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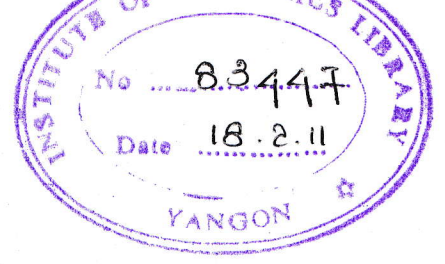
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An ever longer list of global challenges such as global warming, environmental degradation, climate change, etc becomes the yardstick for the relevance of the knowledge. Universities and colleges play a central role in knowledge development, knowledge transfer and innovation. As an attempt to perform this role the Yangon Institute of Economics Research Journal Volume 2 has come out under the guidance of the Minister, Ministry of Education in Myanmar. The articles in this journal are written by the teaching staff of our University, Institute of Economics. We fully appreciate their efforts to contribute in this journal though gradually increasing number of students enrolled in the Yangon Institute of Economics makes them to devote most of their time on teaching.

Our guiding principle of publishing this journal is quality. We do welcome the papers for next series of this research journal.

Editorial Board





# ANALYSIS ON INTERNATIONAL TRADE OF MYANMAR (1998 ~ 2007)

Nu Nu Lwin<sup>1</sup>

## Abstract

Since its participation in AFTA, Myanmar's trade volumes have grown rapidly while its trade patterns and directions have significantly changed. This study attempted to analyze the trade patterns of Myanmar based on the gravity model identifying the factors of Myanmar's bilateral trade flows with other ASEAN countries and policy implications for promoting trade with them. The results indicate that Myanmar's trades are mainly affected by partner country's GDP, the difference between per capita GDPs of the two countries, distance, common border, and presence in particular FTA. The trade relations with East Asian countries namely China, Japan and Korea have yet to be exploited to their full potential. These findings suggest that Myanmar needs to promote its bilateral trade with countries in close proximity and having large economic size and high consumers' purchasing power through accelerating its trade liberalization efforts in FTAs in progress.

**Keywords:** ASEAN, East Asia, FTA, Bilateral trade

## 1. Introduction

Myanmar became a full-fledged member of ASEAN in July 1997 and since then Myanmar endeavored to integrate its economy to the region through several institutional and economic reforms. As a result, Myanmar can be seen as the fastest-growing economy in the region and have enjoyed a certain degree of macroeconomic stability in recent years. However, in fact, Myanmar is still included in the least developed countries characterized by primary sector-based transition economy with high poverty rate, insufficient infrastructure, and weak institutions. The economy is still facing huge challenges in tackling poverty, reducing income gap and narrowing development gap in the region.

Indeed, since its membership in ASEAN Free trade Area (AFTA), trade volumes of Myanmar have grown rapidly. At the same time, the pattern and direction of trades have significantly changed with the various reasons. To explore the determinants of trade flows in Myanmar, this study empirically analyses the bilateral trade flows between Myanmar and its trading partners in a framework of the gravity model over the period for 1998 to 2007. The aims of this paper are to investigate the determinants of bilateral trade flow of Myanmar, to examine whether bilateral trade flows Myanmar and its trade partners are lower or higher than what is predicted by the economic model, and to extract implications for trade policies of Myanmar. Thus, this study would assist in understanding trade patterns and formulating trade policies of Myanmar.

## 2. Overview of Myanmar Economy

Since its accession to ASEAN, Myanmar has implemented specific measures and provisions under the several agreements of ASEAN including ASEAN Free trade Area (AFTA), ASEAN Framework Agreement on Services (AFAS) and (ASEAN Investment Area) AIA, together

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with the other member countries, in the areas of liberalization, facilitation and promotion of trades, services and investment. Moreover, with the intention to promote trade and attract greater FDI, Myanmar has also undertaken several institutional and economic reforms.

Despite these efforts, as shown in Table 1, Myanmar is far behind the other ASEAN members in terms of per capita GDP and economic structure which highlight their development stage. Although, Myanmar shows higher GDP growth rate than other countries in the region, their per capita GDP are much lower than ASEAN average per capita GDP of US\$5000. Moreover, its economic structure are quite different from the original members countries, with the agriculture sector accounting for more than 40 percent while representing only 11 percent of the GDP in ASEAN on average. Although Myanmar has rapidly increased its participation in regional trade since its accession in AFTA, its trade openness ratios is very low even comparing with other new members of ASEAN.

Table - 1

## Socio-economic Indicators of ASEAN Countries (2008)

Country	GDP Growth Rate	Per capita GDP	GDP Structure (2007) (% of GDP)			Trade Openness (% of GDP)	
	%	US\$ PPP	Agriculture	Industry	Services	Exports	Imports
Brunei	0.4	50,235	0.7	71.0	28.3	61.9	22.0
Cambodia	6.0	1,794	31.9	26.8	41.3	38.3	40.4
Indonesia	6.1	3,705	13.8	46.7	39.4	26.8	25.3
Lao, PDR	8.4	2,237	41.8	32.2	26.0	15.6	34.1
Malaysia	4.6	13,192	10.2	47.7	42.0	87.3	64.8
<b>Myanmar</b>	<b>4.5</b>	<b>1,083</b>	<b>43.7</b>	<b>19.8</b>	<b>36.5</b>	<b>24.4</b>	<b>14.0</b>
Philippines	3.6	3,421	14.1	31.7	54.2	29.4	34.0
Singapore	1.1	50,347	0.1	31.1	68.8	131.1	125.3
Thailand	2.6	7,890	11.4	43.9	44.7	63.9	64.9
Vietnam	6.3	2,595	20.3	41.6	38.1	68.1	87.7
<b>ASEAN</b>	<b>4.4</b>	<b>5,007</b>	<b>11.0</b>	<b>43.0</b>	<b>46.0</b>	<b>58.3</b>	<b>55.2</b>

Source: World Development Indicator Database, World Bank; Asian Development Outlook 2009, ADB; and ASEAN Secretariat

Despite these efforts, as shown in Table 1, Myanmar is far behind the other ASEAN members in terms of per capita GDP and economic structure which highlight their development stage. Although, Myanmar shows higher GDP growth rate than other countries in the region, their per capita GDP are much lower than ASEAN average per capita GDP of US\$5000. Moreover, its economic structure are quite different from the original members countries, with the agriculture sector accounting for more than 40 percent while representing only 11 percent of



the GDP in ASEAN on average. Although Myanmar has rapidly increased its participation in regional trade since its accession in AFTA, its trade openness ratios is very low even comparing with other new members of ASEAN.

### 3. Structure and Performance of Myanmar's International Trade

Myanmar has become a much more open economy over the past decades, a process spurred by the trade liberalization that occurred gradually since early 1990s. As a result, its trade values grew at an average annual growth rate of roughly 16 percent during the period of 1998-2007. Myanmar experienced rapid increases in exports and imports volumes about three times during one decade. However, the trade to GDP ratio was around 40 percent in 2008. Myanmar has experienced continual trade deficits throughout the study period.

**Table - 2**  
**Top-Ten Trade Partners of Myanmar (1998-2007)**  
(US\$ Million & Percent of Total)

		Exports		Import		
		1998	2007	1998	2007	
<b>Myanmar</b>						
1	Thailand	9.0	44.3	China	24.9	33.7
2	India	14.9	14.5	Thailand	18.5	19.1
3	China	4.9	7.1	Singapore	21.3	15.5
4	Japan	7.1	5.7	Korea	6.9	5.8
5	Malaysia	4.6	2.7	Indonesia	7.8	5.2
6	Germany	4.0	2.3	Malaysia	13.7	4.2
7	Korea	1.1	1.5	Japan	8.7	3.5
8	Hong Kong	3.6	1.5	India	1.6	3.4
9	Vietnam	0.1	1.4	Italy	0.9	1.9
10	United Kingdom	2.3	1.2	Germany	2.4	1.1
Intra-ASEAN		15.5	50.2	Intra-ASEAN	42.9	44.6
<b>Total Exports</b>		<b>1138.60</b>	<b>4753.74</b>	<b>Total Imports</b>	<b>2358.47</b>	<b>5520.09</b>

Source: Direction of trade Statistics (DOTS)

Myanmar trades have grown at an average annual rate of 13 percent over the last decade to reach over US\$10 billion in 2007. The major export destinations are Thailand, India and China whereas its import sources are China, Thailand and Singapore, in order. In 2007, Thailand took 44 percent of exports, mainly natural gas, and 19 percent of imports while China held 7 percent of exports and 20 percent of imports. Since early 2000, Myanmar export has been mainly dominated by natural gas, which accounted for 40 percent of total exports in 2007 mainly channeled to Thailand. Wood, woven apparel and vegetables are also top export commodities, with 19 percent, 12 percent and 11 percent, respectively, of total exports in 2007. Major import items are machinery, mineral fuel, oil, electrical machinery and vehicles, altogether taking 40 percent of total imports in 2007. Since imposition of trade sanction by the United States and European countries Myanmar trade mainly concentrates on its neighboring countries and,



hence, the share of intra-ASEAN in Myanmar's trade takes around 50 percent in both exports and imports.

**Table - 3**  
**Shares of Top-Ten Trade Commodities of Myanmar (1998-2007)**  
(Percent of Total)

HS	Commodity	Exports		HS	Commodity	Import	
		1998	2007			1998	2007
<b>Myanmar</b>							
1	27 Mineral Fuel, Oil Etc	0.1	39.4	84	Machinery	17.3	17.2
2	44 Wood	17.8	18.6	27	Mineral Fuel, Oil Etc	6.9	10.7
3	62 Woven Apparel	18.7	12.4	85	Electrical Machinery	10.2	6.8
4	7 Vegetables	6.1	11.0	87	Vehicles, Not Railway	3.4	6.2
5	3 Fish And Seafood	15.2	5.1	73	Iron/Steel Products	6.7	5.8
6	71 Precious Stones,	4.6	2.1	15	Fats And Oils	6.8	5.3
7	61 Knit Apparel	19.9	1.9	72	Iron And Steel	2.6	5.1
8	64 Footwear	1.0	1.2	39	Plastic	2.3	4.3
9	12 Misc Grain, Seed, Fruit	3.1	1.2	30	Pharmaceutical	1.5	2.8
10	40 Rubber	0.9	1.1	55	Manmade Staple	2.5	2.2
<b>Top-10</b>		87.3	94.0	<b>Top-10</b>		60.2	66.4
<b>Total Exports</b>		100	100	<b>Total Imports</b>		100	100

Source: Global Trade Atlas

Note: All shares are derived from partner countries trade data

In fact, relatively low records of economic performance of Myanmar reflect its struggles in a number of challenging domestic and international problems. Moreover, the stagnation of economy has been highly deepened by the investment restrictions and trade sanctions imposed by Western countries.

#### 4. Empirical Analysis by using Gravity Model

##### 4.1 Literature Review

Following the Newton's law of gravity, gravity model of international trade estimates the bilateral trades as a function of attraction factors such as economic mass and resistance factors such as distance or various obstacles to trade. Specifically, trade volume between two countries should increase with their GDPs, since rich countries should trade more than poor ones and decrease with geographical distance because proximity reduces transportation and information costs. Moreover, population (or per capita income) and land area are frequently included in the model as proxies for economic size. This standard model is commonly extended to include other factors generally perceived to affect bilateral trade relationships.

The gravity model was first applied to the international trade field by Tinbergen (1962) and Linneman (1966) as an econometric analysis of bilateral trade flows based on gravity-type equations to provide empirical evidence. Since then, many researchers applied variants of the gravity equation as an empirical benchmark for the bilateral trade volume. It is generally accepted that a number of trade models are responsible for the empirical success of the gravity



equation. While the Heckscher-Ohlin (H-O) theory would account for the success of the gravity equation in explaining bilateral trade flows among countries with large factor proportion differences and high shares of inter-industry trade, the Differentiated Product Model would serve well in explaining the bilateral trade flows among countries with high shares of intra-industry trade. Frankel (1997) formulated a more complex and advanced form of gravity equation by including geographical factors, such as distance, landlockedness and population as determinants of bilateral trade flows, and regional trading blocs in order to estimate the impact of regional integration on bilateral trade flows.

Hassan (2001) applied the gravity model to analyze trade creation and trade diversion effect of South Asian Association for Regional Cooperation (SAARC) and examine whether intra-SAARC trade is lower or higher than what is predicted by the model. Sohn (2005) used the gravity model to identify the underlying trade model of Korea's bilateral trade flows. He used such determinants of trade as GDP, distance, and trade conformity index and dummy variables for (Asia-Pacific Economic Cooperation) APEC. Empirical results proved that gravity model is very effective in explaining Korea's bilateral trade flows. By comparing actual trade volume with predicted trade by the model, he also pointed out that there is significant un-exhausted trade potential from which Korea can enjoy a large trade expansion by forming a FTA with respective countries.

Bussière and Schnatz (2006) practiced the gravity model to examine whether China's share in international trade is consistent with fundamentals of the model such as economic size, distance. They also included dummy variables for common language, common border, being same territory in the past and participation in a free trade area (FTA) on sample of 61 countries for the period of 1980-2003. Huot and Kakinaka (2007) analyzed Cambodia's bilateral trade flows through investigating the impact of trade structure in a framework of the gravity equation. They regressed the bilateral trade with the product of GDPs, the product of per capita GDPs, distance, exchange rate volatility, trade conformity index and dummy variables for ASEAN. The result showed that all explanatory variables have significant impact on Cambodia's trade flows, which are notably dependent on inter-industry trade that comes from factor endowment difference rather than intra-industry trade from monopolistic competition.

## 4.2 Methodology and Data

Since the theoretical foundation of gravity model had been established in 1960s, most of the empirical studies have confirmed that the gravity equation remains at the center of applied researches on international trade of the day. However there is a little work that has been done on examining whether the gravity equation fits to the trade flows of new members of the ASEAN. This paper attempts to test to what extent the gravity model is applicable to explain the trade flows of Myanmar and to extract implications for its trade policies. The empirical analysis is conducted by using bilateral trade data with 27 trading partners of Myanmar, over the period from 1998 to 2007.

The gravity equation that this paper seeks to estimate follows closely the standard gravity model developed by Frankel (1997), in which emphasis is given to the role of geopolitical factors such as distance, adjacency and regional trading blocs. In this study, the model uses five basic variables; GDP, gap in per capita income between each pair of trade partners,



distance, adjacency, and FTA. Moreover, to address the peculiarity of its trade patterns, this paper adds two more variables, generalized system of preference (GSP) and dummy variables for trade sanction as the United States imposed the trade sanctions on Myanmar since 2003.

The empirical gravity equation takes the form:

$$\ln T_{ij} = \alpha + \beta_1 \ln[Y_i] + \beta_2 \ln[Y_j] + \beta_3 \ln[GAP_{ij}] + \beta_4 \ln D_{ij} + \beta_5 FTA_{ij} + \beta_6 GSP_{ij} + \beta_7 ADJ_{ij} + \beta_8 SANC_{ij} + \varepsilon_{ij}$$

where  $T_{ij}$  is the bilateral trade flow (exports + imports) between Myanmar (i) and its trading partner (j). Since national products are valued at current exchange rates, the influence of exchange fluctuation can distort the underlying trade pattern. Drysdale (2005) recommended to use the purchasing power parity (PPP) valuations of national product in order to estimate the relative size of economies. Thus,  $Y_i$  and  $Y_j$  stand for GDPs of country i and partner j based on PPP, which are considered as an approximation for economic sizes of respective countries, in terms of both production capacity and market size.  $GAP_{ij}$  is the absolute value of difference in per capita GDP (PPP) of country (i) and partner (j), which is used as a proxy for level of development stage gap of each pair of countries to determine the trade pattern between Myanmar and its trading partners.  $D_{ij}$  is the distance variable, measured in terms of great circle distances between the capitals of country i and partner j.  $FTA_{ij}$  is a dummy variable assuming the value "1" if country i and partner j have a free trade agreement and "0" otherwise.  $GSP_{ij}$  is also a dummy variable which takes on a value of "1" if partner country j grants preferential tariff treatment to Myanmar and a value of "0" otherwise.  $ADJ_{ij}$  is a dummy variable with the value "1" if country i and partner j share a common land border and "0" otherwise. Finally, one important dummy variable, SANC, is added in the model to examine the impact of trade sanctions on bilateral trade flows of Myanmar, which is "1" if partner country imposes trade sanction on Myanmar and "0" otherwise, and  $\varepsilon_{ij}$  is the error term. In the equation, all variables are in natural logarithm except for dummy variables.

Since countries seem to export more or import more as their size and purchasing power increase, bilateral trade volume is expected to rise when the GDPs of respective countries increase. This implies that our estimated coefficients,  $\beta_1$  and  $\beta_2$ , are predicted to be positive. Bergstrand (1989) and Frankel (1997) among others suggest the gravity equation should include both income and per capita income. This study incorporates GAP into our gravity model in order to identify the trade pattern of respective countries since the GAP reflects some of the differences in location advantages and factor endowments between exporting and importing countries. The coefficient of GAP,  $\beta_3$  would be positive when trade volume increases with higher gap in per capita income which implies that the country trade more with more developed countries. On the other hand, the coefficient becomes negative when trade volume increase with falling income gap, which implies that the country has strong trade relationship with the country at similar development stage.

Furthermore, the distance between Myanmar and its trading partner j,  $D_{ij}$ , reflects trade barriers such as transportation cost, delivery time, and market access barriers, etc. Most of previous literature interpreted the coefficient of distance variable as the elasticity of trade with respect to an absolute level of geographical distance. Since a larger trade resistance factor is likely to lessen bilateral trade volume, in this study, the coefficient  $\beta_4$  is anticipated to be negative. To examine the extent to which a regional trade arrangement is important in determining Myanmar's bilateral trade flows, a dummy variable,  $FTA_{ij}$ , is included in the model. This



provides a means of determining how much trade within each FTA is due to factors common to trade throughout the world and how much remains to be explained by the effects of FTA. Since each country's bilateral trade volumes are expected to expand through FTA membership, the sign of the coefficient  $\beta_5$  is expected to be positive.

In addition, since the preferential tariff privilege granted by partner countries can directly stimulate the exports volume of respective country and also encourage imports from them with the lesser extent,  $GSP_{ij}$  may have a positive impact on bilateral trade volumes. As the existence of a common border usually facilitates trade, the coefficient of adjacency,  $\beta_6$ , is supposed to be positive. Moreover, the trade sanction imposed by the United States has an impact on its direction of trade after 2003, the coefficient of trade sanction,  $SANC_{ij}$ , is likely to be negative.

In this study, ordinary least-squares (OLS) linear regression is conducted by using Statistical Package for the Social Sciences (SPSS version-17). Although SPSS is given the tremendous popularity throughout the social science community, it provides no means for correcting OLS standard error estimates for the possible effects of heteroscedasticity to the user. In this paper, therefore, the heteroscedasticity-consistent standard error estimates of OLS regression (HCREG) is conducted by using the SPSS macro formulated by Hayes (2003). The macro is implemented based on the methods described in MacKinnon and White (1985) for computing a heteroscedasticity-consistent covariance matrix (HCCM) and heteroscedasticity-consistent standard error estimates in OLS regression (HCREG).

Top twenty-seven trade partners of Myanmar are selected for analysis which covers more than 90 percent of its total trade volume. Nominal trade flows are from the Direction of Trade Statistics, DOTS (May 2009) from International Monetary Fund (IMF) for the period from 1998 to 2007; these data are deflated by U.S. GDP deflator to generate real trade flows. Missing trade flows are excluded and  $\ln(1+T_{ij})$  is used to deal with zero trade values in logs.

GDP, per capita GDP and U.S GDP deflator come from IMF's World Economic Outlook Database (2009) and then GDP and per capita GDP are deflated by U.S. GDP deflator. The distance is measured in kilometers as the direct line distance between the capital cities of the two countries which is taken from GEOBYTES. GSP statuses are collected from Handbooks on the GSP Schemes of United Nations Conference on Trade and Development (UNCTAD).

### 4.3 Empirical Results

#### 4.3.1 OLS Regression Results

The pooled cross-sectional OLS regression results for the period of 1998-2007 are presented in Table 4. It is observed that the overall performance of the model seems to be good with high  $R^2$  values of about 80 percent and almost all estimates of the coefficients are highly significant with expected signs, indicating that the gravity models are fitting and efficient in explaining bilateral trade flows of Myanmar.

The power of the model to explain the variation in bilateral trade flows of Myanmar is considered to be strong as the value of the  $R^2$  is roughly 0.80 and the value of F-test, the



overall significance of the model, come out highly significant at 1 percent level. Almost all explanatory variables show expected sign in coefficients and highly significant at the 1 percent level whereas Adjacency is significant at 5 percent level. The coefficient of GDP<sub>i</sub> and GSP are insignificant while former shows unexpected sign.

The estimated coefficient of GDP<sub>j</sub> is around 1.156, suggesting that the increase in partner country's GDP by 1 percent point will rise up almost 1.2 percent point of bilateral trade volume which is consistent with the basic hypothesis of the gravity model that trade volumes will increase with an increase in economic size of trade partners. The unexpected negative sign in the coefficient of GDP<sub>i</sub> suggests that Myanmar's GDP is inversely related with its bilateral trade volume with trading partners even though it is insignificant. The coefficient of GAP variable is highly significant with 0.664. As per capita GDP of Myanmar is fixed, the greater the GAP means the higher the per capita GDP of partner country. The positive and significant coefficient of GAP indicates that Myanmar's trade flows are dependent on its trading partners' income level. However, the coefficient of GAP is much lower than that of GDP<sub>j</sub>. It can be concluded that Myanmar's trade patterns would be affected by its trading partner's overall economy size rather than their consumers' purchasing power. Moreover, it can be envisaged that Myanmar export items are quantity-based standardized products that are sensitive to the overall market size rather than quality-based high value-added products that are sensitive to the trading partner's income level.

