

The Agricultural Input Productivity and Rural - Urban Migration in Myanmar (1965-2000)

Thin Thin Oo¹

Abstract

This study examines the relationship between agricultural input productivity and rural – urban migration by developing an econometric model and applying it to the case of Myanmar. Myanmar economy relies more on agricultural sector than other sectors till now. Moreover, over 70 % of the total populations live in rural areas where agriculture is the main source of employment and income. Growth in the agricultural sector is therefore one of the most effective ways of reducing poverty, since it can raise the income of farmers, narrow the rural-urban income gap, raise the earnings of landless labourers, and improve access to food. Asides from these direct benefits, agriculture has important linkages with the rest of the economy, creates jobs in other sectors and shrinks rural to urban migration. In Myanmar, rural-urban migration has been increasing since 1986. In fact, rural- urban migration and agricultural performance are tied together because rural workers compare their income with what they could obtain if they migrate to the city. Rural-urban migration occurs where there is economic disparity between rural and urban areas. Some economists, therefore, argue that boosting agricultural productivity and/or income can reduce the incidence of economic problems partially posed by rural- urban migration. In this paper, an attempt is made, using a recursive equation system and a Myanmar data set for period 1965 - 2000, to measure the indirect elasticity of rural – urban migration. The findings support the hypothesis that rural-urban migration is a positive function of the ratio of urban per capita income to rural per capita income, agricultural inputs have a positive impact on agricultural output and agricultural inputs have a negative impact on rural-urban migration. Moreover, the result helps to set up possible policy aimed to reduce migration flow through increase per capita earning of rural people derived from increase investment in agricultural inputs.

Key words: rural-urban migration, agricultural input, recursive equation system

1. Introduction

Migration which can be considered a significant feature of livelihoods in developing countries is frequently in pursuit of better living standards. The decisions of migrants mostly rely on the wage gap between rural and urban area and hoping of getting job for their life. Most of the migrations are caused by the income inequality between rural and urban employment sectors. That is why rural urban migration employment, a higher income in urban area and lower income in rural sector are the most dominant factors underlying migration.

Seventy percent of the world's poor inhabitants in less developed countries live in rural areas where agriculture is the main source of their employment and income for many purposes especially to reduce poverty and to increase their income. Myanmar, as a developing country, is an agricultural country, and the agricultural sector including crop cultivation, livestock and fisheries and forestry, is the back-bone of Myanmar's economy and is the main source of income

¹ Assistant Lecturer, Department of Economics, Yangon Institute of Economics

for over 75 percent of the total population living in rural areas, employing about 58 percent in the agricultural sector, 70.2 percent of total labour force are in the agricultural sector, contributing to over 57 percent of GDP, 34 percent of total export earnings, supporting raw materials and other inputs for agro- processing industries, and market for domestic manufacturing and also rural income, rural poverty alleviation and rural development etc all depend on agricultural sector development. Thus Myanmar's economy was still dominated by the agricultural sector and according to the calculation, Myanmar has significant rural-urban migration and rural- urban wage differential.

According to Todaro (1969) and to Harris and Todaro (1970), rural-urban migration in less developing countries is a function of the difference between the expected wage from migration (urban wage) and the agricultural wage. Stieglitz (1969), Todaro (1976), Byerlee (1974), and Sabot (1979) have suggested that the most consistent policy for decreasing rural – urban migration should be built upon the improvement of agricultural per capita income through an increase in investment in agriculture and this fact points out agricultural factors that have a significant impact on rural-urban migration. Another policy is to implement labour intensive projects in cities to reduce urban unemployment and poverty.

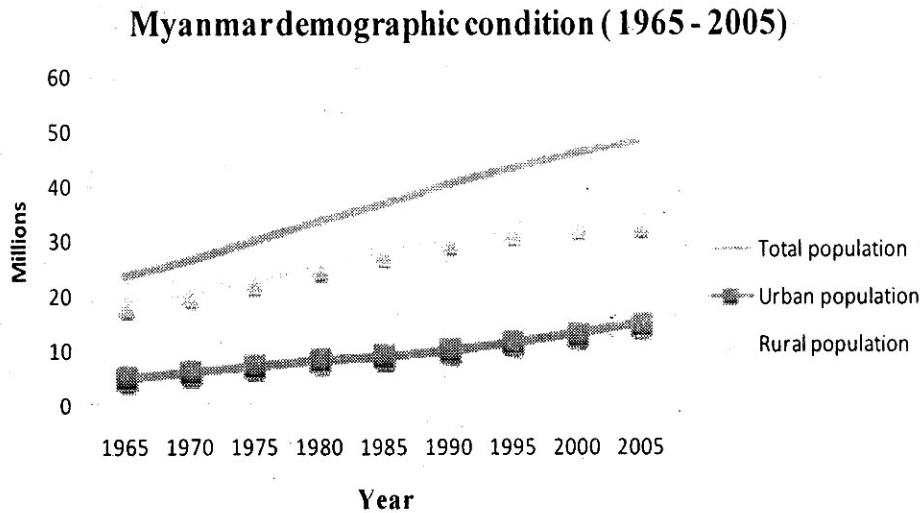
The principal objectives of the study are as follows:

- (1) To analyze the relationship between the agricultural input productivity and rural – urban migration.
- (2) To examine the interrelation between the urban- rural wage ratio and rural – urban migration.
- (3) To investigate which agricultural inputs have a negative effect on rural-urban migration
- (4) To design an appropriate policy aimed at reducing rural-urban migration from research findings.

To fulfill these objectives, a recursive equation system is used in this study. The result will be used to identify those agricultural factors that have a significant impact on rural- urban migration and to derive indirect elasticity indicators that could be used to design a policy aimed at reducing rural-urban migration.

