Some Statistical Evidence of Poverty Ratios in Asia and the Pacific Based on Logit Models

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Introduction

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Introduction

The Millennium Declaration was adopted by 191 member states in 2000. The eight measurable Goals derived from the Declaration were to be achieved by 2015. Among several review reports by UNIDO (2003), UNCTAD (2004), UNDP (2003 and 2005) and United Nations (2005), the study presents some empirical results to achieve MDG by employing the logit model at the regional and sub-regional level.

The seventeen countries shown in Appendix have completed national reports in Asia and the Pacific region. Among them, three countries (China, Thailand and Viet Nam) have only succeeded in poverty reduction by half as stated in Goal 1. The study analyzes MDG achievement in identifying the problems to meet MDG, particularly poverty reduction, and touches upon some of the best practices using national MDG reports.

The main objective of the paper is to analyze the relationships among MDGs, particularly the interrelationships of the several goals related to global economic setting on poverty reduction. It explains why some countries or some regions succeeded in reducing poverty, while some did not over the decade from 1990s to 2000s. The facts and causes of such phenomena were statistically analyzed using the pooled data of 26 developing countries in Asia and the Pacific.

Some studies showed that three exogenous variables, that is, the share of domestic capital formation in GDP, increase rate of employment, and inflation rate, affected the three endogenous variables, namely GDP growth rate, changes in Gini, and poverty incidence (UNESCAP(2002)).
The MDG seminar organized by UNDP discussed that poverty incidence in South Asia could be explained by export growth, agriculture growth and employment creation, while inflation did not seem to bear significant effect on poverty.\textsuperscript{1} UNCTAD (2004) analyzed the relationship between trade and poverty reduction, by identifying the composition of trade, level of development and structure of production. UNCTAD discussed the nature of the interdependence between trade and financial and investment flows, as well as between trade and debt and trade and technology transfer.

Data set and models are discussed, respectively, in the next two sections, and the statistical outcomes are examined in Section III. The linkages between MDG and poverty reduction, and focuses on their synthesis and implication of Doha development perspectives are discussed in Section IV. The study will assist policy makers in identifying problems and targets to meet MDG in national, sub-regional and regional levels. The model will contribute as a tool for formulating and implementing the most effective macroeconomic policy to accelerate achievement of the MDG.

1. The Data

Two kinds of definitions are commonly used for poverty data. One definition is the people gaining less than one dollar per day, which is known as the “international data”. The other is the “national data” whose threshold levels are set by individual countries. Most National MDG reports employ two definitions in parallel.\textsuperscript{2} Thus we also consider these two types of poverty ratios in our model.

The 26 developing economies from the Asia and Pacific region were selected, i.e., Armenia, Azerbaijan, Bangladesh, Cambodia, China, Georgia, India, Indonesia, Kazakhstan, Republic of Korea, Kyrgyzstan, Lao People’s Democratic Republic, Malaysia, Mongolia, Nepal, Papua New Guinea, Pakistan, Philippines, Russian Federation, Sri Lanka, Tajikistan, Thailand, Turkey, Turkmenistan, Uzbekistan, and Viet Nam. These countries were selected on the grounds that the poverty ratio is available in at least one year during the study period of 1990 through 2001. Consequently, the data set includes the sum of 85 observations.

The list of variables considered in our study is summarized in Table 1. The first three variables correspond to the target variable representing the poverty level, and remaining 31 variables are chosen as the candidates for explanatory variables. They are compiled from the data set published by MDG Centre and World Bank’s World Development Indicators (WDI). The 85
observations, or the subset of them, are pooled to derive statistical results. However, the effective number of observations may vary depending on the variables chosen in each model due to frequent emergence of missing values.

1.1. Relevant variables

Although we leave the details of analyses to the later sections, some variables are found particularly relevant to poverty ratio. GDP per capita along with the income distribution index such as GINI would directly be related to poverty, for which we basically employ the international standard that those with daily income of US $1 or less. Figure 1 summarizes the relationships among the variables relevant to the poverty ratio.

There are many variables directly or indirectly related with GDP. When viewing from the expenditure side, it can be decomposed into consumption, investment, government spending, and net exports, which comprise the major portion of current account (CA). In developing economies agricultural raw materials or foods would be one of the important exporting commodities, which we often take as the engines of the growth in some of the least developed countries.

Flow of ODA and FDI affect investment and government components of GDP and current account. Exports, particularly those of agriculture and food related products, imports and external debt affect the current account in developing economies. The deficit in current accounts would be compensated by the capital inflows, or capital account. Such inflows to developing economies, for the most part, take the form of ODA, FDI or other flows including remittance from overseas workers. The former is closely related to the government spending while the latter would become a part of investment. As some of capital inflows would be the loans from outside the country, the interests against the existing balance must be paid abroad (payment to debt service).