Highly significant negative coefficient of distance variable (1.787) indicate that when the distance between Myanmar and its trading partner is increased by 1 percent point, the bilateral trade between them falls by about 1.8 percent point, holding other variables constant. FTA variable is highly significant with positive coefficient of 0.960, which implies that if Myanmar and its trading partner belong to any specific FTA, their bilateral trade flows will be more than 2.6 times [ $\exp(0.960)=2.612$ ] as large as those with a non-member. The estimated coefficient of GSP is 0.084 which means that Myanmar's bilateral trade flows with the countries which offer GSP privilege is 1.1 times [ $\exp(0.084)=1.088$ ] as much as two otherwise similar countries. The coefficient on adjacency is about 0.687 which suggests that two countries sharing a common border trade roughly 2 times [ $\exp(0.687)= 1.988$ ] as high as those with non-border. Combining with high significant of distance variable, it can be conjectured that the Myanmar's trades mainly concentrate on its neighboring countries. The sanction variable is statistically significant with negative coefficient of -3.738, which stipulates that Myanmar's bilateral trade flows with the countries which imposed trade sanction on it is roughly 0.02 times [ $\exp(-3.738)=0.024$ ] as low as two otherwise similar countries.

Overall, the standardized regression coefficient ( $\beta$ -coefficient) of distance has the largest value among explanatory variables, explaining 30 percent of the ability to predict the variability of Myanmar's bilateral trade flows when the variance explained by other variables is controlled for. The next most important variables is partner country's GDP, taking 28 percent, followed by GAP with 18 percent.  $\beta$ -coefficient of FTA and trade sanction are 9 percent and 8 percent, respectively, indicating lesser contribution to variability of bilateral trade flows between Myanmar and its partners. The relative influence of Myanmar's GDP and GSP seems to be almost 0 each as it proved to be an insignificant factor.



**Table – 4**  
**Regression Result of Gravity Equation of Myanmar**

Explanatory Variables	Myanmar	
	OLS Coefficient (B)	Standardized Coefficient ( $\beta$ )
Constant	5.757*** (1.310)	-
GDP of Country i	-.185 (.171)	-.034
GDP of Partner j	1.156*** (.053)	.730
GAP	.664*** (.090)	.464
Distance	-1.787*** (.096)	-.801
FTA	.960*** (.133)	.211
GSP	.084 (.117)	.022
Adjacency	.687** (.269)	.129
Trade Sanction of U.S.	-3.738*** (.233)	-.241
No. of observation	270	
R <sup>2</sup>	.795	
Adjusted R <sup>2</sup>	.788	
F-statistics	142.240***	

- Note: 1. Heteroskedasticity-consistent standard errors (White) are in parentheses.  
 2. \*\*\* and \*\* and \* mean significant at 1%, 5% and 10% level, respectively.  
 3. All variables except dummy variables are in natural logs.

#### 4.3.2 Comparison of Actual Trade with Trade Potential

The gravity model is supposed to provide a long-term equilibrium view of trade flows. The difference between actual trade flow and its long-term equilibrium value can be regarded as unexhausted trade potential. Baldwin (1994), Nilsson (2000) and Sohn (2005) suggested that the ratio of potential trade to actual trade as a measure of the degree of trade integration. Indeed, the gravity model prediction can be differed from actual trade volume due to various reasons. The most obvious reason is exclusion of immeasurable variables in gravity estimation like domestic policies including competition and antitrust rules, corporate governance, product



standards, worker safety, regulation and supervision of financial institutions, environmental protection, tax codes and other national issues. In this paper, the important viable that left out in the gravity equation is trade barriers which encompass various forms such as tariffs, non-tariff barriers, and other trade restrictions due to the unavailability of data, thus, the unrealized trade potential can be seen as the result of trade barriers.<sup>2</sup> The comparison between actual and potential trade volume of Myanmar in 2007 is presented in Table 5, in which the potential trade is predicted by using gravity equation.

Among top-ten trading partners of Myanmar, the actual trade volumes of many Asian countries such as Thailand, China, India, Japan, and Korea are lower than trade potentials predicted by the model. Among ASEAN, Singapore, Malaysia, Indonesia and Vietnam record high trade volume with more than 100 percent. There are several reasons for significantly high ratio at Singapore. Main reasons are the import-export transactions of the branch offices located in Singapore, which are set up by the many Myanmar business firms to facilitate their trades and the convenience of bank transactions between Singapore banks and stated-own Myanmar Foreign Exchanged Bank (MFTB) and Myanmar Industrial and Commercial Bank (MICB). Another reason is Myanmar's reliance on logistic services of Singapore. As there are very few cargo ships and container services in Myanmar, most exporters and importers normally use Singapore's logistic services.

Although Thailand and China are two largest trade partners as well as sharing the same border with Myanmar, the trade with these two partners has yet to be exploited to the full potential predicted by the gravity model. The low ratios of Thailand and China also suggest the existence of some trade barriers and the extent of unrecorded informal trades and smuggling in the border area. And the bilateral trade volumes with India, which is the second largest export destination of Myanmar, also left far behind the potentials estimated by the model, indicating the latent trade potential. Even though the United States and European Union have imposed the investment restrictions and trade sanctions on Myanmar, their actual trade volume are generally higher than the potential predicted by the model as an indication of reaching full trade potential. On the other hand, the actual trade volumes with all East Asia countries: China, Japan and Korea are lower almost by 20 percent than their potentials projected by the model, highlighting an urgent need to further liberalize the trade with them in order to realize the full potential.

Overall, Myanmar has already reached the trade potential with almost all ASEAN countries except for Thailand. Myanmar's trade volumes with the United States and most European countries are larger than the forecasted trade volumes of the gravity equation highlighting it well-integration with these economies. On the other hand, the trade relations with East Asian countries, namely China, Japan and Korea, have yet to reach their full potential albeit ASEAN+1 FTAs have being implemented. Since it is an indicator for the existence of substantial trade barriers between trade partners, Myanmar should endeavor to promote bilateral trade through elimination of trade barriers, thus Myanmar can enjoy large benefits from unexhausted trade potential.

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<sup>2</sup> The exchange rate volatility is also excluded due to the reason that any exchange rate volatility affects all trading partners equally as US dollar is the invoicing currency of most trades in Myanmar. Moreover, common language and historical ties are also omitted as they are irrelevant for Myanmar.



Table – 5  
Actual and Predicted Trade Flows (2007)

(US\$ Million, Percent)

		Actual Trade	Predicted Trade	Actual as % Predicted			Actual Trade	Predicted Trade	Actual as % Predicted
1	Thailand	2637.0	3491.7	76%	15	Australia	42.3	27.8	152%
2	China	1834.5	2215.8	83%	16	Spain	37.8	31.8	119%
3	Singapore	760.7	297.0	256%	17	Bangladesh	27.8	17.5	159%
4	India	730.9	769.9	95%	18	Ukraine	24.2	3.8	628%
5	Japan	386.6	493.6	78%	19	Netherlands	22.2	19.7	112%
6	Korea	329.3	410.7	80%	20	Belgium	12.8	9.7	132%
7	Malaysia	299.0	263.0	114%	21	Denmark	8.2	5.6	147%
8	Indonesia	263.9	95.1	278%	22	USA	7.9	7.8	101%
9	Germany	140.6	111.2	126%	23	Canada	7.4	20.3	37%
10	Italy	125.4	58.4	215%	24	Sweden	4.6	10.7	43%
11	Hong	106.0	115.3	92%	25	Switzerland	2.8	9.3	30%
12	Vietnam	77.2	72.4	107%	26	Poland	1.3	13.1	10%
13	UK	53.4	69.6	77%	27	Ireland	1.2	4.4	27%
14	France	50.9	64.4	79%					

### 5. Findings and Policy Recommendations

Generally, Myanmar possesses rich factor endowments and low cost advantage. However, at the present, the low level of industrialization and, hence, insufficient diversification of production base creates mainly dependence of its exports on very few commodity groups mainly dominated by natural gas. And then, wood products share almost 14 percent in exports of Myanmar. Aside from wood products, garments and footwears are important export items in exports. Even though garment industry is classified as a manufacturing sector, it is greatly labor-intensive and low technology involvement, accordingly, limited opportunity for technology transfer and industrial development. These figures highlight the high dependence on natural factor endowments and low level of industrialization in its economy. Regarding the direction of trades, the trade sanction of the United States and economic restriction of European countries are apparent reasons for concentration of its trades on Asia countries.

The empirical results of the analysis highlight the fact that major determinants of trade flows between Myanmar and its trading partners are partner country's GDP, GAP, distance, FTA and adjacency. It implies that its trade volumes grow up with an increase in economic size of trade partners and larger differences in per capita income between them. Myanmar's trade pattern is more affected by its trade partner's overall economy size than their consumers' purchasing power. In fact, GAP represents the different level of income with different production and consumption pattern, rising GAP lead to increase in inter-industry trade rather than intra-industry trade. Moreover, geographical distance is an important resistance factor for bilateral trade flows. At the same time, FTA has a significant impact on increasing bilateral trade flows



between Myanmar and its partners. Since the trade sanction also has large impact on Myanmar trades, it can be envisioned that improving political process in Myanmar will lead to increase in its international trades.

Myanmar has already reached the trade potential with almost all ASEAN countries except for Thailand. Although Thailand and China are sharing the border with Myanmar, their trade volumes are far behind the trade potential predicted by the model. Large extent of unrecorded informal trades and smuggling in border is likely to be one of the reasons for lowering the ratio of actual trade to trade potential. On the other hand, high trade ratio of Singapore indicates its entrepôt position in ASEAN and a hub of the financial and business services. The trade volumes with the United States and most European countries are higher than the forecasted trade volumes, reflecting its well-integration with these economies. However, the trade relations with East Asian countries mainly China, Japan and Korea have yet to be exploited to their full potential even though ASEAN+1 FTAs have being implemented.

The outcomes of the study highlight the need for a set of development and reform policies for Myanmar. Given rich natural endowments and the importance of resource-based sectors, in the short-term, industrialization process in Myanmar should focus on the value-added natural resource-based products and labor-intensive manufactured goods for exports with the purpose of conserving capital and providing as much employment as possible. However, since natural resources-based sector has a limited opportunity for intra-industry trade whereas technology-intensive structures offer better prospects to realize economic benefits associated with intra-industry integration, Myanmar should move upward in the development ladder by shifting from primary sector to secondary sector in the long-term. For this purpose, Myanmar need to speed up foreign trade liberalization, financial sector reforms, improvement in investment regime, privatization of state-owned economic enterprises and private sector development especially the promotion of small and medium enterprises, infrastructure development, and intensification of domestic savings mobilization.

Having large extent of informal trades and smuggling in border areas, Myanmar needs to take possible measures to formalize these trade activities, thereby, the government can enjoy the custom duty to improve its revenues at least in the short-term before full realization of implementing FTAs while consumers benefits from wider varieties of safety products at a lower price. At the same time, there is an urgent need to promote bilateral trades between Myanmar and East Asian trade partners through elimination of trade barriers in order to enjoy large benefits from unexhausted trade potential. For this purpose, Myanmar needs to accelerate the pace of trade liberalization by speeding up the elimination of tariff and non-tariff barriers and simplification of trade facilitating procedures under the context of ASEAN+1 FTAs.

## 6. Concluding Remarks

Recognizing the importance of international trade for Myanmar, this study attempted to analyze the trade patterns of Myanmar based the gravity mode. This paper also seeks to identify the determining factors of each country's bilateral trade flows and policy implications for promoting bilateral trade of Myanmar.



According to the results of this study, it can be conjectured that Myanmar needs to promote their bilateral trade with countries in close proximity and having large economic size and high consumers' purchasing power through accelerating their trade liberalization efforts in FTAs in progress with those countries. Moreover, since the trade sanction has large impact on its trade flows, improving political process is expected to increase its trade volumes and ultimately lead to development of the whole economy.

This paper has attempted to identify empirically the underlying trade patterns and to provide applicable trade policy implications under the framework of basic gravity model without analyzing the corresponding theoretical basis. The empirical outcomes might differ if such omitted explanatory variables as tariffs, NTBs, and other trade restrictions are included in the model or if bilateral trade volumes are disaggregated into commodity level. Although this study used total trade volumes (sum of exports and imports) as a dependent variable, the separated analyses for exports and imports might also have more specific implications for trade policy of respective countries. Nonetheless, this study is believed to have significant implications for promoting bilateral trades of Myanmar and more detailed researches on this topic are expected to continue in the near future.

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## DETECTION OF OUTLIERS IN WHEAT PRODUCTION OF MYANMAR (1950-2006)

Mya Thandar<sup>1</sup>

### Abstract

Outliers are commonplace in statistical data analysis. Noting that the effects of outliers in a time series could be serious, the presence of the outliers has significant influence on the analysis of the series. Direct use of conventional statistical time series analysis may occasionally ignore the fact that the observed time series no longer covers the time period with the same condition. Consequently, it leads to use of the inadequate model and to the biased estimates of the parameters in time series analysis. Therefore, the consideration of outliers in a time series is a crucial aspect of time series analysis. This study reviews outliers in a time series, including definitions and types of outliers, ARIMA models for time series with outliers, as well as likelihood ratio test for detection of outliers in a time series. In addition, the detection and identification of outliers in wheat production series of Myanmar is also empirically investigated as an illustration in this study.

**Key words:** outlier, ARIMA models, likelihood ratio test.

### 1. Introduction

A time series is an ordered sequence of observations on a variable of interest collected usually in time, particularly in terms of some equally spaced time intervals. Time series exist in several fields such as agriculture, business, economics, engineering, geophysics, medical studies, meteorology, natural sciences and social sciences. An important feature of a time series is that, typically, adjacent observations are dependent or correlated. Because of dependence structure, statistical procedure and techniques that rely on independence assumptions are not applicable, and different statistical techniques are needed for a time series analysis at the presence of outliers.

Economic time series are sometimes more or less significantly influenced by certain external and special events or circumstances such as political or economic policy changes, strikes, outbreaks of war, monetary crises, implementation of a new rule and regulation, advertising promotions, and similar events. These events are referred to as intervention events and they usually bring outliers into the time series data.

Time series data with outlying observations needs to be analyzed using statistical outlier analysis. The effect of the change due to the unusual event and its position in time series should be analyzed in order to provide the most suitable and reliable forecasts for the future values. Thus, the investigation into the presence of outliers, identification of outliers, assessment of their effects and the remedial measures to accommodate the outliers become a crucial aspect of analyzing many economic time series and have gained much important momentum in recent years.

### 2. Types of Outliers

Outliers in a time series data set can arise for different reasons. There are two types of anomalies, namely gross errors and outliers. Gross errors are faulty observations, for example

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measurement, reading and typing errors. Identifying these is the least controversial aspect of outlier detection, since gross errors should naturally be identified and corrected whenever possible. If an observation treated as a potential outlier cannot be shown to be a gross error, it has to be considered as an outlier.

Outliers can take different forms in time series. The formal definition and classification of outliers in time series context were first proposed by Fox (1972). He proposed a classification of time series outliers as type I and type II, based on an autoregressive model. These two types have later been renamed as additive and innovational outliers, and are usually abbreviated as AO and IO, respectively. AO affects single observation, and there is no "carry-over" effect. IO affects the observations from the outlier position onwards, and it has "carry-over" effect as well as decays.

### 3. ARIMA Models for Time Series with Outliers

In the outlier literature (e.g. Tsay, 1986; Chen and Liu, 1993), a time series with outliers is modeled as ARIMA plus intervention. The basic reference to ARIMA model is Box and Jenkins (1976).

The parametric approach to modeling the time series in terms of linear difference equations has led to an important class of models, namely autoregressive integrated moving average model with order  $p$ ,  $d$  and  $q$ , popularly known as ARIMA ( $p, d, q$ ) (Box and Jenkins, 1976). If  $Z_t$  is an observed time series, then the ARIMA ( $p, d, q$ ) model is given by

$$\phi(B) (1-B)^d Z_t = \theta(B) a_t \quad (1)$$

where  $\phi(B) = 1 - \phi_1 B - \phi_2 B^2 - \dots - \phi_p B^p$  and  $\theta(B) = 1 - \theta_1 B - \theta_2 B^2 - \dots - \theta_q B^q$  are polynomials of degree  $p$  and  $q$  in  $B$ ,  $\phi_i, i = 1, 2, \dots, p$  and  $\theta_j, j = 1, 2, \dots, q$  are the autoregressive and moving average parameters of the time series respectively and  $B$  is the backward shift operator, that is,  $B^j Z_t = Z_{t-j}$ . In the above model,  $a_t$  is the white noise or error series with mean zero, and variance  $\sigma_a^2$  is referred to as the error variance.

It is assumed that the series  $(1-B)^d Z_t$  is stationary, that is, the roots of  $\phi(B) = 0$  lie outside the unit circle, and invertible, that is, the roots of  $\theta(B) = 0$  lie outside the unit circle. When  $d = 0$ , Equation (1) represents a stationary process ARMA ( $p, q$ ), given by

$$\phi(B) Z_t = \theta(B) a_t \quad (2)$$

The ARMA ( $p, q$ ) process  $Z_t$  can also be represented as a random shock model of the form

$$Z_t = \psi(B) a_t \quad (3)$$

where  $\psi(B) = 1 + \psi_1 B + \psi_2 B^2 + \dots$  and  $\psi$  weights are calculated by equating the coefficients of  $B$  in the equation  $\phi(B) \psi(B) = \theta(B)$ . For the series to be stationary, it is assumed that  $\psi(B)$  converges for  $|B| \leq 1$ ; that is, the  $\psi$  weights have the condition  $\sum_{j=0}^{\infty} |\psi_j| < \infty$ . Similarly,  $Z_t$  can also be represented as an inverted form of the model using the  $\pi$  weights as

$$\pi(B) Z_t = a_t \quad (4)$$

where  $\pi(B) = 1 - \pi_1 B - \pi_2 B^2 - \dots$ . The  $\pi$  weights are analogously obtained by equating coefficients of  $B$  in  $\phi(B) = \theta(B) \pi(B)$ . To satisfy the condition of invertibility it is assumed



that  $\pi(B)$  converges on or within the unit circle. Alternatively, the  $\pi$  weights are assumed to satisfy the condition  $\sum_{j=0}^{\infty} |\pi_j| < \infty$ . (Box, Jenkins and Reinsel, 1994).

Following Box and Jenkins (1976), the analysis based on these models has been extensively studied in the literature and for details, Abraham and Ledolter (1983), Chatfield (1989), Kendal and Ord (1990), Wei (1990), Box et al. (1994), Mills (1994), Brockwell and Davis (1991, 1996) and Liu (2006) are referred to interested researchers and readers.

Box and Jenkins suggested that the principle of parsimony is important in model building; that is, the number of parameters  $p$ ,  $d$ , and  $q$  of the fitted model must be minimum (Box et al., 1994). The inferential problems considered in the literature are usually identification of the order  $p$ ,  $d$ , and  $q$  in the model, estimation of the time series parameters and error variance, diagnostic checking of the model, and forecasting of the future values, etc.

In this study, the analysis of stationary and invertible time series ARMA ( $p$ ,  $q$ ) with outliers are considered with the help of empirical analysis of time series data with outliers.

Let  $Y_t$  be the observed time series and  $Z_t$  be the underlying time series which is free of the impact of outliers. Assume that  $Z_t$  follows a general ARIMA model in Equation (1). Then the general outlier model for an observed time series  $Y_t$  is defined as

$$Y_t = f(t) + Z_t \quad (5)$$

where  $Z_t$  is a regular ARIMA model and outliers are incorporated into  $f(t)$ . The  $f(t)$  can be denoted by different outliers types.

An additive outlier (AO) model, that is,  $f(t) = \omega P_t^{(T)}$  at time  $T$  in ARMA ( $p$ ,  $q$ ) (Fox, 1972) is

$$Y_t = \omega P_t^{(T)} + Z_t \quad (6)$$

where  $Y_t$  is the observed series,  $Z_t$  is an unobserved outlier free series as in Equation (2),  $\omega$  is the outlier parameter,  $-\infty < \omega < \infty$  and

$$P_t^{(T)} = 1, t = T, \\ = 0, t \neq T,$$

is the indicator variable representing the presence or absence of an outlier at time  $T$ . The presence of AOs, is clearly seen in a time sequence plot as AO does not have any carry-over effect.

An innovational outlier (IO) model at time  $T$ , that is,  $f(t) = \omega \psi(B) P_t^{(T)}$ , in ARMA ( $p$ ,  $q$ ) is specified by (Fox 1972; Abraham and Box, 1979)

$$Y_t = \omega \psi(B) P_t^{(T)} + Z_t \quad (7)$$

where, as before,  $Y_t$  is the observed series,  $Z_t$  is an unobserved outlier free series as in Equation (2),  $\omega$  is the outlier parameter  $-\infty < \omega < \infty$  and

$$P_t^{(T)} = 1, t = T,$$



$$= 0, t \neq T,$$

is the indicator variable which represents the presence or absence of an outlier at time  $T$ . The IO affects all observations  $Y_T, Y_{T+1}, \dots$  beyond time  $T$  and decays with  $\psi$  weights as it has carry-over effect.

It is not unusual to come across time series data with more than one outlier. The problem of handling multiple outliers in time series is more complicated, for the simple reason that the outliers could be of different types (Barnett and Lewis, 1994).

More generally, an observed time series  $Y_t$  might be affected by outliers of different types at  $k$  points of time  $T_1, T_2, \dots, T_k$  and we have the following multiple outlier model of the general form

$$Y_t = \sum_{j=1}^k \omega_j V_j(B) P_t^{(T_j)} + Z_t \quad (8)$$

where  $k$  is the total number of outliers present in the series,  $\omega_j, j = 1, 2, \dots, k$  are the corresponding outlier parameters which may not be distinct and

$$V_j(B) = 1 \quad \text{for an AO,}$$

$$= \psi(B) = \frac{\theta(B)}{\phi(B)} \quad \text{for an IO,}$$

when an outlier type presents at time point  $T_j, j = 1, 2, \dots, k$ .

Problems of interest associated with these types of outlier models are to be identified from the standpoints of the timing and the type of outliers and estimation of the magnitude  $\omega_j$  of the outlier effect, so that the analysis of the time series will adjust for these outlier effects.

#### 4. Likelihood Ratio Criterion for Detection of Outliers in a Time Series

In practice, the timing of an intervention event may or may not be known. Often in such cases, when the timing and causes of a series of interventions are known, an appropriate handling can be carried out using intervention analysis that was proposed by Box and Tiao (1975). In many situations, the timing of intervention is rarely known beforehand and it has significant influence on the analysis of time series. It leads to the general time series outlier analysis. The presence of outliers is often not known at the start of the time series data analysis; additional procedures for detection of outliers and assessment of their possible impacts are important in practice. Therefore, they need to be developed.