2. Rural - Urban Migration in Myanmar

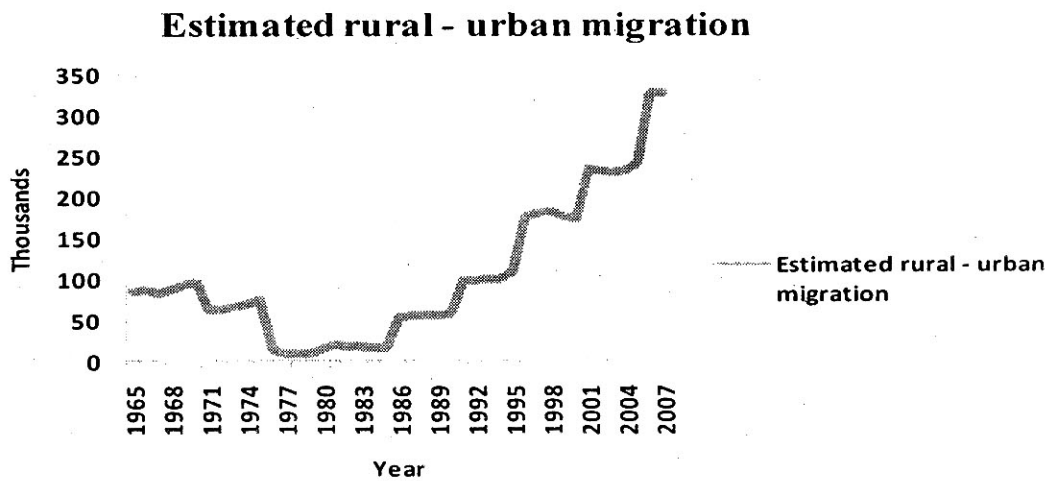
In 1965, Myanmar's population was estimated at 23 million (World Bank 2007), with a natural annual growth of 2.32 %. Myanmar's population reached 46 million in the year 2000 and its decreasing annual growth rate is 1.4 % as seen in Fig (1). Although Myanmar still has decreasing population growth rate, migration from rural to urban areas has increased and urban industries were not doing well. According to ADB, unemployment has increased from 0.69 million in 1990 to 0.92 million in 1997 and unemployment rates are still increasing, 4.1 % during 1990 –1997.



Source: World Population Prospect 2007 Revision

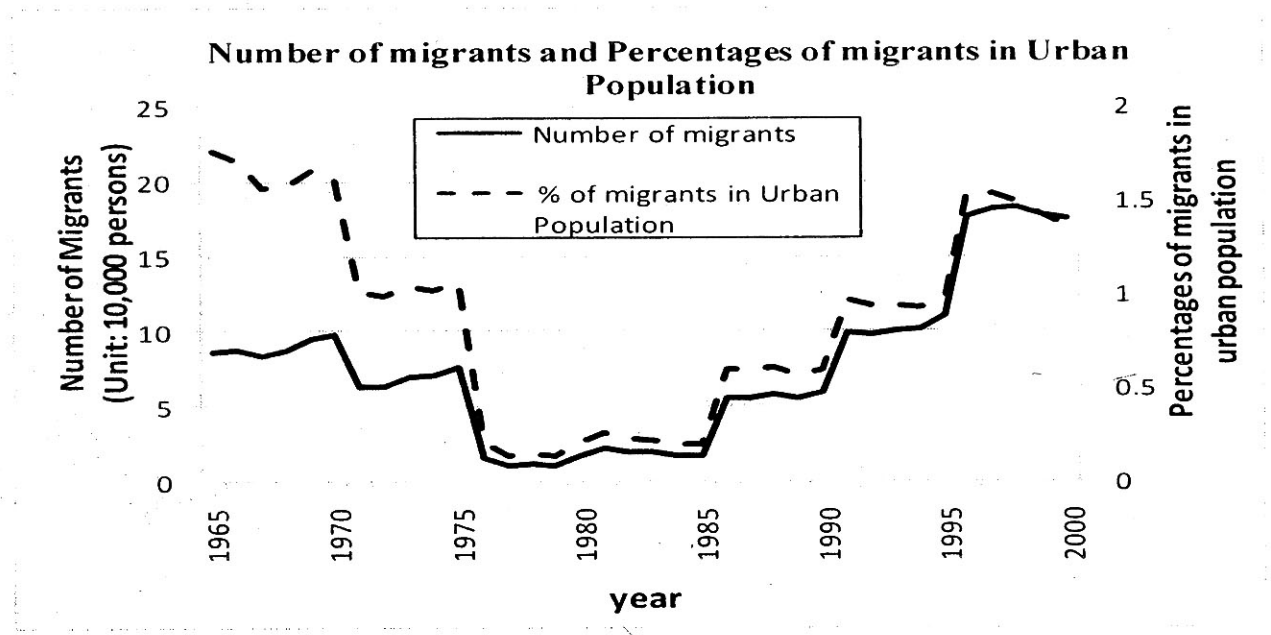
Figure. 1. Population of Myanmar Total, Urban and Rural (1965 – 2005)

There are three main factors affecting rural-urban migration: an increasing in young people between ages of 15 – 24, decreasing rural wages and the desire to find urban jobs created by the government’s creation of industrial zones. According to the calculation, in Myanmar, the estimated rural-urban migration has continued to increase after 1986 and at the same time urban population and the percentage of migrants in urban populations are increasing from 0.6 % in 1986 to about 1.5 % in the year 2000 (Figure 2&3).



