Chapter 2

Theoretical Foundation

"A community without roads does not have a way out"- Ecuadorian Campesino.[8]

(USAID from the American People,Poverty Reduction and Transportation Infrastructure In Timor-Leste, Sept 2006)

2. 1 Introduction

This chapter emphasizes three distinct dimensions of this study. The first is a theoretical review which explores the role of isolation, the lessons gleaned from the experiences of other countries that have opened their economy, and the opportunities which a nation can exploit when opening up its economy. The second is a careful analysis of transportation and economic development by some scholars so as to identify to what extent infrastructure must be encouraged or discouraged in recently opened economies in order to attain further stages of development. The third is a review of the usefulness of Social Accounting Matrices (SAM) that have been used by various scholars and policy makers in real world contexts. Of course, we know that no specific model is completely applicable to the real conditions of a country as unique as Myanmar. Nevertheless, SAM modeling has been seen in various places such as Thailand, Indonesia, Africa, India, USA, China and applied in various fields

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[8] . Original message from the poor's views were captured by a World Bank series titled "Voices of the Poor", which provides insights on poverty and development from the poor's perspective.

such as tourism, poverty, agriculture and environment. At the same time, the review of using seemingly unrelated regressions will be given in this section.

2.2 Role of isolation by von Thunen [9]

The model created by von Thunen focused on a city or a state before industrialization. "It reposed on the following six assumptions:

(1) The city is located centrally within an "Isolated State" which is self-sufficient and has no external influences.

(2) The isolated state is surrounded by an unoccupied wilderness.

(3) The land of the state is completely flat and has no rivers or mountains to interrupt the terrain.

(4) The soil quality and climate are consistent throughout the State.

(5) Farmers in the isolated state transport their own goods to markets via oxcart, across land and directly to central city. Therefore, there are no roads.

(6) Farmers act to maximize profits

In an Isolated State with the foregoing statements being true, von Thunen made the hypothesis that a pattern of rings around the city would develop" (Rosenberg, no date). He emphasized four rings of agricultural activity surrounding the city. He predicted that "dairy and intensive farming would occur in *the ring closest* to the city. Since vegetables, fruit, milk and other dairy products must get to

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[9] Johann Heinrich von Thünen (24 June 1783, Wangerland – 22 September 1850) was a prominent nineteenth century economist. Von Thünen was a Mecklenburg (north German) landowner, who in the first volume of his treatise, *The Isolated State* (1826), developed the first serious treatment of spatial economics, connecting it with the theory of rent. The importance lies less in the pattern of land use predicted than in its analytical approach (Hall, 1966).

market quickly, they would be produced close to the city" (Rosenberg, no date). (At the time, there were no refrigerated vehicles.)

The second ring would see the production of timber and firewood produced for fuel and building materials. It would present the era of industrialization as wood was a key source of fuel. However, the locus of production should be located relatively close to the city as things creating fuel and fire are heavy and difficult to carry between two places. The third ring would focus on the production of cereal/ grains for wheat production because these commodities would last longer than the production from the first ring and are lighter than the production of the second ring. Therefore, to reduce transportation costs, grains could be located further out than the first and second rings.

Finally, the fourth ring would specialize in ranching since the author assumed that animals can be herded on the hoof from places farther away; the assumption of self-transportation would help bring animals to the city at that time. The resulting four-ringed pie could be cut into any number of slices, each of which contained a cross section of the four economic zones. It has been said that "even though the Von Thunen model was created in a time before factories, highways, and even railroads, it is still an important model in geography" (Rosenberg, no date).

Needless to say, countries in today's era do not use oxcarts when they conduct trade from country to country or even from city to a city. Nonetheless, the fundamental principle of Von Thunen's theory can be applied to a country which is less open and which is trying to be self-sufficient with little communication with the outside world. Nevertheless, achieving economic development of a country can be seen as the primary goal of that country. It will also be noticed that Von Thunen did

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not mention access to the sea or to international trade. His only focus was on access to an interior town or capital city, with the entire State surrounded by a huge forest.[10] We shall note in the remainder of this thesis that Mawlamyine Township resembles, in many ways, von Thunen's "Isolated State", in that it has been effectively by-passed by the Asian highway and the initial fragment of the East-West highway, and that the deep-sea port construction project has been moved to another site. We shall therefore return to the practical and strategic implications of von Thunen's model in the concluding chapter of the thesis.

2.3 A review of scholarly economic perspectives on transportation and economic development

The nations of the world have taken different approaches towards development. Trading is one of the most important approaches to the progressive economic development of a country regardless of its size or relative endowments in natural resources. Trade consists not only of goods and services; but also of the migration of labour; and the transfer of technological skills, entrepreneurship and direct investment for capital formation. Of the factors affecting economic growth, the availability of capital is likely the most important. Economic development is achieved through the improvement in efficiency of labour and the full utilization of natural resources. Capital is needed for the realization of both these events. The productive employment of labour presupposes an increase in the general level of education, the

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[10]. Therefore, although this thesis will be testing the idea of road development suggested by Von Thunen, it will also reflect the possibility of road and shipping connections to foreign countries. Indeed, Mawlamyine Township was chosen because of its favourable location in both regards.

acquisition of technical skills, the formation of capable administrators and entrepreneurs, the provision of adequate tools and machineries, as well as a rising of the standard of living for the whole population of potential "consumers."

Starting from early history, countries traded with each other based on their endowments of resources so as to increase the standard of living of their citizens. When we observe past theories, we find first those currently called old trade theories. These include Mercantilism, Smith's (1766) absolute advantage theory, Ricardo's comparative advantage theory, Hoechsher-Ohlin's abundant-factor model, the opportunity cost concept, the production possibilities curve, and the gains from trade paradigm (Chipman, 2008).

Today, Venon's (1966) product cycle theory (cited in Chipman, 2008) has received increasing attention. It focuses on where products are designed and produced rather than on comparative advantage. In his theory, technical innovations leading to new products tend to occur where large concentrations of capital and knowledge converge. The essence of his theory is that the production of many products moves from one country to another depending on the stage of the product's life cycle. Venon's theory consists of four stages -- introduction, growth, maturity and decline. Most importantly, a specific export sector must be included in the early stages of product introduction. This is very similar to the "flying geese" or Japanese model. In the case of Myanmar, for example, the garment and rice industry will no longer be in the early stages of introduction before they mature due to political reasons, i.e., trade sanctions.

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In the 1980s, production concepts based upon first mover advantages and economies of scale were presented by Nobel Laureate Paul Krugman[11]. His view stresses that in some cases countries specialize in production and export of a particular product not because of differences in factor endowments predicted by Hoecksher-Ohlin, but because of differences in certain industries. This is because the world market can support only a limited number of industries. He also pointed out the effects of learning by doing and learning by repetition. Since trade is important for any country, the role of transportation can be seen as an essential element among or between trading partners.

"It is not the wealth of a nation that builds roads, but the roads that build the Wealth of a nation." - US President John F. Kennedy (cited in Midwest Regional University Transportation Center, no date)).

As stressed by US President John F. Kennedy, the role of transportation has been emphasized by the majority of researchers and economists since it provides crucial support and complements to trade for the economic development of the country. Todaro (2003) pointed out that capital accumulation resulting from peoples' saving and investment is vital to supplementing and encouraging future income and output. Another economist, B.A. Prakesh (2004), from India, posits that;

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[11] . "Paul Robin Krugman (born February 28, 1953) is an American economist, columnistand author. He is a Professor of Economics and International Affairs at the Woodrow Wilson School of Public and International Affairs at Princeton University, and Centenary Professor at the London School of Economics. In 2008, Krugman won the Nobel Memorial Prize in Economics for his contributions to New Trade Theory and New Economic Geography." (www.krugmanonline.com)

> "Any capital including new factories, machinery, equipments and materials upgrades the country's physical capital and makes it possible for expanded output levels to be achieved. These directly productive investments are supplemented by investments in what is known as social and economic infrastructure – roads, electricity, water and sanitation, communications and the like – which facilitates and integrates economic activities" (Prakash, 2004, p. 34).

Therefore, the role of transportation has been growing in the promotion of human well-being and one should expect to observe the impacts of road infrastructure development in a country in general. Since countries nowadays regardless of size rely to some extent upon trade, the relationship between trade and transportation should be scrutinized. Within economic theories, several "new" theorists such as those of Krugman, Helpman and Whee Rhee are famous for their trade theories, but few are famous for transportation economics.