Primary school enrollment (SCH) and youth literacy rate (LITE) are introduced to represent the human capital. We cannot deny that education is one of key elements to achieve economic development. However, the present level of educational activity is not necessarily related to the current poverty ratio as it will take many years for education to produce some visible results. Meanwhile the literacy rate represents the quality of existing human stock, and thus expected to be more closely related to the poverty ratio.
2. The Model

2.1. Functional forms

The simplest way is to describe the model is to formulate a linear model. For example, a typical expression based on variables shown in Figure 1 is given as follows.

\[ \text{POV} = \alpha_0 - \alpha_1 \text{PCY} - \alpha_2 \text{ODA} - \alpha_3 \text{FDI} + \alpha_4 \text{DEBT} - \alpha_5 \text{EXP} - \alpha_6 \text{AEXP} - \alpha_7 \text{LITE} \]  (1)

where POV is the poverty ratio (per head), PCY is the GDP per capita, FDI and ODA are also standardized to the per capita basis. EXP and DEBT are the total export of goods and services and the total external debt, respectively, which are standardized against the GDP. AEXP is the share of agricultural raw materials export against total merchandise exports. LITE is the literacy rate for people between ages 15 and 24.

Besides the above variables, we also consider the share of food export FEXP and primary school enrollment SCH. These variables are dropped as the former is virtually parallel to the agricultural export AEXP, but includes processed food which is not directly connected to the level of primary industry. We regard LITE as the better proxy for the level of human capital than SCH due to the reason mentioned above.

By the same token, the flow variables such as FDI and ODA in a single year are not directly related to the present poverty ratio. To ease this problem, the sums of the current and previous years (two-year moving sums) are used for these variables to smooth out drastic changes.

In equation (1), all the variables but DEBT are assigned the negative signs. This indicates that the increases in per capita income, ODA, or literacy rate are expected to reduce the poverty rate, while the increase in total external debt will increase it. Equation (1) does not guarantee that its prediction takes a value between 0 and 1, where the poverty ratio must stay. Thus we consider a logarithmic formula as an alternative.

\[ \log \text{POV} = \alpha_0 - \alpha_1 \text{PCY} - \alpha_2 \text{ODA} - \alpha_3 \text{FDI} + \alpha_4 \text{DEBT} - \alpha_5 \text{EXP} - \alpha_6 \text{AEXP} - \alpha_7 \text{LITE} \]  (2)

By virtue of logarithm, the values predicted by this expression are necessarily positive. However, they can still violate the upper bound condition, \( \text{POV} \leq 1 \).

The probit and logit models are commonly used when the endogenous variable is proportions or probabilities. In this case, the events are dichotomous, where people are classified into the two categories: in poverty or not in poverty. In such a case, the binary probit or binary logit models would be applicable.\(^3\)
When we introduce some variable representing the general level of welfare $U_i$, it would be negatively related to the probability that a person in an economy is in poverty. Then the applicable probit model would take the following form, based on normally distributed disturbances.

$$ p_i = F(-U_i) = \int_{-\infty}^{-U_i} \frac{1}{\sqrt{2\pi}} \exp(-\frac{z^2}{2})dz $$  \hspace{1cm} (3)

In practice, $U_i$ can be described as a function of various variables. When a linear model is assumed, we are required to estimate the parameters $\beta_j$ in

$$ U_i = \beta_0 + \sum_j \beta_j X_{ji} $$  \hspace{1cm} (4)

Theoretically the probit model provides statistically clear representation of binary event. However, the problem is that it is difficult to estimate the function for $U$ as it involves integration. The logit model is derived when the disturbance follows the Weibull distribution. In that case, the cumulative distribution follows the logistic distribution.

$$ p_i = \frac{1}{1 + \exp(U_i)} $$  \hspace{1cm} (5)

Here we can easily confirm that the poverty ratio $p_i=0$ when $U_i=+\infty$, and $p_i=1$ when $U_i=-\infty$.

As both probit and logit models give the expressions for probability, their LHS ($p_i$) always stays between 0 and 1. Apparently, the utility function (4) is much easier to estimate with the binary logit model (5) than with the binary probit model (3). However, we must take note that the distribution it depends on is slightly skewed from symmetric.

By rearranging (5), we have

$$ \log\left(\frac{1 - p_i}{p_i}\right) = U_i, $$  \hspace{1cm} (6)

and the utility function (4) can be estimated linearly. By differentiating the LHS of (6) by $p_i$, we have

$$ \frac{\partial}{\partial p_i} \log\left(\frac{1 - p_i}{p_i}\right) = \frac{p_i}{1 - p_i} \left(-\frac{1}{p_i^2}\right) = -\frac{1}{p_i(1 - p_i)} < 0 $$
Thus we know that the LHS decreases with the increase in $p_i$. In other words, a variable expected to contribute to the decrease in poverty ratio will have a positive sign, while one expected to contribute to the increase will have a negative sign.

Then the working formula for (6) becomes:

$$\log\left(\frac{1 - \text{POV}}{\text{POV}}\right) = \alpha_0 + \alpha_1 PCY + \alpha_2 ODA + \alpha_3 FDIT - \alpha_4 DEBT + \alpha_5 EXP + \alpha_6 AEXP + \alpha_7 LITE, \quad (7)$$

where the signs attached to the variables are interchanged from (1).