The well-known procedure for detection of outliers in a time series is the likelihood ratio test, which was first proposed by Fox (1972) followed by Chang and Tiao (1983), Tiao (1985), Tsay (1986), Chang, Tiao and Chen (1988) and Chan and Liu (1993).

As stated above, Fox (1972) classified time series outliers as type I (additive outlier) and type II (innovational outlier) based on an autoregressive model. The basic idea (in an autoregressive



model) is to add a dummy variable for every observation in turn, maximize these likelihoods, and see whether the maximum of the likelihood ratio statistics thus achieved is significant. Fox also suggested the use of more practical simplifications of likelihood ratio test, such as standardized estimated errors in the observations being tested. These were developed by, among others, Muirhead (1986), Chang, Tiao and Chen (1988) and Tsay (1986), and are also used as a part of a complete outlier modeling strategy.

The models for additive outliers (AO) and innovational outliers (IO) are as described in Equations (6) and (7) respectively. These two models can be written in terms of the innovation sequence  $a_t$ 's as follows:

$$\text{AO: } Y_t = \frac{\theta(B)}{\phi(B)} a_t + \omega P_t^{(T)} \tag{9}$$

$$\text{IO: } Y_t = \frac{\theta(B)}{\phi(B)} (a_t + \omega P_t^{(T)}) \tag{10}$$

Thus, the AO case may be called a gross error model, since only the level of the  $t^{\text{th}}$  observation is affected. On the other hand, an IO represents an extraordinary shock at time point T influencing  $Y_T, Y_{T+1}, \dots$ , through the dynamic system described by  $\frac{\theta(B)}{\phi(B)}$ .

Let  $e_t = \pi(B) Y_t$  for  $t = 1, 2, \dots, n$  where  $\pi(B) = \frac{\phi(B)}{\theta(B)}$ . We can write Equations (9) and (10), respectively as

$$\text{AO: } e_t = \omega \pi(B) P_t^{(T)} + a_t \tag{11}$$

$$\text{IO: } e_t = \omega P_t^{(T)} + a_t \tag{12}$$

In other words, the information about an IO is contained in the residual  $e_T$  at that particular point T, whereas that of an AO is scattered over a string of residuals  $e_T, e_{T+1}, \dots$ .

For n available observations, the AO model (11) can be written as

$$\begin{bmatrix} e_1 \\ \vdots \\ e_{T-1} \\ e_T \\ e_{T+1} \\ e_{T+2} \\ \vdots \\ e_n \end{bmatrix} = \omega \begin{bmatrix} 0 \\ \vdots \\ 0 \\ 1 \\ -\pi_1 \\ -\pi_2 \\ \vdots \\ -\pi_{n-T} \end{bmatrix} + \begin{bmatrix} a_1 \\ \vdots \\ a_{T-1} \\ a_T \\ a_{T+1} \\ a_{T+2} \\ \vdots \\ a_n \end{bmatrix} \tag{13}$$



Let  $\hat{\omega}_A$  be the least square estimator of  $\omega$  for the AO model. Because  $\{a_t\}$  is white noise, from the least squares theory, we have

$$\begin{aligned} \text{AO: } \hat{\omega}_A &= \frac{e_T - \sum_{j=1}^{n-T} \pi_j e_{T+j}}{\sum_{j=0}^{n-T} \pi_j^2} \\ &= \tau^2 \pi(F) e_T \end{aligned} \quad (14)$$

where  $\tau^2 = \left( \sum_{j=0}^{n-T} \pi_j^2 \right)^{-1}$  and  $\pi(F) = (1 - \pi_1 F - \pi_2 F^2 - \dots - \pi_{n-T} F^{n-T})$ ,  $F$  is the forward shift operator such that  $Fe_t = e_{t+1}$ . The variance of the estimator  $\hat{\omega}_A$  is

$$\text{var}(\hat{\omega}_A) = \tau^2 \sigma_a^2 \quad (15)$$

Similarly, letting  $\hat{\omega}_I$  be the least squares estimator of  $\omega$  for the IO model, we have

$$\text{IO: } \hat{\omega}_I = e_T \quad (16)$$

and

$$\text{var}(\hat{\omega}_I) = \sigma_a^2. \quad (17)$$

Thus, the best estimate of the effect of an IO at time  $T$  is the residual  $e_T$ , whereas the best estimate of the effect of an AO is a linear combination of  $e_T, e_{T+1}, \dots$  and  $e_n$  with weight depending on the structure of the time series process. Since  $\tau^2 \leq 1$ , it is easily seen that  $\text{var}(\hat{\omega}_A) \leq \text{var}(\hat{\omega}_I) = \sigma_a^2$  and in some cases,  $\text{var}(\hat{\omega}_A)$  can be much smaller than  $\sigma_a^2$ .

Let  $H_0$  denote the null hypothesis that  $\omega = 0$  in Equations (9) and (10),  $H_1$  denote the situation  $\omega \neq 0$  in Equation (9) for AO and  $H_2$  denote the situation  $\omega \neq 0$  in Equation (10) for IO. The likelihood ratio test statistics for AO and IO are given by

$$\begin{aligned} H_0 \text{ vs } H_1 : \quad \lambda_{1,T} &= \frac{\hat{\omega}_A}{\tau \sigma_a} \\ H_0 \text{ vs } H_2 : \quad \lambda_{2,T} &= \frac{\hat{\omega}_I}{\sigma_a} \end{aligned} \quad (18)$$

Under the null hypothesis  $H_0$ , the statistics  $\lambda_{1,T}$  and  $\lambda_{2,T}$  both have the standard normal distribution.

The likelihood ratio method further leads to the criteria

$$\text{AO} : \quad \max |\lambda_{1,T}|$$



$$\begin{aligned}
 & t = 1, \dots, n \\
 \text{IO} & : \max_{t=1, \dots, n} |\lambda_{2,T}| \\
 & t = 1, \dots, n
 \end{aligned}$$

for testing the possibility of an AO or IO, respectively, at an unknown position in the series  $Y_1, \dots, Y_n$ .

A simple rule was mentioned by Fox (1972) as a possible way to distinguish between AO and IO. At any suspected point  $T$ , the possible outlier is classified as an AO if  $|\lambda_{1,T}| > |\lambda_{2,T}|$  and it is classified as an IO if  $|\lambda_{1,T}| \leq |\lambda_{2,T}|$ .

In practice, the ARMA parameters and  $\sigma_a^2$  are usually unknown. Estimates of these parameters, together with that of  $\omega$  under either the AO or the IO case, can be obtained by maximizing the likelihood function of  $(\phi_1, \dots, \phi_p, \theta_1, \dots, \theta_q, \omega, \sigma_a^2)$  in the same fashion as that described by Box and Jenkins (1976). Based on these estimates, the likelihood ratios can be computed accordingly for testing the hypotheses, one against another, in Equation (18).

The iterative procedure for the detection of outliers in a time series at unknown positions is as follows:

**Step 1**

Model the series  $\{Y_t\}$  by assuming that there is no outlier. From the estimated model, compute the residuals, that is,

$$\hat{e}_t = \hat{\pi}(B)Y_t = \frac{\hat{\phi}(B)}{\hat{\theta}(B)} Y_t$$

where  $\hat{\phi}(B) = (1 - \hat{\phi}_1 B - \dots - \hat{\phi}_p B^p)$  and  $\hat{\theta}(B) = (1 - \hat{\theta}_1 B - \dots - \hat{\theta}_q B^q)$ . Let

$$\hat{\sigma}_a^2 = \frac{1}{n} \sum_{t=1}^n \hat{e}_t^2$$

be the initial estimate of  $\sigma_a^2$ .

**Step 2**

Calculate  $\hat{\lambda}_{1,t}$  and  $\hat{\lambda}_{2,t}$  for  $t = 1, 2, \dots, n$ , using the estimated model. Define

$$\hat{\lambda}_T = \max \{ |\hat{\lambda}_{1,t}|, |\hat{\lambda}_{2,t}| \}$$

for  $t = 1, 2, \dots, n$ , where  $T$  denotes the time when the maximum occurs. If  $\hat{\lambda}_T = |\hat{\lambda}_{1,T}| > C$ , where  $C$  is a predetermined positive constant, then there is the possibility of an AO at time  $T$  with its effect estimated by  $\hat{\omega}_A$  in Equation (14). The effect of AO can be removed by defining new residuals

$$\tilde{e}_t = \hat{e}_t - \hat{\omega}_A \hat{\pi}(B)P_t^{(T)} \quad \text{for } t \geq T.$$



If  $\hat{\lambda}_T = |\hat{\lambda}_{2,T}| > C$ , then there is the possibility of an IO at time T. The impact of IO is estimated by  $\hat{\omega}_1$  in Equation (16). Then, the effect can be eliminated by defining a new residual

$$\tilde{\epsilon}_T = \hat{\epsilon}_T - \hat{\omega}_1 = 0 \quad \text{at time T.}$$

In practice, Chang et. al. (1988) recommended using  $C = 3$  for high sensitivity,  $C = 3.5$  for median sensitivity and  $C = 4$  for low sensitivity in the outlier detecting procedure when the length of the series is less than 200. In either of preceding cases, a new estimate  $\tilde{\sigma}_a^2$  is computed from modified residuals.

### Step 3

If an IO or an AO is identified in Step 2, recompute  $\hat{\lambda}_{1,T}$  and  $\hat{\lambda}_{2,T}$  based on the same initial estimates of time series parameters, but using the modified residuals  $\tilde{\epsilon}_1$ 's and the estimate  $\tilde{\sigma}_a^2$ , and repeat Step 2.

### Step 4

Continue to repeat Steps 2 and 3 until no further outliers can be identified.

### Step 5

Suppose that Step 4 terminated and k outliers have been tentatively identified at times  $T_1, T_2, \dots, T_k$ . Treat these time points as known and estimate the outlier parameters simultaneously using general outlier model of the form

$$Y_t = \sum_{j=1}^k \omega_j V_j(B) P_t^{(T_j)} + \frac{\theta(B)}{\phi(B)} a_t \quad (19)$$

which is equivalent to Equation (8) where  $V_j(B) = 1$  for an AO and  $V_j(B) = \frac{\theta(B)}{\phi(B)}$  for an IO at time  $T_j$ .

Treating Equation (19) as the suggested model, we start the outlier detection stage again. If no other outliers are found, we stop. Otherwise, the estimation stage is repeated, with the newly identified outliers incorporated into the model (19), until no more outliers can be found, and all of the outlier effects have been simultaneously estimated with the time series parameters. Thus, we have the following fitted outlier model:

$$Y_t = \sum_{j=1}^k \hat{\omega}_j V_j(B) P_t^{(T_j)} + \frac{\hat{\theta}(B)}{\hat{\phi}(B)} a_t \quad (20)$$

where  $\hat{\omega}_j$ ,  $\hat{\phi}(B) = (1 - \hat{\phi}(B) - \dots - \hat{\phi}_p B^p)$  and  $\hat{\theta}(B) = (1 - \hat{\theta}_1 B - \dots - \hat{\theta}_q B^q)$  are obtained in the final iteration.



### 5. Detection of Outliers in Wheat Production Series

The likelihood ratio test is used for the detection of outliers in the "Wheat Production Series (in thousand metric ton) of Myanmar from 1950-51 to 2005-06". The data is plotted in Figure 1.

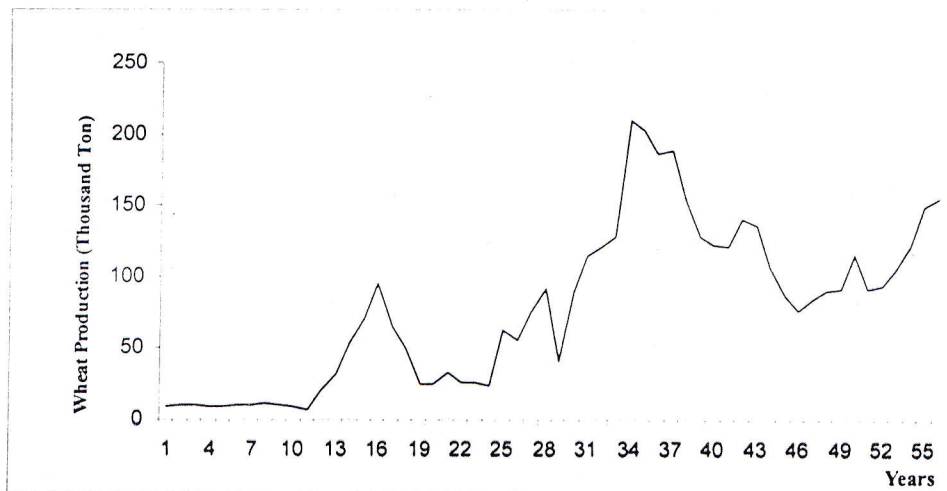


Figure 1: Plot of Wheat Production Series (1950-1951 to 2005-2006)

In Figure 1, the unusual peaks at  $t = 16, 29,$  and  $34$  look like the possible outliers in this series. But the question is whether all are outliers or not and what are the types of outliers to which these outliers belong. It may be difficult to get the correct answer by visualization from the time series sequence plot as in Figure 1 and the detection of outliers is an important issue in such case.

Firstly, the identification of the time series model is needed for the observed data series. Using SPSS software, the plots of autocorrelation function (*acf*) and partial autocorrelation function (*pacf*) of the observed series are obtained which show a tail off pattern of *acf* and a cut off after lag 1 for *pacf*, respectively. Hence, the model suggested for this data is AR(1) specified by

$$(1 - \phi B)Z_t = \theta_0 + a_t \tag{21}$$

where  $\theta_0$  is the overall constant in the model. Based on the tentative model AR(1) without outlier, fitted model is obtained as

$$(1 - 0.938 B)Z_t = 79.832 + a_t \tag{22}$$

with  $\hat{\sigma}_a^2 = 530.151$ .

By likelihood ratio test under the AR (1) model, an AO at  $t = 29$  and an IO at  $t = 34$  are identified. Thus, the fitted AR(1) model with an AO  $t = 29$  and an IO at  $t = 34$  is given by

$$Z_t = \theta_0 + \frac{1}{1 - \phi B} [\omega_1 P_t^{(34)} + a_t] + \omega_2 P_t^{(29)} \tag{23}$$

The estimates of parameters for model in Equation (23) on the basis of the wheat production series are presented in the following table.



**Table (1)**  
**Estimated Parameters of AR(1) with an AO and an IO Outliers**  
**for Wheat Production Series**

Parameter	Estimate	S. E.
$\theta_0$	64.839	26.308
$\phi$	0.936	0.035
$\omega_1$	86.220	15.628
$\omega_2$	-49.744	11.223
$\sigma_a^2$	287.981	-

Hence, the simultaneous estimation of the parameters of the model is given by

$$Z_t = 64.839 + \frac{1}{1-0.936B} [86.220P_t^{(34)} + a_t] - 49.744\omega_2 P_t^{(29)} \quad (24)$$

(26.308)
(0.035)
(15.628)
(11.223)

with  $\hat{\sigma}_a^2 = 287.981$ , where the values in parentheses below the parameter estimates are the associated standard errors.

From the above table, it is also noticed that the estimate of error variance  $\sigma_a^2$  from model (24) is smaller in comparison with the estimate obtained on ignoring the outliers from model (22). The reduction percentage in error variance by model (24) for wheat production series is given in the following table.

**Table (2)**  
**The Reduction Percentage in Error Variance for Wheat Production Series**

Model	Estimated Variance	Reduction Percent
AR(1) with 2 outliers (24)	287.981	45.67%
AR(1) with no outlier (22)	530.151	-

From Table (2), it is noticed that the error variance for model (24) is smaller than that for model (22), and the reduction percentage in error variance by model (24) is 45.67% when the effects of an IO at  $t = 34$  and an AO at  $t = 29$  are taken into account.

For the diagnostic checking, the residuals series of the fitted model with two outliers is examined to check the residuals are white noise or not. Thus, the *acf* and *pacf* of the residual series for the fitted model with outliers are plotted in the following figure.



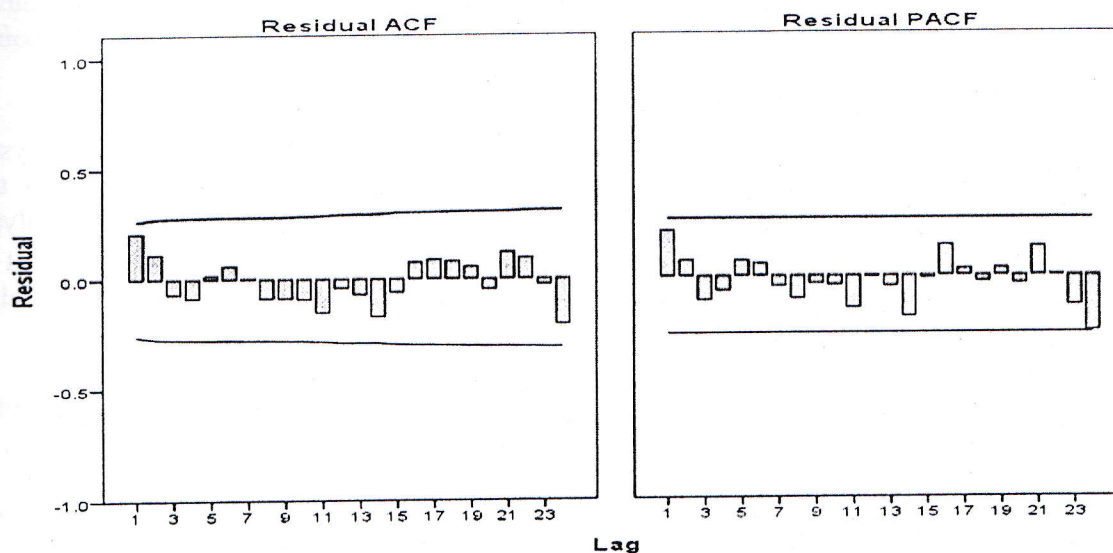


Figure 2 The *acf* and *pacf* of Residual Series for Model (24)

From Figure 2, the *acf* and *pacf* of the residuals series of the fitted model do not form any pattern, and they are statistically significant since the *acf* and *pacf* lie within two standard deviations for 5% level of significance.

Besides, Box-Ljung Q statistic of the fitted model is 12.407 which is not significant at 5% level of significance. This means that the fitted model is adequate for the wheat production series. Based on the results of these residual analyses, the tentative model with an AO at  $t = 29$  (1978-79) and an IO at  $t = 34$  (1983-84) is found to be adequate for the observed time series on wheat production of Myanmar.

First, an AO with negative sign at  $t = 29$  is found when the sharp fall of wheat production occurred in 1978-79. It might be due to the fact that the number of irrigated area for wheat cultivation decreased relative to the previous years, and the utilization of fertilizer and amount of pure strain of seeds distributed also declined. Consequently, the wheat production declined to 41 thousand metric tons in 1978-79.

Second, an IO with positive sign at  $t = 34$  is detected as wheat production increased to 210.2 thousand metric tons in 1983-84. The causes of such increase were increase in the supply of pure strain of seeds, the utilization of fertilizer and insecticides as wheat was considered as one of the most important crops. Besides, new pure strain seeds, which became suitable for the climate of Myanmar, could be produced after doing necessary agricultural research. Then, the State took necessary measures to supply the pure strain of seeds to the wheat cultivators. And, it rained enough for the crops in late monsoon days, then the volume of wheat production not only surpassed the production of previous years but also it exceeded the production target. Similarly, production of wheat in 1984-85 onwards continued rising but it dropped considerably in years to come.

## 6. Conclusion

Outliers do exist in economic time series data and can at least theoretically have harmful effects on their analysis. It is difficult to say that how frequently outliers occurred and which is



the best way to describe them (that is, additive or innovational outlier or others), how serious a threat they pose in practice, and how to handle them or indeed whether anything at all should be done about them.

In practice, the presence of outliers is assumed as indicated in the graph at the start of analysis; additional procedures for detection of outliers and assessment of their possible impacts are essential. We should stress the importance of adjusting outliers prior to and during the analysis of time series data. All outliers lead to the worst type of forecasting; consequently, it is necessary to detect these outliers. Even more emphasis should perhaps be placed on examining and explaining the possible causes of detected outliers in the observed data.

For detection of outliers, simple statistical tools such as time series plots, frequency distributions and simple t-tests can be used. These methods are simple and perhaps useful in some cases, but obviously not sufficient for the wide variety of situations encountered in empirical time series analysis. It is, therefore, necessary to consider more complicated but effective methods one of which is likelihood ratio test for the detection of outliers in a time series. It has become almost a standard method for detection and identification of outliers in time series. It is already featured in some computer software packages and easy to understand as well as seem to work reasonably well in most practical situations, especially when used iteratively.

The effect of the change in the economic time series due to special events should be analyzed by statistical outlier analysis in order to provide the timings and the causes of occurring these events which could be useful in future planning. In Myanmar, many economic time series were affected by events that are planned by decision and policy makers and caused by economic changes, weather conditions, out-of-stock situations, and similar events. This study attempts to detect the timing of the presence of outliers, identifies the type of outliers in wheat production series of Myanmar and also explains the possible causes of occurrence of outliers in the observed data series. In the detection of outliers, this study focuses only on the applications of likelihood ratio test. Then, ARIMA models with outliers are constructed and the fitted models could be useful in decision-making and planning purposes. For detection of outliers in wheat production series of Myanmar, AR(1) model with an AO outlier at  $t = 29$  and an IO outlier at  $t = 34$  is obtained.

In this study, emphasis has been put only on two types of outliers, namely, additive outlier (AO) and innovational outlier (IO) which can occur most often in practical time series. It is also needed to detect and investigate the effects of other types of outliers using suitable outlier detection procedures as well as causes of presence of these types of outliers in observed data series as a further research in this field of study. The detection of outliers can also be extended to seasonal time series models. The detection of outliers in multivariate time series should be investigated as a further study. It is also recommended that the outlier detection and model fitting to practically important sets of time series data should be carried out now and often in order to have better estimates as well as forecasts.