In addition, the role of transportation costs may be observed in the explanation of trade between similar countries. This was proposed byKrugman in a 1979 paper in the *Journal of International Economics*. In his view, some factories and firms which have already achieved economies of scale do not spread out their factories and firms all over the world but choose instead to set up one or a handful of factories because of economies of scale and consumer preferences for non-homogenous products or brand name recognition. This situation may lead a country to specialize in producing a few brands of any given type of product but not many brands.

Transportation is one kind of infrastructure that fits the definition of "*the basic physical and organizational structures needed for the operation of a society or enterprises, or the services and facilities necessary for an economy to function*"

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(Oxford Dictionary, no date). This being so, a series of research works in transportation have been taken to gauge the impact of transportation upon economic development or growth within macroeconomic models. In other words, researchers are endeavouring to estimate how much benefit a society could earn from investments in the development of its transportation sector. Roughly, benefits can be divided into economic benefits and social benefits.

For the economic benefits, at least three different arguments are used to link transportation to economic growth (Penne, 2004), while social benefits are rather complex. In Penne's view, the first benefit of transportation is macroeconomic. That approach generally looks upon economic indicators and searches for the correlation between transportation investment and efficiency. As shown in Figure (2.1), transportation investments lead to increased transportation capacity, efficiency and reliability. This yields cost savings, time savings and scope for business expansion throughout the economy. Economic growth is the result of increased productivity and competitiveness from investments in transportation.

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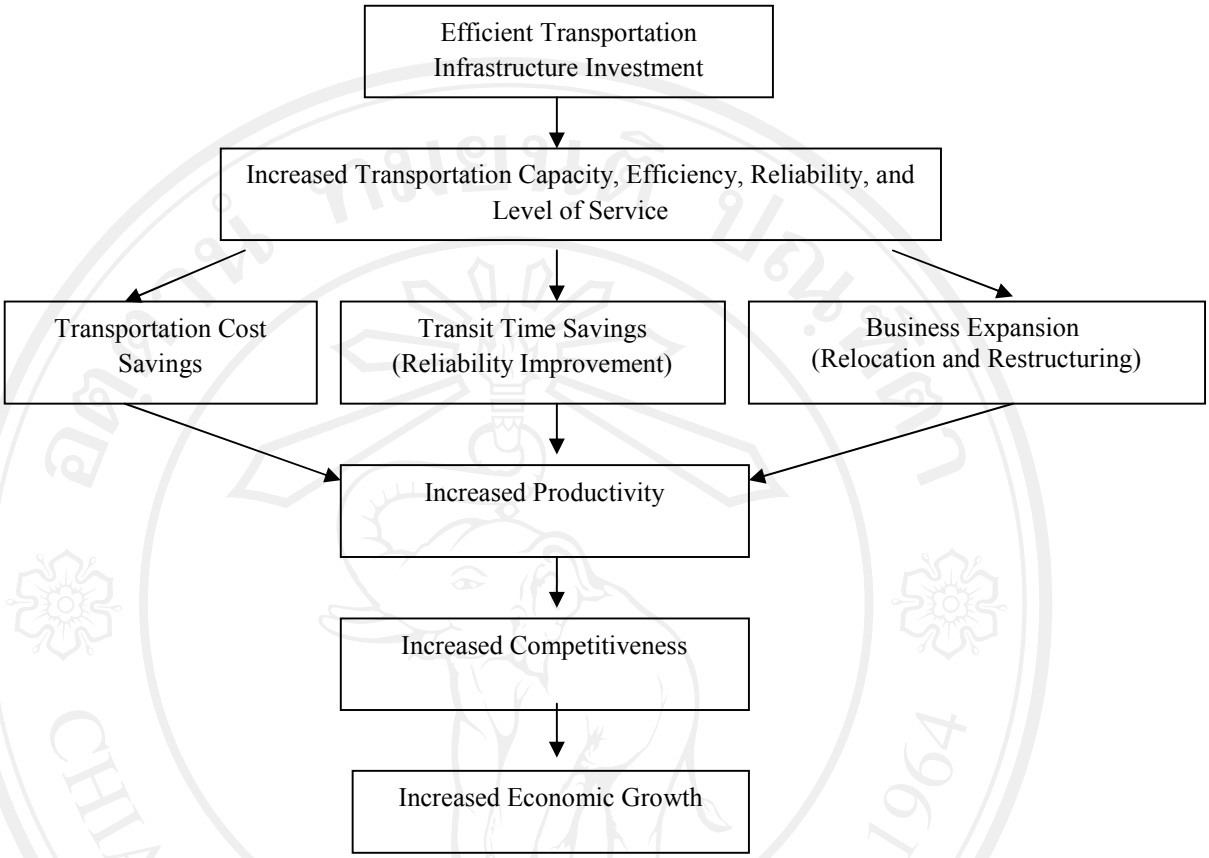
Figure 2.1 Transportation and the Economy



Source: Penne (2004)

A second viewpoint is microeconomic. It focuses upon the actions of specific companies due to improvements in transportation services or reliability. Compared with the macro perspective above, the impacts of transportation infrastructure are more complicated to measure as they concern the actions of specific businesses which may give different responses to changes in efficiency or reliability of transportation services. A document publicized by the Midwest Regional University Transportation Center (no date) of the United States cited two major events in logistics of the last two decades as major examples of individual businesses responding to changes in transportation. First, "just-in-time delivery" has significantly reduced inventory costs

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for many businesses. Secondly, “network distribution systems” in transportation were adopted by most manufacturing and retail companies.

Finally, Penne cites a third perspective, equilibrium; which considers that improved transportation facilitates economic specialization for trade, leading to wealth creation. Equilibrium models frequently address Free Trade Agreements (FTAs) based on the concept of specialization. Regions, countries or firms should do those things they are most efficient in doing and deal with trade to gain the benefits of each of their greatest efficiencies. In turn, no one can deny that deeper specialization is occuring more than ever before and that as a result easier access to transport facilities now exists all over the world. For example, different parts of airplanes produced in different countries within the European Union contribute to assembling an Airbus.

Basically, all three perspectives share the common view that better transportation leads to economic growth in their specific field. Transportation is considered a component of economic productivity in Penne’s model from “Transportation and the Economy.” Other literature and works have also highlighted the relationship between economic development and transportation infrastructure. Among them, Lem (2002) has enumerated four key aspects which are very similar to micro and equilibrium perspectives of Penne (2004). In addition, some scholars have been pointed out similar aspects in their different research. These aspects are:

(1) Production Costs

(2) Industrial Location

(3) Regional Productivity

(4) Cost of Interregional Trade

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Setting up industries in specific regions promotes regional economic development via the creation of more regional employment opportunities and increases the demand for local products produced by those industries. Therefore, the transportation infrastructure indirectly generates regional employment growth (Lem 2002 and Kim 2006).

In addition, it is commonly acknowledged that the effects of transportation infrastructure investment originate in employment opportunities in the transportation sector, pass through household welfare including leisure and business and industry competitiveness, and end up in the reduction of the economic and labour productivity losses associated with accidents (Lem 2002, O'Fallon 2003, Ali and Pernia 2003, Penne 2004, Kim 2006, and Calderon & Serven 2004). The lack of infrastructure is hindering economic growth in many developing countries (Kim, 2006).

Kim (2006) studied the relationship between infrastructure investment and economic development in developing countries (Korea and Japan) during the 1910s and 1990s for Korea and the 1950s and 1990s for Japan. He found that infrastructure, especially transportation and communication, were important to the economic growth of Korea and Japan. According to his paper, "infrastructure investment has been recognized as an important tool to achieve balanced development of the national land, correcting regional income disparities" in Japan after 1962 (Kim, 2006, p. 25). He concluded that infrastructure development in Japan and Korea provided favourable conditions for comparative advantage and cooperative economic development with other developing countries.

Calderon and Serven (2004) evaluated the impacts of infrastructure development on the distribution of income and economic growth by using a large

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panel data set for more than 100 countries, including Latin America countries, which spanned the period 1960 through 2000. Both simple regressions for GDP growth and inequality measures with GMM estimation were used to demonstrate that the stock of infrastructure assets has positive effects on a country's growth. Additionally, it was found that the higher the infrastructure quantity and quality, the lower the income inequality in general. Simulation results for Latin American countries gave a significant result that quantity and quality of infrastructure prompted growth acceleration and reduction of inequality in their study.