It must be noted that the estimation results from equation (7) will be biased in real scale in the sense that minimization of logarithms of squared errors does not necessarily imply minimization of squared errors in real scale. To avoid such problems, it is possible to apply maximum likelihood (ML) method to estimate (5) directly. However, as nonlinear estimations are generally time-consuming, ML is not an efficient way to choose particularly when we are to find the appropriate models by testing various combinations of explanatory variables. Thus in the following, we employ (7) as the basic formula for our empirical analyses.

2.2. Discussion

The model proposed in the previous subsection (7) is to predict the poverty ratio. While it represents the probability, it can easily be transformed into the poverty headcount when accompanied by the proper projection of population increase. Suppose $N$ gives the population of the country. Then the headcount in poverty can easily be obtained by $\text{POV} \cdot N$.

If the policy maker is concerned about the changes in headcount in poverty, it can also be obtained by a simple difference equation.

$$\Delta(\text{POV} \cdot N) = \Delta\text{POV} \cdot N + \text{POV} \cdot \Delta N, \quad (8)$$

where $\Delta N$ is the (annual) change in population and $\Delta\text{POV}$ is the same for poverty ratio.

When the POV function can simply be written as $\text{POV} = 1/(1 + \exp(\sum_i \beta_i X_i))$, we have the following result from differentiation with the time.

$$\frac{d}{dt} \text{POV} = \frac{-\exp(\sum_i \beta_i X_i)}{(1 + \exp(\sum_i \beta_i X_i))^2} \sum_i \beta_i \frac{dX_i}{dt}$$

By discretizing, we obtain the equivalent difference expression.
Thus the policy maker can easily evaluate how changes in the exogenous variables $\Delta X_i$, such as FDI or agricultural export, affect the poverty rate, and the poverty headcount. It is clear from (8) that curbing population growth is a key element for controlling the poverty in terms of headcount. In any case, equation (7) on which (9) is based, effectively provides a tool for evaluating the significance of respective policies on the MDG goal to halve the people in poverty.

3. Empirical Results

3.1. Linear and logarithmic linear models

We here estimate the models to explain the poverty head count ratio, both national and international. The seven variables included in the RHS of the formulae in the previous section are selected after examining an extensive set of variables shown in Table 1. As the LHS variable, we first consider the national poverty ratio (% of population), $\text{NAHC}$, based on the standards set by individual countries.

$$\text{NAHC}=0.7679+0.0001506\text{PCY}+0.00148\text{ODA}+0.00408\text{FDI}+0.8121\text{DEBT}$$

$$(4.36)\quad (0.76)\quad (0.82)\quad (1.62)\quad (1.57)$$

$$-0.8426\text{EXP}+0.07002\text{ACP}\text{EXP}+0.00872\text{LITE}, \quad R^2=0.7433 \quad (F=2.07)$$

$$(0.67)\quad (1.45)\quad (2.81)\quad \text{DF} = 5 \quad (10)$$

where the values within the parentheses show the absolute t-values.

In the above, DEBT only is expected to have a positive parameter, while the rest of the parameters are negative. In this regard, PCY, ODA, and FDI are associated with wrong signs, and the literacy rate, LITE, is the only variable that is significant at 1% level. One of the reasons that we have a poor result is that the degree of freedom, DF, is too low to obtain reliable results. When we introduce these seven variables, we barely have 13 effective observations out of 85 in our data set due to missing values.

On the other hand, the linear regression result for the international poverty level, $\text{US1D}$, which is defined as the fraction of the people living with 1993 US $1$ per day or less is calculated as follows.
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\[
US1D = 0.6336 - 0.0000760PCY - 0.00281ODA - 0.0000773FDI - 0.1306DEBT \\
\quad (5.82) \quad (2.28) \quad (2.14) \quad (0.21) \quad (1.06) \\
-0.01945EXP + 0.00696AEXP - 0.00329LITE, \quad R^2 = 0.7751 (F = 8.37) \\
\quad (0.08) \quad (0.80) \quad (2.46) \quad DF = 17 \quad (11)
\]

The signs are incorrect for the total external debt, DEBT, and the share of agricultural export, AEXP, but those two variables along with the FDI per capita and the share of export to GDP are insignificant. Other three variables demonstrate correct signs and significance at 5% or less.

With the larger DF and R-square values, this result seems better than the NAHC case (10). This partly stems from the fact that the LHS variable, the national poverty level, itself is difficult to obtain. In fact, 35 observations for NAHC are much smaller than 65 for the international poverty level, US1D. Taking the difference in the sizes of effective observations into account, we focus on US1D rather than NAHC as the poverty measure throughout the rest of this paper.

The above result suggests the elimination of insignificant variables would increase the degree of freedom by reducing the number of missing values. Stepwise regression is a typical method of selecting variables, which delivers a significant expression. We here apply the backward elimination method, but our method differs from the standard one in the sense that the set of effective observations is revised every time a variable is eliminated.