## Appendix

## Wheat Production of Myanmar (Thousand Metric Ton)

Years	Wheat Production	Years	Wheat Production
1950-51	9.5	1978-79	41
1951-52	10.6	1979-80	89.4
1952-53	10.4	1980-81	114.9
1953-54	9.6	1981-82	122
1954-55	8.8	1982-83	128
1955-56	10.1	1983-84	210.2
1956-57	10.7	1984-85	203
1957-58	10.9	1985-86	186.9
1958-59	10.7	1986-87	188.7
1959-60	9.7	1987-88	154.4
1960-61	7.3	1988-89	128.1
1961-62	20.7	1989-90	122.2
1962-63	31.9	1990-91	121.5
1963-64	53.4	1991-92	141.1
1964-65	70.6	1992-93	136.4
1965-66	94.8	1993-94	106.9
1966-67	65.7	1994-95	87.7
1967-68	50.3	1995-96	76.7
1968-69	25.4	1996-97	85.4
1969-70	25.4	1997-98	90.7
1970-71	32.9	1998-99	92
1971-72	26.5	1999-00	115.3
1972-73	26.3	2000-01	92.1
1973-74	24.3	2001-02	94.4
1974-75	62.6	2002-03	105.7
1975-76	55.7	2003-04	122.4
1976-77	75.2	2004-05	150
1977-78	92.2	2005-06	156.2

Source: Report to the People (1964-1965 to 1979-1980); Report to the Phyithu Hluttaw (1971-1972 to 1988-1989); Review of Financial, Economic and Social Conditions (1989-1990 to 1997-1998); Selected Monthly Economic Indicators (1955-2008)

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## Public Awareness of Hepatitis B Infection in South Okkalapa Township in Yangon

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### Abstract

Hepatitis B virus is a serious public health problem that affects people of all ages around the world. Myanmar is regarded as a country with a high endemicity of HBV infection. This study is descriptive research based on primary data information on Hepatitis B infection prevention and control activities in Myanmar. It aims at assessing the awareness of people in responses to Hepatitis B by conducting survey on their knowledge and practice. Ministry of Health, Myanmar is now collaborating and cooperating with national, regional, and international partners to scale up response to fight against Hepatitis B. It is important to continue and enhance prevention and control efforts and implement more effective prevention and control activities in order to combat this public health problem.

**Key words:** Hepatitis B, Public awareness, public health problem

### 1. Introduction

Hepatitis means inflammation of the liver. Although drugs, toxins, and many other exposures also can inflame the liver, the most common cause of hepatitis is viral. In general hepatitis viruses are identified by the letter A through G. Hepatitis B is infected from blood, sexual contact, both heterosexual and homosexual, close personal contact and can easily be transmitted from mother to infant at delivery.

Hepatitis B virus (HBV) infection is a global health problem and it has been estimated by the World Health Organization (WHO) that 2,000 million are chronically infected carriers. Of the carriers, 25% are at risk of serious illness and eventual death from cirrhosis or hepato-cellular carcinoma (HCC). The highest rates of Hepatitis B occur in the developing world: Sub Saharan Africa, most of Asia (including Myanmar) and the Pacific Rim, the Amazon, the Southern parts of Eastern and Central Europe, portions of the Middle East and the Indian subcontinent.

Therefore under the guidance of government, Ministry of Health has been functioning the preventive and control measures. These include building up the Hepatitis B vaccine factory, providing the Hepatitis B vaccination services at the cheap price by Department of Medical Research (Lower Myanmar), providing the information concerning the knowledge of HBV through media. However, the infectious disease Hepatitis B cannot be controlled by health sector alone, public awareness plays a crucial role. This study will find out the awareness of people in response to their knowledge and practice by using people in South Okkalapa Township as sample scopes.

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The objectives of this study are to review the prevention and control activities in Myanmar and to assess the public awareness of Hepatitis B Infection. Descriptive method is used in this study. In order to find out the public awareness of Hepatitis B infection in South Okkalapa Township, a survey was conducted in cooperation with the local authorities.

## **2. History of Hepatitis B**

Since ancient times, people have known about hepatitis and the jaundice that sometimes accompanies the infection. During 1942 in the United States, there was an outbreak of Hepatitis in military personnel who were given vaccine to protect them from yellow fever. It was unknown at the time that this vaccine contained a human blood component which was contaminated with hepatitis B virus.

In the mid 1950s and 1960s Dr. Saul Krugman's studies showed that the outbreaks of hepatitis were caused by two separate strains of virus. One had a short incubation period, was transmitted primarily by fecal-oral contamination, did not enter a chronically infected stage, and was later determined to be hepatitis A. The other had a long incubation period, was transmitted primarily by contact with contaminated blood, did enter chronic stage in a small proportion of patients, and was later determined to be hepatitis B.

During the 1960s, Dr. Baruch Blumberg was researching genetic differences by examining the blood of people around the world who had received transfusions. When people received blood, they produce antibodies (special types of proteins that defend against foreign proteins). Dr. Blumberg discovered antibodies in the blood of a patient with hemophilia living in New York that reacted with the blood of an Australian aborigine. He named the antigen after Australia, calling it the Australian or Au antigen. Further research determined that the Australia antigen was the surface antigen of hepatitis B.

## **3. Prevalence and Mode of Transmitted for HBV Infection in Myanmar**

Myanmar is regarded as a country with a high endemicity of hepatitis B virus infection; it considered an important health problem. One of the earliest reports on hepatitis syndrome in Myanmar was based on the recordings made during the War World II period. However, the first study of HBV infection was based on patients hospitalized at the Rangoon (now Yangon) General Hospital during 1967.

Hepatitis B infection in Myanmar was reported in both lower and upper Myanmar where 10.4% of the populations were found to be seropositive to hepatitis B surface antigen (HBs Ag). Subsequent studies carried out among different population groups revealed HBsAg carrier rate of 10% to 12% and hepatitis B virus marker positivity rate was 35% to 60%.

Since 1981, mother infant transmission studied that perinatal transmission is the main mode of spread in Myanmar, it has been estimated that 61.1% of infants born to HBs Ag positive mothers become carriers and prevalence of HBsAg in pregnant mothers is 8%. Total viral hepatitis in patients for the whole country is 10,000 to 30,000 annually.



Hepatitis B virus is highly associated with chronic liver diseases, HBs Ag positive in 40% is chronic hepatitis patients, HBs Ag positive in 40% is liver cirrhosis and HBsAg positive in 60% is Hepatocellular carcinoma (HCC). Myanmar is included in the top five countries with the highest incidence of HCC in the worldwide (25.5 per 100,000 populations for males, 8.8 per 100,000 populations for females). According to age specific prevalence study in Myanmar since 1995, 9% of babies less than one year of age were positive for HBs Ag.

Thus, health authorities in Myanmar have taken various steps to control and manage hepatitis B infections. The Head of State has also clearly stated that emphasis is to be placed on research and development in every field to improve human resource development and material development. Since the early 1970s, DMR has actively participated in activities towards the control of hepatitis B infections in Myanmar. Activities to assist in the diagnosis, management and prevention of hepatitis B infections have been carried out and knowledge dissemination and technology transfer had been carried out at various phases.

Vertical transmission of HBV infection has been shown that 25% of children born to hepatitis B surface antigen positive mothers and up to 60% of children born to HBs Ag and HBe- Ag positive mothers became HBs Ag positive within the first year of life. DMR study confirms that peri-natal transmission is main mode of transmission in Myanmar.

Horizontal transmission is through sharing of razors and toothbrushes. Several specific modes of transmission included sexual contact, parenteral drug use, occupational exposures, household contact, recipient of unsafe blood and certain blood products.

In Myanmar, the prevalence of HBs Ag among the novices and monks of a monastery has been reported that it might due to the common sharing of razors (or thin-done-dah) used for shaving the hair periodically. The occupational risk is highlighted by laboratory workers.

There are two types of hepatitis B vaccine licensed in Myanmar. The first type is manufactured from the plasma of chronically infected persons and the others type is produced by recombinant DNA technology.

#### **4. Awareness of South Okkalapa Township People in HBV infection**

For conducting the survey, total 300 people of age 16-70 years; each 100 people from each quarter of South Okkalapa Township were taken as samples and asked questionnaires of knowledge and practice concerning HBV.



Table (1) Base line characteristics of candidate

Character	No. of candidates	Percentage
<b>Sex</b>		
Male	108	36.0
Female	192	64.0
<b>Age</b>		
16-20	52	17.3
21-40	128	43.0
41-70	120	40.0
<b>Marital Status</b>		
Single	167	55.7
Married	133	44.3
<b>Education Level</b>		
1	4	1.3
2	11	3.7
3	58	19.3
4	223	74.3
5	4	1.3
<b>Occupation</b>		
1	130	43.3
2	49	16.3
3	70	23.3
4	30	10.0
5	9	3.0
6	12	4.0

Source: Survey data

Knowledge questionnaires include questions about the nature of the virus, mode of transmission, prevention and treatment measures. Practice questionnaires include question about testing for HBV infection, vaccination, vaccination of children, preventive measures and social dealing between infected people and community.

A survey of knowledge and practice varying with age, sex, education, occupation and marital status was accessed. The sample is composed of 108 male and 192 female. The age limit is from 16 to 70. Starting point is set as 16 years for their considerable maturity and ability to enter work. The end point is set as 70 because over 70s have poorer memory and may be confused in their answers.

There are three age groups as young, medium and elder age groups, 52 people in young age group (16-20 years), 128 people in medium age group (21-40 years), and 120 people in elder age group (41-70 years). There are 167 unmarried people and 133 married people. In the young age group (16-20), all are unmarried, and in the medium age group (21-40) few are married. In the elder age group (41-70), majority are married.

There are five groups of education levels 1,2,3,4 and 5. Education level 1 is for primary school level and there are (4) people in it. Education level 2 is for middle school level and there are (11) people. Education level 3 is for high school level and contains (58) people. Education level 4 is for university/graduate level and there are (223) people and the last education level 5 is for post graduate level and having (4) people in it. The largest group is education level 4 and the second largest group is education level 3. The level 1 and 5 have equal number of people. There is no illiterate person in the survey group.

According to occupation, six groups are divided as group 1 with 130 of dependent people, group 2 with 49 people with odd jobs, group 3 with 70 government employees, group 4 with 30 company staffs, group with 9 business owners group 6 with 12 retired people. All are in common earning steady income.

**Table (2) Knowledge score according to Age-group**

Score Age Group	Low (0-6)	Medium (7-12)	High (13-19)	Total
16-20	3 (5.77%)	34 (65.38%)	15 (28.85%)	52
21-40	4 (3.13%)	55 (42.97%)	69 (53.91%)	128
41-70	3 (2.5%)	46 (38.33%)	71 (59.16%)	120
<b>Total</b>	<b>10</b>	<b>135</b>	<b>155</b>	<b>300</b>

Source: Survey Data

The knowledge levels among by respondents concerning with HBV in different age groups are shown in Table (2). According to the knowledge level, 71 respondents in age group (41 – 70) have high level of correct knowledge score. 69 respondents in age group (21-40) have high level of knowledge score. 15 respondents in age group (16 – 20) have 29% level of knowledge score.

**Table (3) Practice score according to Age-group**

Score Age Group	Low (0-3)	Medium (4-6)	High (7-10)	Total
16-20	2 (3.85%)	12 (23.08%)	38 (73.08%)	52
21-40	3 (2.34%)	7 (5.47%)	118 (92.19%)	128
41-70	0 (0%)	4 (3.33%)	116 (96.67%)	120
<b>Total</b>	<b>5</b>	<b>23</b>	<b>272</b>	<b>300</b>

Source: Survey Data



The practice levels among by respondents concerning with HBV in different age groups are shown in Table (3). According to the practical level, 118 respondents in age group (21-40) have high level of practice score. 116 respondents in age group (41-71) have high level of correct practice score. 38 respondents in age group (16-20) have high level of practice score. It can be seen that the middle age group (21-40) got the highest score. The score of the elder age group (41-70) and the middle age group (21-40) are almost the same. In this study, Majority of the young age group (16-20) have medium knowledge level and yet they are quite strong in practice, both middle and elder age groups are strong in both knowledge and practice, all three groups have good practice but the young age group has weaker knowledge than the rest. Therefore, it is found out that the knowledge concerning HBV varies with the age.

**Table (4) Knowledge score according to Education level**

Score Education level	Score			Total
	Low (0-6)	Medium (7-12)	High (13-19)	
Primary School	2 (50%)	1 (25%)	1 (25%)	4
Middle School	1 (9.09%)	7 (63.64%)	3 (27.27%)	11
High School	0 (0%)	30 (52.63%)	28 (49.12%)	58
University	7 (3.13%)	91 (40.63%)	127 (56.69%)	223
Post Graduate	0 (0%)	3 (75%)	1 (25%)	4
<b>Total</b>	<b>10</b>	<b>132</b>	<b>158</b>	<b>300</b>

**Source: Survey Data**

Table (4) shows different knowledge levels by education of 300 respondents concerning with HBV. Among 4 respondents are at primary school level, 11 respondents are at middle school level, 58 respondents are at high school level, 223 respondents are at university/graduate and 4 respondents are post graduate.

At high score level of knowledge, 127 respondents in education level 4 group have high level of knowledge score. The rest are mostly got medium score level. Group 1 and 5 have smallest number of people.

**Table (5) Practice Score according to Education level**

Score Education level	Low (0-3)	Medium (4-6)	High (7-10)	Total
Primary School	1 (25%)	0 (0%)	3 (75%)	4
Middle School	0 (0%)	2 (18.18%)	9 (81.81%)	11
High School	1 (1.72%)	4 (6.89%)	53 (91.38%)	58
University	3 (1.35%)	26 (11.66%)	194 (86.99%)	223
Post Graduate	0 (0%)	0 (0%)	4 (100%)	4
<b>Total</b>	<b>5</b>	<b>33</b>	<b>262</b>	<b>300</b>

Source: Survey Data

Table (5) shows that different practice level by education level of 300 respondents concerning with HBV. As the practice, at the high score level of practice, 194 respondents in education level (4) group have high level of practice score. According to the study, all five levels have good practice, education level 4 is good in both knowledge and practice, generally knowledge and practice varies with different education levels and knowledge and practice level gets higher with higher education level.

**Table (6) Knowledge score according to Education level in Age- group 16-20**

Score Education level	Low (0-6)	Medium (7-12)	High (13-19)	Total
Primary School	1 (100%)	0 (0%)	0 (0%)	1
Middle School	0 (0%)	0 (0%)	0 (0%)	0
High School	0 (0%)	10 (83.33%)	2 (16.67%)	12
University	2 (5.13%)	25 (64.10%)	12 (30.77%)	39
<b>Total</b>	<b>3</b>	<b>35</b>	<b>14</b>	<b>52</b>

Source: Survey Data

Table (6) shows knowledge concerning with HBV at different levels of education in the young age group (16-20). No one in this group is in education level 2 and 5. One respondent is in primary school level, 12 respondents are high school level and 39 respondents are university/graduate level. Majority of them get medium scores.



**Table (7) Practice score according to Educational level in Age group 16-20**

<b>Score</b> <b>Education level</b>	<b>Low (0-3)</b>	<b>Medium (4-6)</b>	<b>High (7-10)</b>	<b>Total</b>
Primary School	0 (0%)	0 (0%)	1 (100%)	1
Middle School	0 (0%)	0 (0%)	0 (0%)	0
High School	1 (8.33%)	3 (25%)	8 (66.67%)	12
University	1 (2.56%)	9 (23.08%)	29 (74.36%)	39
<b>Total</b>	<b>2</b>	<b>12</b>	<b>38</b>	<b>52</b>

Source: Survey Data

Table (7) shows practice concerning with HBV at different levels of education in the young age group (16-20). Study of their practice at different education levels in this group shows majority of them gets high scores. This age group (16-20) obtains the highest practice score.

**Table (8) Knowledge score according to Education level of Age group 21-40**

<b>Score</b> <b>Education level</b>	<b>Low (0-6)</b>	<b>Medium (7-12)</b>	<b>High (13-19)</b>	<b>Total</b>
Primary School	1 (50%)	0 (0%)	1 (50%)	2
Middle School	1 (25%)	1 (25%)	2 (50%)	4
High School	0 (0%)	9 (36%)	17 (65.4%)	25
University	2 (2.08%)	43 (45.26%)	50 (52.08%)	96
Post Graduate	0 (0%)	0 (0%)	1 (100%)	1
<b>Total</b>	<b>4</b>	<b>53</b>	<b>71</b>	<b>128</b>

Source: Survey Data

Table (8) shows knowledge concerning with HBV at different levels of education in the middle age group (21-40). In this group, 2 respondents are in primary school level, 4 respondents are in middle school level, 25 respondents are in high school level, 96 respondents are graduates level and 1 respondent is in post graduate level.

At the high score level of knowledge, 50 respondents in education level 4 group have high level of knowledge score. Majority of them are in high score level. Highly educated and mature people have high level of knowledge.

**Table (9) Practice score according to Education level in Age group 21-40**

<b>Score</b> <b>Education level</b>	<b>Low (0-3)</b>	<b>Medium (4-6)</b>	<b>High (7-10)</b>	<b>Total</b>
Primary School	1 (50%)	0 (0%)	1 (50%)	2
Middle School	0 (0%)	0 (0%)	4 (100%)	4
High School	0 (0%)	1 (3.85)	25 (96.15%)	26
University	2 (2.11%)	5 (5.26)	88 (92.63%)	95
Post Graduate	0 (0%)	0 (0%)	1 (100%)	1
<b>Education level</b>	<b>3</b>	<b>6</b>	<b>119</b>	<b>128</b>

**Source: Survey Data**

Table (9) shows the practice concerning with HBV at different levels of education in the middle age group (21-40). In this group, at the high score level of practice, 88 respondents in education level 4 group have high level of practice score. People in all five levels of education are good in practice. In this group (21-40), both knowledge and practice concerning with HBV are good.

**Table (10) Knowledge score according to Education level in Age group 41-70**

<b>Score</b> <b>Education level</b>	<b>Low (0-6)</b>	<b>Medium (7-12)</b>	<b>High (13-19)</b>	<b>Total</b>
Primary School	0 (0%)	1 (100%)	0 (0%)	1
Middle School	0 (0%)	6 (85.71%)	1 (14.29%)	7
High School	0 (0%)	11 (55%)	9 (45%)	20
University	3 (3.37%)	22 (24.72%)	64 (71.91%)	89
Post Graduate	0 (0%)	3 (100%)	0 (0%)	3
<b>Total</b>	<b>3</b>	<b>43</b>	<b>74</b>	<b>120</b>

**Source: Survey Data**

Table (10) shows the knowledge concerning with HBV at different levels of education in the middle age group (41-70). In this group, 1 respondent is in primary school level, 7 respondents are in middle school level, 20 respondents are in high school level, 89 respondents are graduates and 3 respondents are post graduates. At the high score level of knowledge, 64 respondents in education level 4 group have high level of knowledge score. Among adult people, university/ graduates obtained the highest level of knowledge.



Table (11) Practice score according to Education level in Age group 41-70

Score Education level	Low (0-3)	Medium (4-6)	High (7-10)	Total
Primary School	0 (0%)	0 (0%)	1 (100%)	1
Middle School	0 (0%)	2 (28.57)	5 (71.43%)	7
High School	0 (0%)	0 (0%)	20 (100%)	20
University	0 (0%)	12 (13.48%)	77 (86.52%)	89
Post Graduate	0 (0%)	0 (0%)	3 (100%)	3
Total	0	14	106	120

Source: Survey Data

Table (11) shows the practice concerning with HBV at different levels of education in age group (41-70). At the high score level of the practice, 77 respondents in education level 4 have high score level of practice score. In general, total scores of this age group in both knowledge and practice are mainly formed by scores of high scores level.

To study the knowledge and practice at different education levels in all three age groups, the youngest age group is weak in knowledge and yet having better practice manners. The middle age group has less knowledge than the elder age group, but in practice they have better practice manner. The elder age group has the highest level of knowledge but has weaker practice than the middle age group.

Table (12) Knowledge score according to Occupation

Score Occupation	Low score (0-6)	Medium score (7-12)	High score (13-19)	Total
Dependent people	5 (3.85%)	73 (56.15%)	2 (1.54%)	130
Odd jobs without steady income	2 (4.08%)	26 (53.06%)	21 (42.86%)	49
Government employees	2 (2.86%)	19 (77.14%)	49 (70%)	70
Company staff	0 (0%)	9 (30%)	21 (70%)	30
Business owners	0 (0%)	0 (0%)	9 (100%)	9
Retired people	1 (8.33%)	6 (50%)	5 (41.67%)	12
<b>Total</b>	<b>10</b>	<b>133</b>	<b>157</b>	<b>300</b>

Source: Survey Data

Table (12) shows knowledge concerning with HBV in different occupation groups. In knowledge, group 3 comprises the majority of High scores. For group 1 which contains maximum number of people comprises the majority of medium score level. Government employees and company staff score the highest knowledge score. Odd jobs have average knowledge.

Table (13) Practice score according to Occupation

Score Occupation	Low score (0-3)	Medium score (4-6)	High score (7-10)	Total
Dependent people	3 (2.31%)	18 (13.85%)	109 (83.84%)	130
Odd jobs without steady income	1 (2.04%)	4 (8.16%)	44 (89.79%)	49
Government employees	0 (0%)	7 (11.11%)	63 (90%)	70
Company staff	1 (3.33%)	4 (13.33%)	25 (83.33%)	30
Business owners	0 (0%)	0 (0%)	9 (100%)	9
Retired people	0 (0%)	2 (16.67%)	10 (83.33%)	12
<b>Total</b>	<b>5</b>	<b>35</b>	<b>260</b>	<b>300</b>

Source: Survey Data

Table (13) shows the practice concerning with HBV in different occupation groups. In practice, group 1 comprises majority of high score level. And group 3 also comprises many of high



score level. Group 1 is at the medium level of knowledge; but its practice skills are quite better. Group 3 is efficient in both knowledge and practice. Although group 2 has the least knowledge score and its practice score is relatively high.

**Table (14) Knowledge score according to Occupation in Age group 16-20**

Occupation \ Score	Low (0-6)	Medium (7-12)	High (13-19)	Total
Dependent people	2 (4%)	34 (68%)	14 (28%)	50
Odd jobs without steady income	1 (50%)	1 (50%)	0 (0%)	2
<b>Total</b>	<b>3</b>	<b>35</b>	<b>14</b>	<b>52</b>

Source: Survey Data

Table (14) shows the knowledge concerning with HBV at different occupation groups in the young in age group (16-20). In this group none of the people are involved in occupation groups 3, 4, 5 and 6. 50 respondents are in occupation group 1 and 2 respondents are in occupation group 2. It can be seen that the majority of people in this group are in occupation group 1; and most people in this group have a medium level of knowledge score.