Recent research on the linkages among infrastructure, economic growth and poverty reduction in East Asia by the Asian Development Bank, World Bank and the Japan Bank for International Cooperation (2005) has shown that infrastructure should promote economic growth and that the fruit of that growth should be shared by as many people as possible. Whatever its purpose — whether for water systems, electric power generation or transportation — infrastructural enhancement has the potential to greatly improve the quality of life. Yet, the poor remain poor because they often cannot benefit from the most basic infrastructural services. Infrastructure, an essential factor in securing an adequate livelihood, promotes job opportunities by linking production centers with markets; it raises productivity levels as well. These benefits translate into higher incomes for workers.

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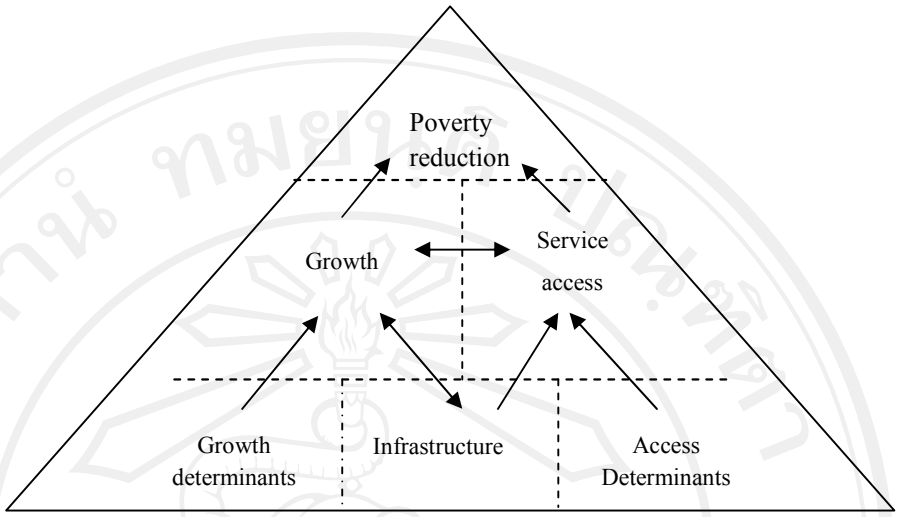
Linkages between infrastructure, poverty reduction and growth



Source: (Asian Development Bank, World Bank and Japan Bank for International Cooperation, 2005)

As noted, improving access to infrastructural services and promoting economic growth through infrastructure brings benefits that create a virtuous cycle contributing to poverty reduction. But benefits from improved infrastructure will not always be shared fairly by all people, and the interests of some stakeholders may clash with the interests of others. It is therefore important that all stakeholders, including those who will benefit from the infrastructure, participate in the decision-making process.

Warr (2007) has explored the impacts of road improvement on poverty reduction in Laos by using general equilibrium modeling based on the Laos Expenditure and Consumption Survey (LECS) for 1997-98 and 2002-03. His model distinguished three types of road areas: (1) no vehicular access, (2) dry season only access, and (3) all weather access. Transportation costs were calculated by types of vehicles used in those road accesses. Calculations from the LECS 2002-03 data

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revealed that poverty of rural villages in his categories 1 and 2 (no road access and dry season only access) was higher than that of the rural average and much higher than that of the national average. The results from the simulation showed that road improvements had positive quantitative impacts on rural poverty reduction.

Fedderke, Perkins & Luiz (2006) also attempted to isolate the role of productive public infrastructure expenditure in South Africa in promoting economic growth and supporting private investment or not. Using time-series data for 1875-2001, they proved that infrastructure investment played a leading role in the growth of South Africa.

Ozbay, Ozmen-Ertekin, & Berechman (2007) tried to investigate the impacts of infrastructure (highway) investment on economic development of the New York/New Jersey metropolitan area between 1990-2000. Their results confirmed that highway capital had positive impacts on economic development. Additionally, theyreported that country highway capital had influenced economic production.

Among a number of studies, Esfahani, & Ramirez (2003) employed time series data for the three decades 1965-1975, 1975-1985 and 1985-1995 to estimate average infrastructure and per capita GDP growth rates for 57 countries. They found substantial impacts from infrastructure on economic growth.

Based upon all of the above studies, we may safely conclude that trade offers great benefit to nations while transportation, in turn, is crucial to supporting trade. Current trade wisdom says that the exports of a country with an unsound transportation system cannot compete in the international market as the price cannot be reduced given the high transportation costs. Since trade may have dramatic effects in boosting a country's economic condition, the majority of countries in the 21st

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century are actively participating in trade and trying to encourage exports as much as possible. Some are forming trade blocs or are endeavouring to do so in the near future.

Trade creation[12] and trade diversion[13] effects were firstly introduced by Viner (1950) and have remained a cornerstone in the classic theory of international economic integration. Groups of contiguous countries are operating free trade areas within their boundaries such as the ASEAN Free Trade Area, Central American Integration System, and the South Asia Free Trade Agreements. Proposed agreements may extend zones such as the African Free Trade Zone and the Free Trade Area of the Asia and Pacific. Therefore, countries are preparing roads and deep sea ports in their regions, and Myanmar is no exception. Asia's highways and economic corridors provide tangible evidence of how countries can save transportation costs and time, thereby bringing themselves closer to each other. Furthermore, Krugman (2003) shows that there is a positive correlation between rapid growth in exports and rapid overall economic growth in many countries. Infrastructure development, road construction, trade, employment creation and economic growth are all positively interrelated.

Normally, trade in the business sector alone does not seem to work. The relationship between government and the business sector therefore assumes a key position in creating advantages from trade. In so doing, Porter's Diamond of National Advantage Theory has increasingly guided the global trading strategies of nations

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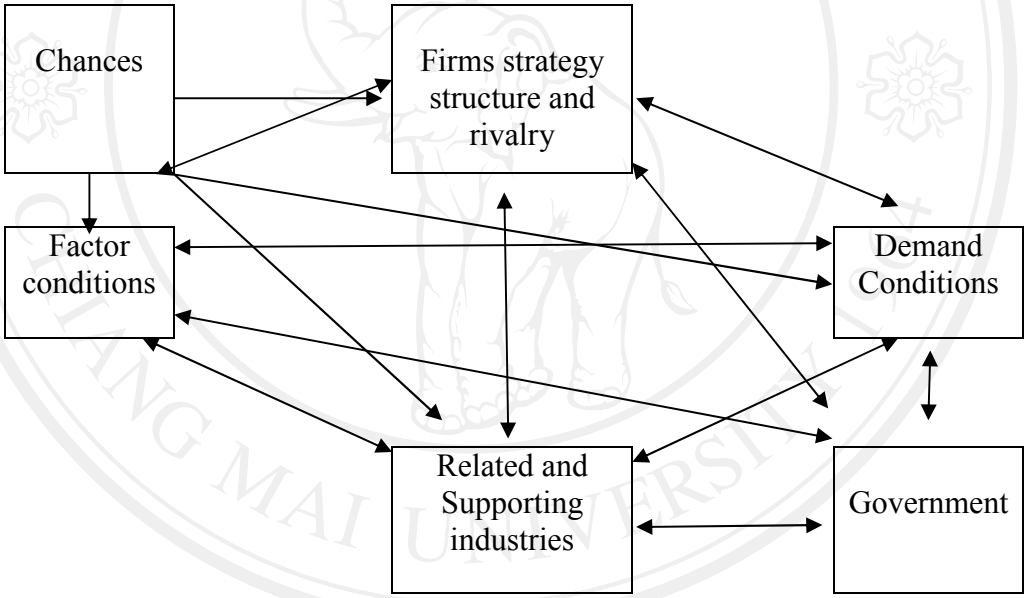
[12] . Trade creation means that a free trade area creates trade that would not have existed otherwise. As a result, supply occurs from a more efficient producer of the product. In all cases trade creation will raise a country's national welfare.

[13] Trade diversion means that a free trade area diverts trade, away from a more efficient supplier outside the FTA, towards a less efficient supplier within the FTA. In some cases, trade diversion will reduce a country's national welfare but in other cases national welfare could improve despite the trade diversion.

(Value Based Management, no date). Porter's model emphasizes the link between government and the business sector. Most Asian success stories have involved the strategic alliances between the government, the holders of private capital and the managers of companies. Government helps to identify the areas of competitive advantage of the entire country and provides massive capital investment in the beginning to achieve economies of scale.

Figure 2.2 Michael Porter's Diamond Theory



Source : (Value Based Management, no date)

Four attributes of a nation make up Porter's[14] Diamond Theory of National Advantage (see Figure 2.2). They are:

- Factor conditions
- Demand conditions

[14] . Michael Porter's Theory of National Competitive Advantage published in 1990 was based on a study of 100 firms in ten developed nations.

