the Indonesian gross domestic product (GDP). Manufacturing sector's contributions is 28.1 percent, the largest share in GDP, while trade is the second largest one with 15.8 percent of GDP.

Table (8) Share of Production Sectors in Indonesia's GDP
(Rupiah in Billion)

No	Sectors	Contribution to GDP	Percentage
1.	Agriculture	365,560	13.4%
2.	Mining	285,087	10.4%
3.	Manufacturing	765,967	28.1 %
4.	Electricity, Gas, & Water	24,993	0.9%
5.	Construction	173,441	6.4%
6.	Trade	429,944	15.8%
7.	Transport & Communications	180,969	6.3%
8.	Finance	228,108	8.4%
9.	Public Administration	135,133	5.3%
10.	Others	140,508	5.0%
Gross Domestic Product (GDP)		**2729710**	**100%**

Source: Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries, Updated December 21,2006.



In **manufacturing** sector, crude petroleum production is significant. It produced 438,455,000 metric tons in 2004. In Asia, this country is the only one which is the member of the Organization for Petroleum Exporting Countries (OPEC). It contributes 5 percent of the total production of OPEC. It has not only crude oil as natural resources but also coal and natural gas. Hence, these two items are major sources of export revenues. Indonesian textile

output is the largest in the Association of South East Asian Nations (ASEAN) and 96%of textile output has to be exported. In the automotive and IT sectors, consumers spending is greater than on the construction and real estate sectors.

Indonesia's **mining** resources are very large: nickel ore, copper ore, and tin ore. Among them, nickel ore has produced huge amount, 4119,000 metric tons in 2004. Coal is also another mining product. In 2000, coal production is 77.02 metric ton. However, in 2004, it goes up to 92.5 metric ton. Coal can be exported 66.5 million metric ton or nearly 72 percent of the overall coal production in 2001. As a domestic consumption, there is 27.2 million metric tons in 2001. Main industries for coal consumption are power plants as well as the industry of cement. They consume over 70 percent of all coal consumption.

In the Indonesian **finance** industry, banking sector plays the major role of the whole financial sector. Share of the banking sector is 90.45 percent of the financial market. Other financial institutions in the Indonesian financial market are: 1) insurance company with 3.38 percent, 2) pension/pension funds, 3.01 percent, 3) multi-finance company, 2.31 percent, 4) securities companies, 0.65 percent, and 5) pawn shop, 0.20 percent. After banking sector, insurance company is the second-largest financial sector.

For external **trade,** exports volume is US$77,536 million while imports volume is US$52,811 million in 2005. Therefore, the trade surplus is US$24,725 million. The principal commodities for export are the petroleum products, forestry products and the agricultural products. Japan, U.S, Singapore, China, South Korea, Malaysia, Australia, and Thailand are the major trade partners. Among the import items, mostly are consumer products. Tourism industry plays a critical role of the nation’s economy by finding the foreign earning. Although there are some problems with the local people, almost 5 million foreigners come to visit the Indonesia. In addition, this industry was severely affected by the consequences of the terrorist attack in Bali (2002) and in Jakarta (2003). Again, the Tsunami disaster struck the Indonesian

tourism industry in 2004. The next section discusses the final demand shock brought about by the 2004 Tsunami disaster.