Table (15) shows the practice concerning with HBV at different occupation groups in the young age group (21-40). Among 50 respondents in occupation group 1; 37 respondents have a high level of practice score. 2 respondents in occupation group 2; 1 respondent has a high level of practice score.

**Table (15) Practice score according to Occupation in Age group 16-20**

Occupation \ Score	Low (0-3)	Medium (4-6)	High (7-10)	Total
Dependent people	2 (4%)	11 (22%)	37 (74%)	50
Odd jobs without steady income	0 (0%)	1 (50%)	1 (50%)	2
<b>Total</b>	<b>2</b>	<b>12</b>	<b>38</b>	<b>52</b>

Source: Survey Data

It can be seen that the majority of people in this age group are in the high score level. The majority of group 1 are dependent, and thus they comprise the 75% of people having a high practice score. Odd jobs will regular income earners got low score.

Table (16) Knowledge score according to Occupation level in Age group 21-40

Score Occupation	Low (0-6)	Medium (7-12)	High (13-19)	Total
Dependent people	3 (5.45%)	26 (47.27%)	26 (47.27%)	55
Odd jobs without steady income	1 (3.57%)	13 (46.43%)	14 (50%)	28
Government employees	0 (0%)	7 (36.84%)	12 (63.16%)	19
Company staff	0 (0%)	9 (34.62%)	17 (65.38%)	26
<b>Total</b>	<b>4</b>	<b>55</b>	<b>69</b>	<b>128</b>

Source: Survey Data

Table (16) shows knowledge concerning with HBV at different occupation groups in the middle age group (21-40). 55 respondents in occupation group 1; 26 respondents have high score level. 28 respondents in occupation group 2; 14 respondents have high score level. 19 respondents in occupation group 3; 12 respondents have high score level. 26 respondents in occupation group 4; 17 respondents have high score level. It can be seen that there are many people in all four groups of occupation who get the high score level in this age group.

Table (17) Practice score according to Occupation level in Age group 21-40

Score Occupation	Low (0-3)	Medium (4-6)	High (7-10)	Total
Dependent people	1 (1.82%)	2 (3.64%)	52 (94.55%)	55
Odd jobs without steady income	1 (3.57%)	2 (7.14%)	18 (64.28%)	28
Government employees	0 (0%)	1 (5.26%)	18 (94.74%)	19
Company staff	1 (3.85%)	4 (15.38%)	21 (80.76%)	26
<b>Total</b>	<b>3</b>	<b>9</b>	<b>116</b>	<b>128</b>

Source: Survey Data

Table (17) shows the practice concerning with HBV at different occupation groups in the middle age group (21-40). It can be also seen that there are many people in all four groups of occupation who get the high score level of practice in this age group.



**Table (18) Knowledge score according to Occupation in Age group 41-70**

Score Occupation	Low (0-6)	Medium (7-12)	High (13-19)	Total
Dependent people	0 (0%)	13 (52%)	12 (48%)	25
Odd jobs without steady income	0 (0%)	12 (63.16%)	7 (41.18%)	19
Government employees	2 (3.92%)	12 (23.53%)	37 (72.55%)	51
Company staff	0 (0%)	0 (0%)	4 (100%)	4
Business owners	0 (0%)	0 (0%)	9 (100%)	9
Retired people	1 (8.33%)	6 (50%)	5 (41.67%)	12
<b>Total</b>	<b>3</b>	<b>43</b>	<b>74</b>	<b>120</b>

Source: Survey Data

Table (18) shows the knowledge concerning with HBV in different occupation groups of the elder age group (41-70). Among these, 25 respondents in occupation group1; 12 respondents have high score level. 19 respondents in occupation group2; 7 respondents have high score level. 51 respondents in occupation group3; 37 respondents have high score level. 4 respondents in occupation group4; 4 respondents have high score level. 9 respondents in occupation group5; 9 respondents have high score level. 12 respondents in occupation group6; 5 respondents have high score level. All respondents in occupational level 4 and 5 have high scores.

**Table (19) Practice score according to Occupation in Age group 41-70**

Score Occupation	Low (0-3)	Medium (4-6)	High (7-10)	Total
Dependent people	0 (0%)	5 (20%)	20 (80%)	25
Odd jobs without steady income	0 (0%)	1 (5.88%)	18 (94.74%)	19
Government employees	0 (0%)	6 (11.32%)	45 (88.24%)	51
Company staff	0 (0%)	0 (0%)	4 (100%)	4
Business owners	0 (0%)	0 (0%)	9 (100%)	9
Retired people	0 (0%)	2 (16.67%)	10 (83.33%)	12
<b>Total</b>	<b>0</b>	<b>14</b>	<b>106</b>	<b>120</b>

Source: Survey Data

Table (19) shows the practice concerning with HBV in different occupation group of the elder age group (41-70). It can be also seen that the practice of all six occupation groups are high score level.

**Table (20) Total score according to Age group**

Score Age group	Low score (0-10)	Medium score (11-20)	High score (21-30)	Total
16-20	0 (0%)	32 (62%)	20 (39%)	52
21-40	3 (2%)	43 (34%)	82 (64%)	128
41-70	2 (1%)	38 (32%)	80 (67%)	120
<b>Total</b>	<b>5</b>	<b>113</b>	<b>182</b>	<b>300</b>

Source: Survey Data

Table (20) shows the total score of different age groups. Most of the young age group (16-20) have in medium level. The middle age group (21-40), many of them are in high level. Most of the age group (21-40) and (41-70) are with high level score.

**Table (21) Total score according to Education level**

Score Education Level	Low score (0-10)	Medium score (11-20)	High score (21-30)	Total
Primary School	1 (25%)	2 (50%)	1 (25%)	4
Middle School	0 (0%)	7 (63.64%)	4 (36.36%)	11
High School	0 (0%)	27 (46.55%)	31 (53.45%)	58
University	1 (0.45)	81 (36.32%)	141 (63.23%)	223
Post Graduate	0 (0%)	2 (50%)	2 (50%)	4
<b>Total</b>	<b>2</b>	<b>119</b>	<b>179</b>	<b>300</b>

Source: Survey Data

Table (21) shows the total scores at different education levels. Majority of people in all five levels are in high score level. And education level 4 comprises the majority of people in high score.



**Table (22) Total score according to Occupation**

Score Occupation	Low score (0-10)	Medium score (11-20)	High score(21-30)	Total
Dependent people	1 (0.77%)	66 (50.77%)	63 (48.46%)	130
Odd jobs without steady income	1 (2.4%)	15 (32.61%)	33 (67.35%)	49
Government employees	2 (2.78%)	20 (27.78%)	48 (68.57%)	70
Company staff	0 (0%)	10 (33.33%)	20 (66.67%)	30
Business owners	0 (0%)	1 (11.11%)	8 (88.89%)	9
Retired people	0 (0%)	1 (50%)	6 (50%)	12
<b>Total</b>	<b>4</b>	<b>118</b>	<b>178</b>	<b>300</b>

Source: Survey Data

Table (22) shows the total scores at different occupation groups. Majority of people in high score level are from occupation group 1. Group 3 comprises the second largest number of people in high score level.

**Table (23) HBV status of unmarried candidates according to Age group**

Age group	Sex	HBV tested	HBV not tested	Total
16-20	M	6 (31.58%)	13 (68.42%)	19
	F	17 (51.51%)	16 (48.48%)	
21-40	M	14 (46.67%)	16 (53.33%)	30
	F	23 (48.94%)	26 (53.06%)	
41-70	M	2 (66.67%)	1 (33.33%)	3
	F	15 (45.45%)	18 (54.54%)	
<b>Total</b>		<b>77</b>	<b>90</b>	<b>167</b>

Source: Survey Data

Table (23) shows HBV testing status at different ages, gender and marital status. It is found out that there only a few people in all three age groups who have performed testing of HBV. HBV testing status in relation to marital status shows only single female is found out to get

tested. Among them singles from the middle age group are more likely to get tested for HBV.

**Table (24) HBV status of married candidates according to Age- group**

Age group	Sex	HBV tested	HBV not tested	Total
21-40	M	10 (58.82%)	7 (41.18%)	17
	F	23 (71.88%)	9 (28.13%)	32
41-70	M	13 (33.33%)	26 (66.67%)	39
	F	22 (48.89%)	23 (51.11%)	45
<b>Total</b>		<b>68</b>	<b>65</b>	<b>133</b>

Source: Survey Data

Table (24) shows HBV testing status at different age, gender and marital status. It can be seen that people in the young age group(16-20) are found out to be married. To compare the HBV testing status of married people in the middle and the elder age group, more people from the elder age group have tested for HBV. Form this table, there are no married candidates with HBV status until the age of 20.

**Table (25) HBV status of candidate according to sex & marital status**

Sex	Marital Status	HBV status		Total
		HBV tested	HBV not tested	
Male	Single	22 (42.31%)	30 (57.69%)	52
Female	Single	55 (47.83%)	60 (52.17%)	115
Male	Married	23 (41.0%)	33 (58.9%)	56
Female	Married	45 (58.44%)	32 (41.56%)	77

Source: Survey Data

Table (25) shows HBV testing status according to gender and marital status. It is found out that single females are more likely to get tested than single males. And married females are more likely to get tested than married males.



**Table (26) HBV vaccination status according to age group**

Age group \ Status	Vaccinated	Not vaccinated	Total
16-20	20 (38.5%)	32 (62.0%)	52
21-40	50 (39.1%)	78 (61.0%)	128
41-70	39 (32.5%)	81 (68.0%)	120
<b>Total</b>	<b>109</b>	<b>191</b>	<b>300</b>

Source: Survey Data

Table (26) shows HBV vaccination status in different age group. In all three age group, the medium age group (21-40) has the most number of people who have had vaccination. In general, number of people who get vaccinated is relatively few as for the all three age groups.

**Table (27) HBV vaccination status according to sex & marital status**

Sex	Marital Status	Vaccinated	Not vaccinated	Total
Male	Single	15 (28.9%)	37 (71.15%)	52
Female	Single	47 (40.9%)	68 (59.13%)	115
Male	Married	17 (30.4%)	39 (69.64%)	56
Female	Married	30 (38.9%)	47 (61.04%)	77
<b>Total</b>		<b>109</b>	<b>191</b>	<b>300</b>

Source: Survey Data

Table (27) shows HBV vaccination status according to gender and marital status. In this table, more of the single females are vaccinated than that of single males. And married females are more likely to get vaccinated than the married males.

**Table (28) HBV vaccination status of married candidates according to Age- group**

Age group	Sex	Vaccinated	Not vaccinated	Total
21-40	M	7 (41.18%)	10 (58.82%)	17
	F	15 (44.12%)	17 (53.13%)	32
41-70	M	10 (25.64%)	29 (74.36%)	39
	F	15 (33.33%)	30 (66.67%)	45
<b>Total</b>		<b>47</b>	<b>86</b>	<b>133</b>

Source: Survey Data

Table (28) shows HBV vaccination status according to age group and marital status. In this table, there are mainly occupied married people. So there is married person in the young age group (16-20) and the elder age group, more people of the married people in the elder age group is vaccinated.

**Table (29) HBV vaccination status of unmarried candidate according to Age- group**

Age group	Sex	Vaccinated	Not vaccinated	Total
16-20	M	5 (26.32%)	14 (73.68%)	19
	F	15 (45.55%)	18 (54.54%)	33
21-40	M	8 (26.67%)	22 (73.35%)	30
	F	20 (42.55%)	28 (58.33%)	48
41-70	M	2 (66.67%)	1 (33.33%)	3
	F	12 (36.36%)	22 (64.71%)	34
<b>Total</b>		<b>62</b>	<b>105</b>	<b>167</b>

Source: Survey Data

Table (29) shows HBV vaccination status according to age group and marital status. In this table, there are mainly occupied single people. It can be seen that singles from the middle age group (21-40) get more vaccination than the others groups. The young age group (16-20) is the group which has the second most number of people who get vaccinated.

**Table (30) HBV vaccination status according to Education level**

Status Education level	Vaccinated	Not vaccinated	Total
1	0 (0%)	4 (100%)	4
2	4 (25%)	7 (63.64%)	11
3	6 (13.64%)	52 (89.66%)	58
4	99 (42.67%)	124 (55.61%)	223
5	0 (0%)	4 (100%)	4
<b>Total</b>	<b>109</b>	<b>191</b>	<b>300</b>

Source: Survey Data



Table (30) shows HBV vaccination status at different education levels. It can be seen that among all five levels, education level 4 has the most number of vaccinated people.

**Table (31) HBV vaccination status according to Occupation level**

Occupation	Status		Total
	Vaccinated	Not Vaccinated	
1	48 (36.92%)	82 (63.08%)	130
2	12 (24.49%)	37 (75.51%)	49
3	25 (35.71%)	45 (64.29%)	70
4	13 (43.33%)	17 (56.67%)	30
5	5 (55.56%)	4 (44.44%)	9
6	6 (50%)	6 (50%)	12
<b>Total</b>	<b>109</b>	<b>191</b>	<b>300</b>

Source: Survey Data

Table (31) shows HBV vaccination status in various occupation groups. It can be seen that occupation group 1 has the most number of vaccinated people.

**Table (32) Full practice score according to Age- group**

Age group	Score	Full practice score		Total
		(+)	(-)	
16-20		14 (27%)	38 (73.05%)	52
21-40		40 (31%)	88 (68.8%)	128
41-70		33 (28%)	87 (73%)	120
<b>Total</b>		<b>87</b>	<b>213</b>	<b>300</b>

Source: Survey Data

Table (32) shows full practice score according to age group. The medium age group (21-40) comprises most of people who get full practice score. The elder age group (41-70) comprises the second most number of people who get full practice score. The young age group (16-20) has the least of people with full practice score.

## 5. Conclusion

Hepatitis B education messages should be conveyed to cover both rural and urban population by using local languages in clear and easily understandable format. Health education should be intensified especially directed to young people regarding the danger of addiction and sexual promiscuity. Health education should be widely spread to all people regarding the not all HBV infected show Hepatitis symptoms, HBV infection is not curable, there is no transmission by living together, through coughing and sneezing and by eating the food prepared by HBV infected people and babies born to HBV infected mothers can be breastfed.

Health education should be intensified directed to all people regarding the HBV testing and vaccinating much more do. Health education should be intensified directed to elder people regarding not present habit of sharing one spoon and bowl in serving at dining tables. Health education should be raise the awareness of Hepatitis B among general population as well as target population, Hepatitis B infection education talks were conducted at various levels by the Ministry of Health in collaboration with related sectors. Information and education messages were also raise through mass media such as TV sports, short messages and documentaries, movies and songs and through printed media such as daily newspaper, pamphlets, posters, stickers and billboards.

The Ministry should develop a coverage goal for the Hepatitis B vaccine birth dose, in the same way that goals have been set for the routine immunization coverage. The effective communication channel should be developed between the Ministry of Health and local and international social organizations that are actively participating in Hepatitis B infection prevention and control activities. Of these education programs involve more in encouraging preventive measures and also providing vaccine more available, including low price for vaccine, it can be sure that the prevalence of Hepatitis B will be very much reduced among population within the country.

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# SOCIO-ECONOMIC DEVELOPMENT THROUGH HUMAN CAPITAL INVESTMENT

## IN KANBAUK AREA OF TANINTHAYI DIVISION (1997-2008)

Yi Aye<sup>1</sup> and Htun Myint<sup>2</sup>

### Abstract

Kanbauk Pipe Line Corridor (PLC) area is located in Yephyu Township, Dawei District, Taninthayi Division in southern Myanmar. In 1995, **Yadana** Project has started exploration and production of natural gas in Mottama Gulf. Since then, Yadana Project has started implementing a Socio-Economic Program there as a part of its Corporate Social Responsibility. It is a good example of Public Private Partnership on sustainable social and economic developments of the host community. Time series data was used to analyze the impacts of the Socio-Economic Program over time on the social and economic developments through human capital investment in Kanbauk PLC area from 1997 to 2008. The findings revealed that the Socio-Economic Program provided not only financial and technical assistances to beneficiaries, but also changed them from the mere recipients of donation to the implementers of the community development activities and turned the vicious circle of human deprivation into a virtuous cycle of long-term growth and development in the area

**Key Words:** Yadana Project, Corporate Social Responsibilities, Public Private Partnership

### Introduction

Kanbauk Pipe Line Corridor (PLC) area is located in Yephyu Township, Dawei District, Taninthayi Division in southern Myanmar. It is 60 kilometers from Dawei in the south and 90 kilometers from Ye in the north. The major occupations of the area are farming and fishing. The ethnic made up of the region is fairly diverse. The population of the area is mainly composed of Dawei (subgroup of Myanmar national group), Karen and Mon. The coastal villages are mainly inhabited by Mon fishermen. Three villages in the center of the area, near the Dawei River, are occupied by Karen, usually Christians (Baptists). The other villages are dominated by Myanmar Buddhists. The largest city, Kanbauk, also has a small Muslim community and a mosque.

In 1995, **Yadana** Project (a partnership of TOTAL Exploration and Production – Myanmar; UNOCAL; Petroleum Authority of Thailand Exploration & Production; and Myanma Oil and Gas Enterprise) has started exploration and production of natural gas in Mottama Gulf. The extracted natural gas has been exported to Thailand, passing through Kanbauk PLC area.

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Since then, Yadana Project has started implementing a Socio-Economic Program (SEP) as part of its Corporate Social Responsibility (CSR) (Socio-Economic Program, 1998-2009). It is a good example of Public Private Partnership (PPP or P3) on sustainable social and economic developments of the host community. The said program officially covers 25 villages with an estimated population of more than 32,000 people. It is estimated, however, that the overall population benefiting from the program is over 50,000 people. It has assisted local community in the areas of sustainable social and economic development activities such as health, education, community development, agriculture and livestock breeding (veterinarian), infrastructure, and microcredit (Socio-Economic Program, 1998-2009).

Development is not only in growth in GDP of country but also increasing social status of the people in the country. Human Development Index is one of the development indicators. Human capital plays an important role in development on both individual and aggregate level.

Yadana's Socio-Economic Development Program has been implemented in Kanbawk PLC area for over a decade. The development in the area may be due to SEP's investment in human capital, that may have impact on regional development. Improvement in social and economic sectors directly affects the quality of life and well-being of the community. This research performs time series analysis and quantifies the impacts of social and economic developments through human resource investment. The policies, strategies, and best practices of the program could be used to apply in other rural areas of Myanmar where applicable.

The objective of the study is **to review and analyze the impacts of SEP over time on the improvement in social and economic services through human capital investment in Kanbawk PLC area from 1997 to 2008**. The study used descriptive method using time series data of Kanbawk PLC area from 1997 to 2008.

The rural development activities, outcome and impacts were reviewed and analyzed to determine improvement. The social development of the area were also compared with national data to determine **comparative** improvement. The comparisons of the trends of social status with those of Myanmar using double difference method was recommended by the World Bank (World Bank, 2007).

The study applied time-series secondary data were mainly from Yadana Project's annual reports, relevant data from current Socio-Economic Program, Public Health Office, and national data from Central Statistical Organization (CSO).

### **Socio-Economic Development in Kangauk PCL Area**

Before SEP started implementing in the Kanbawk PLC area, there were rampants of human deprivation including illiteracy, malnutrition, and poor access to water and sanitation in the area (TOTAL, 2009). Therefore the SEP has tried its best to meet the needs of the residents while respecting their culture and way of living. Its priorities, which were defined with the villagers, focus on four key areas: economic development, health, education and infrastructure. Its success comes from the commitment of the villages and villagers, since it must drive a sustainable improvement in living conditions throughout the region. It also provides enabling environment for community empowerment by allowing community in decision making. All members of the Socio-Economic Program are Myanmar nationals and all the related projects



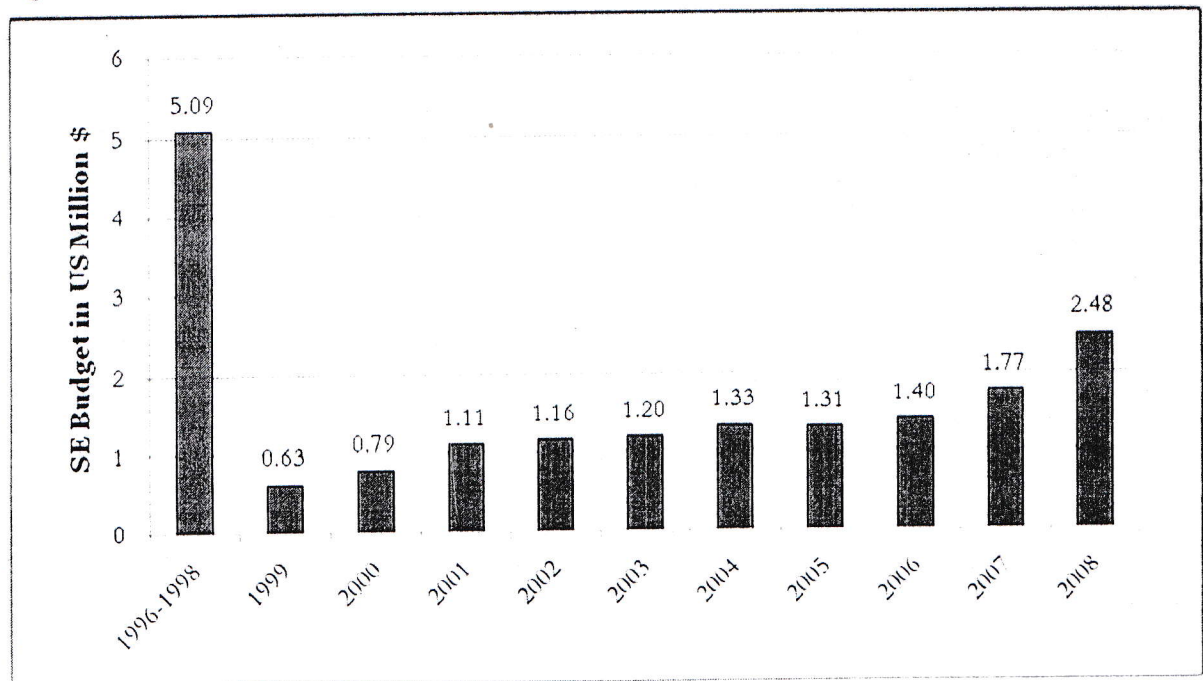
(e.g., health clinics, schools, transportation infrastructure) are owned by the local communities concerned or by the villagers themselves (agricultural and small business projects) (TOTAL, 2009).