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- Related and supporting industries, and firm strategy, structure and
- Rival firms strategy, structure and rivalry

Apart from the four key elements, chance (good or bad luck) may also play a role in success. The role of government[15] is to act as a facilitator to push and organize the efficiency of companies and to raise companies to a higher level of competitiveness at the international level. Porter's book was the first to explain a theory of competition based on the role of productivity with which companies could be in the fields of exploiting opportunities instead of traditional comparative advantage theory which was founded upon natural resources and labour.

Developing countries can take opportunities to learn from the Porter Diamond so as to know in which factors they are weak. Since Porter's theory is based on the experience of developed countries which are already fruitful in their economic development, developing countries, then, may try to strengthen these weaker factors in order to enhance their competitiveness.

The theories we have reviewed point to different factors for success in trade through accessing opportunities in trade and enhancing competitiveness in the field. These factors include economic location (Von Thunen), geography (Krugman), the role of transportation on economic development (Penn 2004, Lem 2002, O'Fallon 2003, Kim 2006, Calderon and Serven 2004) and the role of government (Porter). A review of the literature and the empirical applications of the above scholars' and researchers' work has also clearly demonstrated the positive impacts of infrastructure development on trade and economic development at the micro and macro level. From

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[15]. Government influences on 4 elements consists of subsidies; education policies; regulations or deregulation of capital markets; establishment of local market standard and regulations, purchases of goods and services; tax laws; and antitrust regulations.

the standpoint of most of these theories, Mawlamyine compares less favourably than the other parts of the EWEC. This is because the road transport routes within Myanmar have not yet been finished, even though the rest of the EWEC links outside of Myanmar have all been completed.

2.4 Current literature on Myanmar and EWEC

At the present moment, few studies have been done on transportation in Cambodia, Laos and Myanmar as a group and even fewer on Myanmar alone. Within such studies, econometric modeling is rare, and using the Social Accounting Matrix method for Mawlamyine, Myanmar has never been done.

A Study to Formulate a Master Plan on Industrial Linkages between Myanmar and Thailand for the East-West Corridor was commissioned by the JODC (Japanese Overseas Development Cooperation) Bangkok Office (2005). It addressed the following issues: What should be the realistic targets and objectives for a victorious industrial linkage between Thailand and Myanmar? What forms of assistance are needed to build up to get that linkage, and which people or countries could best provide them? Library research was conducted in order to understand "Current Industrial Linkages", their strengths and weaknesses, and the potential synergy of development between the two neighbouring countries. The main source of information for addressing these issues was gained both from in-depth interviews with the key players in the government and private sector in order to supplement extensive desk research.

A draft master plan was developed and then reviewed by the key players whose comments were used to formulate the recommended master plan for industrial

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linkage between Thailand and Myanmar. According to their research, there is no doubt about the positive impacts that would come from successful industrial and economical linkages between Myanmar and Thailand. The report posits that;

> "Most of the background work has been completed and all that is needed is an initiative from the supporting international agencies to mobilise the private sector of both countries. Especially in Myanmar, it will be necessary to convince Myanmar policy makers of the validity of such an initiative. The Thai government is instrumental in showing its support to any linkages that may be possible with Myanmar. The international agencies which are involved with the EWEC initiative should support the cause to promote the EWEC to the private sector especially when the infrastructure projects needing support from the private sector have been identified" (JODC, 2005, p. 105).

There is, however, little research on the subsequent changes in the culture and behavioral practices of people and potential improvements of EWEC, especially for the Myanmar side, as the East-West Economic Corridor is a fresh undertaking.

Ishida (2007) focused on three economic corridors, the EWEC (East West Economic Corridor), the NSEC (North South Economic Corridor), and the SEC (Southern Economic Corridor). That study reported that economic corridors became popular in the late 1990s and that many businesses and logistics companies were interested in those corridors. The Japanese government were highly interested in the EWEC while businesses paid attention more to the Bangkok - Hanoi Road (the initial skeleton of the North-South Economic Corridor). The author focused on the Bangkok–Hanoi Road (BHR) instead of the NSEC. As businesses paid more attention to the BHR, the author was curious to measure the effectiveness of those economic corridors. Therefore, he applied the gravity model to compare the effectiveness of the EWEC and BHR in terms of distance, population, population density, volume of trade, GRP (Gross Regional Product), and GRP per capita. Using secondary data from

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the ADB and Vietnam statistical yearbooks, he concluded that the EWEC is less effective than other similar growth corridors around the developing world in terms of both GRP and GRP per capita, largely because "the route which connects larger cities is more effective than the route which connects smaller cities" (Ishida, 2007, p. 8).

2.5 Review of the Social Accounting Matrix (SAM) and its real world application

Although national income accounting estimation and the concept of productive activity was developed from 1665-1902, methods of estimation took much longer to evolve. Quesnay's 1758 "Tableau economique" of the French economy was without a doubt the first input-out table, the inner core of a social accounting matrix. After extensive developments to the table from 1930-1945 and an explanation of the applications to the Soviet economic planning models, Wassily Leontief was awarded the Nobel Prize for perfecting the input-output method in 1973. Ten years later, Richard Stone was conferred another Nobel prize for the implementation of systems of development in national accounts based on empirical economic analysis. Although Stone was awarded the prize in 1983, he had actually proposed his invention of accounting systems as early as 1945 (Vanoli, 2005).

A SAM represents a square matrix and an extension of the Input-Output model. SAM model is based on the macro income and expenditure equations. "A SAM is a form of single entry accounting. SAMs also embody the fundamental principle, but they record transaction between accounts in a square tableau or matrix format" (Reinert and Roland-Holst, 1997, p. 95). Therefore, a SAM normally captures of the relationship between income and expenditure linkages.

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A SAM can be written algebraically as a square matrix:

T = $\{t_{ij}\}$, where t_{ij} represents the transaction value from the expenditure account "j" to the income account "i".

"Nominal flows cross the SAM from columns to rows. For transactions involving goods and services, there are corresponding real flows crossing the SAM from rows to columns, for financial transactions, there are corresponding flows of assets from rows to columns. For pure transfers, there are only the nominal flows from column accounts to rows account" (Reinert and Roland-Holst, 1997, p. 96). Rows and columns stand for income and expenditure respectively. More specifically, row totals for each account must be equal to column totals of the respective accounts. Algebraically,

$$\sum_j t_{kj} = \sum_i t_{ik} \quad , \forall k$$

"SAMs satisfy a variant of Walras's Law. If all accounts but one balance, then the last account must also balance" (Robinson's study (1989) as cited by Reinert & Roland-Holst, 1997, p.96).

Although a SAM for a small economy size, such as a village or township such as Mawlamyine, could be different from a standard one, a basic SAM structure for an open economy can be illustrated by the following form;

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Table 2.1 A Basic SAM for an economy

Expenditure		Production			Institution			Capital Account	ROW	Total
Income		Activities	Products	Factors	Households	Firms	Government			
Production	Activities		Sales (within)				If it is, export subsides		Export	Production
	Products	Demand (Intermediate)			Household consumptions		Government expenditure and consumption			Demand (Within)
	Factors	Wages							Factor income from abroad	Gross Township products at Factor costs
Institution	Households			Labour income		transfers	transfer		transfer	Households income
	Firms				transfers					firms income
	Government	VAT	Tax	Tax	Tax	Tax				Government Income
Capital Account					saving	saving	saving	transfers		Total saving
ROW			if any, imports	factor payments		transfer from abroad				Import
Total		Production	supply	factor payments	Household expenditures	firms expenditures	government expenditure	total investment	Total FE income	

Source: Adopted from Santos (2005)

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The six main accounts in SAM are activities, commodities, factors, institutions, capital and export / import accounts. Normally exports / imports represent the rest of the region or rest of the world's account. SAMs are square (the number of columns equals the number of rows) in the sense that all institutional agents (Firms, Households, Government and "Rest of Economy" sectors) are both buyers and sellers. Columns represent buyers (expenditures) and rows represent sellers (receipts). SAM's were created to identify all monetary flows from sources to recipients, within a disaggregated national account. The SAM is read from column to row, so each entry in the matrix comes from its column heading, going to the row heading. Finally columns and rows are added up, to ensure accounting consistency, and each column is added up to equal each corresponding row. In the illustration below for a basic open economy, the item consumption comes from Households and is paid to Firms. SAM is also a data system, including both social and economic data for an economy. The data sources for a SAM come from input-output tables, national income statistics, and household income and expenditure statistics. Therefore, a SAM shows great detail about all kinds of transactions within the economy.