Source: WDI 2008 indicator and calculation

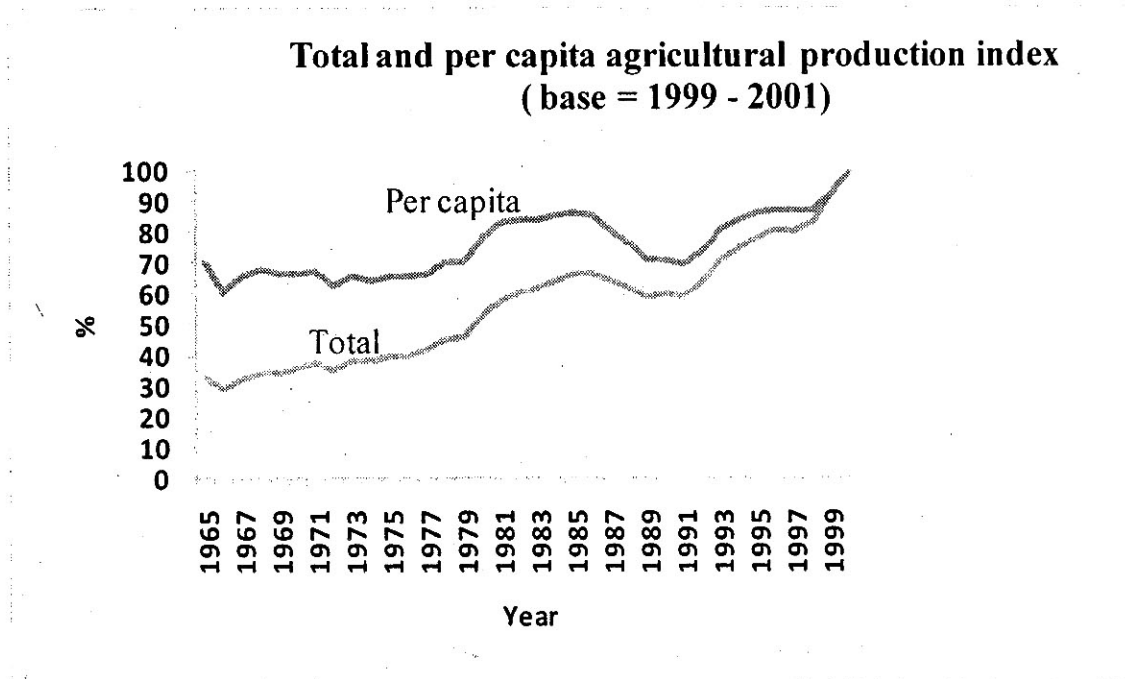
Figure 2. Rural-Urban Migration in Myanmar (1965 – 2007)



Source: World Population Prospect 2007 and Author's calculation

Figure 3. Numbers of Migrants and Migrant as a Percentage of the Urban Population in Myanmar, (1965 – 2000)

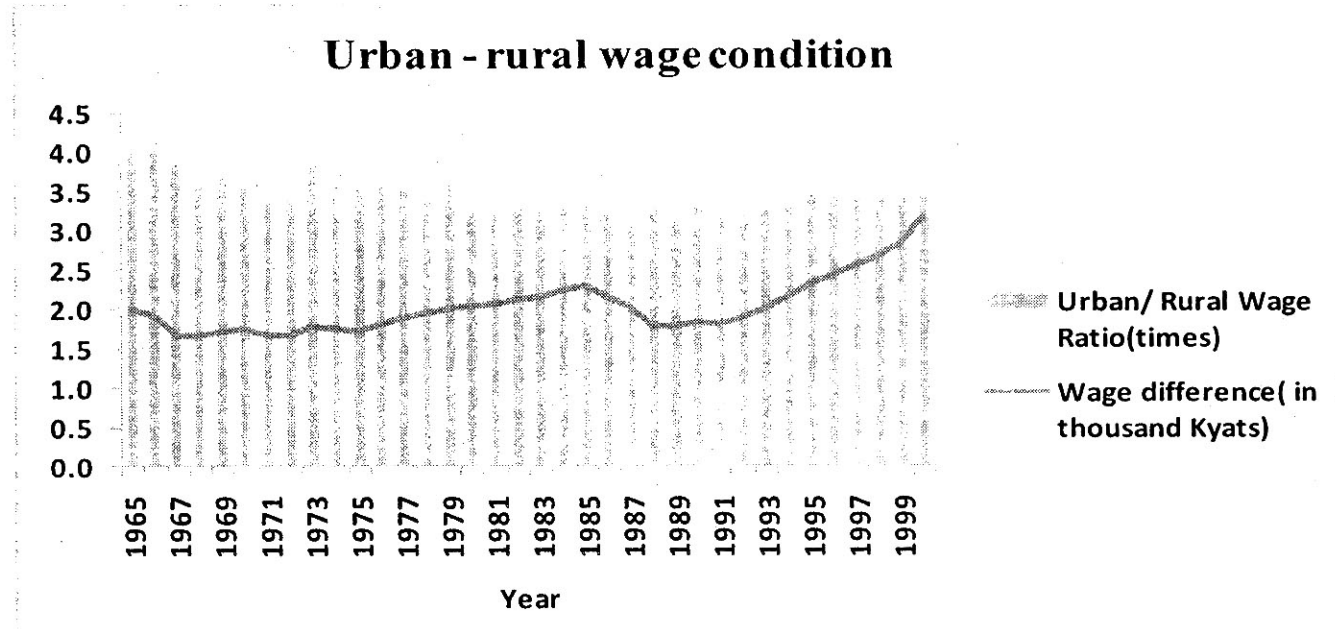
On the other hand, in Myanmar, the aggregate agricultural production index and per capita agricultural production index varied between 30 % and 100 % during the period 1965 to the year 2000. Total agricultural production index increased from 30 % to 100 % and per capita agricultural production index rose from about 70 % to 100 % during the same period in (Figure 4).



Source: FAO, Online data (<http://www.fao.org>)

Figure 4. Myanmar, Total and Per Capita Agricultural Production Index (base year =1999 – 2001)

According to calculation, urban – rural wage ratio is slightly decreased compare with 1965 to 2000 (Figure 5) but the wage difference between urban and rural areas continued to increase after 1990 and it showed that urban wage is higher than rural wage and it is one of the attractions for rural people to move to urban areas.



Source: WDI 2007 and Author's calculation

Figure 5. Urban – Rural Wage Condition in Myanmar (1965 – 2000)

3. Conceptual Framework

The scholars, Stieglitz (1969), Todaro (1976), Byerlee (1974), and Sabot (1979) have proposed that the most reliable policy for decreasing rural – urban migration should be built upon the improvement of agricultural per capita incomes. Generally speaking, agricultural productivity is measured as the ratio of agricultural output to agricultural inputs. If agricultural input productivity decreases, this will cause a decrease in agricultural productivity and; rural income and thereby can influence rural people to move out to the cities.