Hereafter \textit{POV} denotes the poverty ratio based on US1D, and the final result from backward elimination is calculated as follows.

\[
POV = 0.6446 - 0.0000690PCY + 0.00636ODA - 0.0829DEBT + 0.0483LITE \\
\quad (9.51) \quad (3.83) \quad (1.77) \quad (3.53) \quad (5.68) \\
R^2 = 0.7230 (F = 26.76), \quad DF = 41 \quad (11a)
\]

Four variables are retained, and all the sign conditions in (11a) are correct. The adjusted \(R^2\) is higher for this case (0.6960) than the original case (0.6826) despite the smaller value of \(R^2\). It means that four variables, PCY, DEBT, LITE (1% significant), and ODA (8.4% significant), are enough to explain the poverty ratio, as far as the linear model is concerned.

With three variables being eliminated, the degree of freedom for this model is expected to be 20. Thus DF=41 implies that 21 observations have been added to the set of effective observations due to elimination of these variables. It must also be noted that the youth literacy rate, LITE, is always significant in all of the above expressions. As LITE can be regarded as a proxy of human
capital, such results clearly suggest the significance of human capital development in poverty reduction.

While the predicted values from linear models could become negative, such a risk can be avoided by taking logarithms of the LHS variable. Thus it might be useful to calculate the log-linear formula (2), which becomes:

\[
\log \text{POV} = 0.7465 - 0.000754 \text{PCY} - 0.02303 \text{ODA} - 0.00187 \text{FDI} - 0.2970 \text{DEBT} \\
+ 0.3126 \text{EXP} - 0.01739 A \text{EXP} - 0.01899 \text{LITE} \\
R^2 = 0.7791 (F = 8.57) \\
DF = 17 \quad (12)
\]

The incorrect signs are assigned to DEBT and EXP, but both are insignificant. Three variables, PCY, ODA, and LITE, are significant between 0.9 and 8.3% levels. The final result from the backward elimination also has three variables, but is slightly different from the above, with the per capita ODA being replaced by the total external debt.

3.2. Logit models

The log-linear formulae are better than the linear ones due to their positive nature. However, predicted values from both formulae could exceed one, another restriction that a proportion, or probability, must satisfy. Following discussion in the previous section, we adopt the binary logit model (5) as our basic formula, which can be estimated linearly by a logarithmic transformation shown in equation (7).

\[
\log \left( \frac{1 - \text{POV}}{\text{POV}} \right) = -1.564 + 0.000849 \text{PCY} + 0.02675 \text{ODA} + 0.00193 \text{FDI} + 0.4551 \text{DEBT} \\
- 0.2551 \text{EXP} + 0.00708 A \text{EXP} + 0.02342 \text{LITE} \\
R^2 = 0.7873 (F = 8.99) \\
DF = 17 \quad (13)
\]

It must be noted that the proper signs are opposite to the previous models, viz. the variables contributing to poverty reduction should have positive parameters. In this sense, only DEBT and EXP have incorrect signs, but both of them are insignificant. Among the rest of variables, PCY and ODA are significant at 1% and 3%, respectively, and LITE is barely significant at 6%.

The backward elimination method is applied to obtain the following result.
The sign conditions are satisfied, and both PCY and LITE are highly significant at less than 0.1% level. DEBT is also significant at 2% level. It is interesting to know that these three variables have also survived through the backward elimination processes in the linear formula (11a). In this regard, the effects of these variables in poverty ratio seem quite robust irrespective of the functional forms chosen.5)

3.3. Synthesis of MDG

The logit model with international pooling data showed significant results, and it guarantees the condition that the predicted values of poverty ratio to stay between zero and one. Thus we employ the logit model for synthesis of MDG. Among the seventeen countries that completed national MDG reports, only three countries, China, Thailand and Viet Nam, halved their poverty ratios over the past decade. One of the questions is why three countries have succeeded in poverty reduction. We also present the sub-regional MDG syntheses using three sub-regional groups including 1) East, North-East Asia, South-East Asia, 2) South and South-West Asia, and 3) North and Central Asia.

3.3.1. China, Thailand and Viet Nam

We first see if the poverty structures in these three countries are different from the rest. Chow test is employed as an insufficient number of samples are available for them. The model without AEXP is considered for that purpose since its inclusion significantly reduces the number of effective observations, particularly when a subset of countries is concerned. The result concerning all the countries is required as the reference.

$$\log\left(\frac{1 - POV}{POV}\right) = -1.287 + 0.000784PCY - 0.4629DEBT + 0.03195LITE \quad R^2 = 0.7164 (F = 37.05)$$

$$\text{(13a)}$$

By dropping AEXP, we can use 11 more observations. The signs of FDI and EXP are different.
from (13), but both are insignificant. The only statistical difference is that ODA, which was significant in (13), becomes insignificant in (14).

The same formula is fitted to the subset excluding China, Thailand and Viet Nam, which removes five samples from the original data set.

\[
\log\left(\frac{1 - POV}{POV}\right) = -0.1247 + 0.000784PCY + 0.00518ODA + 0.000745FDI - 0.6166DEBT
\]

\[
= -0.2109EXP + 0.03249LITE
\]

\[
R^2 = 0.7357 (F = 11.14) \quad DF = 24 \quad (14a)
\]

No essential change is found in the above, except for the interchanged signs in two insignificant variables, FDI and EXP. Both in (14) and (14a), PCY and LITE are significant at 1.5% or less.