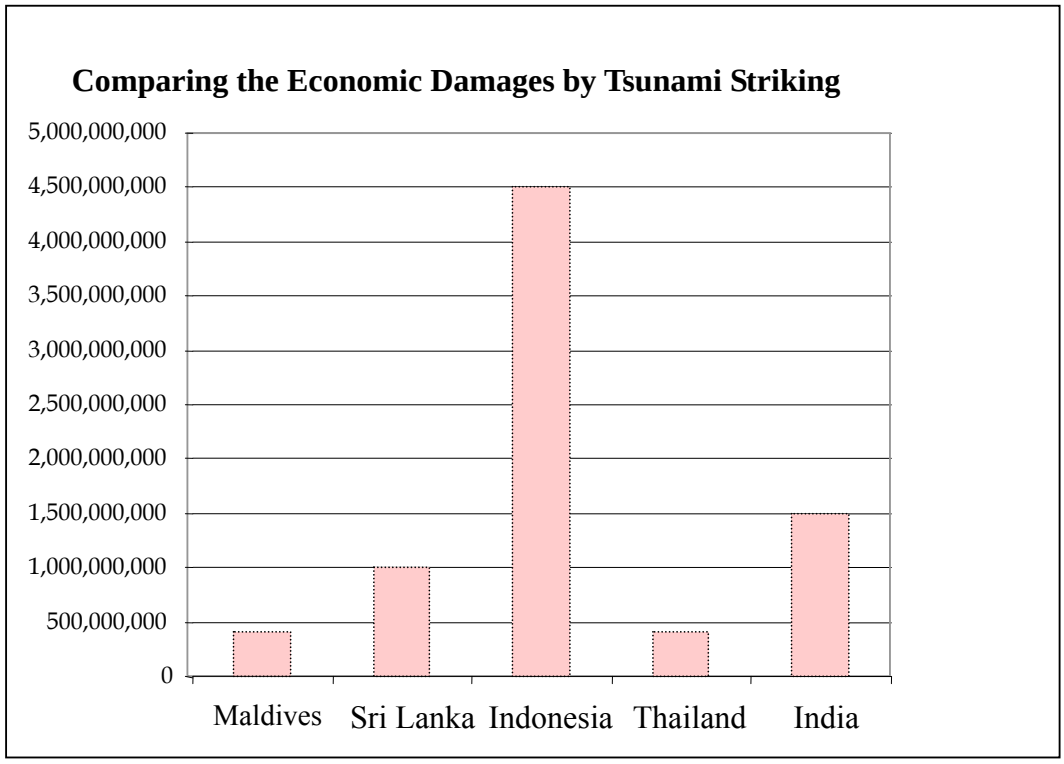
4.5 Capturing the Final Demand Shock Due to 2004 Tsunami

In this section, final demand shock due to tsunami is estimated. In terms of the economic damages, Indonesia suffers the most in the amount of US$ 4,505,000,000 (US$ 4.5 billion). Maldives, Sri Lanka, Thailand, and India also have huge amount of damages as well. In terms of the percentage of GDP, Maldives is in severe situation with 65.47 percent of its GDP. Thailand is the lowest one with 0.32 percent of its GDP while Indonesia is only 2.61 percent. All of this information is shown in table (9).

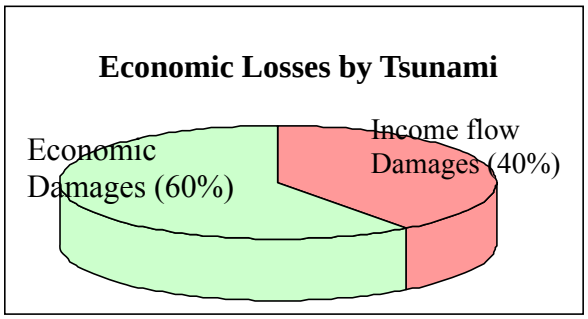
Table (9) Comparing the Economic Damages vs. GDP on Tsunami Striking Countries

Country	Economic Damage (US$)	GDP (2002) (US$)	Economic Damage/GDP
Maldives	410,000,000,	626,249,019	65.47%
Sri Lanka	1,000,000,000	16,567,132,195	6.04%
Indonesia	4,505,000,000	172,911,305,030	2.61%
Thailand	405,200,000	126,905,108,610	0.32%
India	1,500,000,000	510,177,250,750	0.29%

Source: CRED EM-DAT, World Bank World Development



For this study, the Tsunami impact on household income in the Aceh province of Indonesia will be addressed. Tsunami is the source of the external shock because it comes from outside the SAM model. Yet, it can alter the total output of the region's economy through the multiplier process. Hence, the amount of the initial external shock, or new final demand, needs to be estimated as a first step. This paper also evaluates the effect on production sector as well as on the household income distribution. According to the available information, the World Bank has estimated that "out of total loss, US$ 4.5 billion, 60 percent has caused by the physical destruction and the remaining part will be occurred through the flow of income. Source of this information is the "WHO collaborating Center for Research on the Epidemiology of Disaster (CRED) at the Universite Catholique de Louvain" through http:// www .adrc.or.jp website.