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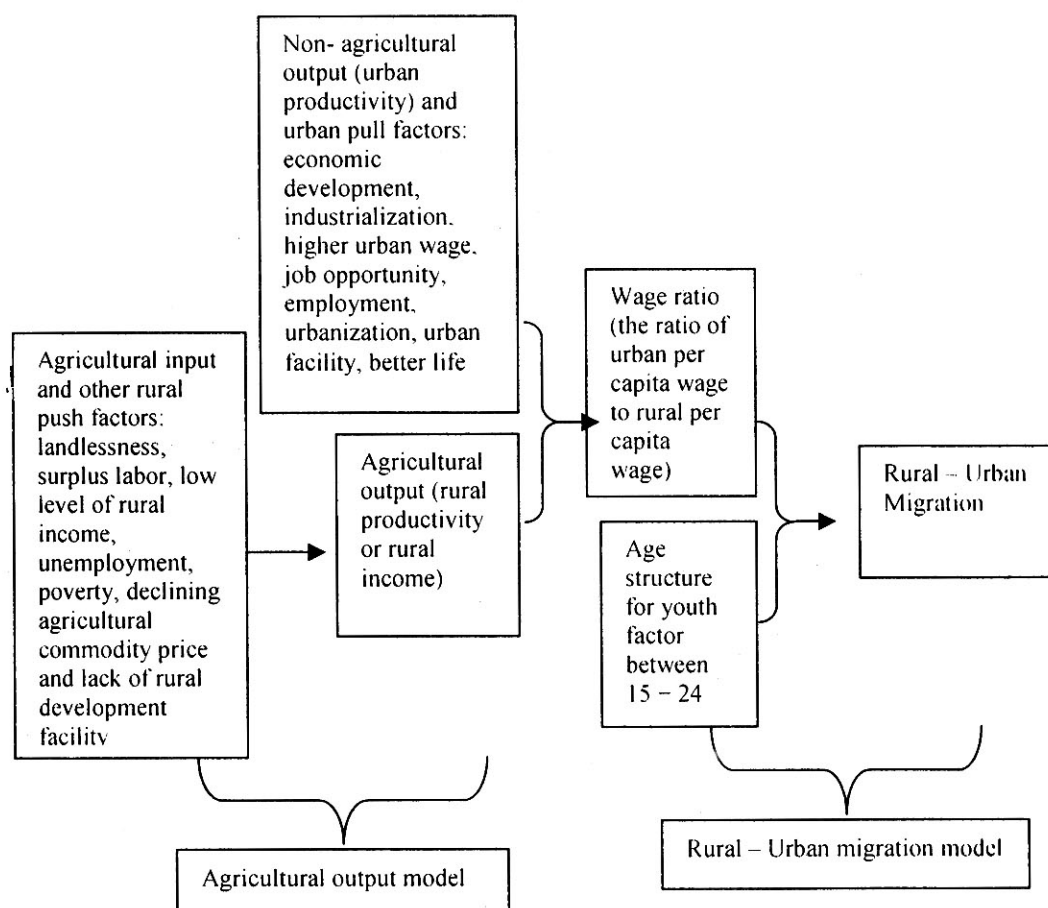


Fig 6. Overall research framework for rural-urban migration

Figure (6) shows the conceptual framework used in this study. It shows the relationship between the rural-urban migration and agricultural input productivity. In this study, it is found out that rural - urban migration is the function of wage ratio and wage ratio refers to the ratio of urban per capita income to the rural per capita income. Rural per capita income depends on agricultural productivity and it relies on agricultural input productivity. From this relationship, it can be understood that rural-urban migration will decrease by increasing per capita rural earning through increased investment in agricultural inputs. In this framework, there are two main parts: agricultural output model and another is rural-urban migration model. In agricultural output model, agricultural output is dependent variable but it is independent variable in migration model. It is important to identify which agricultural inputs have a negative effect on rural - urban migration that point refers to the fact why the two models used to combine in this study.

4. The model

Economic theory and empirical research have shown that the foundation of rural - urban migration is the excess of the urban wage over the rural wage. The model developed below is used to identify what factors derived agricultural productivity. It is hypothesized that a rise in agricultural wages as a result of an increase in productivity will reduce, *ceteris paribus*, the wage

differential between urban and rural sectors. This change in the wage differential can supply into a migration equation, reducing the rural-urban migration. Therefore, there is a recursive relationship between the agricultural production equation and the rural-urban migration equation, linked by the agricultural output that is common to both equations. By creating a recursive system of equation, the migration elasticities can be estimated with respect to changes in agricultural inputs. The computed elasticities can then be used to estimate the impact of agricultural inputs on rural-urban migration.

4.1 Migration Models

According to Martin (2002), migration models are divided into two parts: macro and micro approaches. The macro approach is concerned with where migrants move and what triggers migration and the micro approach tries to answer questions such as who moves and why. Macro migration functions using time series data sets are used to estimate the important determinants of aggregate migration flows from rural to urban areas, calculate their relative importance, assess possible trade-offs and predict migration flows based on the estimated elasticities (Todaro, 1976). Godfrey (1973)'s specific migration model depended on rural-urban wage differential and on the difficulty of getting a job in a modern sector.

$$M = g(Y_A, Y_U, U, P_A, P_U, Z) \quad (1)$$

Equation (1) refers to the macro migration model, M is the dependent variable at a time t is the rate at which rural people move to cities compared to the total population flow and the independent variables are wage or income levels in both rural and urban areas (Y_A, Y_U), unemployment rates (U), population size in both areas (P_A, P_U) and degree of urbanization (Z). The indexes A and U refer to the agricultural and urban areas respectively.

4.2 Agricultural Productivity Models

Empirical researches have often used the Cobb – Douglas production function to measure the relationship between inputs and output, the marginal products, and production elasticities (Dillion and Hardaker, 1993).

