

Agricultural Productivity and Poverty Reduction in Thailand

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Abstract

Thailand's growth used to rely on agriculture as a main driver for a long period of time. However, in 1980s, agriculture has been demoted from an engine of growth because a supply of labor came to an end. Thai economy shifted the concentration to industrial and service sectors instead. Nonetheless, it is unreasonable to overlook its importance since the majority of labor forces still lives in this sector. While agriculture is devaluated in Thai economy, population in agricultural sector suffer from a natural disaster and interference in an industrial production solely. That is why more than half of poor belong to agricultural sector. Poverty is then an everlasting issue that Thailand confronts with. Enhancing agricultural productivity might be one of many solutions to aid escaping from poverty. In the study, agricultural productivity would be introduced as the key determinant for Thailand's poverty reduction in four aspects: the poverty rate measuring by national poverty line; an employment in overall and sectoral issues; a migration from rural to urban areas; and the purchasing power. The study would begin with understanding the measurement of Thai agricultural productivity learnt from various studies. The following section would construct the model to examine the pattern of agricultural productivity to the poverty. The results from the model are discussed in the next section. Lastly, the paper would end with suggesting the policy recommendation in hope of solving Thai poverty situation.

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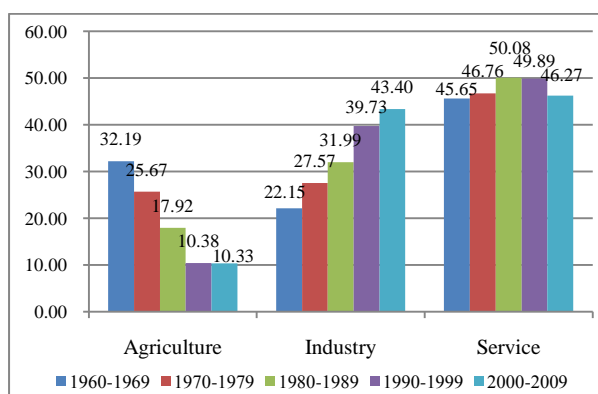
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I. Introduction

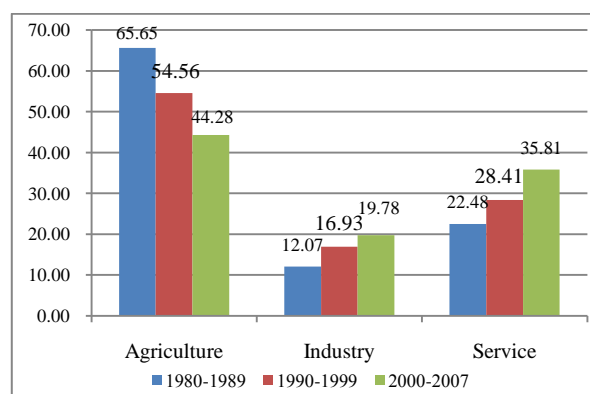
Agriculture used to be an engine of economic growth in Thailand. Before 1980, an expansion of agricultural land increased outputs of the economy. Thai agricultural sector became a major comparative advantage in the international trade. In addition, as being the labor-abundant country, agriculture supplied an industrial sector with cheap labors and other factors of production. The role of agriculture in growth was undeniable. However, in 1980s, land surplus began to disappear (Siamwalla, 1996). Industry and service then stepped up to the frontier instead. That’s why agricultural value-added share to GDP becomes small as an industrial sector became a bigger sector as shown in figure 1.

Figure 1: Sectoral Value-Added (% of GDP)



Source: World Bank (2010)

Figure 2: Sectoral Employment (% of Population)