Based on this information, the region-wide impact of the external shock can be estimated. In SAM, the monetary unit is the Indonesian domestic currency Rupiah. Therefore, the original household income unit, rupiah will first have to be converted into dollar terms. Hence, ***40 percent of the total losses are equivalent to U.S $1.8 billion.*** (US$ 1=Rp. 9000 approximately)

Total Household Income = Rp 787,491.08 billion = US$ 87.50 billion

Total Economic Losses by tsunami = US $ 4.5 billion

Household Income Flow Loss by tsunami = 40% of Total Economic Loss

Household Income Flow Loss by tsunami = US $ 1.8 billion

If I denote the change in final demand due to Tsunami shock as 'd', then I can algebraically express the following:

$$\triangle d = \text{US\$ } 1.8 \text{ billion}$$

V. IMPACT ANALYSIS

In this part, I will consider not only direct effect but the indirect effect and induced effect as well. Direct effect comes from outside of the model. As mentioned in the previous section, the initial income loss is US$1.8 billion.

5.1 Direct Losses Share on Household Groups

The income losses, US$ 1.8 billion, were distributed across household groups. After aggregation, there are only eight household groups: agri-worker (H_AGW), farm small (H_FARM.S), farm medium (H_FARM.M), farm large (H_FARM.L), rural low and rural non (H_RUR.L), rural high (H_RUR.H), urban low and urban non (H_URB.L), and urban high (H_URB.H). The most vulnerable group is 'urban low' with losses of US$0.43 billion, followed by 'urban high' with losses of US$0.39 billion. The less vulnerable groups are 'farm medium' and farm large with losses of US$0.08 billion each. Table (10) describes the distribution of the initial losses across household groups. The next section considers the general equilibrium impact, which includes not only the direct effects but also the indirect and induced effects.

Table (10) Distribution of Direct Losses across Household Groups in Aceh

No.	*Household Groups*	*Original Income (Rp. in Billion)*	*Before Tsunami ($ in Billion)*	*Income Losses ($ in Billion)*	*After Tsunami ($ in Billion)*
1.	H_AGW	50062.27	5.56	-0.12	5.44
2.	H_FARM.S	67600.59	7.51	-0.15	7.36
3.	H_FARM.M	36,590.08	4.07	-0.08	3.99
4.	H_FARM.L	36,735.33	4.08	-0.08	4.0
5.	H_RUR.L	135,364.17	15.04	-0.32	14.72
6.	H_RUR.H	102,205.78	11.36	-0.23	11.13
7.	H_URB.L	190,100.39	21.12	-0.43	20.69
8.	H_URB.H	168,832.47	18.76	-0.39	18.37
	Total	**787,491.08**	**87.5**	**-1.8**	**85.7**

5.2 Measuring General Equilibrium Effects of Tsunami Disaster in Aceh Region

To measure the total effects of disaster, I compute the SAM multipliers. As mentioned earlier, my SAM inverse matrix has (40) sub-matrices. SAM inverse incorporates the indirect and induced effects. The SAM multiplier can be calculated by using MS Excel 2003.

Insert ⟶ Function ⟶ MINVERSE⟶ OK ⟶ array⟶ select⟶drag ⟶ F2 ⟶ control + shift ⟶enter

To compute the total multiplier impact, I sum each column and get the total effect for each sector. These total effects can be divided into indirect and induced effects. Indirect effects were generated from intra-groups as well as inter-groups transactions, while induced effects derive from extra groups. Induced effect can derive from the extra-groups' feedbacks such as household spending i.e. consumption expenditure as well as inter-household transfers and additional factor incomes generated. Note that to compute the indirect effect for household groups', it has to subtract the direct losses. To measure the magnitude of the decreased output level (or new output in the economy) requires a change in the 'X' calculation. When I multiply SAM inverse matrix by the change in 'final demand', I get the change in 'X' for each sector. If I subtract this change in 'X' from the original output for each sector, new output level which is generated in equilibrium can be captured. Table (11) explains not only the Aceh region's sectoral new total output level with US$ 562.96 billion, but also the total, general equilibrium effects on the entire Aceh economy.