Although SAM application is very useful for policy planning and implementation, the structure of a SAM might differ substantially from country to country based on the country's specific technological, economic, social, and institutional structure (Pradhan, Saluja, & Singh, 2006). Construction of a SAM might be started "top-down" from the macro level study to form an economy wide SAM in many cases; or "bottom-up" to build a micro SAM at the district/township/village levels.

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Reinert & Roland-Holst (1997) have suggested that the construction of a SAM should begin by recasting the macroeconomic accounts for the economy into a simple tableau, a so-called Macro SAM. “This of course assumes that the macroeconomic account exists and that the aggregates are to be relied on without further revision or adjustment” (Round, 2003, p.174). However, “ the extra should be exercised in a strict application of the ‘form Macro to Micro ’ rule, especially if household survey data are used to construct the SAM and if the corresponding national accounts have not relied on these data or only to a minimal extent” (Round, 2003, p.174).

Parikh and Thorbecke (1996) used the SAM approach to capture and compare the socioeconomic interdependence and structure of a traditional vs. industrializing village in India. Their goal was to examine the impact of rural industrialization on village life and the economy of the two villages. The main transformations in their SAM are (1) the allocation of value added to factors (labour and capital) by production activities yielding the pattern of factor use and the consequent factorial income distribution; (2) given the amount of land owned and the amount of human capital possessed by households, the factorial income distribution, mapped into the distribution of household income earned by distinct socioeconomic household groups; and (3) the corresponding expenditure patterns (consumption of different goods and services, savings, direct taxes and imports) of the various socioeconomic group so that they can estimate multiplier effects and framework for the two villages.

Li (2002) created a 1998 social accounting matrix (SAM) for Thailand with a description of the overall economy both via a macro SAM and a national accounts balance sheet. The macro SAM was the result of aggregating micro SAM. A mapping

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of the final micro SAM to the macro SAM is also presented. Thorbecke (2001) studied the direct and indirect macroeconomic effects of technology choice on income distribution and the level and composition of output and employment are analyzed within the framework of a Social Accounting Matrix (SAM).

Reinert and Roland-Holst (1992, vol. 4,) had conducted the SAM to present integrated data on inter-industry flows, value added, imports, and final demand for 487 production sectors into a consistent framework for the United States.

2.6 A review of multiplier and balancing techniques

Round's (2003a and 2003b) papers and Professor David Roland-Holst's (2009, 2010) lectures on SAM multipliers analysis help to review the countries which have already developed the SAM-based multiplier model application. Based on Round's (2003) literature, the methodology of using the SAM-based multiplier is quite straightforward in an excel spreadsheet although "few multiplier analyses are now published but are often available as unpublished studies" (Round, 2003a, p.10).

Among developing countries, Sri Lanka, Ghana, Indonesia, Thailand and Vietnam are already using the SAM-based multipliers application in decision making processes (Round, 2003). There can be different kinds of SAM-based multipliers due to researchers' interest. Here, we review SAM-based multipliers.

From Professor David Roland-Holst's lecture on January 14, 2009 and July 12, 2010, the national income for an open economy structure can be written as follows.

$$Y= C+I+G+ X-M \qquad (2.1)$$

Starting from that equation (2.1), we can write down the SAM multiplier

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In equilibrium,

Investment and saving are closure, i.e I=S

Government expenditure and Taxes are closure, i.e G=T

Among right hand side variables, consumption is described endogenously as

$C= a Y$

or Keynes' consumption function;

where a= the marginal propensity to consume and the rest occur exogenously. Therefore, we can see this identity as the composition of endogenous variable and exogenously.

$Y= aY+I+G+X-M$

$Y-aY= I+G+X-M$

$Y(1-a) = I+G+X-M$

$Y= (1-a)^{-1} [I+G+X-M]$

$Y= (1-a)^{-1} Ex$

where $[I+G+X-M]=Ex$, if $(I-a)^{-1}$exists, then

OR it can be written as follows

$$y_n = A_n * y_n + X$$

Where y_n= endogenous total income

$A_n * y_n$ = Transaction Matrix

X= Exogenous Changes

$y_n - A_n * y_n = X$

$y_n (1- A_n) = X$

$y_n = (I- A_n)^{-1} X$

$= (I+a^2+a^3+----------) X, (I+a^2+a^3+----------)$

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= recursive expenditure

$$=[\sum_{k=0}^{\infty} a^k]X$$

$$= M_a X = M_{a3} M_{a2} M_{a1} X \qquad (2.2)$$

$M_a = \frac{1}{1-a} \rangle 1 =$ M_{a3} M_{a2} M_{a1} = SAM multiplier matrix or accounting multipliers

Equation (2.2) shows the receipts of productivity activities, factors and institutions which are endogenously determined following exogenous injections. The inverse, $(1- A_n)^{-1}$, is a multiplier matrix M_a. Therefore, this multiplier matrix is related to endogenous income /receipts y_n to injections X. The "SAM based multiplier accounts not only for the direct and indirect effect but also for the induced effects on factor and household income and activity output due to the (Keynesian) income–expenditure multipliers" (Robinson (1989) as cited in Round, 2003a, p. 7).

Multiplier Decomposition

As described in Pyatt and Round's 1979 study, "the SAM multiplier can be shown too decomposable into three multiplicative components" (Pyatt and Round (1979) as cited in Round, 2003a , p. 8).

$y_n = M_a X = M_{a3} M_{a2} M_{a1} X$

Round also states that;

> "M_{a1} represents the within account effects, that is multiplier effects an exogenous injection into one set of accounts (say either the activities accounts or the household account) will have on that same set of accounts. For activities, this component is the input-output multiplier, for households this component will reflects any interdependencies that arise from the patterns of transfers of income between households. M_{a2}

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captures the cross (or spill over) effects, whereby an injection of income into one sets of accounts (say, activities) has effects on other sets of accounts (say, households), with no reverse effects. M_{a3} shows the multiplier effects due to full circular flows, these are between-account effects, after extracting the within-account multiplier" (2003a, p. 8).

Table 2.2 The Summarization of SAM model

		Expenditures		Total
		Endogenous Account	Exogenous Account	
Receipt	Endogenous Account	N	X(Injections)	y_n
	Exogenous Account	L(leakages)	T	y_x
Total		y_n	y_x	

Source: Lectures from Professor David Roland-Holst (2009), Pyatt and Round (2006)

With reference to the text of Pyatt and Round (2006) and lectures of Professor David Roland-Holst (2009, 2010), the matrix N in Table (2.2) represents all the circular flows on income within a township/country/economy. Though, the matrix T organizes the matrix of expenditures transaction between exogenous accounts. The matrix 'L' represents anything which leaks from 'endo' into 'exo' accounts while 'X' stands for injections of income from exogenous accounts to endogenous accounts. In this multiplier, it is called fixed price multiplier under the assumption of prices of goods and services are fixed.

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SAM Balancing Techniques

Since SAM must be balanced in the final matrix, technically some methods in literature. Some professionals assert that balancing can be done in one of two ways;

(1) By experts' judgments (Round (2003), Lectures from Roland-Holst (2009 & 2010)

(2) Mathematical balancing

Under the mathematical balancing techniques, two well known technical methods are RAS methods and Cross Entropy method (Chowdhury & Kirkpatrick (2005), Fofana, Lemelin & Cockburn (2005), Round (2003), Lahr & Mesnard (2002)).

RAS Technique

RAS Technique is an algorithm that row and column scaling bipropotional adjustment and originally is developed by Stone (1962) (as cited in Round (2003), Robinson et al. (1998), Reinert & Roland-Holst (1997), and the Asian Development Bank (1993)) The mathematical form of simple RAS technique is as follows;

A_0= coefficient matrix of benchmark I-O matrix

A_1= coefficient matrix of updated I-O matrix

r and s = row and Column vectors

X_1 = output vector of the current year

u and v = row and column total of intermediate inputs of updated matrix

i= a column vector in which each element is equal to 1.

$A_1 = rA_0 s$

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$$A_1 = \begin{bmatrix} r_1 & 0 \\ 0 & r_2 \end{bmatrix} * \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} * \begin{bmatrix} s_1 & 0 \\ 0 & s_2 \end{bmatrix}$$

$$= \begin{bmatrix} r_1 a_{11} s_1 & r_1 a_{12} s_1 \\ r_2 a_{12} s_1 & r_2 a_{22} s_2 \end{bmatrix}$$

Although it seems to be a more appropriate technique in balancing SAMs, Round (2003) suggested that this method might not be a proper method as the estimates of each cell from a SAM come from different sources and then adjusting the same scaling in rows total and column totals may not be appropriate. "The general problem is that of estimating a set of parameters with little information" (Robinson, Cattaneo, & El-Said, 1998, p. 4).