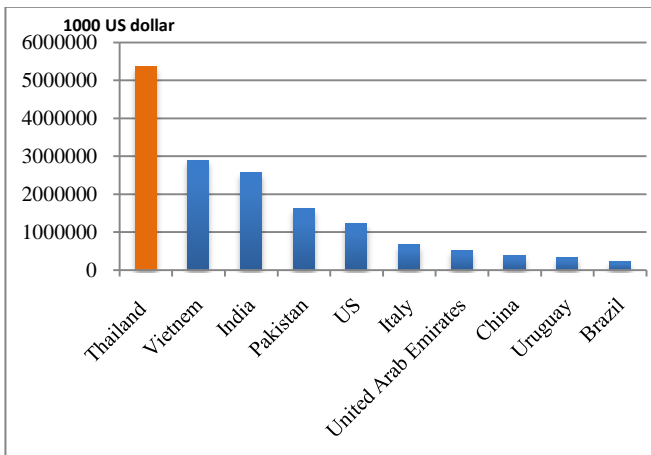


Source: World Bank (2010)

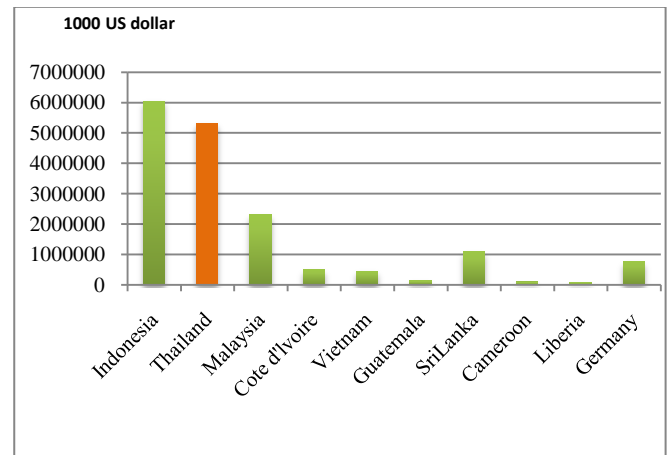
Nevertheless, figure 2 demonstrates that the majority of labor force still belongs to agricultural sector even an employment is in the decreasing trend. NESDB (2008) indicated that households in agricultural sector are among Thai poorest. That means solving the agricultural problem would help the most of the poor in Thailand. Timmer (2003), who studied the relationship between the agriculture, growth and poverty of several countries including Thailand, expected the positive direct impact in agriculture to the farmers who are normally classified as poor. Additionally, Thai agriculture is well-known as a major agricultural exporter in the world with the rank of fifteenth. Figure 3 introduces export statistic for milled rice and natural dry rubber as the first and the second rank respectively in the world. Thereby agriculture turns to be a key source of export earning and rural income (Suphannachart and Warr, 2010). Agriculture also plays a crucial role of shock absorber for unemployed labors in non-agricultural sectors during adverse circumstances, such as Asian financial crisis in 1997 and sub-prime crisis in 2008-2009. Unemployed labors from non-agricultural sector went back to agriculture as the second-best solution at their hometown. Furthermore, Thai agriculture suits for the future source of income and growth if Thailand could be able to maintain a net food supplier during an anxiety of food security around the world (FAO, 2008). Therefore, Thai agriculture should not take out of the consideration.

Figure 3: Major exporters in milled rice and natural dry rubber in 2008

(A) Major exporters in rice milled



(B) Major exporters in natural dry rubber

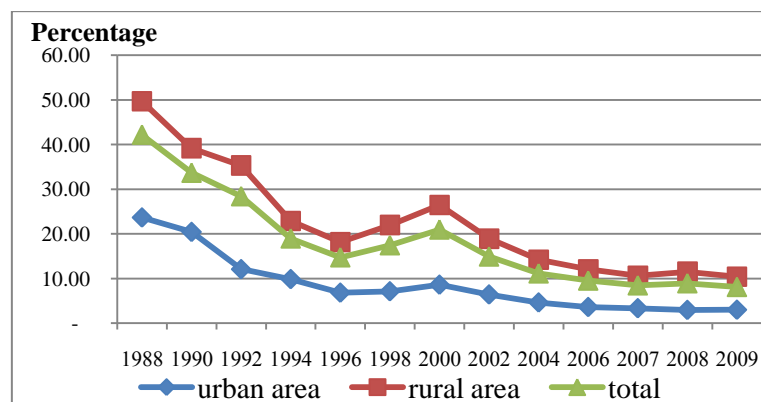


Source: FAO (2011)