Chow test can be summarized as follows. Suppose the original sample size is \(n_1\) and additional samples of size \(n_2\) become available. After the normal regression procedures, we obtain the sum of squared errors \(SSE_1\) and \(SSE\) for the original and augmented data sets, respectively. The null hypothesis that the augmented data set is statistically indifferent from the original data can be tested by the following F-statistic.

\[
F = \frac{(SSE - SSE_1) / n_2}{SSE_1 / (n_1 - k - 1)},
\]

where \(k\) is the number of explanatory variables commonly used in the regressions for the two data sets.

From the regressions (14) and (14a), \(SSE=18.9323\) and \(SSE_1=16.2560\) are obtained. In this case the original and additional sample sizes are \(n_1=31\) and \(n_2 = 5\), respectively. Thus the degrees of freedom become 5 for the numerator and 24 for the denominator. Consequently, \(F\) is calculated as 0.7902. When we consider the applicable p-value of 0.5671, the null hypothesis cannot be rejected. In other words, if the poverty ratios are significantly smaller for those countries, we can conclude that the difference is simply resulted from the level of economic activities.

3.3.2. East, North-East Asia, and South-East Asia

To see the regional differences, we first estimate the logit model for the countries in East, North-East, and South-East Asia. However, as the sample size necessarily becomes smaller in the calculations concerning those sub-regions, we here concentrate on the model (13a) obtained as a
result of the elimination process. This will facilitate reasonable degrees of freedom as well as model significance.

22 effective observations are available for this sub-region, which lead to the following.

\[
\log\left(1 - \frac{POV}{POV}\right) = -2.014 + 0.000773PCY - 0.2866DEBT + 0.03568LITE \quad R^2 = 0.7357( F = 15.77 )
\]

\[
(1.10) \quad (4.37) \quad (1.20) \quad (1.83) \quad DF = 17
\]

The model is 1% significant, and GDP per capita is highly significant, but the youth literacy rate is barely significant at 8.5% level, and total external debt is insignificant. One of the reasons why DEBT is insignificant may be explained from relatively high negative correlation between DEBT and PCY in the region, which reflects the samples from China, Indonesia, Cambodia, Laos, Mongolia, Malaysia, Philippines, Thailand, and Vietnam. The explanatory power of LITE will drop where universal primary education is achieved.

3.3.3. South and South-West Asia

The same model as above is applied to 15 samples from this sub-region.

\[
\log\left(1 - \frac{POV}{POV}\right) = -2.454 + 0.000766PCY - 3.666DEBT + 0.02386LITE \quad R^2 = 0.8816( F = 27.29 )
\]

\[
(3.90) \quad (3.12) \quad (3.42) \quad (2.40) \quad DF = 11
\]

Again the model is highly significant, and all the parameters are significant at 3.5% or less. Thus the region contains larger diversities in external debt as well as literacy rate comparing to the previous sub-region.

3.3.4. North and Central Asia

It must be noted that the parameters associated with PCY are remarkably similar whether the samples are from the entire region (0.000784), the region excluding China, Thailand, and Vietnam (0.000728), East Asia and vicinity (0.000773), or South Asia and vicinity (0.000766). Along this line, this sub-region seems quite different from the rest of Asia as shown below.
In the transitional economies, per capita GDP is completely ineffective in reducing poverty. The extremely large negative intercept implies that the baseline poverty level is fairly high in those countries. The model is significant at 1%, and the rest of variables are significant at 1 to 2% level.

To see the regional differences in the baseline poverty level, we introduce regional dummies to the model (13a). As we consider three sub-regions, two dummy variables, DS and DC are introduced. The former represents South and South-West Asia, while the latter does North and Central Asia.

\[
\log\left(\frac{1 - \text{POV}}{\text{POV}}\right) = -2.036 + 0.00788PCY - 2.638DEBT + 0.03553LITE + 0.5423DS + 0.2746DC
\]

\[
(2.34) \quad (5.82) \quad (1.28) \quad (3.76) \quad (1.34) \quad (1.86)
\]

\[R^2 = 0.7458(F = 24.65), DF = 42\]

While the regional dummy of DC (North and Central Asia) is significant at 7%, DS (South and South-West Asia) is significant only at 13% level. This coincides with the above observation that the economic structure in the former might be somewhat different from the developing economies in the rest of Asia and Pacific.

In order to see if North and Central Asia is statistically different from rest of the countries, Chow test can also be used. The result based on the samples in the region excluding North and Central Asia is obtained as follows.

\[
\log\left(\frac{1 - \text{POV}}{\text{POV}}\right) = -0.6486 + 0.00122PCY + 0.00339ODA - 0.00774FDI - 0.4138DEBT
\]

\[
+ 2.398EXP + 0.01169LITE
\]

\[
(0.98) \quad (4.44) \quad (0.70) \quad (2.30) \quad (1.11)
\]

\[\quad (1.69) \quad (1.16)
\]

\[R^2 = 0.7724(F = 12.44), DF = 22\]

\[\text{(14b)}\]

This can be compared with (14) to calculate the F-statistic. As the original sample size \(n_1\) is 29, the degrees of freedom are 7 for the numerator and 22 for the denominator. We have SSE\(_1\)=12.1634 for (14b), and the F-statistic and the corresponding p-values are calculated as 1.7490 and 0.1492, respectively.