Hayami and Ruttan (1970), Peter D. Goldsmith et al (2004) and TA Asfaha & A Jooste (2006) used the same form of agricultural production function. They specified total agricultural output (Y_A) to be a function of traditional conventional capital inputs land (L) and livestock (S), and of modern conventional capital inputs, fertilizers (F) and machinery (Mc). They also included a conventional labour input: agricultural labour force (LBR) and a modern non-conventional labour input education (E). Conventional inputs are measured in relatively simple physical terms that mask potentially important qualitative variations. An additional non-conventional input is infrastructure capital (IK) (Schultz, 1964). The Cobb – Douglas agricultural production function is expressed in the implicit and explicit forms as follows:

$$Y_A = f(L, LBR, F, Mc, S, E, IK) \quad (2)$$

where Y_A is agricultural output, L , land area, LBR agricultural labour, F , fertilizer, Mc , machinery, S , livestock, E , farm education and IK , agricultural infrastructure capital.

Eqs. (1) and (2) together comprise the model. Expressing Eqs. (1) and (2) as a double logarithmic function creates a system of two equations, (3), linked by agricultural output in the migration equation.

$$\begin{cases} \ln Y_A = \alpha_0 + \alpha_1 \ln L + \alpha_2 \ln LBR + \alpha_3 \ln F + \alpha_4 \ln Mc + \alpha_5 \ln S + \alpha_6 \ln E + \alpha_7 \ln IK + \varepsilon_1 \\ \ln M = \beta_0 + \beta_1 \ln Y_A + \beta_2 \ln Y_U + \beta_3 \ln U + \beta_4 \ln P_A \\ \quad + \beta_5 \ln P_U + \beta_6 \ln G + \mu_1 \end{cases} \quad (3)$$

It is crucial to determine which agricultural inputs have a negative effect on rural – urban migration. The sensitivity of migration with respect to agricultural investments can be expressed by indirect agricultural input elasticities of migration, since migration is expected to decrease when the ratio of urban to rural wages is reduced by agricultural investments. This chain process can be expressed as follows:

$$\begin{aligned} M &= f(WR); \quad WR = g(Y_A, Y_U); \quad \text{and } Y_A \\ &= h(X_i, X_j) \end{aligned} \quad (4)$$

where $WR = \frac{Y_U/P_U}{Y_A/P_A}$ and is the wage ratio between the two sectors, Y_A is the agricultural output, X_i and X_j are the agricultural inputs and f , g and the h are functions. This relationship can be derived from the chain rule and it is interpreted as indirect elasticities of rural-urban migration from individual agricultural inputs. By assuming all other variables X_j constant, the rural-urban migration indirect elasticity of X_i is:

$$\begin{aligned} \eta_{M, X_i} &= \left\{ \frac{\partial M}{\partial WR} \frac{\partial WR}{\partial Y_A} \frac{\partial Y_A}{\partial X_i} \frac{X_i}{M} \right\} \\ &= \left\{ \left[\frac{\partial M}{\partial WR} \frac{WR}{M} \right] \frac{M}{WR} \left[\frac{\partial WR}{\partial Y_A} \frac{Y_A}{WR} \right] \frac{WR}{Y_A} \left[\frac{\partial Y_A}{\partial X_i} \frac{X_i}{Y_A} \right] \frac{Y_A}{X_i} \right\} \frac{X_i}{M} \\ &= \left\{ \left[\eta_{M, WR} \frac{M}{WR} \right] \left[\eta_{WR, Y_A} \frac{WR}{Y_A} \right] \left[\eta_{Y_A, X_i} \frac{Y_A}{X_i} \right] \frac{X_i}{M} \right\} \\ &= \left[\eta_{M, WR} \eta_{WR, Y_A} \eta_{Y_A, X_i} \right] \left\{ \frac{M}{WR} \frac{WR}{Y_A} \frac{Y_A}{X_i} \frac{X_i}{M} \right\} \end{aligned}$$

Since the parameters in the last curly brackets cancel each other and the value of η_{WR, Y_A} is equal to -1 as shown below:

$$\eta_{M, X_i} = \eta_{M, WR} \eta_{WR, Y_A} \eta_{Y_A, X_i}$$

$$WR = \frac{Y_U/P_U}{Y_A/P_A} \quad \text{by assumption and}$$

$$\begin{aligned}\eta_{WR, Y_A} &= \frac{\partial WR}{\partial Y_A} \frac{Y_A}{WR} \\ &= - \left[\frac{P_A}{P_U} \frac{Y_U}{Y_A^2} \right] \frac{Y_A}{WR} = -1\end{aligned}\quad (5)$$

By using the chain rule, the agricultural inputs have a negative effect on rural-urban migration, since the rural-urban migration function includes agricultural output as an independent variable.

4.3 Definitions of Variables and Sources of Data

As stated before, this research uses the demographic and economic data of Myanmar that covers a period of 36 years, from 1965 to 2000. All variables were transformed into natural logarithms in the agricultural model but the log-linear model will be used in the migration model by following the empirical foundation.

(1) Agricultural Output (Y_{A_t})

In some previous studies, agricultural output was measured as the sum of crops, livestock, and fishery and forestry production in real terms. In this study, agricultural value added (constant local currency unit in Kyat) will be used to measure agricultural output is the proxy. The sources of data are the World Development Indicators 2008.

(2) Labour (LBR_t)

Labour represents the number of residents aged between 15 and 64 which are economically active in agriculture. In Myanmar, the agricultural sector involves traditional means of production and most of the farmers are mainly to intend for subsistence purposes, whereby the family provides the labor, workload and income are shared. Therefore in Myanmar, it is reasonable to use that economically active population as a measure of agricultural labour resource. The data source for this variable is from FAO.