Source: FAO (2011)

Similar to other countries in the world, the poverty is the long-lasting issue in Thailand. Although figure 4 shows a decline in Thai poverty rate through times, this problem is decisively standstill. Most of the poor lives in rural areas (NESDB, 2011). Their livings depend solely on farm and non-farm performances (Timmer, 2003). Low agricultural production would directly reduce their income and standard of living. Since Thailand could not prolong a comparative advantage from expansion of agricultural land, agricultural productivity should be introduced as alternatives to increase the output production. The number of previous studies, such as Suphannachart and Warr, (2010), Tinakorn and Sussangkarn (1998), Brimble (1987), Tinakorn (2001), Timmer (2003), and Warr (2006), recognizes the contribution of agricultural productivity to the economic growth and the economic growth to reduce poverty in many countries including Thailand. That's, poverty problem could not be taken care of if the country faces economic bust.

Figure 4: Poverty rate by location



Source: NESDB (2011)

Thirtle et al. (2003) anticipated an implicit function between agricultural productivity and poverty reduction. Agricultural productivity contributes to higher outputs in this sector. Farmers and agricultural workers would receive higher income with the lower costs. The standard of living of the poor would be improved. It is the reason for them in trying to track

the relationship into the explicit form. Being aware of location issue, they collected sample from Asia, Africa, and Americas to compare the results. From their study, they found that agricultural productivity improves the poverty situation in an overall region. Investment in R&D is very matter in progressive of the productivity in agriculture. An employment in agricultural sector would rise while the cost per unit of output falls because the improvement of agricultural productivity. However, there is some variation in detail among locations.

Agriculture and Natural Resources Team and Thomson (2004) indicated four transmission mechanisms when there is an increase in agricultural productivity to progress the poverty reduction. These four transmission mechanisms are the direct impact of improved agricultural performance on rural incomes; an impact of cheaper food for both urban and rural poor; an agriculture's contribution to growth and the economic opportunity in the non-farm sector; and agriculture's fundamental role in stimulating and sustaining economic transition as shift from being primarily agricultural towards a broader base of manufacturing sector and services.

In finding an impact of agricultural productivity to the poverty incidence, monetary measurement such as poverty line is not comprehensive as the representative for the actual poverty situations. Non-monetary aspects for the poverty are also introduced.

Employment implies poverty incidence in the sense that unemployed workers normally have no income for their spending in everyday life. They have to borrow from the financial institutions or rely on other people to take care of. The lower employment in economy reflects an increase in the poverty problem. In this paper, employment is divided by economic activities in order to observe the swing of employment among sectors while the employment in overall economic level would still be experimental.

Secondly, the migration from the rural to urban area would entail the urbanization problems which lead directly to the poverty in urban areas. Immigrants envisage a job opportunity outside the rural area or agricultural area. If living in rural area can generate higher income, rural people would not migrate outside and the density in urban area would reduce. The competition for jobs and consumption would decline as well as the social problems in education and health care which are initiated when the urban areas do not expand properly. Migration then implicitly responds to the poverty incidence.

The last one is the purchasing power. People with the higher real income would have more freedom in choosing their consumption. In other words, people feel wealthier because in fact they can consume in terms of quantities of outputs more than before. Normally, the poor have the limited choices for consumption. Higher freedom in life could parallel with the better poverty position for those persons.

Therefore, the poverty incidence is divided into four aspects, namely monetary poverty; employment by economic activities; migration from rural areas; and purchasing power in terms of real wage. The time-series data are utilized from 1980 to 2009 in both aggregate and economic sector levels including agriculture, industry and service. This study will begin with indicating the determinants of total factor productivity in Thai agriculture. Furthermore, the model that finds out the impact of agricultural productivity on Thai poverty

incidence in those four aspects is initiated. Eventually, if their relationship is significant in the third section, an improvement in the total factor productivity in agriculture from sources that mention in the second section would be the major sources for the policy suggestion.