Despite the fact that the hypothesis of North and Central Asia being statistically similar to the
rest of Asia and the Pacific cannot be rejected, the level of significance is 15%, which is much smaller than the case regarding China, Thailand, and Viet Nam. It means that if the poverty ratios are significantly high for the sub-region, it may be likely concluded that the difference could result from the fundamental structural difference in socio-economic backgrounds, unlike the case on three countries including China, Thailand and Viet Nam. Therefore three sub-regions differed in the relationships of MDG variables to explain the poverty. Particularly, North and Central Asia is different from other sub-regions.

4. Perspective of Doha Development Agenda into MDG

4.1. Doha Development Agenda

The Doha development agenda has set the stage for a development round of trade liberalization, establishing modalities for negotiations on agriculture and providing greater substance to special and differential treatment for developing countries. While tariffs and agricultural support in developed countries have been reduced, the process has been still slow.

The focus of future negotiations under Doha Development Agenda will be summarized as follows:7)
a) Agriculture: substantially improve market access; reduce all forms of export subsidies, with a view to phasing them out; and substantially reduce trade-distorting domestic support;
b) Services: further liberalize all categories of services and modes of supply;
c) Industrial goods: further reduce tariffs, including tariff peaks, high tariffs, and tariff escalation, as well as nontariff barriers, particularly on products of export interest to developing countries;
d) Antidumping measures and subsidies: clarify and improve disciplines, while preserving the basic concepts, principles, and effectiveness of these agreements and their instruments and objectives;
e) Regional trade agreements: clarify and improve disciplines and procedures under existing WTO rules applying to regional trading agreements;
f) TRIPS: establish a multilateral system of notification and registration of geographical indications for wines and spirits. Protection of geographical indications of other products addressed under review of implementation of TRIPS agreement;
g) Dispute settlement mechanism: improve the implementation of rulings and participation of the developing countries;
h) The environment: negotiations limited to the relationship between existing WTO rules and specific trade obligations set out in multilateral environmental agreements and to the reduction or elimination of tariff and nontariff barriers to environmental goods and services; and

i) Singapore issues: Possible negotiations on investment, competition policy, transparency in government procurement, and trade facilitation. Last July, it was decided that only trade facilitation would be went ahead in the round.

4.2. MDG 8: Develop a global partnership for development

The Millennium Declaration establishes a mutual accountable partnership between developed and developing countries. Goal 8 addresses the way developed countries can assist developing countries to achieve poverty reduction through more development assistance, improved market access, and debt relief. To achieve Goal 8: Develop further an open trading and financial system that is rule-based, predictable and non-discriminatory; includes a commitment to good governance, development and poverty reduction—nationally and internationally, the following actions on trade, investment, ODA and debt, among others, are targeted.

a) Market access: Address the special needs of LDCs, LLDCs and SIDS. This includes tariff-and quota-free access for their exports;

b) Debt: Enhanced debt relief for heavily indebted poor countries; cancellation of official bilateral debt; deal comprehensively with developing countries’ debt problems through national and international measures to make debt sustainable in the long term;

c) ODA: More generous official development assistance for countries committed to poverty reduction; and

d) FDI: Technology transfer and employment creation through private sector development.

4.3. Trade, Per Capita Income, Market access, Technology, Agriculture and Poverty

The relationships between trade, per capita income, market, agriculture, and poverty have been studied by many researchers and seem to be summarized as follows:

a) Increased export opportunities and specialization in productive activities that can exploit comparative advantages;
b) Higher economic growth and real income through better access to ideas, technology, goods, services and capital;

c) More efficient use of resources leading to higher productivity as a result of increased international and domestic competition;

d) Long-term effect on increased inflow of foreign direct investment and technology transfer;

e) increased opportunities to produce competitive goods and services in global demand and incentives to adopt new business practices develop new products and markets;

f) Enlarged market for local producers, allowing them to better exploit economies of scale, which increases income levels and the efficiency of resource allocation;

g) Developing countries might be more competitive in low-skill intensive sectors and these sectors might expand and increase the demand for low-skilled workers, who typically belong to the poorer segments of the population;

h) Increased access to cheaper imported products (UNIDO(2003)): It is also pointed that increased trade on agriculture and processing food products derived from SPS and TBT conformity will be leading to poverty reduction, as the majority of poor people depend on agriculture in developing countries; and

i) The target of halving the poor people earning less than $1 per day is likely to be achieved by improving farmers’ capacity in production and processing food, followed by marketing in national and international and export.

As Doha development agenda is reducing export subsidies with a view to phasing them out and as a part of global partnership as in MDG 8, the special needs of the least developed countries including tariff and quota-free access must be addressed for the least developed countries’ exports competitiveness. The benefits that developing countries may derive from a phasing-out of agricultural support provided by advanced countries are likely to be underestimated (UNCTAD(2004)).