In SAM inverse matrix, the largest sub-matrix is m_{33} with 1.67 in P_DMANF. It is aggregated private manufacturing sector (P_DMANF) and significantly large on all household groups' spending. Indeed, P_DMANF is aggregated for five domestic production sectors from the original SAM; DFPROD (domestic food production), DTEX (domestic textile), DWOOD (domestic wood), DPAP (domestic paper), and DCHEM (domestic

chemical products). Apart from household groups, there is no direct effect on any sectors. Meaning that, although there is no original injection into manufacture sector, indirect effects go entirely to the domestic manufacturing sector, whose output will decrease by US$8.14 billion. The manufacturing sector contributes US$75.87 billion or 13.48 percent of the total new output level US$ 562.96 billion. Before Tsunami disaster, the original total output level is US$ 767.48 billion. Hence, the output level has decreased by US$ 204.52billion (US$ 767.48 billion - US$ 562.96 billion). In household institutions, agriculture worker (H_AGW) group contributes 43.94 percent of total spending in manufacturing sector. The second largest one is m_{22}, P_PMANF (public manufacturing sector), worth US$ 64.93 billion of new output. In SAM, its diagonal value is 1.59.

In SAM, sub-matrix m_{20}, P_PAG (public agriculture sector) and $m_{31,}$ P_DAG (private agriculture sector) are relatively larger than the other diagonal sub-matrices with 1.50 and 1.53 respectively. These sectors are aggregated into five sectors for each in the original SAM such as food, non-food, livestock, forestry and fishery products. According to the SAM transaction table, I can also see the household spending in terms of their respected total expenditure on economic activities. Here, the poor agriculture workers group spent 17.59 percent of their total expenditure. It is the largest portion among the households. Farm small and rural low groups also spend significant portions of their income on agricultural products with 15.79 and 16.71 percent respectively. It appears that lower-income households use large portion of their expenditure on basic needs.

In the eight household groups, H_AGW (agri-worker) group experienced the largest total effect with US$ 8.42 billion. Although the direct effect, US$ 0.12 billion is the lowest amount rather than the other household groups, this group is the most vulnerable with indirect effect of US$ 3.17 billion and induced effect of US$ 5.13 billion, respectively. The second group is H_URB.H (urban high income) group with the total loss, US$ 8.15 billion. Its direct

loss is US$ 0.39 billion, indirect loss US$ 2.65 billion and induced loss US$ 4.94 billion. H_FARM.L (farm large) group is the least vulnerable group, with total effect of US$ 7.48 billion consisting of direct effect US$ 0.08 billion, indirect effect US$ 2.92 billion and induced effect US$ 4.47 billion. And the other household groups such as H_RUR.H (rural high income), and H_RUR.L (rural low income) groups are relatively spared. When I consider the direct losses due to initial shock, the most vulnerable group is 'urban low' with US$ 0.43 billion. Now, I consider the entire economic structure, i.e. factorial, household institutions and production. It means that I consider the general equilibrium impact this time. Again, 'urban low' group experienced losses of US$ 7.74 billion this time. As mentioned earlier, the largest total effect among household groups is experienced by agriculture workers. In this way, I can see easily how the SAM inverse matrix can be utilized to capture the multiplier process.

For the eleven factorials, 'F_PROURB (urban professional) suffered the most with total effect US$ 9.07 billion. Although it has no direct effect, indirect effect is US$ 4.18 billion and induced effect, US$ 4.89 billion. And, the output of F_OTCAP (other capital for rural and urban) fell significantly in amount of US$ 17.85 billion.

Table (11) Direct, Indirect, Induced and Total Impact on Tsunami Disaster in the Aceh region (US$ in Billion)