Cross Entropy Technique

Another method of balancing technique "which has been used extensively by Sherman Robinson and his associates in the IFPRI group for compiling and balancing several SAMs, is the cross-entropy (CE) method" (from Robinson *et al.*, 2001 as cited in Round, 2003, p. 177). "The starting point for cross entropy approach is Information Theory as developed by Shannon (1948). Theil (1967) brought this approach to economics" (Robinson, Cattaneo, & El-Said, 1998, p. 5).In the study of Robinson, Cattaneo and El-Said (1998), the authors said that a SAM problem is a kind of information problem that is "estimating a set of parameters with little information". (p. 4).

Apart from the RAS and Cross Entropy methods, Stone-Byron method and quadratic minimand are sometimes used for balancing SAM based on the circumstances.

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Limitations of the SAM

Although a SAM states the flows of income and expenditures, SAM has some limitations. As SAMs are generally fixed price models and there is no allowance for substitution effects, multipliers will tend to overstate the total effect if capacity constraints exist. In addition, it has limited to the endogenous effects that can be captured. Exogenous accounts will be affected by initial shock which is a leakage (Lectures from David Roland–Holst, June 14, 2009 and July 12, 2010). Under such conditions, constrained optimization through linear programming can lead to a more realistic guide to investments and to optimal shifts in economic structure.

2.7 Constrained optimization problem

Chenery writes, as cited in Chowdhury & Kirkpatrick (2005), that;

> "Historically speaking, the programming approach is thus the operational counterpart of the theory of balanced growth. It is only with the development of linear programming that it is possible to reconcile the consistency criteria and the productivity criteria in a systematic way. A link between the test of consistency (feasibility) in resource allocation and the test of productivity (efficiency) is provided by a consideration of the price implications of a given allocation" (p. 55).

An optimization problem (or a mathematical programming) is a kind of maximization or minimization of an objective function subject to the constraints. Decision variables and parameters are in the objective function and constraints. The following equations are a general form of optimization.

Max(Min) Objective function : $F(x, y)=0$

Subject to : $g((x, y)=0$

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There is a feasible solution when that solution can satisfy all the constraints in the problem. In reality, a sequence of feasible solutions could be on the point of production possibilities frontier.

Linear programming

Linear programming is a kind of optimization problem which is a special case of above functions such as objective functions and parameters are assumed to be linear in which constraints could be inequality or equality. To solve the constrained optimization problem, some methods such as the simplex method, the pivot madly method, substitution methods and Lagrange multiplier methods are well known. Here we will present the Lagrange multiplier method.

Lagrange Multiplier Method

Lagrange multiplier method solves the problem without substituting the constraint function with the objective function. The method brings in one more variable, λ, into the problem although it is similar to the substitution method. The method of Lagrange multiplier is associated with the function after we add the λ into the problem. It is called Lagrangian (L).

L: max or min (x,y, λ) $\qquad F(x,y)+\lambda(g(x,y))$

The equations will be the following;

(x): $f_x - \lambda g_x$

(y): $f_y - \lambda g_y$

$(\lambda)\, g(x,y)$

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Then, set the three equations to be zero and solve those equations simultaneously by taking partial derivatives with respect to the three control variables. Using the Lagrange multiplier rule, we have n+1 equation and n+ 1 unknown since λ is in the problem. Therefore, the equations can generally solve for solution variable x, y and λ here.

In Lagrange multiplier method, using λ is a kind of mathematical trick to get the solution we wanted. On the other hand, it also has an key economic explanation. Based on our original equation 'n', here we have 2 equations, we can write down as

$$\frac{f_x}{-g_x} = \frac{f_y}{-g_y} = \lambda$$

In other words, the ratio of $f_x tog_x$ is the same for every x. Therefore, numerators in our problem are marginal contributions of each x to the function f . For denominators, these usually have marginal costs explanations. Therefore, λ can be seen as the ratio of marginal benefits to marginal costs.

In our case the decision variables are importantly assumed to be the total products of the transportation sector that Mawlamyine economy should focus on. This is because the transportation sector could currently offer the most positive attribution to the township by multiplier analysis. Accordingly, agriculture and the other sectors have been noted as to what level those sectors' outputs should be increased or decreased. Therefore, our objective is going to be maximization of the value of township output. Constraints are resources which are land and labour in our study.

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2.8 A review of Seemingly Unrelated Regressions

The idea of seemingly unrelated regression (SUR) is based on a set of equations which may be related not because of their interaction but because the disturbances are correlated across equations (Zellner 1962, Binkley and Nelson (1988), Fiebig (2001) and Alba *et al* (2010)). The application procedures can be applied in the analysis of both cross section and time series data (Zeller, 1962). Various methods have been applied to estimate a set of equations. For instance, linear least square estimator can be applied equation by equation. Although OLS yields unbiased and consistent estimates for each equation, the problem is that OLS does not consider the correlations of the error terms in the set of equations. Since equation by equation estimation method lacks information for correlation of error terms, the estimates will not be efficient anymore. As SUR has a set of equations, the estimation procedure which is proposed by Zellner (1962) yields "coefficient estimators at least asymptotically more efficient than single-equation least squares estimator" (p. 348).

One of applications used in SUR estimation is generalized least squares (GLS). Since a set of equations needs to be estimated and the explanatory variables in the equations are not the same in each equation, then the correlation between disturbance terms in that set of equations are not zero. In this case, GLS estimator which is used in SUR models is more efficient than normal ordinary least square (OLS) which is used to estimation equation by equation (Sribonchitta, 1983).

Moon & Perron (2006) expressed the two main motivations of using SUR. They commented that "the first one is to gain efficiency in estimation by combining information on different equations. The second motivation is to impose and/or test restrictions that involve parameters in different equations." (p. 2).

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Technically, some researchers have emphasized the methodology and efficiency of that method. Zellner (1962), Binkley and Nelson (1988), Fiebig (2001) and Alba *et al* (2010) have evaluated the efficiency of the SUR. Some researchers have applied SUR in their problem statement and research. The normal form of SUR regression model which is accepted by Zellner (1962) and Sriboonchitta (1983) is as follows;

$$y_i = x_i\beta_i + \varepsilon_i \quad \text{i= 1, 2, 3,……. N}$$

in which the errors are contemporaneously correlated where y_i and ε_i are T*1dimensional vectors, X_i is $T * K_i$ and $\beta_i$is a K_{i*1} dimensional vector. Stacking all N equations yields: In Matrix form

$$\begin{bmatrix} y_1 \\ y_2 \\ ; \\ y_N \end{bmatrix} = \begin{bmatrix} x_1 & 0 & 0 & 0 \\ 0 & x_2 & 0 & 0 \\ 0 & 0 & . & 0 \\ 0 & 0 & 0 & x_N \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ . \\ \beta_N \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ . \\ \varepsilon_N \end{bmatrix} \qquad \text{(a)}$$

This can be written in vector form as:

$$\underline{y} = X\ \underline{\beta} + \underline{\varepsilon} \qquad \text{(b)}$$

Unknown parameters in equation (a) and (b) can be estimated by SUR .

Where

$$\underline{y} = \begin{bmatrix} \underline{y_1} \\ . \\ . \\ \underline{y_n} \end{bmatrix}$$

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$$X = \begin{bmatrix} x_1 & & \\ & x_2 & \\ & & x_n \end{bmatrix}$$

and $\underline{\beta} = \begin{bmatrix} \underline{\beta_1} \\ . \\ . \\ \underline{\beta_n} \end{bmatrix}$, $\underline{\varepsilon} = \begin{bmatrix} \underline{\varepsilon_1} \\ . \\ . \\ \underline{\varepsilon_n} \end{bmatrix}$

Where β is a K*1 -dimensional vector of unknown parameters that needs to be estimated and $K = \Sigma^{N}_{i=1} K_i$. For the NT * 1 vector of stacked disturbances

Assumptions of SUR

The assumptions are (1) Error terms are *independent between observations i.e* $E(\varepsilon) = 0$, and may have cross-equations and (2) The NT * NT covariance matrix is comprised of N^2 blocks of the form $\mathrm{E}(\varepsilon_i \varepsilon_j^{'}) = \sigma_{ij} \mathrm{I}_T$ where I_T is a T * T identity matrix.