(3) Fertilizer (FER_t)

Increase in use of modern conventional capital input fertilizer is one of the conditions for increasing productivity (Schultz 1964; Hayami and Ruttan, 1985). Goldsmith et al., (2004) and Asfaha and Jooste (2006) also showed the role of fertilizer in agricultural production. For Myanmar case, total fertilizer (nitrogenous, phosphate and potash) consumption in metric tones are used to reference fertilizer inputs, as source from the FAO.

(4) Livestock (LS_t)

Livestock is a part of the agricultural productivity and is represented as the number of animal units for agricultural production. It is utilized as a long run capital input in the agricultural sector. Livestock contributes in many ways to support agricultural production like providing animals for cultivation and transportation, supplying meat, milk, hides and organic fertilizer. In addition, animals contribute to the agricultural sector by providing financial security in the form of savings and investments. To avoid double counting, the livestock variable excludes milk, meat, and skin production; all are included in the agricultural output variable (Y_{A_t}). In order to estimate livestock's contribution in agricultural output, each animal has been assigned a weight to obtain an equivalent animal unit: 1.0 for buffalo and horses, 0.8 for cattle and 0.1 for sheep and goats,

0.2 for pigs and 0.01 for poultry [Hayami and Ruttan (1985)]. Yearly livestock data were from the FAO.

(5) Machinery (M_{C_t})

Machinery is measured as the number of tractors in use according to FAO in this study. Binswanger (1982) said that machinery might have positive complementary effect on the usage of modern inputs like fertilizers and irrigation and thereby on agricultural production. Tractors become valuable input for multiple uses in land preparation, planting, harvesting, threshing, and drying etc. and also contribute to the increase of cropping intensity. In Myanmar, farmers usually grow two or three crops a year and most of the farm activities must be completed in time. If any significant delay in these process will seriously effect on crop production and other related process.

(6) Education (E_t)

Education is one of the factors to measure the agricultural labour force. If a farmer is a more literate person, it would be expected his ability to make use of information provided by extension services, or to calculate better cost and returns to alternative inputs or marketing opportunities. Asfaha and Jooste (2006) used the number of agricultural graduates from South African Universities and Technicians as a proxy for this variable. Although the measure of education attempts to represent the quality of agricultural labour, the reliable data are not readily available; the literacy rate is used as a proxy for farmer's education index in this study. UNESCO defines the literacy rate as the proportion of the population over the age of 15 that can read and write a short statement about their daily life. The data sources come from UNESCO, UNDP and Human Development Index and Myanmar statistical year books respectively by following Goldsmith et al (2004).

(7) Agricultural Infrastructure Capital Stock (IK_t)

The infrastructure includes expenditures and investments in rural utilities, irrigation and drainage, rural markets, transport, commodity storage and facilities. Government expenditure on agricultural infrastructure can be used as an alternative proxy for this variable and in Asfaha and Jooste (2006) used the proportion of irrigated and drained land as the agricultural infrastructure variable. Agricultural infrastructure represents a modern capital input that permits traditional inputs to produce to their maximum level. Total area equipped for irrigation (hectare) is used as a proxy for this variable in this research and data were from the FAO.

(8) Rural – Urban Migration (M_t)

Asfaha and Jooste (2006) defined rural – urban migration is the total urban population change minus the portion of urban population due to the natural population increase. Goldsmith et al (2004) predicted the rural – urban migration by using the equation as follows

$$M_t = P_{ut} - (1 + g)P_{ut-1} \quad (6)$$

where M_t is rural – urban migration, P_{ut} is the total of the population in the present year, g is the natural growth rate of the total population and comes from the crude birth rate and crude death rate, and P_{ut-1} is the population in the previous year. In most countries, time series data for rural – urban migration is not freely available. Therefore, estimating the rural – urban migration in Myanmar for the period between 1965 – 2000 will be determined by the definition and estimation method of Goldsmith et al (2004). Time series data for P_{ut} originates from WDI (2008).

(9) Implicit Agricultural Wage (W_{A_t})

Goldsmith et al (2004) defined the implicit agricultural wage as the ratio of agricultural output to the total agricultural population. Therefore, the agriculture wage is approximated by the average productivity of the family labour force, not by the marginal productivity of a single worker. In this study, agriculture wage W_{A_t} is defined as the ratio of agricultural GDP to rural population and data were obtained from WDI 2008.

$$W_{A_t} = \frac{Y_{A_t}}{P_{A_t}} \quad (7)$$

(10) Implicit Urban Wage (W_{U_t})

The implicit urban wage, the ratio of urban output to the urban population was used as the best available proxy by Goldsmith et al (2004), where output is equal to the sum of industrial and service production. In the case of Myanmar, there are no specific data to refer to urban wage. That is why, the ratio of non- agricultural output to urban population is used as a proxy for urban wages, and non- agricultural output is defined as GDP minus agricultural GDP. Both data were taken from WDI 2008 and showed by the constant local currency unit and measurement as Kyats.

$$W_{U_t} = \frac{Y_{u_t}}{P_{u_t}} \quad (8)$$

$$\text{Wage Ratio } WR_t = \frac{Y_{U_t}/P_{U_t}}{Y_{A_t}/P_{A_t}} \quad (9)$$

(11) Age Structure (G_t)

According to Goldsmith et al (2004), age structure is defined as the proportion of individuals aged 15 – 25 in the total population. It is used to account for the youth factor in the rural-urban migration function. It means that if the proportion of young people in the whole population were to increase, one would expect, ceteris paribus, rural-urban migration to augment. There are many reasons why young people are more likely to move than older people. In this study, the age structure will be set between 15 – 24 and is as the youth factor and the data are taken from the world population prospect (the 2008 revision population data base).

5. The Estimated Model

Based on available data, the estimated model for migration and agricultural production will be constructed and explained by the following equations.