As a support to agricultural and veterinary activities, the Socio-Economic Program provides technical assistance (4 veterinarians, 3 agronomists and 32 auxiliaries), vaccination program, supply of plants, and fertilizers to the villagers. Model farms (pigs, poultry, perennial crops, plantations) have been established. The microcredit scheme (more than 5,000 beneficiaries since 1997) has been running successfully. As a result, production and productivity have been increasing in the area, successful development of many small farm operations, support given to fishing and small business, and general improvement of living conditions have been observed in the area. Regarding infrastructure, complete revamping of the local road network, health and educational facilities, irrigation and drinking water supply programs, renovation of community facilities such as meeting rooms, soccer fields, markets, churches and pagodas have been built (TOTAL, 2007).

### Investment of Socio-Economic Program

The Socio-Economic Program invests heavily in SEP's budget, especially on the human capital, since the beginning of the project and spending increases substantially. In 2008, Socio-Economic Program spent US \$ 2.48 million (figure 1). It is a good example of Corporate Social Responsibility (CSR) – multination corporation (MNC) serving the community where it does the business. The trend of annual budget on SE program can be seen as follow:

Figure 1: Annual budget for Socio-Economic Program (US \$ Million), 1996 to 2008



Source: Annual reports of Yadana's Socio-Economic Program (1997-2008)

## Public Health Activities of Kanbauk Socio-Economic Program

Since 1995, Socio-Economic Program (SEP) has been implementing Primary Health Care (PHC) program along the pipeline corridor villages in order to improve health status of local people as well as to build a high level of trust and confidence with them aiming to achieve community empowerment. The aim of the activities of the health sector in the program is "promoting health and preventing diseases by balance of preventive and curative services". The objective of program is to reduce mortality and morbidity of local people by providing the requisite facilities, promoting immunization programs, introducing free medical consultations and public health supervision for the villagers, and improving hygiene. These initiatives, which were funded by Yadana Project, had been carried out in close collaboration with the Ministry of Health.

The SEP's PHC program consists of medical care, health education, immunization program for children under one year and pregnant women, and birth spacing, annual school health program, distribution of insecticide treated (impregnated) bed nets (ITNs) program for malaria control, village sanitation program for control of food and water borne diseases – FWBD (by construction of fly-proof latrines, concrete water well boundaries construction, chlorination of water wells and hilly stream water supply), tuberculosis control program and hospital referral program. Today, ten medical doctors: a public health supervisor and 9 public health (village) doctors, are working in Kanbauk area representing 34 doctors per 100,000 population, increased eleven times - from three doctors per 100,000 population in 1995 (TOTAL, 2009).

Moreover, as the capacity building, SE program has trained local people interested in health as healthcare volunteers such as community health worker (CHW) and auxiliary midwife (AMW) in each village for provision of services to their people (TOTAL, 2009). CHWs were trained to address minor ailments at village level, and to promote safe practices in local population. AMWs are also able to assist in child delivery and address minor ailments. During absence of the doctor, CHWs and AMWs provide consultations in village clinics, that villagers have been encouraged to build with the support of SE program. The SE Program has also provided monthly incentives to 20 AMWs and 35 CHWs.

For long-term sustainability of health status of local people, community participation, involvement, and empowerment are very important in public health services and it is enhanced by initiation of SE program's Public Health team. SE program's Public Health team moved forward an optimum balance among comprehensive and integrated health care (promotive, preventive, curative, and rehabilitative) activities in public health program and started to initiate community-based health care system.

### Trends in health status

Health conditions in the Kanbauk PLC area were said to be poor prior to the arrival of the Socio-Economic Program. It had had high infant mortality rate (IMR) and maternal mortality ratio (MMR), widespread malaria, tuberculosis, poor water quality and bad sanitation facilities. Health staff appointed by the government was minimal and the only health infrastructure was a station hospital in Kanbauk which had lacked necessary resources (TOTAL, 2009).

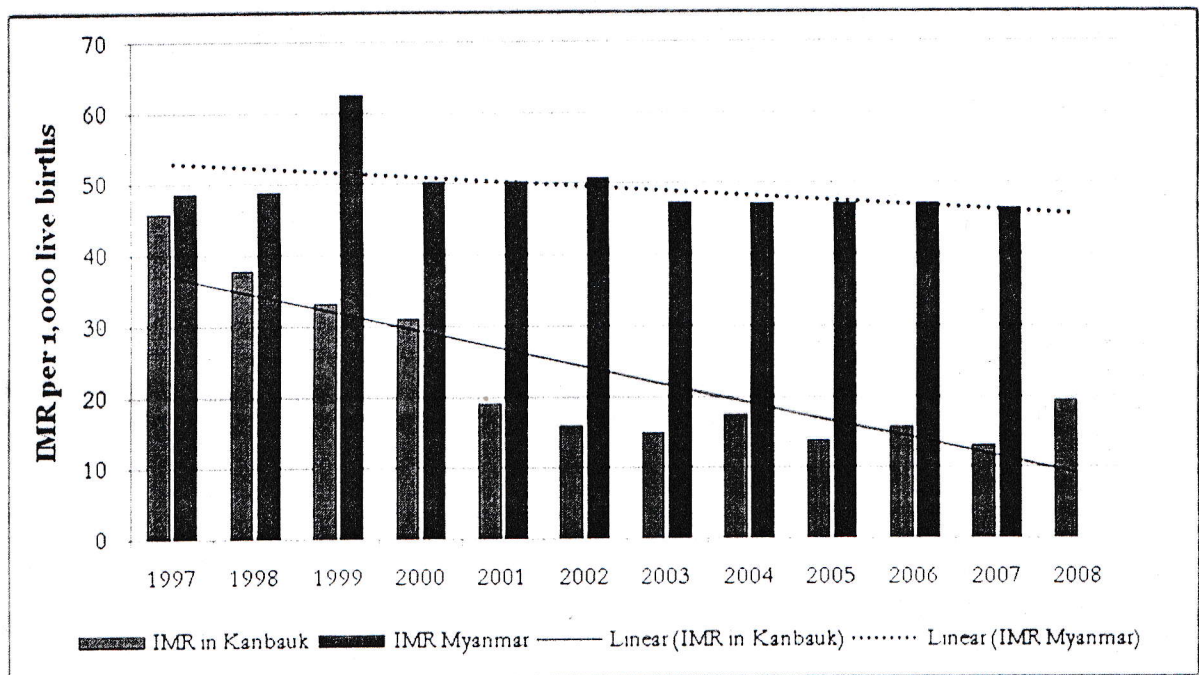


### Infant mortality rate (IMR)

Infant Mortality Rate (IMR) and Under-Five Mortality Rate (U5MR) are important basic health indicators for a nation. **IMR** is the single most sensitive indicator of the **socio-economic** situation in any given community. There was a steady downward trend of IMR in Kanbauk PLC area for more than 10 years (until last year) from 45.7 per 1,000 live births in 1997 to 13.1 per 1,000 live births in 2007 – a decline of more than 71 percent in 10 years. The IMR of Kanbauk area has already achieved the Myanmar's MDG target (28.3/1,000 live births in 2015) (Ministry of National Planning and Economic Development, 2006) since 2001. However, the IMR went back to 19.5 per 1,000 live births in 2008.

During the same period, Infant Mortality Rate was not markedly changed nationally. National IMR fluctuates around 50 per 1,000 live births (TOTAL, 2009). The IMR of Kanbauk area declined much faster and steeper compared to national levels (figure 2).

Figure 2: Infant Mortality Rate (IMR): comparison of trend in Infant Mortality Rate in Kanbauk PLC area with that in Myanmar, 1997 to 2008



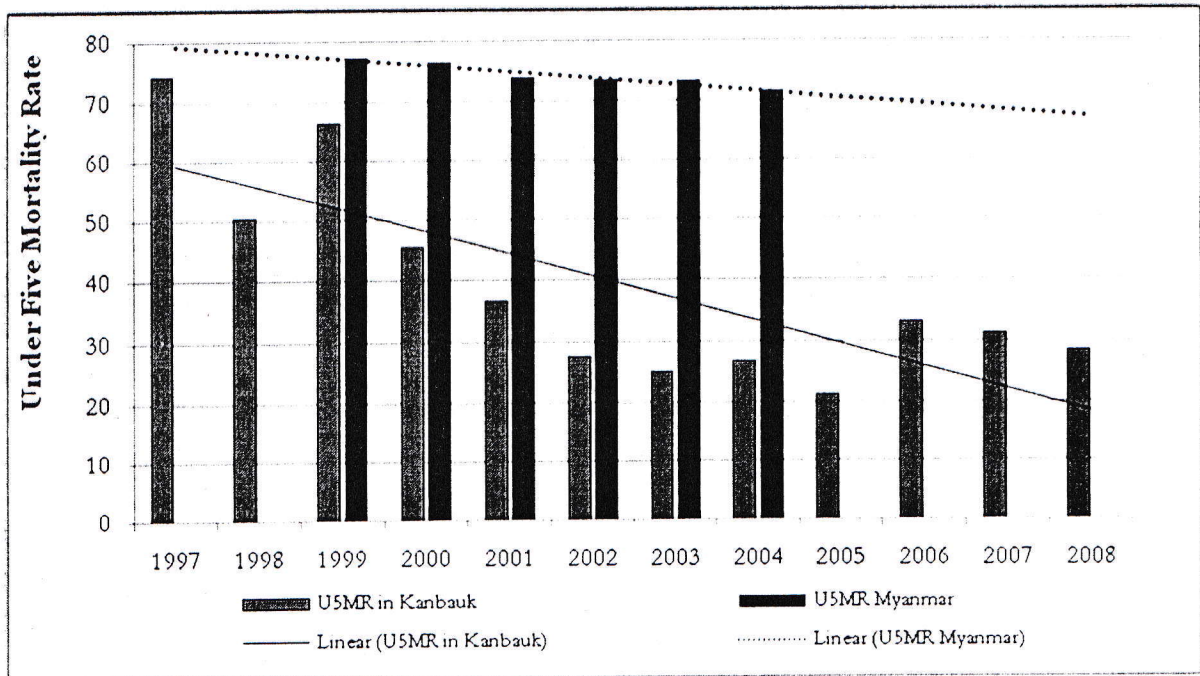
Source: Annual reports of Yadana's Socio-Economic Program (1997-2008) and CSO's data

### Under five mortality rate (U5MR)

There was a steady downward trend of Under Five Mortality Rate (U5MR) in Kanbauk PLC area from 74.3 per 1,000 live births in 1997 to 21.3 per 1,000 live births in 2005 – a decline of over 70 percent in 8 years. The U5MR of Kanbauk PLC area has already achieved the Myanmar's MDG target (38.5/1,000 live births in 2015) (Ministry of National Planning and Economic Development, 2006) since 2001. However, the U5MR went back to 33.1 per 1,000 live births in 2006 and stays around 30 per 1,000 live births since then.

U5MR was well below national level of over 70 under five deaths per 1,000 live births in the same period (figure 3).

Figure 3: Under Five Mortality Rate (U5MR): comparison of trend in Under Five Mortality Rate in Kanbauk PLC area with that of Myanmar, 1997 to 2008



Source: Kanbauk PLC area Public Health Office data (1997-2008) and CSO's data

### Maternal mortality ratio

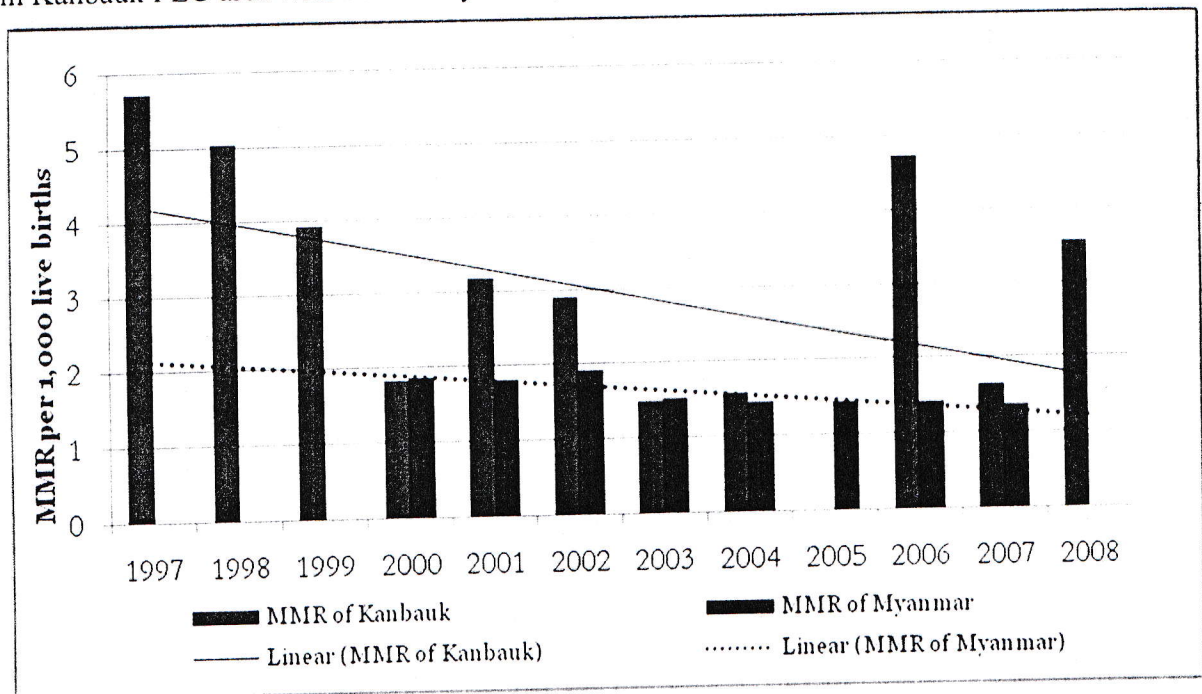
Maternal Mortality Ratio (MMR) is a very sensitive indicator of **quality of health services**. It also reflects the **overall status of the health** of any population.

There was a steady downward trend of maternal mortality ratio (MMR) for more than 10 years from 5.71 per 1,000 live births in 1997 to 1.64 per 1,000 live births in 2007 – a decline of more than 70 percent in 10 years. However, the MMR went back to 3.55 per 1,000 live births in 2008. The current situation was five times higher than the Myanmar's MDG target (0.58/1,000 live births in 2015 for rural area) (Ministry of National Planning and Economic Development, 2006).

Although there was a steady downward trend of maternal mortality ratio (MMR) for more than 10 years in Kanbauk PLC area, it was still much higher than national level of about 1.5 maternal death (or pregnancy related death) per 1,000 live births (figure 4).



Figure 4: Maternal Mortality Ratio (MMR): comparison of trend in Maternal Mortality Ratio in Kanbawk PLC area with that of Myanmar, 1997 to 2008



Source: Kanbawk PLC area Public Health Office data (1997-2008) and CSO's data

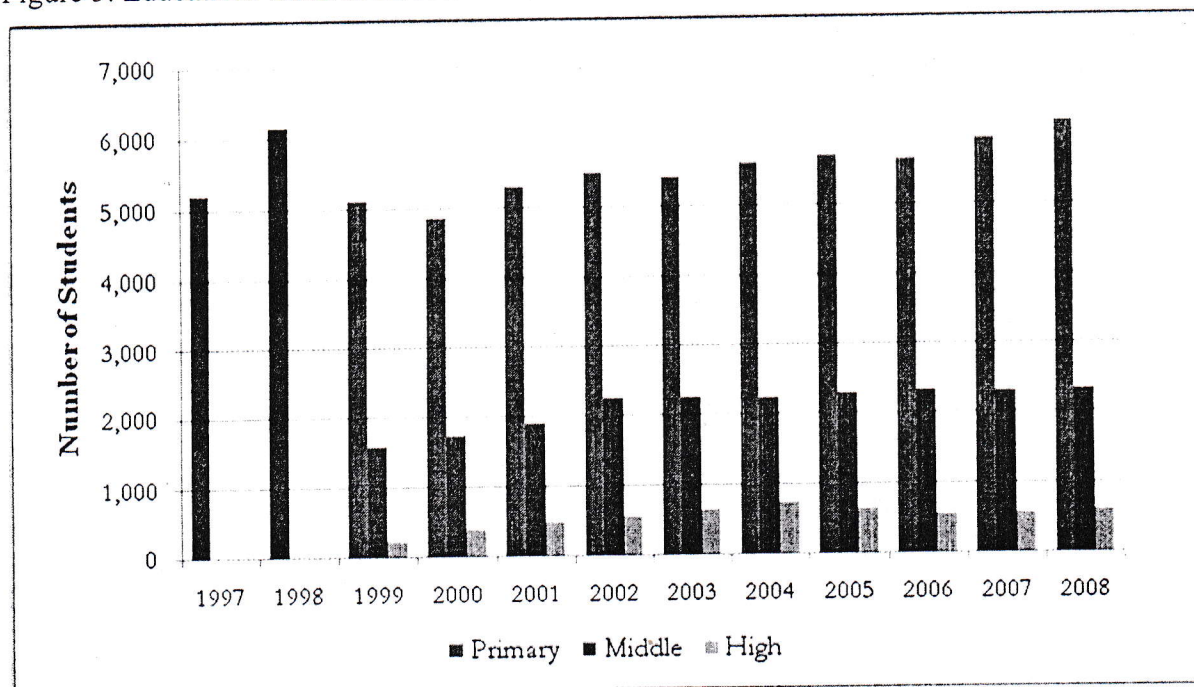
### Education For All (EFA)

Myanmar attains the high education status in Asia Pacific region and education level of Myanmar was 94.89% in 2009 (Ministry of Education, 2009). According to a finding from the household survey conducted in Kanbawk PLC area in 2008, the area also has a high adult literacy rate of 92.29% (Tun Myint, 2008). Equity in access to education was also observed: only small difference in the education status was seen among males and females - 96.9% among males and 87.9% among females with a less than 10% difference (Tun Myint, 2008).

### Total student enrollment

Villagers living in the Kanbawk PLC area showed strong aspirations in education. An extensive program to improve the region's educational infrastructure was launched in 1996 and now, each village has at least one school. Teaching materials have been supplied by the Socio-Economic Program and a school library program has been established in 16 schools. During early years, 44 schools were constructed and 20 were renovated. The basic education student enrollment has increased gradually from 5,210 in 1997 to 9,110 in 2008 (an increase of 78% in 11 years period) (figure 5).

Figure 5: Education: trend in student enrollment in schools in Kanbawk area, 1997 to 2008



Source: Annual reports of Yadana's Socio-Economic Program (1997-2008)

### Student-Teacher Ratio (STR) and scholarship program

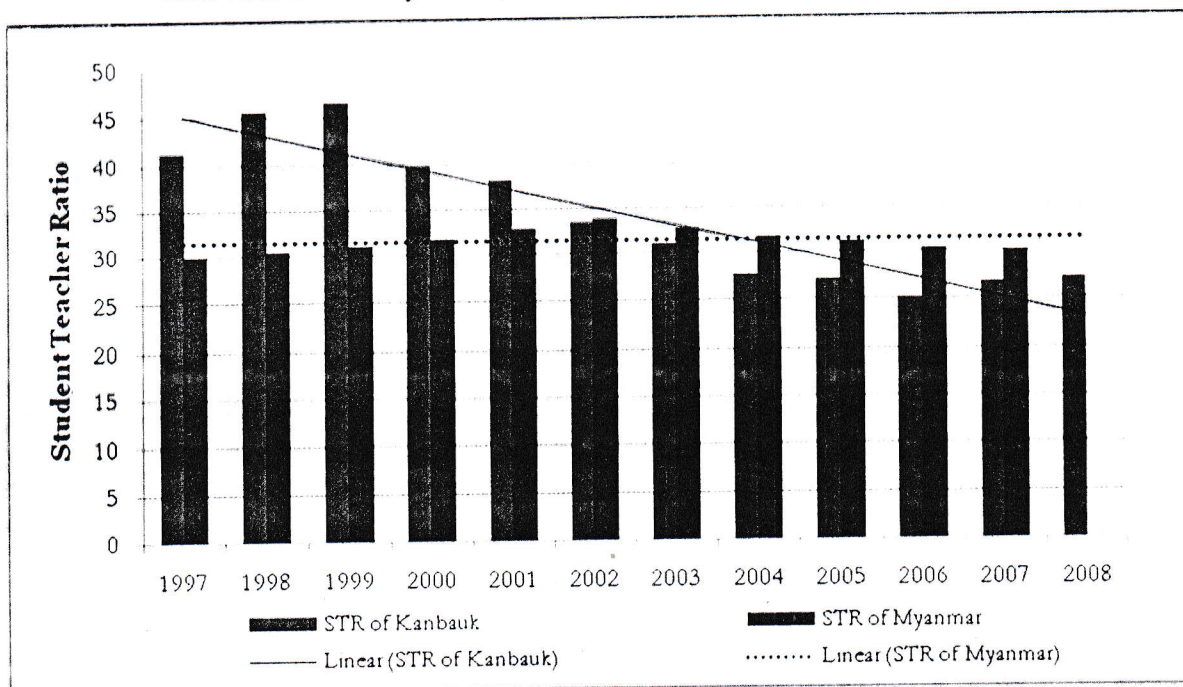
The measures designed to support education were implemented in collaboration with the Ministry of Education in-line with local practices and programs. The school teachers are civil servants paid by the Ministry of Education. To enable teachers to encourage serving in remote regions and maintaining an acceptable standard of living, salaries are supplemented with financial aid granted for over 350 teachers and assistants by the Socio-Economic Program.

The student-teacher ratio (STR) was down from more than 41.3 students per teacher in 1997 to 27 students per teacher in 2008. While the student-teacher ratio of the nation has been stable around 30 students per teacher for decades, it was prominent that the STR in Kanbawk area has improved significantly (figures 6).

Once they had their high school diplomas, young people who wanted to continue their studies were supported by scholarships program that had allowed some students to go on to higher education in Yangon and Dawei. The numbers of scholarship recipients for college/university education had grown gradually, from four students each for 2003 to 2005, five students in 2006, six students in 2007, and 13 students in 2008.