With the background above, the study analyzed the perspective of Doha development agenda into MDG, using results in the previous chapter in all sub-regions with pooled data, in the three sub-regions, viz. (1) East, North-East Asia, and South-East Asia, (2) South and South-West Asia, and (3) North and Central Asia. The major inference from our empirical analyses will be summarized in the next section.
5. Concluding Remarks

In general, the theoretical foundations for recent empirical studies of growth relies on dynamic models with physical and human capital depending on initial conditions and the institutions and policies that affect the return to saving and investment with growth rate of per capita GNP as the dependent variable. Policy improvements are likely more potent if a country receives aid with good governance and institutional capacity building. The estimated impact of aid on growth in a good policy environment is likely positive.

Our statistical results indicate that the external debt burden is significantly related to the poverty. Thus the reduction of the debt burden will help LDCs and developing countries in reducing poverty. It is noted that poverty reduction and debt burden are more likely related in all models. On the other hand, our results were not conclusive whether ODA or growth of ODA will bring positive impact on poverty reduction.

Investment climate including domestic and foreign is central to growth and poverty reduction (World Bank (2005)). A good investment climate may enhance the lives of people as employees, entrepreneurs, and consumers. FDI and other sources of financial flow will help in mitigating poverty. Governments must influence the investment climate through the impact of their policies and behavior on the costs, risks, and barriers to competition facing firms. However, FDI did not show any clear relationship with poverty reduction in empirical analyses. Other flows including remittances of overseas workers may have a potential for productive use leading to the poverty reduction.

The relationship between trade and poverty reduction was not conclusive. The data on market access from supply side are generally unavailable in developing economies. As an alternative, TBT and PSP conformity costs, for example, could be utilized as the explanatory variables.

The models regarding sub-regions were also estimated. We found that North and Central Asia is statistically different from the rest of the area. Thus we might conclude that such a difference is likely to be resulted from differences in the basic economic structures such as socio-economic background inherited from the former planned economies. On the other hand, the three countries that succeeded in halving the poverty ratios are basically similar to the other economies.

Finally, rigorous statistical analyses are important in understanding the economic structures. In particular, the significance of literacy rate, or the level of human capital, is found very robust in
poverty reduction. Such a strong statement is only possible with certain statistical evidence. Of course the present study might not be satisfactory in the sense that the statistical observations are associated with a lot of missing observations. As economic statistics are an indispensable resource for every development plans, it is hoped that we can conduct more extensive studies in the near future, when the expanded data set sufficient for the panel analyses becomes available.

Notes

1) MDG seminar in Bangladesh 2004
2) See the national reports listed in Appendix.
3) The endogenous variable can be discrete. In fact, the probit or logit models have been developed in conjunction with the discrete choice problems. The number of events (or alternatives) can exceed two. In such cases, the applicable models are called either multinomial probit or multinomial logit models.
4) It must be noted that if \( p_i \) is positively related to the utility, we will have \( p_i = 1/(1+\exp(-U_i)). \)
5) The variable ODA remains until one step prior to (13a). If we retain ODA instead of LITE, R-square drops to 0.4657 even though all the parameters are significant at 5.3% level or less.
6) When Chow test is applied to the formula (13a) after elimination, the F-statistic and the corresponding p-value become 1.0889 and 0.3866, respectively.
8) The Monterrey consensus has confirmed the partnership on global development. In order to halve the poverty, it approached financing development with trade, debt, ODA, FDI and technical cooperation.

References

Appendix: List of national MDG reports and their achievements in Goal 1.

   Opening Doors to Opportunity Afghanistan’s Millennium Development Goals

   Armenia Millennium Development Goals (2001)


4. Bhutan: not conclusive due to insufficient data and information

5. Cambodia: has not achieved.
   United Nations Development Goals Cambodia (2001)

6. China: Both proportion of population below national poverty line (the government poverty line) and the proportion of population living below $1 per day have declined by more than 50%.
   Millennium Development Goals China progress: An Assessment by the UN Country Team in China (2003)

7. Indonesia: Proportion of population below national poverty line increased from 15.1% (1990) to 18.2% (2002), while proportion of population living below $1 per day declined from 20.6% to 7.2%.

8. Kazakhstan: not yet
   Millennium Development Goals in Kazakhstan (2002)


10. Islamic Republic of Iran: not yet achieved, but national poverty line has significantly decreased from 12.75% in 1995 to 8.99% in 2002.
    The First Millennium Development Goals Report, November 2004

11. Malaysia: partially achieved. Poverty rate has not halved yet in rural areas, while it has achieved in urban areas from 1990 to 2002.

12. Mongolia: not yet achieved. Depth of poverty and disparity appear to have increased and the poverty has not declined over the last decade. Poverty headcounts were 36 percent in 1990 and 35 percent in 2000.