No.	*Sectors*	*Direct Effect*	*Indirect Effect*	*Induced Effect*	*Total Effect (SAM Multipliers)*	*New Reducing Output*
1.	F_AGRUR	0.00	-4.15	-4.79	-8.95	13.62
2.	F_AGURB	0.00	-4.13	-4.76	-8.89	1.58
3.	F_MANRUR	0.00	-4.18	-4.83	-9.00	7.60
4.	F_MANURB	0.00	-4.11	-4.72	-8.83	9.40
5.	F_CLERRUR	0.00	-4.17	-4.83	-9.01	6.27
6.	F_CLERURB	0.00	-4.14	-4.79	-8.93	16.20
7.	F_PRORUR	0.00	-4.16	-4.82	-8.99	1.55
8.	F_PROURB	0.00	-4.18	-4.89	-9.07	3.27
9.	F_LAND	0.00	-4.13	-4.75	-8.88	6.04
10.	F_RESDI	0.00	-4.16	-4.82	-8.96	1.61
11.	F_OTCAP	0.00	-3.92	-4.47	-8.39	17.85
12.	H_AGW	-0.12	-3.17	-5.13	-8.42	5.32
13.	H_FARM.S	-0.15	-2.98	-4.74	-7.87	7.19
14.	H_FARM.M	-0.08	-3.06	-4.94	-7.94	3.89
15.	H_FARM.L	-0.08	-2.92	-4.47	-7.48	3.90
16.	H_RUR.L	-0.32	-2.86	-4.81	-7.99	14.38
17.	H_RUR.H	-0.23	-2.92	-4.83	-7.98	10.86
18.	H_URB.L	-0.43	-2.65	-4.66	-7.74	20.24
19.	H_URB.H	-0.39	-2.82	-4.94	-8.15	17.98
20.	P_PAG	0.00	-5.87	-3.81	-9.68	27.82
21.	P_PMIN	0.00	-2.26	-0.90	-3.15	17.60
22.	P_PMANF	0.00	-4.77	-2.32	-7.09	64.93
23.	P_PULT	0.00	-4.14	-1.81	-5.94	2.90
24.	P_PCONS	0.00	-5.05	-3.36	-8.40	4.10
25.	P_PTRD	0.00	-5.02	-3.09	-8.11	20.35
26.	P_PRES.HOT	0.00	-5.85	-3.08	-8.93	7.29
27.	P_PTRANS	0.00	-4.20	-2.30	-6.50	9.37
28.	P_PFIN.REAL	0.00	-4.26	-2.51	-6.77	10.34
29.	P_PPUB	0.00	-5.01	-3.10	-8.11	13.73
30.	P_PTRD.TRAN	0.00	-6.41	-2.66	-9.08	17.44
31.	P_DAG	0.00	-6.86	-3.68	-10.53	30.73
32.	P_DMIN	0.00	-3.30	-0.92	-4.23	18.83
33.	P_DMANF	0.00	-5.84	-2.30	-8.14	75.87
34.	P_DULT	0.00	-4.83	-1.67	-6.51	3.13
35.	P_DCONS	0.00	-6.04	-3.35	-9.39	4.11
36.	P_DTRD	0.00	-5.63	-2.85	-8.47	22.09
37.	P_DRES.HOT	0.00	-6.43	-2.86	-9.29	7.85
38.	P_DTRANS	0.00	-4.63	-1.99	-6.62	10.84
39.	P_DFIN.REAL	0.00	-5.11	-2.42	-7.53	10.72
40.	P_DPUB	0.00	-5.86	-3.01	-8.87	14.16
	Total	***-1.8***	***-176.21***	***-144.83***	***-322.85***	***562.96***

5.3 Comparing the SAM vs. I-O multipliers

For comparison purposes, I-O multipliers are also computed. Within the classical Leontief I-O framework, inter-industry transactions are the only endogenous accounts. To be consistent with the SAM model, I use 21 sub-matrices in the I-O model. Endogenous vs. exogenous accounts for inter-industry transactions are the same as in the SAM. Moreover, aggregated and disaggregated accounts are also the same as in the SAM. Apart from the production accounts, factorial accounts, household and other institutions accounts are all considered exogenously determined outside the model. We will compute the I-O multiplier by using MS Excel 2003. Detail computation can find in attached excel file. After computing the multipliers, I calculate the 'change in d' corresponding to the I-O final demand shock. As before, the initial shock of 40 percent struck the Aceh's household groups directly. I then multiply the corresponding inter-industry sectors by household losses, and divide by each production sectors' total expenditure. In this way, changes in final demand can be captured for I-O analysis.