5.1 The Estimated Model for Migration

As mentioned above, rural- urban migration levels depend on the urban- rural wage ratio and the proportion of young people (15 – 24) in the total population. We filled missing values for the crude birth rate, crude death rate and age structure by multiplying the increasing ratio of the variables.

$$\text{Migration model} \quad M_t = f(WR_t) \quad (10)$$

In this model, M_t is the rural-urban migration level at any time period t , WR_t is the wage ratio between two sectors, and G_t is the age structure between: 15 – 24 in the total population. Equation (6) will be used to measure the migration level. Log-linear functional form will be used to estimate elasticity of migration with respect to wage ration and age structure, respectively. Here is the estimated model for migration,

$$M_t = \beta_0 + \beta_1 \ln WR_t + \beta_2 \ln G_t + u_1 \quad (11)$$

Equation (9) will be used for measuring wage ratio.

5.2 The Estimated Model for Agricultural Output

There are two options for the agricultural output model: one for the general model including all variables, and the other is a specific model for the case of Myanmar based on available data. The agricultural output is the function of land, labor, fertilizer, livestock, machinery, farmers' education level or adult literacy rate and infrastructure capital stock. That is why, the general model for agricultural productivity is

$$Y_{A_t} = f(L_t, LBR_t, FER_t, LS_t, E_t, M_t, IK_t) \quad (12)$$

For the case of Myanmar, we reconstructed the model for agricultural productivity by the following except land variable,

Specific model for agricultural output is

$$Y_{A_t} = f(LBR_t, FER_t, M_{C_t}, LS_t, E_t, IK_t) \quad (13)$$

In this model, the definitions of the included variables have already been explained as above. To estimate the elasticity of agricultural output with respect to these inputs: labour, fertilizer, machinery, livestock, education and irrigated areas for infrastructure capital stock, double logarithmic function will be used as seen in the following equation.

$$\ln Y_{A_t} = \alpha_0 + \alpha_1 \ln LBR_t + \alpha_2 \ln FER_t + \alpha_3 \ln M_{C_t} + \alpha_4 \ln LS_t + \alpha_5 \ln E_t + \alpha_6 \ln IK_t + \varepsilon_1 \quad (14)$$

Based on the available data and the unique characteristics of the Myanmar economy, the second equation of the model (3) has been simplified to yield the following estimable model:

$$\begin{aligned} \ln Y_{A_t} &= \alpha_0 + \alpha_1 \ln LBR_t + \alpha_2 \ln FER_t + \alpha_3 \ln M_{C_t} + \alpha_4 \ln LS_t + \alpha_5 \ln E_t + \alpha_6 \ln IK_t + \varepsilon_1 \\ M_t &= \beta_0 + \beta_1 \ln WR_t + \beta_2 \ln G_t + u_t \end{aligned} \quad (15)$$

6. The Estimated Results and Interpretation

The model specified in the system of equations (11) and (14) on the basis of the previous studies by Goldsmith et al (2004) and Asfaha and Jooste (2006). The structural parameters estimated provide answers to my research questions: Does the agricultural input productivity support an increase in agricultural productivity and can it thereby increase rural income or not? Do the wage ratio and the age proportion have a direct positive influence on migration? Based on the indirect elasticities of agricultural inputs on migration, which agricultural inputs would

produce the effect of lowering rural – urban migration? Table (1) presents the Cobb – Douglas type of production functions of Myanmar agriculture for the period from 1965 to 2000, which estimates the elasticity of agricultural output to a set of agricultural inputs. The total number of observations is equal to 36.

6.1. Direct Agricultural Output Elasticities

The estimated results of the effects of livestock, education and infrastructure elasticities on agricultural output are positive, as expected, statistically significant and also these results support the fundamental hypothesis of this research and is consistent with the literature; these three agricultural inputs are a positive function of agricultural output model (Table1). The model estimates as a 1 % increase use in stock of animals raises agricultural output by 1.12%. This fact shows that very significantly about Myanmar's agricultural sector is still traditional sector and rural farm work mostly relies on the animal power to increase agricultural output during study period. This point shows that the contribution of animal power in Myanmar's agricultural production condition is more important than infrastructure capital stock and education devoting in agricultural sector.

The elasticity of education on agricultural output is positive and statistically significant as expected. This shows that education or agricultural human capital supports considerably to boost agricultural output in rural areas. A 1 % increase of literacy rate in rural area would increase agricultural output by 0.85 %. It shows that more educated rural population may also provide better service to agricultural and improving agricultural productivity.

Similarly, a 1 % increase in the amount of resources devoted to agricultural infrastructure capital stock for irrigated areas and increases agricultural output by 0.34 %, indicating the importance of infrastructure capital as a one important tool for rural economic development. It explains about the importances of irrigated areas expansion in Myanmar agricultural sector supports to augment agricultural output considerably.

Table (1) Estimates of the Production Function of Myanmar Agriculture (1965 – 2000)
 Regression Result for Agricultural Output Equation

Agricultural Output Equation: OLS estimation	
Independent Variables	Elasticities
Labour	0.2870 (1.18)
Fertilizers	0.0093 (0.26)
Machinery	-0.2539*** (-3.58)
Livestock	1.1240*** (3.09)
Education	0.8507** (2.10)
Infrastructure	0.3405*** (3.08)
Constant	-5.2454*** (-2.21)
$R^2 = 0.9818$, $F(6, 29) = 261.33$, $\text{Prob} > F = 0.0000$	

Figures in parenthesis are t statistics.

*** Significant at the 1 % level.

** Significant at the 5 % level.

6.2 Direct Rural - Urban Migration Elasticity

The elasticity of wage ratio with respect to the rural – urban migration amount to 8.16 and is significant at a 1 % level (Table 2) and it is elastic. According to the calculation, Myanmar's annual average rural-urban migration is round about 75 thousands. In this case, a policy aimed to reduce the rural- urban migration level followed by increasing per capita rural income through increased agricultural investment needs to be considered very importantly.

The age structure elasticity of rural-urban migration is positive and statistically significant at 1 % level in (Table 2). For a 1 % increase in the amount of young people, migration increases by 2.01 % and thus it is also elastic. The results support both the theory and previous study observations that higher migration rates are created by containing a high percentage of young people aged 15 – 24.