    Progress toward the Millennium Development Goals Tajikistan (2003)

16. Thailand: poverty incidence reduced from 27.2% in 1990 to 9.8% (national poverty) in 2002.

17. Viet Nam: halve the country’s poverty rate from over 60% in 1990 to 32% in recent years.
    Millennium Development Goals: Bringing the MDG Closer to the People (2002)
Table 1: List of variables considered in the study

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USID1</td>
<td>Poverty ratio less than 1993 US $1</td>
</tr>
<tr>
<td>NAHC1</td>
<td>Poverty headcount, national (% of population)</td>
</tr>
<tr>
<td>GINI</td>
<td>GINI index</td>
</tr>
<tr>
<td>POP4</td>
<td>Population, total</td>
</tr>
<tr>
<td>UPOP</td>
<td>Urban population (% of total)</td>
</tr>
<tr>
<td>FLF</td>
<td>Labor force, female (% of total labor force)</td>
</tr>
<tr>
<td>TLF</td>
<td>Labor force, total</td>
</tr>
<tr>
<td>UNEM</td>
<td>Unemployment, total (% of total labor force)</td>
</tr>
<tr>
<td>YUNEM</td>
<td>Unemployment, youth total (% of total labor force ages 15-24)</td>
</tr>
<tr>
<td>FERT</td>
<td>Fertility rate, total (births per woman)</td>
</tr>
<tr>
<td>NENR</td>
<td>School enrollment, primary (% net)</td>
</tr>
<tr>
<td>SCH</td>
<td>School enrollment, primary (% gross)</td>
</tr>
<tr>
<td>LITE2</td>
<td>Illiteracy rate, youth total (% of people ages 15-24)</td>
</tr>
<tr>
<td>G2B</td>
<td>Ratio of girls to boys in primary and secondary education (%)</td>
</tr>
<tr>
<td>GDP3</td>
<td>GDP (current US$)</td>
</tr>
<tr>
<td>EXP3</td>
<td>Exports of goods and services (BoP, current US$)</td>
</tr>
<tr>
<td>IMP</td>
<td>Imports of goods and services (BoP, current US$)</td>
</tr>
<tr>
<td>CA</td>
<td>Current account balance (BoP, current US$)</td>
</tr>
<tr>
<td>FDE3</td>
<td>Foreign direct investment, net (BoP, current US$)</td>
</tr>
<tr>
<td>ODA3</td>
<td>Official development assistance and official aid (current US$)</td>
</tr>
<tr>
<td>DODA</td>
<td>ODA increase = (ODA/ODA-1) / ODA-1</td>
</tr>
<tr>
<td>AIDG</td>
<td>Aid (% of GNI)</td>
</tr>
<tr>
<td>DEBT3</td>
<td>Total debt service (% of GDP)</td>
</tr>
<tr>
<td>EXDEB</td>
<td>Total debt service (% of exports of goods and services)</td>
</tr>
<tr>
<td>AGRV</td>
<td>Agriculture, value added (current US$)</td>
</tr>
<tr>
<td>AGRR</td>
<td>Agriculture, value added (% of GDP)</td>
</tr>
<tr>
<td>AEXP2</td>
<td>Agricultural raw materials exports (% of merchandise exports)</td>
</tr>
<tr>
<td>FEXP</td>
<td>Food exports (% of merchandise exports)</td>
</tr>
<tr>
<td>FA</td>
<td>Forest area (% of land area)</td>
</tr>
<tr>
<td>EGDP</td>
<td>Energy use per GDP (PPP $ per kg of oil equivalent)</td>
</tr>
<tr>
<td>WATER</td>
<td>Improved water source (% of population with access)</td>
</tr>
<tr>
<td>SANI</td>
<td>Improved sanitation facilities (% of population with access)</td>
</tr>
<tr>
<td>TELE</td>
<td>Telephone mainlines (per 1,000 people)</td>
</tr>
</tbody>
</table>

Notes:
1. Employed as the LHS variables;
2. Employed as the RHS variables;
3. Used as the RHS variables in modified forms; and
4. Used to calculate the per capita variables.
Figure 1. Economic indicators relevant to poverty ratio.
Some Statistical Evidence of Poverty Ratios in Asia and the Pacific based on Logit Models

UNO Kimiko

Poverty reduction is one of the most important objectives prescribed in the UN’s Millennium Development Goals that was adopted by 191 member states in 2000. The eight measurable Goals derived from the Declaration were to be achieved by 2015.

This paper identifies the economic variables that are statistically relevant to the determination of the poverty ratios. For that purpose we compile an extensive data set covering 12 years and 26 countries in Asia and the Pacific. The main objective of the paper is to analyze the relationships among MDGs, particularly the interrelationships of the several goals related to global economic setting on poverty reduction. It explains why some countries or some regions succeeded in reducing poverty, while some did not over the decade from 1990s to 2000s. The facts and causes of such phenomena were statistically analyzed using the pooled data of 26 developing countries in Asia and the Pacific.

Some of the results are:

1. In general, the theoretical foundations for recent empirical studies of growth relies on dynamic models with physical and human capital depending on initial conditions and the institutions and policies that affect the return to saving and investment with growth rate of per capita GNP as the dependent variable. Policy improvements are likely more potent if a country receives aid with good governance and institutional capacity building. The estimated impact of aid on growth in a good policy environment is likely positive.

2. The statistical results indicate that the external debt burden is significantly related to the poverty. Thus the reduction of the debt burden will help LDCs and developing countries in reducing poverty. It is noted that poverty reduction and debt burden are more likely related in all models. On the other hand, our results were not conclusive whether ODA or growth of ODA will bring positive impact on poverty reduction.