Figure 6: Education: Comparison of trends of Student-Teacher Ratio (STR) in Kanbauk area with that of Myanmar, 1997 to 2008



Source: Annual reports of Yadana's Socio-Economic Program (1997-2008) and CSO's data

### Key Findings

The trend of gradual increase in annual SEP's budget was seen since its inception in 1997 and the budget for 2008 was US \$ 2.48 million. Due to increase in SEP's investment in human capital, the parallel and significant health development has also been seen in Kanbauk PLC area.

IMR declined from 45.7 in 1997 to 13.1 in 2007 per 1,000 live births - a decline of more than 71 percent in 10 years, although recent increase to 19.5 deaths per 1,000 live births was seen in 2008. IMR was still well below national level of around 50 infant deaths per 1,000 live births and it has already achieved the Myanmar's MDG target since 2001.

U5MR also declined from 74.3 per 1,000 live births in 1997 to 21.3 per 1,000 live births in 2005 - a decline of over 70 percent in 8 years. U5MR was well below national level of over 70 under five deaths per 1,000 live births and it has already achieved the Myanmar's MDG target since 2001.

MMR declined from 5.71 per 1,000 live births in 1997 to 1.64 per 1,000 live births in 2007 - a decline of more than 70 percent in 10 years. However, MMR of Kanbauk area was much higher than national level of about 1.5 maternal deaths per 1,000 live births and five times higher than the Myanmar's MDG target of 0.58/1,000 live births in 2015 for rural area.



The adult literacy rate in Kanbawk area was 92.29% in 2008. Only small difference in the level of education was seen among males and females: 96.9% among males and 87.9% among females, less than 10% difference.

The basic education student enrollment has increased from 5,210 in 1997 to 9,110 in 2008 (an increase of 78% in 11 years period). At the same time, the student-teacher ratio from more than 41.3 students per teacher in 1997 to 27 students per teacher in 2008, an improvement of 35% in 11 years.

## Discussion

Increasing public resources for human capital investment especially in health and education poses critical challenge in government financing. Alma-Ata declaration promoted health as a tool for socio-economic development of a nation. It requires multi-sectoral approach and health is expressed as not just an 'output' of economic development, but also an important 'input' to development (Primary health care: Alma-Ata). Although, Government of Myanmar now acknowledges building human capital as "investments" than simply "expenditures", it remains one of many competing priorities for government revenues and therefore limited.

In Kanbawk PLC area, fortunately, Yadana Project's Socio-Economic Program activities filled the gap by investing in human capital to promote social development. The findings revealed that social development and improvements in the quality of life of people in Kanbawk PLC area by investing in human capital has led to access to free health care for the community and a dramatic decline in the leading causes of death; and better educational opportunities and conditions for all children, along with other economic opportunities. The approach also invited local beneficiaries in the process of development with the concept of community participation, ownership, empowerment, and sustainable development. The impacts of the program has accelerated economic growth, achieved equitable and balanced development, and reduced the socioeconomic development gap between Kanbawk and urban areas. Social spillover effects were also seen in Kanbawk PLC area. Social spillover effects are externalities of social development upon those who are not directly involved in SEP's activities.

The findings of the study were compared with the results of a cross-sectional survey conducted by the public health consultant in April 2008 in Kanbawk area. A total of 1,627 respondents from 291 households were interviewed regarding practices of health-related issues and heights and weights were measured to observe the health status of community (Tun Myint, 2008). The findings were similar to the trends of the findings of socio-economic development mentioned in previous parts of this paper.

To be able to achieve Integrated Rural Development, we may have to escape from the vicious cycle of various poverty creating forces (cumulative causation) and change it to virtuous cycle (Myrdal, 1968). Making social development through investing in human capital in the Kanbawk PLC area has cut and escaped the vicious cycle of human deprivation. The SEP has shown not only the impacts on social development but also the community participation, ownership, empowerment, and sustainability, as these activities have already built in the program.



However, due to increase in IMR, U5MR, and MMR in recent years, the quality and quantity of maternal and child health (MCH) activities should be enhanced. It is also recommended that due to contradictory findings of better results of IMR and U5MR and worse situation of MMR of Kanbawk PLC area compared to national level data request future detailed analysis of causes and effects, both qualitatively and quantitatively.

### Recommendations

The SEP has shown a dramatic improvement of social conditions in Kanbawk area. The lesson learned was that SEP provided not only financial and technical assistances to beneficiaries, but also trained the local community; changed them from the simply recipients of donation to the decision makers and implementers of the community development activities; or let them stand on their own by training them those of community participation, ownership, empowerment, and sustainability issues. The SEP has created enabling environment for the community to become partners, decision makers, and implementers of their community affairs. The SEP played important role in improving social development (health and education) in the area.

### Conclusion

In conclusion, the Socio-Economic Program has demonstrated a constant commitment to local community and host country by applying the principles of Corporate Social Responsibility (CSR) and Public Private Partnership (PPP). The impacts were quite promising in the area of Integrated Rural Development (IRD) and regional development. The findings revealed and confirmed the effectiveness of the program by showing improvement in social status of the community. Other portions the Socio-Economic Program including development of agriculture and veterinary services, infrastructure development, community development, and microcredit provide more fruitful and integrated impacts in the community.

The impacts of the social development through human capital investment in Kanbawk PLC area by Socio-Economic Program has turned the vicious circle of human deprivation into the creation of an environment conducive to entrepreneurship, long-term economic growth, basic health and education – a virtuous cycle of long-term growth and development in the area. Application of such policies, strategies, and best practices with the concepts of PPP and CSR to other rural areas of Myanmar where multinational corporations (MNCs) are doing business after fine-tuning, adjusting, and customizing according to local context would help in building Myanmar as a new, modern, and developed nation.

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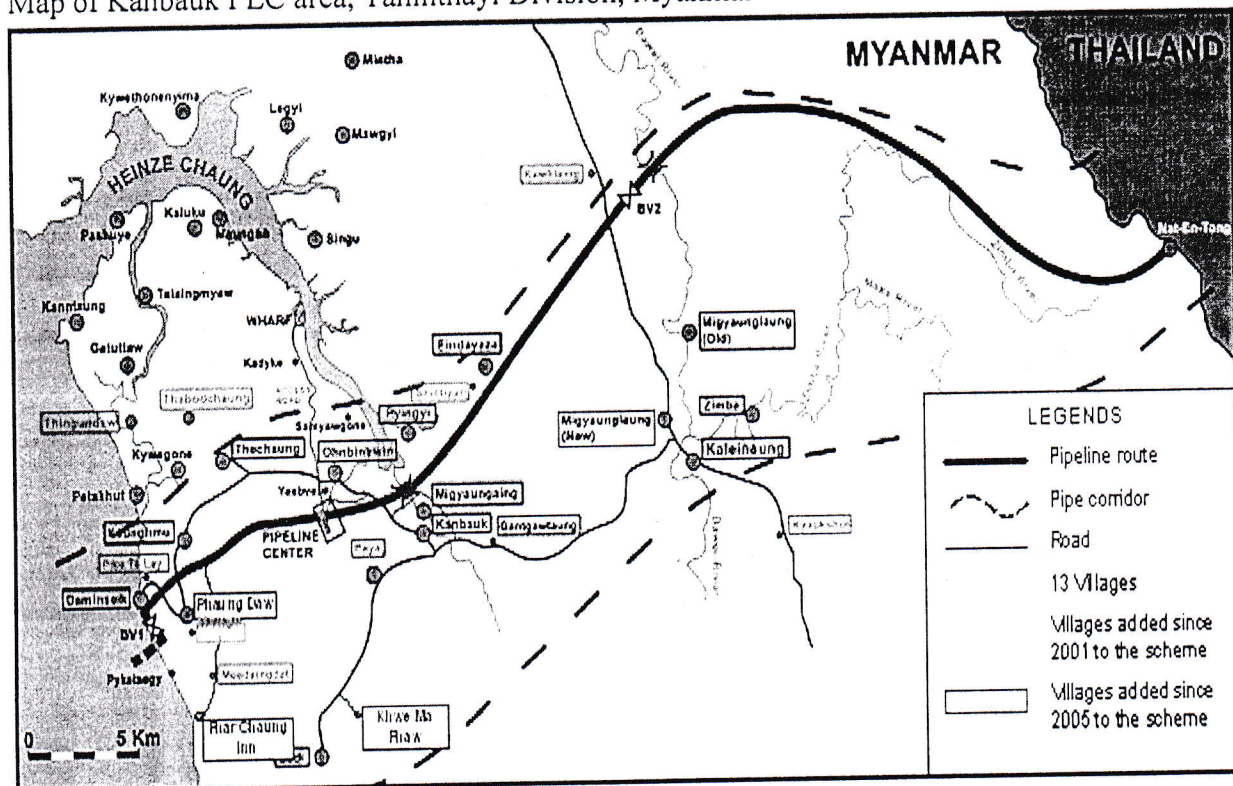
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### Appendix

Map of Kanbawk PLC area, Taninthayi Division, Myanmar



Source: Annual report 2008 by Socio-Economic Program of Yadana project



# Demand for MaHtaTha<sup>1</sup> Bus Lines Transportation Services in Yangon City (1988-2007) Thida Oo<sup>2</sup>

## Abstract

An attempt has been made in this paper to construct a transportation demand model for the services of MaHtaTha passenger bus services in Yangon City from 1988-89 to 2006-2007. Ordinary Least Squares (OLS) method is used. Among all the fitted trend models, the best estimated forecasting model is Sigmoid (S) curve trend model. The adjusted multiple regression results show that the passengers (demand) depends on the number of MaHtaTha's Buses, time (year) and on average MaHtaTha bus's fare. In Yangon, the development of city gives rise to the increase in passengers (demand) that was fulfilled possibly by increasing the number of MaHtaTha's buses. Time (Year) was found to have a positive effect on the passengers (demand). Another important finding of the analysis was the negative impact of MaHtaTha bus's fare as expected.

**Keywords:** transportation demand model, Ordinary Least Squares (OLS), Sigmoid (S) curve trend model.

## 1. Introduction

### 1.1 Rationale of the Study

Transportation is basic means of moving goods and people from one place to another. Transportation is essential in the operation of a market economy, which efficient in system can improve the productivity of the economy. Transportation also has broader role in shaping development and environment.

Transportation is linking the physical movement of people and goods between points. Transport is one of the parts of production. The product commodities need to be transported to the required destination within the specified period. The delays occurred will effect the production. It is important that the raw materials are to be transported to the required destination within required time. Transport from one place to another will occur as value to products. The easy transport will benefit the spreading of market.

Transportation system will affect the price and easy transport will cause a saving on the market price and also have an effect on the low cost of production. On the other hand the low cost of transport will minimize the production cost, and because of the low transport cost the commodity are going to the consumer directly and the consumer's price is reasonable and it will result in consumer's price falling at market. Determination of price stability and economic development depends on transportation.

There are two categories of transport functions ie, cargo transport and passenger transport. The cargo transport includes raw materials of product, finished goods, consumer goods, luxury goods, agricultural products, and capital products etc. The cargo needs to be transported to required place at the required period, easily and quickly.

The passengers transport includes the passenger's transport services of working peoples, government servants, skilled labours, technicians, schools boys and girls. The passengers

<sup>1</sup> Ma Hta Tha in Myanmar language stands for Control Committee for Various Bus Lines in Yangon

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transport services contributes to the passengers travel in the required period to the required destination without harm.

In the regions there are different types of geographic areas, and the national resources are also different according the location. In order for the smooth and timely flow of the national resources there should be better transport systems. If the communication of regions to other regions is quick by smooth transport the regional development can enable the economic development to prosper and the transfer of labour forces also occur and the industrial development zones can be established. That shows that in order to get to an economic development stage of a country, and also in order to achieve the social development there should be an efficient transport system which is the main sector for all round development.

### **1.2 Objectives of the Study**

There is direct relationship between the development of a country and the development of transportation. In order to move the State Owned Economics Enterprise to private sector the transport sector is one of the important sectors.

1. To construct a small transportation demand model for the services of MaHta Tha passenger bus line in Yangon City.
2. To explore the relationship between passenger transportation and passenger transportation demand determinant.

### **1.3 Scope of the Study**

This study is focused on MaHta Tha passenger bus line in Yangon City from 1988-89 to 2006-07. During 1972 some of the bus line were organized by private owners and formed as Yangon Division Buses Central Committee (MaHta Tha). Yangon City passenger transport was mainly managed by Road Trade Transport Corporation (RTC) and MaHta Tha bus line. After 1988, there were extension of new townships and the road communication routes also became longer. There are fifteen bus lines in passenger transportation in Yangon City. MaHta Tha bus line has biggest number of passenger in Yangon City transport.

### **1.4 Methodology**

The statistical methodology employed in developing forecasting models for the passengers (demand) for MaHtaTha's buses services in Yangon city is estimated by the method of Ordinary Least Squares (OLS). Among all the fitted trend models, the best estimated forecasting model is Sigmoid (S) curve trend model. The adjusted multiple regression results show that the passengers (demand) depends on the number of MaHtaTha's Buses, time (year) and on average MaHtaTha bus's fare.

### **1.5 Organization of the Study**

The paper is organized in five chapters. Chapter one gives a brief introduction giving reasons for this study, the objective of the study, the scope of the study, and the methodology will be included. Chapter two contains the general view on transportation such as general significance of transportation, transportation and economic development, demand and supply of transportation. Chapter three contains background on Ma Hta Tha Bus Line in Yangon City transportation. Chapter four contains the Model of demand for Ma Hta Tha Bus Line transportation. It includes the model and empirical specification, the data and estimation methodology, the empirical results and finding and results for the passengers (demand of Ma Tha Bus Line in Yangon City. Finally chapter five conclude with finding.



## **II The significance of the transportation**

Our daily journeys to and from work, shopping centers, or university classrooms involve transportation. Every product we consume has been transported, usually several times, before it gets to us. Even the services we consume would be impossible without transportation of tools, repair parts, or other means of producing services.

In a more general way, transportation is an important part of our culture and heritage. It played a pivotal role in the discovery, settlement, and development of our nation. The freedom and mobility of our people, literally a nation on wheels and a people ever curious to see new places and ever anxious to undertake new tasks, is based upon efficient transportation.

### **2.1 General significance of transportation**

Much of our social and cultural unity is based upon the existence of adequate transportation. Society is a blend of many regional and local viewpoints and traditions growing out of differing heritages, environments, and problems. International contracts through travel and the exchange of goods promote the interchange of ideas and the breakdown of parochialism, thus encouraging an upward uniformity in tastes, health, education, and way of life in general.

Likewise, efficient transportation makes it possible for large geographic areas to be politically unified. Cultural similarity, mutual understanding, and the economic interdependence brought about by large-scale inter-regional trade reduce tendencies toward isolationism, while the ability to communicate rapidly makes unification administratively feasible.

### **2.2 Transportation and economic development**

Several basic elements are necessary for substantial economic growth. Three of these are adequate transportation system, an adequate system of communication, and a flexible source of energy or power. Our primary concern is with adequate transportation. The transportation system is an integral part of production and distribution. Both large-scale production and mass distributions are necessary for economic development. Neither is possible without efficient and relatively cheap transportation. Transportation is the very foundation of economic development.

Economic significance of transportation is that it provides a foundation upon which the economic growth of a nation progresses. Therefore, who make decisions affecting transportation, whether private transport company managers, public officials, or users of transport services, have great social responsibilities.

Economists use three different arguments to link transportation to economic growth. The first is a macroeconomic view that looks at economic indicators and finds correlations to transportation investment and efficiency. The second is a microeconomic perspective that considers that actions of specific companies in response to improvements in transportation services or reliability. The third is an equilibrium model that argues that improved transportation allows for economic specialization, with trade leading to prosperity. While these arguments each have distinctive bases, they share the view that better transportation leads to economic prosperity. Transportation allows for economic specialization, with trade leading to prosperity. While these arguments each have distinctive bases, they share the view that better transportation leads to economic prosperity.



### 2.3 Demand and Supply of transportation

Transportation and the marketplace for transportation function can be studied with demand for transportation and supply of transportation. **Suppliers** are the railroads, airlines, public transit systems, and so on. '**Demand**' for transportation is people wish to travel, for any number of reasons, and they are the people (or firms or governmental agencies) desiring to ship messages and freight. These users pay to use our transportation system. As expenditures by individuals and others on transportation total nearly 20 percent of our nation's gross national product.

When discussing transportation demand, the terms *disaggregate* and *aggregate*. Disaggregate demand is the demand of a single traveller or the shipper of a single piece of freight. Aggregate demand is all these individual demands added together.

### 2.4 Demand for Personal Transportation

Personal travel can be understood, somewhat, by behavioural analysis, that is understand the various "forces" at work influencing one's decision to travel. Depending on a combination of "situations." one makes the travel decision. There are five different types of situational factors influence the personal travel decision.

1. Physical surroundings including the weather, and conditions at the trip's origin, destination, and in between.
2. Social surroundings such as travelling alone, with associates, or family.
3. Temporal, or time, perspective: length of trip, time from now until departure, time pressures.
4. Major purpose of trip.
5. " State " of passenger: anxious, nervous, ill.<sup>3</sup>

Nearly all personal travel is influenced by the prices called *price elasticity*.

We deal with the demand for goods in a specific geographic location. The price of the goods in the marketplace includes the transportation costs of moving them there. It also includes any other transportation costs associated with their assembly. In freight transportation, there is usually slightly less concern about time savings than is the case for passenger transportation because:

- a. time has a different value for the traveller than for the owner of goods.
- b. in passenger transportation, time is usually counted in minutes and hours; in goods transportation, it is counted in hours and most frequently in days.
- c. freight transportation operations are performed continuously day and night whereas, in most cases, the goods to be carried are produced during working hours.
- d. shortened delivery time must meet other requirements, such as reliability, security, and regularity of deliveries.

## III Background on Ma Hta Tha Bus Line in Yangon City Transportation

### 3.1 City Road Transportation in Yangon

The population of Myanmar is spread over seven states and seven divisions and is estimated at 56.68 million in 2006-2007 of which 12% lived in greater Yangon, 22% in urban area and 71 % in rural area.

Yangon division is located in the lower Myanmar, commercial areas and the most important urban centre of the whole country. The urban expansion of the large built up areas has been

<sup>3</sup> James M, Daley, Raymond W. Laforge, and Clifford E. Young, " Situational Influences affecting Consumer Travel Behavior, " Proceeding, 1985 Transportation Research Forum, pp. 169-174.



carried out many times by creation of new sectors added to the existing layout. It is formed with four districts, which are Yangon East District, Yangon West District, Yangon North District, and Yangon South District. There are 33 townships under the Yangon City Development Committee (YCDC) and 12 townships in the regional area outside the YCDC zone of influence.

Under the government of State Law and Order Restoration Council the new satellite townships such as Shwepyitha, Hlaingtharyar, South Dagon, North Dagon, Shwepaukkan, Waibarge were extended and government servants were given plots of land, rendering the transfers of townships and urban areas to new towns associate with secluded land, and new bus lines that were commenting passengers from the year 1990.

### **3.2 The Nature of Commuter in Yangon**

In order to perform the office duties, and to do the daily social affairs of the societies, buses are used for travelling. The road transport facilitates easy access to commercial business, office affairs, juridical affairs, super markets, big store shops, training course etc. In Yangon, Sule Pagoda road, Shwedagon Pagoda road, junctions of Myaynegone, junction of Hledan, junction of 8 miles are major commuter mode of transport. The Sule surroundings are much bigger than other places because there are many office, business and trading centre concentrated in the area.

The extensions of new towns enable industrial zones, to be set up and the population is spreading proportionately in towns and new towns areas. Hence, the populations over crowding in downtown area are automatically avoided.

### **3.3 Transportation Management in Yangon City**

The State Law and Order Restoration Council had declared that among its principal objectives and tasks, the improvement of roads and communications had a vitally important role. With the establishment of new towns and the expansion of the city highways to the city were constructed to facilitate travel for the masses living in the new towns, and to assist in the development of economic enterprises. Thus there are now highways into the city, some expanded from old existing roads and others which were newly constructed.

### **3.4 Types of Road Transport Service Groups**

During the era of State Revolutionary Council (1962), the private transport bus lines were nationalized by the government and from that time onwards, road transport was under the control of government. During 1972 some of the bus lines were organized by private owners and formed as Yangon Division Buses Control Committee (MaHtaTha).

### **3.5. Demand of MaHtaTha Bus Lines in Yangon City**

For Yangon city passenger transport was mainly managed by Road Transport Corporation (RTC) and Yangon Division Buses Control Committee (MaHtaTha). After 1988, there were extensions of new townships and the road communication routes also became longer. Because of market economic system there occurred new jobs opportunities and the travelling of passengers rose more than before.

When road transport was managed the by government, transport business suffered from sustained losses. After 1972 the bus lines were transferred to private sectors gradually. For the State own transport bus lines, instead of running passengers transport service. Themselves,



they only allowed services to private sectors as charter system. The charter of buses to private sector paused for the way the participation of private associations that kept growing to the present level.

After 1990, the Yangon city passenger transport service was strengthened with the extension of each lines as Thanmyanthu, Pyaykhaingphyo, Shweinnwa, City Municipal and Myanmartharkaung et. Moreover, under the supervision of township Peace and Development Council transportation concerns were made to Northern Division, Southern Division, Western Division and Eastern Division.

The Yangon Division Buses Control Committee (MaHtaTha) manages the bus lines in the Yangon city passenger's transport. Besides, under Bandoola transport Co.,Ltd the Parami city passenger transport lines are providing services for the Yangon city people to ensure smooth and easy travelling.