These assumptions mean that the T disturbances in each of the N equations have zero mean, equal variance, and are uncorrelated and that covariance between contemporaneous disturbances for a pair of equations are potentially nonzero but equal, while non-contemporaneous covariances are all zero. Thus the full covariance matrix of *the stacked error term u* is given by $\omega = \Sigma \otimes I_T$ where $\Sigma = [\sigma_{ij}]$ is the N * N contemporaneous covariance matrix and ⊗ denotes the Kronecker product.

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Under this assumption , the covariance matrix of the disturbances vectors is given by

$$\sum = V(\varepsilon) = \begin{bmatrix} \sigma_{11}I & \sigma_{1n}I \\ \sigma_{n1}I & \sigma_{nn}I \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{1n} \\ \sigma_{n1} & \sigma_{nn} \end{bmatrix} \otimes I = \sum_c \otimes I$$

In addition, 'X' is assumed to be full rank (Siribonchita 1983, Moon & Perron 2006).

Since we have "N" equations, each equation can be estimated separately as individual equations are assumed to satisfy the classical linear regression model's assumptions. If we do so, it ignores the correlation between the disturbances of different equations. One of the methods to satisfy this is joint estimation is SUR. (Zellner (1962), Sibonchitta (1983), Binkley and Nelson (1988), Fiebig (2001), Alba et al. (2010)). The individual equations are related, even though supposedly they may not seem to be; they are only seemingly unrelated. The estimator of SUR is readily defined as the following form where there are N equations.

$$\hat{\beta}_{seem} = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}Y \tag{2.3}$$

With asymptotic covariance matrix given by

$$Var(\hat{\beta}_{seem}) = (X'\Sigma^{-1}X)^{-1} \tag{2.4}$$

Where $$\Sigma^{-1} = \Sigma_c^{-1} \Theta I \tag{2.5}$$

$$\Sigma_c = \begin{bmatrix} \sigma_{11} & . & . & \sigma_{1N} \\ . & . & . & . \\ . & . & . & . \\ \sigma_{N1} & . & . & \sigma_{NN} \end{bmatrix} \text{ and } \mathrm{E}(\varepsilon_i \varepsilon_j') = \sigma_{ij} I, \text{ I, j= 1, 2,3,……..N} \tag{2.6}$$

"The most empirical applications Σ is unknown, and so the estimator $\hat{\beta}_{seem}$ cannot be applied. However, EGLS(estimated generalized least squares) can be utilized by

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substituting $\hat{\Sigma}^{-1}$ for Σ^{-1} in equation (2.3) where $\hat{\Sigma} = \hat{\Sigma}_c \Theta I$ and

$$\hat{\Sigma}_c = \begin{bmatrix} \hat{\sigma}_{11} & . & . & \hat{\sigma}_{1N} \\ . & . & . & . \\ . & . & . & . \\ \hat{\sigma}_{N1} & . & . & \hat{\sigma}_{NN} \end{bmatrix} \quad (2.7)$$

and $\hat{\sigma}_{ij} = \dfrac{\hat{e}_i \hat{e}_j}{T}$ where $\hat{e}_i = Y_i - X_i \hat{\beta}_i and \hat{e}_j = Y_j - X_i \hat{\beta}_j$, I, j= 1,……, N (2.8).

The estimator $\hat{\beta}_{seem}$ and $\hat{\sigma}_{ij}$ from equation (2.3) and (2.8) respectively are frequently referred to as Zellner's seemingly unrelated regression estimator. Since $\hat{\sigma}_{ij}$ from equation (2.8) is biased because of the presence of T in the divisor and, generally, the number of explanatory variables in each equation can be different." (Zellner, 1962, p. 351).

It is well known that the GLS estimator reduces to OLS (ordinary least squares) when: (1) there is an absence of contemporaneous correlations ($\sigma_{ij} = 0, i \neq j'$); or (2) The same sets of explanatory variables are included in each equation ($X_1 = X_2 = \ldots = X_N$). "A more complete characterization of when OLS is equivalent to GLS is given in Baltagi (1989) and Bartels and Fiebig (1991)" (Baltagi, 2003, p. 103).

For example, Sriboonchitta (1983) applied the SUR regression as one of estimation methods in his dissertation. Using primary data from a farm survey which was implemented by the World Bank and the Multiple Cropping Centre in 1977/78 , the researcher investigated the results of the restricted OLS estimator, the Stein estimator, and the restricted SUR regression method for the relative share of inputs. As that study also estimated share equations, it was similar to our study.

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Furthermore, Delaney and O'Toole (2005) applied SUR regression analysis in their decomposition of demand for public expenditure in Ireland. The dependent variables in their study were social welfare, education and health care expenditure from a 2004 survey in Ireland.

Fosu (2007) also used the technique in his share equation study of the external debt-servicing and public expenditure composition for 35 Sub-Saharan African economies. The sample period was covered from 1975 to 1994. SUR estimation was applied to estimate a set of equations in which dependent variables are a share of government expenditures such as capital, health, education, agricultures, economic services, public services investment and explanatory variables are official development assistance (% of GDP), population in Agriculture (%), per capita GNP, and predicted debt services ratio.

The latter two research projects focused on the SUR methodology and its constraints. Our study accepted the SUR method which has been proven to be efficient and we will work within its constraints.

Hakro (2009) also used SUR estimation in his work on investigating the relationship between government expenditure and taxation with GDP per capita growth in twenty-one Asian developing countries. His sample was panel data which covered the years 1981 to 2005 . By using those data sets he searched for the effects of a set of explanatory variables such as government expenditures, initial GDP per head, investment and growth of labour force on annual growth rate of GDP.

The efficiency of the seemingly unrelated regression estimator over the OLS has been already proved by Zellner (1962) and Alaba et al. (2010). Joint normality of

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error terms in 3 equations SUR which have been given by Alaba et al. (2010) has shown in the following form;

$$\beta = \begin{bmatrix} \beta_1 & 0 & 0 \\ 0 & \beta_2 & 0 \\ 0 & 0 & \beta_3 \end{bmatrix}$$

$$\varepsilon = \begin{bmatrix} \varepsilon_1 & \varepsilon_2 & \varepsilon_3 \end{bmatrix}$$

Joint Normality of error terms $\varepsilon \sim N(0, \sum \Theta I_3)$, $\sum = \begin{bmatrix} \sigma_{11}^2 & \sigma_{12}^2 & \sigma_{13}^2 \\ \sigma_{21}^2 & \sigma_{22}^2 & \sigma_{23}^2 \\ \sigma_{31}^2 & \sigma_{32}^2 & \sigma_{33}^2 \end{bmatrix}$

Where $Y_1 = N(X_1\beta_1, \sigma_{11}^2)$

$Y_2 = N(X_2\beta_2, \sigma_{22}^2)$

$Y_3 = N(X_3\beta_3, \sigma_{33}^2)$

When we consider a set of equations, only (n-1) equations are linearly independent as a set of equations (a) with the condition that $y_1 + ... + y_n = 1$. (Siribonchihtta, 1983). The author suggests that the sign of estimates and the magnitude of the estimates should be checked so that it will give the determination of which equation will be the most suitable to omit from a system of equations. In order to do so, goodness of fit can be applied to choose which equation could be chosen in the system of equations

However, in this study we consider three equations for food, healthcare and transportation among consumption categories. The other one will be what is left from consumption expenditure after food, healthcare and transportation are omitted. Therefore, we don't need to consider omitting the other equation in estimating the (n-

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1) equations. Consequently, a three equation SUR will be applied in the empirical section in Chapter (4) as one is already omitted and not applicable to our study.

2.9 Model specification in our study

SAM

The model for a SAM is a kind of macroeconomic model, specifically the national income model which is adopted from the Keynesian macroeconomic model for an open economy structure.

$$y = f(x_i)$$

It can be written as following macroeconomic identity.

Y= C+I+G+ X-M

Y = Income

C= Consumption,

I= Investment,

G=government expenditure,

X-M = external sector.

In equilibrium,

Investment and saving achieve closure, i.e., I=S

Government expenditure and taxes are closure, i.e G=T

In the case of Mawlamyine, we used township level data from secondary and primary data sources.

Regarding the expenditure model, again, Keynes's income expenditure formulation is applied to test our hypothesis. The Keynesian Income Expenditure model can be expressed as follows at the macro level.