Table (2) Regression Analysis for Migration for the Period 1965 – 2000

Result for Migration Equation

Migration Equation: OLS estimation

Independent Variables	Coeff.	Elasticities
Wage Ratio	616274.50 *** (3.60)	8.16 *** (3.60)
Age Structure	151336.90 *** (4.25)	2.01 *** (4.25)
Constant	- 3.070,588.00 *** (- 4.23)	

R² = 0.36
F(2 , 33) = 9.39
Prob > F = 0.0006

(Note) Figures in parenthesis are *t* statistics.

*** Significant at the 1 % level.

6.3. Reducing Rural-Urban Migration

From the estimated results and the above interpretation, livestock, education and infrastructure (extension irrigated land areas) support an increase in agricultural output and hence on the rural per capita income (see Table 1).

The policy to reduce rural - urban migration by agricultural investments will thus be based on the improvement of livestock, education and infrastructure. By applying the chain rule formulated in equation (5), the policy aimed to reduce rural- urban migration with these three inputs is summarized as follows.

Rural-urban migration partly depends on agricultural income which depends on agricultural inputs. Following these linkages, it is therefore possible to estimate the indirect elasticity of rural-urban migration in response to agricultural inputs and/ or investment. Goldsmith et al (2004) estimated the indirect agricultural input elasticity of migration (η_{M, X_i}) by multiplying the per capita agricultural output (income) elasticity of migration ($\eta_{M, WR}$) by the elasticity of agricultural output in response to agricultural input (η_{Y_A, X_i}). That is, he used the following equation to estimate (η_{Y_A, X_i}).

$$\eta_{M, X_i} = - (\eta_{M, WR}) (\eta_{Y_A, X_i}) \quad (16)$$

Since migration is inversely related to agricultural output and/ or income, any agricultural investment that raises agricultural output and/ or income are inversely related to rural – urban

migration. In other words, the coefficient of the indirect elasticity of migration in response to agricultural investment is negative.

Table (3) The Agricultural Elasticity for Rural – Urban Migration

The indirect elasticity of rural-urban migration with respect to agricultural input

Agricultural input(X_i)	η_{Y_A, X_i}	$\eta_{M, WR}$	η_{M, X_i}
Education	0.8507	8.16	- 6.9417
Livestock	1.1240	8.16	- 9.1718
Infrastructure	0.3405	8.16	- 2.7784

The indirect elasticity of rural-urban migration with respect to education is equal to – 6.94. This means that for a 10 % increase in improving investment to increase literacy rate in rural areas and, *ceteris paribus*, rural-urban migration would decrease by 69.4 %, this is equivalent to roughly to 52,443 migrant i. e. the average rural-urban migration will fall from 75,567 to 23,124 in each year. In principle, an increase investment in education development in rural area would bring down rural-urban migration.

Similarly, the rural-urban migration indirect elasticity with respect to livestock, keeping all other factors constant can also be calculated using the above formula. The indirect elasticity of rural-urban migration with respect to livestock is – 9.1718. This implies that 10 % increase investment in amount of livestock use, measured in heads, would result in 91.71 % decrease in rural-urban migration which means a reduction in the average annual rural-urban migration from 75567 to 6265. In this study, rural – urban migration indirect elasticity with respect to livestock is more elastic than other two agricultural inputs: education and infrastructure which implies that increasing for agricultural output and rural income are mostly rely on ownership and use of farm power in other words livestock ownership of farmers. In principle, the effect of indirect elasticity of livestock is nearly 100 % on reducing rural-urban migration.

The indirect elasticity of rural-urban migration with respect to infrastructure (irrigated land area) is to – 2.7784. In other words, a 10 % increase investment in per hectare irrigated area extension would result in a 27.78 % decrease in rural-urban migration. This means that an increase in investment in development of irrigated areas expansion and controlled flooding on farm land would bring down the average annual rural-urban migration to reach from 75567 to 54575. In principle, increase investment in total area equipped for irrigation, measure in hectare, would turn down rural-urban migration.

From this finding, generally speaking a roughly 1 % increase investment in growing literacy rate, ownership of animal power and extension of irrigated areas in agricultural sector would reduce rural-urban migration significantly by the amount of 6.94 %, 9.17 % and 2.77 % respectively. Therefore, our results depend on successful implementation of rural education development, livestock ownership increasing and developed irrigated areas expansion policies and other policies as well.

7. Conclusion

In Myanmar, rural- urban migration has been increasing since 1986. To reduce rural-urban migration, the effective policies should be designed. To be a successful a policy, rural-urban migration should be reduced and thereby urban unemployment can be reduced and income differentials between the two sectors, the rural sector and the urban sector can also be narrowed.

Among several feasible policies that can reduce rural- urban migration, one that increases agricultural productivity, and indirectly increases agricultural income, is considered to be the best. Such a policy would be based on the reality that rural-urban migration is fixed in performance from within the agricultural sector.

Using a recursive system of equations modified to rural- urban migration, this study has performed a Cobb-Douglas agricultural production function with inputs resulting from Myanmar's economic and demographic data. The findings support the hypothesis that rural-urban migration is a positive function of the ratio of urban capita income to rural per capita income. Moreover, the result helps to set up a possible policy aimed to reduce migration flow through increased per capita earnings of rural people derived from increased investment in agricultural inputs.

The specific results of this research show how the additional use of investment in rural education development programme, increasement in number of domestic animals, and development of irrigated lands expansion which increases agricultural output, per capita rural income and diminishment of rural- urban migration.

Finally, there may be some weaknesses and shortcomings in estimation and specification. In addition, the structural changes which may occur by different policies adopted in Myanmar are not tested by statistical methods in my study.

Acknowledgements

This paper based on the master's thesis submitted to the Hiroshima University of Japan in 2009. I would like to express my appreciation to Professor Shinji KANEKO, of this university for his supervision.

I sincerely thank Rector, Pro Rectors, Professors, head of my department and all my teachers from Yangon Institute of Economics for their worthy teaching, invaluable guidance and support.

I wish to express my deepest appreciation to all who have contributed to the fulfillment of my research work.

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