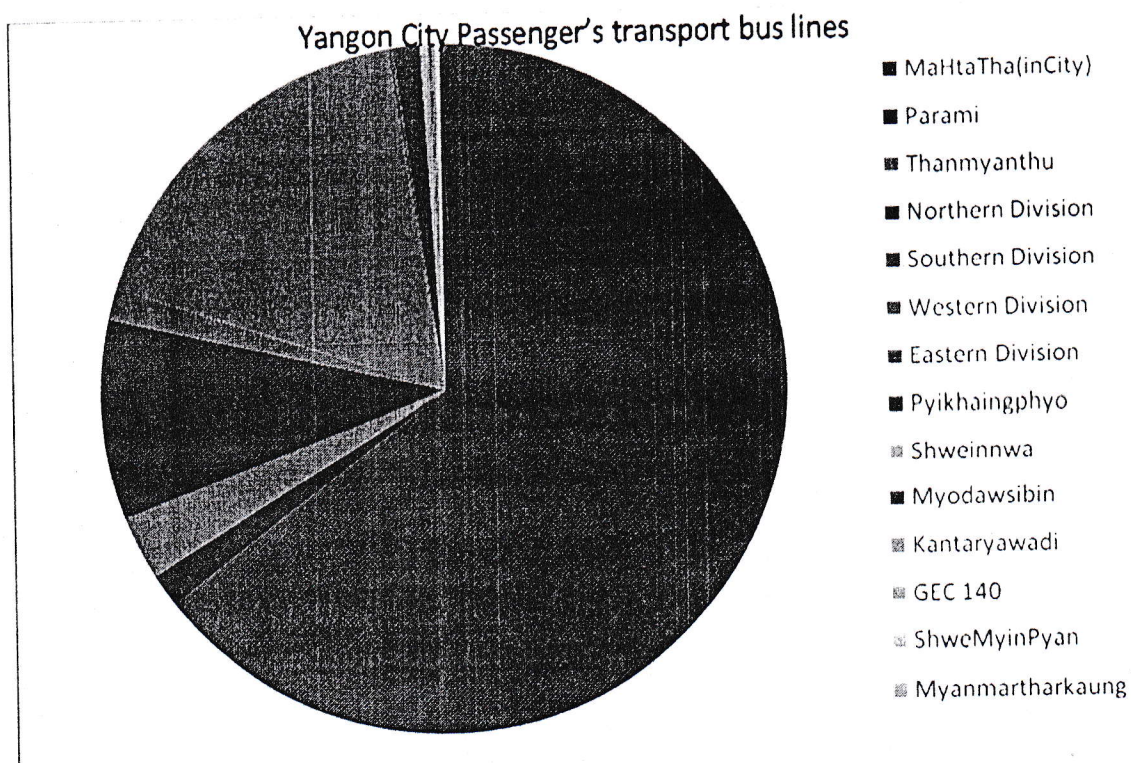
The table (1) shows that among the Yangon city passengers transport lines MaHtaTha with the biggest numbers of buses is giving service to the biggest number of passengers. The other city bus lines transport capacity is 41% and under MaHtaTha supervision there is the biggest buses number and city passenger transport of MaHtaTha is 64% which is a big responsibility. Parami is 1.6%, Thanmyanthu is 3.0%, Northern Division is 9.4%, Southern Division is 1.4%, Western Division is 17.3%, and Eastern Division is 0.24%. Also Pyikhaingphyo is 1.3%, Shweinnwa is 0.4%, Myodawsibin is 0.1%, Kantaryawadi is 0.2%, GEC 140 is 0.02%, ShweMyinPyan is 0.1%, Myanmartharkaung is 0.1%, ShweAethe is 0.84% as shown in the table.

Table (1) Yangon City Passenger's transport bus lines (2008-09)

Sr	Particular	Bus line		Numbers of Buses		Passenger Transport	%
		No.	%	No.	%		
1	MaHtaTha(inCity)	131	41	2321	37	2586378	64
2	Parami	15	5	352	7	62050	1.6
3	Thanmyanthu	26	8	540	7	102140	3.0
4	Northern Division	22	7	741	12	365233	9.4
5	Southern Division	53	17	646	10	44790	1.4
6	Western Division	23	7	1027	16	748210	17.3
7	Eastern Division	7	2	101	2	9996	0.24
8	Pyikhaingphyo	28	9	282	5	50791	1.3
9	Shweinnwa	3	.95	52	0.8	15000	0.4
10	Myodawsibin	1	0.3	20	0.51	1830	0.1
11	Kantaryawadi	2	0.6	68	1.19	8880	0.2
12	GEC 140	1	0.3	6	0.1	800	0.02
13	ShweMyinPyan	2	0.6	15	0.2	4350	0.1
14	Myanmartharkaung	3	0.95	15	0.2	3739	0.1
15	ShweAethe	2	0.6	62	1	16648	0.84
	Total	318	100	6248	100	4020835	100

Source: MaHta Tha Planning Department Yangon





Source: Table 3.6

### 3.6 Yangon Division Buses Control Committee (MaHta Tha)

The Yangon Division Buses Control Committee (MaHta Tha) is operating the city passengers' transportation with the largest number of buses out of total transport buses. Since the government of Myanmar allowed its economy to function with open market economic system after 1988, private road transportation expanded and the role of MaHta Tha becomes more important and wide.

There are nine departments under the management of MaHta Tha and the passengers transport bus lines are running under the supervision of MaHta Tha. The situation of the passenger bus lines running is as mentioned below.

Table (2) Average Daily Running Buses (2008-2009)

Sr No	Department	No: of Bus Line	Buses	Average Daily Running Buses
1	1	22	354	261
2	2	14	301	231
3	3	17	295	215
4	4	17	232	174
5	5	12	293	246
6	6	9	162	125
7	7	10	214	173
8	8	10	253	179
9	9	19	323	237
	Total	130	2427	1841

Source: Planning Department of MaHta Tha (2008-2009)

Under the control of MaHta Tha and the types of buses are city bus, bus, mini bus, light truck bus and special bus etc.:

Table (3) MaHta Tha bus transport and passengers (2008-2009)

Sr No	Types of Buses	Number of Buses	Daily Average Running Buses	Daily Average Running %	Daily Average No of Trips	No of passenger per Trip (Qty)	Daily Passenger (Qty) (Lakh)
1	City bus	1177	834	71	6662	166	11.08
2	Bus ( including minibus)	591	495	84	5010	110	5.49
3	Light truck	516	382	74	3236	94	3.03
4	Special bus	186	162	87	2323	60	1.39

Source: Planning Department of Ma Hta Tha (2008-2009)

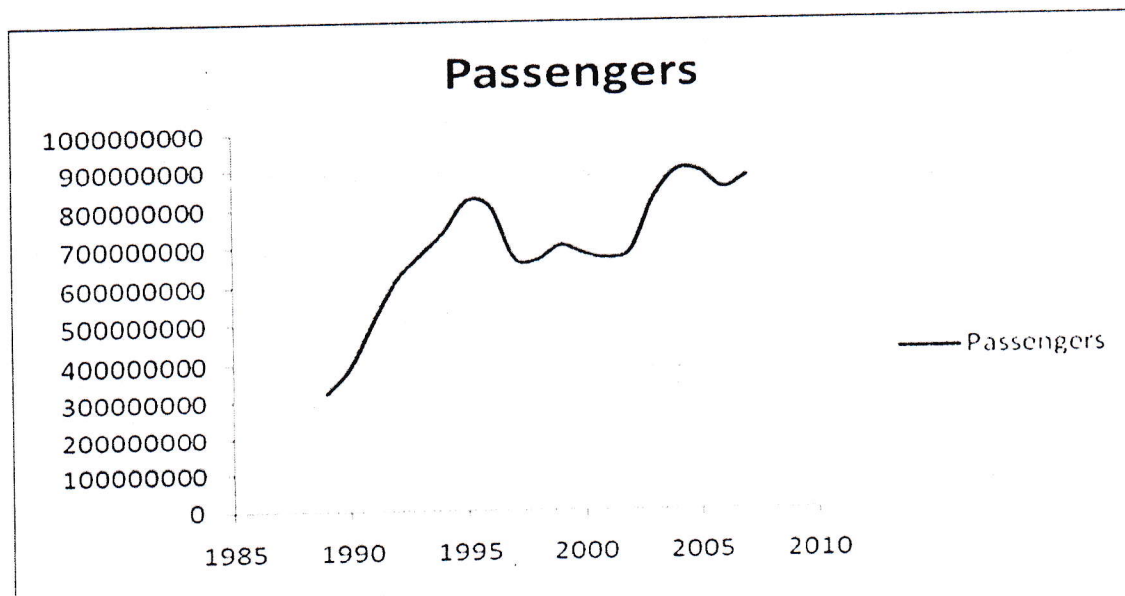
### 3.7 The Ma Hta Tha Committee for Disciplines Control and Actions:

In the MaHta Tha organization, there are investments in the passenger bus by the bus owners for their profit. There has to be a balance between self interest motive and reasonable and economical passenger transport facility motive for the passenger and MaHta Tha is the systematically managed to fulfill these motives.

### 3.8 Trends of Demand for MaHtaTha Bus Lines in Yangon

The information of the passengers was collected from Ma Hta Tha's head office.

Figure (1) Trends of Demand for MaHtaTha Bus Lines in Yangon



Source: Appendix Table (1)

According to Figure (1) the passengers (demand) were increasing form 1988-89 to 1994-95. In 1995-96 to 2001-02 the passengers declined year after year. From 2002-03 to 2004-05, the passengers (demand) were increasing annually. In 2005-06, the passengers declined and in 2006-07 the passengers (demand) increased. Therefore, the pattern of the passenger transport in Yangon City is S shape.



#### IV Model of Demand for MaHtaTha Bus Lines in Transportation

Economic theory solves one but not both of these problems. Economic theory enables the decision-maker to limit the scope of the information required to make informed decisions. In general, the solution to an individual's passenger transportation constrained a set of depend upon the followings simplifying assumptions.<sup>4</sup>

$$D = f(a, b, c, d, f, g)$$

D = demand for transportation

a = distribution over business, factory, school and office

b = population

c = per capital GDP

d = Suburb and a, b, c, d, e distribution

f = private vehicle

g = bus's fare

This paper collect data and try to empirically identify the demand for transportation.

##### 4.1 The Model and Empirical Specification

The statistical methodology employed in developing forecasting models for the passengers (demand) of MaHtaTha's buses in Yangon city is the technique of trend analysis based on the time series data. Different forms of trend models fitted using time series data are eleven models. Among all the fitted trend models, the best estimated forecasting model is Sigmoid (S) curve trend model. The S-curve (Sigmoid) model is

$$Y_i = \left\{ \exp\left(\beta_0 + \frac{\beta_1}{T_i}\right) \right\} \exp(u_i)$$

Estimated model is

$$y_i = \hat{Y}_i = e^{(b_0 + \frac{b_1}{T_i})}$$

$$\ln(y_i) = b_0 + \frac{b_1}{T_i}$$

Where

$Y_i$  = the passengers of Ma Hta Tha's Buses of Yangon city at  $i^{\text{th}}$  year

$T_i$  = Time at  $i^{\text{th}}$  year

$e$  is the base of the natural logarithm. If  $b_1$  is positive, the slope is upward; if

negative, downward. Also,  $\ln(y_i) = b_0 + \frac{b_1}{T_i}$ . Below  $b_0$  is 2.009 and  $b_1$  is -0.331, reported in the

Model Summary and Parameter Estimates".

And then, the effect of factors influencing the passengers (Demand) of Yangon city will be examined by using the multiple regression models.

The multiple regression model, used in this paper is

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 T_i + \beta_3 X_{2i} + u_i$$

Where

$Y_i$  = the passengers of Ma Hta Tha's Buses of Yangon city at  $i^{\text{th}}$  year

$X_{1i}$  = number of Ma Hta Tha's Buses

$T_i$  = Time at  $i^{\text{th}}$  year

$X_{2i}$  = Ln average Ma Hta Tha bus's fare at  $i^{\text{th}}$  year

<sup>4</sup>. McCarthy, Patrick S. Transportation Economics: theory and practice: a case study approach, Blackwell Publishers Inc. USA. 2001

and  $u_i$  is the random disturbance term usually assumed to be satisfying with classical assumptions.

#### 4.2. The Data and Estimation Methodology

The data are compiled from the record books of from Ma Hta Tha's head office and they are described in the Table of appendix. The model for the passengers (demand) is estimated by the method of Ordinary Least Squares (OLS).

#### 4.3. Empirical Results and Finding

##### a. The passengers (demand) exhibits a S-curve during the period (1988/89 - 2006/07)

The estimated trend models are the forecasting models constructed on the time series data, in addition to the model, selection criteria as presented in Swe (2006), the Bayesian information criterion (BIC), Hannan and Quinn (HQ), final prediction error (FPE) as shown in Holden et. al. (1990) are computed for each of the estimate models. On the basic of these selection criteria, the best fitted forecasting model for the demand for Ma HtaTha's buses in Yangon city was selected as Sigmoid (S) curve trend model.

S-shape pattern means, the passengers (demand) curve represents a S-curve. Mathematically, S-curve is represented by the following equation.

$$\ln(y_i) = b_0 + \frac{b_1}{T_i}$$

The best fitted regression model relating the passengers of MaHtaTha's Buses to time is obtained as follows: (computed t-values are presented in parentheses). The \* indicates significance at 5% level.

$$\ln(y_i) = 20.537 - \frac{1.072}{T_i}$$

(570.591)      (- 8.623)\*

$R^2 = 0.814$        $R_a^2 = 0.803$   
 Computed F - value = 74.363\*,      S.E = 0.120

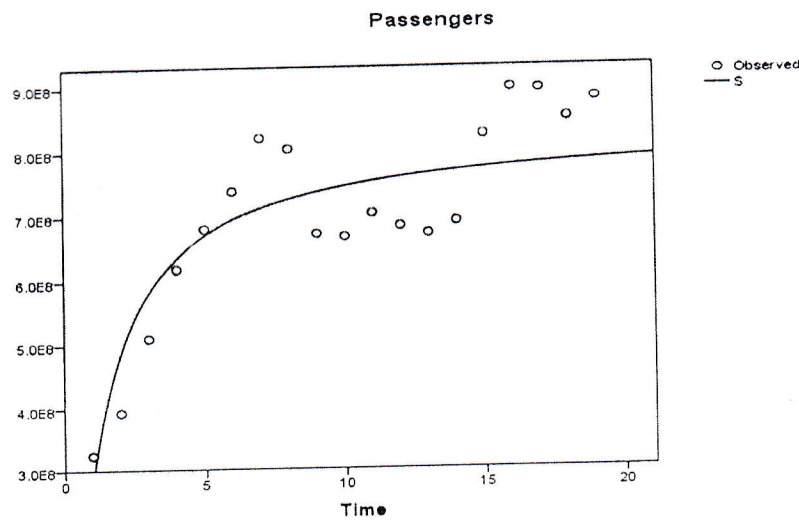
Independent variable = Time (Year)

Dependent variable = Number of Passengers of Ma Hta Tha's Buses

According to above equation, the  $R^2$  value of S-curve form is higher than that of other forms. The coefficients,  $b_1$  and  $b_2$  are significant at 5 percent level. So, the S-curve form is the best fitted form. Therefore, the S-curve pattern is met with the passengers Ma Hta Tha's buses in Yangon city. The Figure (2) shows the observed data and S-curve plotted for the estimated passengers of Ma Hta Tha's buses in Yangon city model. If time (year) trend to infinity, passengers will be have 830,052,907 ( $e^{20.537}$ ).



Figure(2) Observed data and S-curve for The Passengers of Ma Hta Tha Buses in Yangon City (1988/ 89 – 2006/07)



According to Figure (2), the S-curve model is the best fitted regression line for the passengers of MaHtaTha’s Buses in Yangon city.

**b. Results for the passengers (demand) of MaHtatha’s buses in Yangon City**

In this section, the study portrays the relationship between the Passengers of MaHtaTha’s buses in Yangon city and its regressors. Its regressors are number of MaThaTha’s buses, time (year), and Ln average MaHtaTha bus’s fare. The regression model is

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 T_i + \beta_3 X_{2i} + u_i$$

Where  $\mu_i$  is the random error term with mean zero and constant variance  $\sigma^2$ , and  $E(u_i u_j) = 0$  ( $i \neq j$ ). And then, this model is applied with observed data for the period from (1988-89 to 2006/07) by using the ordinary least square methods. The following Table (4) represents the analysis of variance for the estimated passengers (demand) model (1988-89 to 2006-07).

**Table (4) Analysis of Variance for the Passengers (Demand) Model (1988-8980-2006-07)**

	Sun of Squares	Df	Mean Square	F	Sig
Regression	3.976E17	3	1.325E 17	35.257	0.00
Residual	5.638E16	15	3.759E15		
Total	4.540E17	18			

According to Table (4) this model is significant at five percent level of significance. The computed adjusted R square value and its summary statistics are described in Table (2).

**Table (5)**

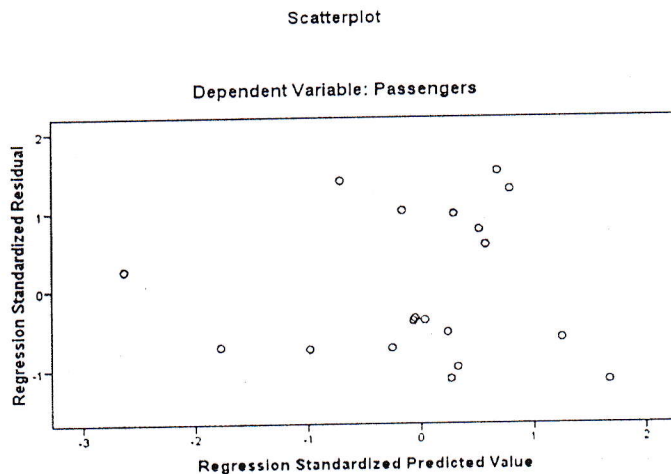
**Summary Statistics for the Passengers (Demand) Model (From 1988-89 to 2006-07)**

R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
0.876	0.851	6.131E7	1.293

According to Table (5), adjusted R square value is 0.851 which means that this model can explain about 85.1 percent for the passengers of MaHtaTha buses in Yangon city. The Durbin-

Watson statistic is 1.293. To check for the assumption of the constant variance, the residual plot is to be plotted. The Figure (3) shows the residual plot for the estimated passengers of MaHtaTha's buses in Yangon city model.

**Figure(3): Residual Plots for The Passengers of MaHtaTha's Buses in Yangon City Model(1988-89 to 2006-07)**



The residual plot does not show any pattern and it can be said that their variance is constant. Hence, the model is the best fitted regression line for the passengers of MaHtaTha Buses in Yangon city. The estimated values of coefficients for this model are described in the Table (6).

**Table (6) Estimated Values of Coefficients for the Passengers of Ma HtaTha Buses in Yangon City Model (1988-89 to 2006-07)**

Variable	Coefficient	Std. Error	t	P value
Constant	-2.754E8	1.477E8	-1.865	0.082
X <sub>1i</sub>	754.533	154.865	4.872	0.000
T <sub>i</sub>	6.253E7	1.302E7	4.803	0.000
X <sub>2i</sub>	-8.889E7	3.567E7	-2.492	0.025

According to Table (6), the estimated regression model can be described as follows:  
 The passengers of Ma Hta Tha Buses = -2.754E8 + 754.533 number of MaHtaTha buses + 6.253E7 time (year) - 8.889E7 Ln average Ma Hta Tha bus fare.  
 All coefficients of number of MaHtaTha Buses, time (year) and Ln average Ma Hta Tha bus fare are significant at one percent level. Hence, we can say that Passengers (demand) is influenced by number of Ma Hta Tha's Buses, time (year) and Ln average Ma Hta Tha bus fare.

## 11. Conclusion

According to our finding, there is the S-curve pattern of the passengers (demand) during the city development period of Yangon.



The passenger (demand) depends on number of MaHtaTha Buses, time (year) and Ln average Ma HtaTha bus fare.

The important findings of this study relate to the determinants of the passengers (demand) as follows:

In Policy implication of the strong link between Ma HtaTha buses and Ma HtaTha bus fare is that the policy makers should concentrate on reducing Ma HtaTha bus fare. Analysis of this paper may provide useful solutions to policy makers in designing city development policies, and for taking initiatives and formulating programs appropriate for promoting city transportation.

#### APPENDIX

Table (A1) MaHtaTha's Buses, Average Fare and Passengers in Yangon City (1988-89 to 2006-07)

Year	MaHtaTha's buses	Passengers	Average fare (Kyat)
1988-89	692337	324814309	1
1989-90	778032	392958096	1
1990-91	851446	509208606	1
1991-92	912622	618505347	1
1992-93	820784	680152677	2
1993-94	893962	738652464	3
1994-95	1015739	820550072	5
1995-96	1007222	803397793	15
1996-97	919361	671189396	15
1997-98	804924	666666986	20
1998-99	807810	702805057	25
1999-2000	767683	682601313	50
2000-01	748845	670788794	100
2001-02	740246	689259231	100
2002-03	694389	824091572	100
2003-04	665655	896211790	100
2004-05	642763	893827972	200
2005-06	672111	848687651	200
2006-07	672630	878813495	200

Sources : MaHtaTha Head Office in Yangon.

**APPENDIX**  
**Table (A2) Curve Estimation**

Sr no:	Curve name	Variable	Coefficient	T value	P- value	R <sup>2</sup>
1	Linear	Const	4.818E8	10.428	0.000	0.613
		t	2.155E7	5.436	0.000	
2	LogLinear	Const	3.444E8	6.947	0.000	0.764
		Ln (t)	1.714E8	7.694	0.000	
3	Inverse	Const	8.095E8	30.250	0.000	0.684
		1/t	-5.840E8	-6.319	0.000	
4	Quadratic	Const	3.889E8	5.587	0.000	0.653
		t	4.694E7	3.075	0.007	
		t <sup>2</sup>	-1.215E6	-1.716	0.105	
5	Cubic	Const	1.869E8	2.356	0.032	0.794
		t	1.504E8	4.679	0.000	
		t <sup>2</sup>	-1.326E7	-3.762	0.002	
		t <sup>3</sup>	381497.839	3.459	0.004	
6	Power	Const	4.754E8	11.928	0.000	0.560
		t	1.036	139.018	0.000	
7	Compound	Const	3.667E8	12.688	0.000	0.794
		Ln (t)	0.297	8.383	0.000	
8	Sigmoid (s)	Const	20.537	573.912	0.000	0.805
		1/t	-1.071	-8.669	0.000	
9	Growth	Const	19.980	238.311	0.000	0.560
		t	0.035	4.891	0.000	
10	Exponential	Const	4.754E8	11.928	0.000	0.560
		t	0.035	4.891	0.000	
11	Logistic	Const	2.103E-9	-	-	0.560
		t	0.965	139.018	0.000	

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