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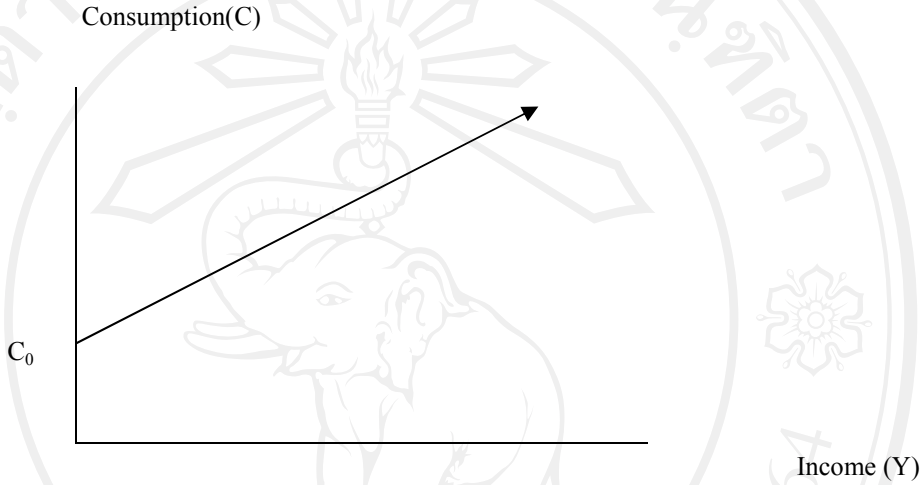
AD = C+ I , where AD = the aggregate demand and C and I = consumption and income respectively.Based on Keynesian's income expenditure model we can derive our interest of consumption expenditure model.

Keynesian's income-expenditure model



Two key assumptions underlie the simple Keynesian's income-expenditure model:

(1) All prices including goods' prices, labour prices wages and financial market prices are fixed.

(2) Outputs in the economy are determined by demand in which firms supply goods and services based on consumers' demand.

The simple consumption expenditure function can be written as

$$C = f(y_i)$$

$$C = c_0 + c_1 Y$$

Where c_0 = autonomous consumption and c_1=marginal propensity to consume

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Seemingly Unrelated Regression Analysis

Since our interest in the consumption expenditure model consists of three types of consumption expenditures (food, health care and transportation), we have different equations. Functional forms could be presented as follows.

$$C_i = f(y_i)$$

Where C_i represents food consumption, healthcare consumption and transportation consumption respectively.

For the food consumption function,

$$C_1 = c_0 + c_1 y + c_2 y^2 + c_3 Age(head) + c_4 edu + c_5 space + c_6 dependent + c_7 employ(trans) + c_8 dis\tan ce + c_9 agri(\%income) + c_{10} sales(\%income) + c_{11} remit\tan(\%income) + c_{12} rural + c_{13} urban + c_{14} gender(head)$$

For the healthcare consumption function,

$$C_2 = a_0 + a_1 y + a_2 Age(head) + a_3 edu + a_4 space + a_5 dependent + c_6 employ(barber) + a_7 dis\tan ce + a_8 remit\tan(\%income) + a_9 rural + a_{10} urban$$

For the transportation consumption function,

$$C_3 = b_0 + b_1 y + b_2 Age(head) + b_3 edu + b_4 space + b_5 dependent + b_6 employ(trans) + b_7 employ(causal) + b_8 dis\tan ce + b_9 totalwor\ker + b_{10} rural + b_{11} urban$$

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Description of the Variables

Dependent Variable Names	Descriptions
Engel_food_exp (C_1)	Share of food expenditure
Engel_health_exp (C_2)	Share of healthcare expenditure
Engel_transp_exp (C_3)	Share of transportation expenditure
Explanatory Variables	**Descriptions**
Income_per_cap	Household income per capita (Kyats)*
Distance	Distance from the EWEC in kilometers
Urban	Urban =1, other =0
Rural	Rural =1, other=0
Gender(head)	Gender of household head
Age(head)	Age of household head
Employ(trans)	Working in transportation (1, 0)
Employ(causal)	Odd jobs (1, 0)
Employ(barber)	Other small services shop (barber shop and sewing) (1,0)
edu	Total years of education of all family members
Totalworker	Total workers
Dependent	Dependency ratio = number of dependent over the number of workers
Space	Living space per capita (square feet)
Agri(%income)	Percent income from agricultural output (share)
Sales(%income)	Percent income from other small scale merchandising and sales (share)
remittan	Percent income from migration remittance (share)
y^2	Household income per capita square

*- Myanmar money –currently around 900 Kyats = 1 USD

In each equation, income per capita (y) is common as a main determinant of consumption. As we have data for the year 2009, the first assumption of Keynesian's income expenditure model holds as for a year we have calculated with fixed price. As Myanmar is one of the developing countries, and still depends on agriculture (meaning no technology change) might hold the second assumption of the supply due to consumption demand since there is no high-tech goods supply.

Since we have three equations, each equation can be estimated separately as individual equations are assumed to satisfy the classical linear regression model's

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assumptions. If we do so, it ignores the correlation between the disturbances of different equations. One of the methods to satisfy this problem is joint estimation i.e SUR (Zellner (1962),Sibonchitta (1983), Binkley and Nelson (1988), Fiebig (2003), Alaba at.el(2010)). As stated before, the individual equations are related, even though supposedly they may not seem to be; they are only seemingly unrelated. Therefore, we have used seemingly unrelated regressions model in our study.

Poverty Analysis

Poverty incidence, poverty depth, and poverty intensity are general measures. Head count index or poverty incidence is one of the common measures of absolute poverty. Between 1987 -1998, the income poverty in the East Asia and Pacific region, excluding China, was shown by Todaro (2003) to be decreasing except for the year 1998 Though the share of the population who were living on less than $1 a day was 26.6% in 1987, those shares decreased to 25.2% in 1993 and to 14.9% in 1996. Even though the method used in poverty measures can be different, general poverty conditions can be explored.

Incidence of Poverty (Headcount Index)

This is “the share of the population whose income or consumption is below the poverty line, that is, the share of the population that cannot afford to buy a basic basket of goods.” (Coudouel et al., 2002, p.34).

HCI = m/n

Where m = total number of poor

n = total population

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Depth: Poverty Gap

Sometimes economists attempt to measure how serious the poverty problem is in a region. This can be called depth of poverty or poverty gap. "A poverty gap measures the total amount of income necessary to raise everyone who is below the poverty line up to that line" (Todaro and Smith, 2003, p. 206).

Total Poverty Gap (TPG)= $\sum_{i=1}^{H}(Y_p - Y_i)$

The Foster- Greer-Thorbecke Measure

Apart from the above measures, economists and development economists are interested to work with the poor by searching the coefficient of variations of incomes among the poor or by using the Gini coefficient which normally shows the degree of inequality (Todaro and Smith 2003).

FGT = $\frac{1}{n}\sum_{i=1}^{m}\left[\frac{z - y_i}{z}\right]^{\alpha}$

Where

y_i = consumption or income of i-th poor

z= poverty line

n = total population

m = number of poor

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Poverty Gap Index

Poverty Gap index is the special case "α" turns out to be "1".

Therefore, the formula for Poverty Gap; PGI = $\frac{1}{n}\sum_{i=1}^{m}\left[\frac{z-y_i}{z}\right]$. Our head count ratio or head count index discussed above is the same as the special case of "α" turns out to be "0" in

Foster-Greer-Thorbecke FGT = $\frac{1}{n}\sum_{i=1}^{m}\left[\frac{z-y_i}{z}\right]^{\alpha}$

Intensity or Severity of Poverty

One of the FGT measures which is called squared poverty gap or severity of poverty occurs when, "α" turns out to be "2".

Severity of poverty or SPG= $\frac{1}{n}\sum_{i=1}^{m}\left[\frac{z-y_i}{z}\right]^{2}$

2.10 Conclusion

Undoubtedly, this literature review has proven that infrastructure investment has positive impacts on a country's economic growth and development. When a city shares characteristics of an 'isolated states', investments in infrastructure may not have yet been proved fruitful. As for the structure of Mawlamyaine, it is very similar to the city in the Von Thunen model. Although there are trade and transportation infrastructure such as highways and a sea port, Mawlamyine is less open compared to other countries within the region and, consequently, is weak in the development indicators reported in Chapter (1). Since Myanmar is one of the developing countries, doing research and development mostly depends on outside sources. Additionally,

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little research can be found that has measured growth and development opportunities of the country.

The present study should help policy planning authorities and decision making units to rationalize the planning process. Our study's goals are to measure and/ stimulate the economic growth and job creation potential of key sectors of Mawlamyine; and to estimate the effects of these processes on the level and distribution of income per capita. The results from the SUR modeling, poverty analysis, SAM-multiplier and optimization will hopefully help Mawlamyine township to better formulate their economic development strategy for the benefit of all township residents.

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