Table (12) Comparing the SAM vs. I-O multipliers

No.	*Sectors*	*SAM multiplier*	*I-O multiplier*	*Reduced Output Level in SAM*	*Reduced Output Level in I-O*
1.	P_PAG	***1.50***	***1.11***	0.77	0.37
2.	P_PMIN	1.09	1.07	0.18	0.09
3.	P_PMANF	***1.59***	***1.15***	1.42	0.69
4.	P_PULT	1.03	1.01	0.12	0.06
5.	P_PCONS	1.02	1.00	0.05	0.02
6.	P_PTRD	1.12	1.01	0.29	0.14
7.	P_PRES.HOT	1.13	1.00	0.32	0.16
8.	P_PTRANS	1.08	1.02	0.20	0.10
9.	P_PFIN.REAL	1.17	1.05	0.35	0.17
10.	P_PPUB	1.13	1.02	0.27	0.13
11.	P_PTTMAR	1.11	1.01	0.27	0.13
12.	P_DAG	***1.53***	***1.11***	0.85	0.41
13.	P_DMIN	1.10	1.07	0.19	0.09
14.	P_DMANF	***1.67***	***1.16***	1.66	0.80
15.	P_DULT	1.03	1.01	0.13	0.06
16.	P_DCONS	1.02	1.00	0.05	0.02
17.	P_DTRD	1.12	1.01	0.31	0.15
18.	P_DRES.HOT	1.13	1.00	0.35	0.17
19.	P_DTRANS	1.08	1.02	0.23	0.11
20.	P_DFIN.REAL	1.17	1.05	0.37	0.18
21.	P_DPUB	1.13	1.02	0.28	0.14
Reducing Total Output (US$ in Billion)				8.67	4.17

According to table (12), I can distinguish the magnitude of SAM multiplier and I-O multiplier as follows. Out of 21 sub-matrices, the four SAM inter-industry accounts differ significantly from the I-O accounts: agriculture and manufacturing sectors of public and private, namely, P_PAG, P_DAG, P_PMANF and P_DMANF. It shows that the SAM multipliers augmented by induced effects such as the feedbacks coming from consumption expenditures on economic activities, additional factor incomes and inter-household transfers. Moreover, change in output in SAM is quite larger than in I-O with the corresponding sectors.

VI. CONCLUSION

The magnitude of economic losses is too difficult to predict for disaster. Mostly, it creates a great negative impact on the related regional economy. Sometimes, it brings the positive signal during the recovery period which regarding with falling in the unemployment and comes out the new opportunities for a region's economy. This can be changed in consumption behavior as well as market condition. Government financing assistance on the reconstruction program also plays a critical role in public policy. In turn, people will response the government actions and the market requirement.

Even though there is no direct external shock within the business activities, the intra/inter-industry response and households spending feedbacks are considerably large. The SAM multipliers (i.e. total effects) for P_DMANF and P_PMANF are relatively small in production sectors. However, their corresponding new output levels are substantially falling with the worth of US$ 64.93 billion for P_PMANF and US$ 75.87 billion for P_DMANF. It indicates that these two sectors for public and private are the major industries in Aceh region.

When comparing the I-O and SAM multipliers, all SAM multipliers are greater than the I-Os. Similarly, there is the same result for comparing the new output level through the respective multiplier process. As the SAM implication, this context can indicate more reasonable outcome for the regional economy on the disaster. If the I-O framework has been applied to evaluate these impacts, it can be underestimation for the region's socio-economic situation.

In household groups, 'urban low' is the most hit by the Tsunami with the direct loss US$ 0.43 billion while 'agri-worker' is the second smallest with US$ 0.12 billion. Remarkably, 'agri-worker' group is the most vulnerable among the eight household groups with the total losses of US$ 8.42 billion. In fact, this group of people is already poor. They

have no factorial items such as capital, land, and advanced knowledge for high technology. It can observe that the labor who works in the primary sector like the agriculture may become poor more and more during the post-disaster period. SAM implication can explain that condition vividly.

As a result, the income inequality range becomes wider and wider. Hence, poverty becomes the critical issue after the disaster. In order to reduce the income inequality, the policy makers should consider reduction the income inequality gap as a major problem for the regional development with equal income distribution.

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