II. Measurement of Agricultural Productivity

It is important to identify factors that influence on total factor productivity (TFP) in Thai agriculture because these factors would automatically have indirect impacts on the poverty incidence if the force of agricultural productivity to the poverty is significant. Moreover, these factors would be the major focus for the policy makers and development workers in improving the total factor productivity, which aims ultimately to poverty reduction in Thailand. However, there are numerous empirical studies on those TFP factors in terms of growth and absolute amount. Essentially, the determinants of agricultural productivity in particular country are different and distinctive from others. This section would refer to some studies in indicating of determinants of agricultural productivity in Thailand.

Patmasiriwat and Suewattana (2010), which aimed to obtain the long-term sources of total factor productivity, divided the factors that possibly involved in the total factor productivity in agriculture into three categories: price including both commodity price and input price; quasi-fixed factors²; and uncertain climate factors. In studying the connection, they introduced the log-log functional form with recursive structure into the model. Eventually, they found there are seven factors relative to the growth of the agricultural productivity which are education, agricultural capital stock, cultivated land, price of fertilizer, expected crop price, irrigation and agricultural research expenditure, and crop location. For the climate factor, it has no evidence in guarantee the effect of the rain volume to the long-term productivity.

While Suphannachart and Warr (2010) also supported both economic and non-economic factors as well as agricultural research in determining total factor productivity in short- and long-run. The lag explanatory and dependent variables are initiated as they allow the current impact on total factor productivity from these factors in previous periods. The error correction model (ECM) was employed to find out the correlation between them. The results from the study were similar to Patmasiriwat and Suewattana (2010)'s study that real public agricultural expenditure for research and extension played the major role for productivity, following international agricultural research spillovers, infrastructure, economic and social situation such as trade openness and resource allocation, and climate factor.

From above studies, there are plenty sources that pressure total factor productivity in Thai agriculture to change. Mechanically, those factors indirectly affect the poverty. Policy makers can be able to improve agricultural productivity through its sources in order to reduce the severe of poverty if its influence of agricultural productivity is significant.

² Quasi-fixed factors are the factors that are fixed in the short-run but varied in the long-run such as human capital, irrigation, and road.

III. Methodology and Data

The study has an ultimate purpose in finding the long-run influence of total factor productivity (TFP) in agriculture to the poverty. Agricultural valued added per worker is used as the representative to total factor productivity in agriculture as Patmasiriwat and Suewattana (2010) and Nidhiprabha (2005) had initiated. Thirtle et al. (2003) recognized the possibility of time lag in adjusting TFP to the poverty incidence. In their study, they applied one-period lagged explanatory variables to Asia, Africa and Americas cases which results to be the critical factors for the poverty. This study then will establish one-period lagged TFP besides its current variable into the model for the case of Thailand. Autoregressive model is employed to be the reference model since the concept of the model matches with an expectation and the various studies which already mention above. By doing so, Ad-hoc estimation framework³ is introduced as it can be observed the prior experiment that there is one-period lagged in explanatory variable (Gujarati and Porter, 2009). However, this study observes an insignificant of the current TFP in agriculture to the poverty incidence. It means that the current TFP does not have a strong impact to the poverty in the same period. Moreover, one- period lag dependent variable is also included in order to get rid of an autocorrelation problem⁴, which causes the estimation to be unreliable.

As in the previous section has said, this study would examine the force of agricultural productivity to the poverty incidence in four aspects: monetary aspect; employment; migration from the rural area; and purchasing power. It results in four estimated equations with the same framework. In order to prevent the price fluctuation problem from agricultural value added per worker which is calculated from the multiplication between the quantities of output and commodity price, this study will use the agricultural value added per worker in year 2000 in the unit of US dollar to analyze.

In figure 5, the poverty incidences as the dependent variables are plotted against agricultural productivity (an explanatory variable). Agricultural value-added per worker (VA_agr) is initiated as Thai agricultural productivity in every graph. For graph A, the poverty rate goes in the opposite direction with agricultural value-added per worker. Employment in every sector in graph B is also negative non-linear relationship with the productivity. Graph C obviously shows that the linear estimation is improper since it will generate the higher error from mean than non-linear from. In graph D, purchasing power and agricultural value-added per worker are in the increasing trend. In every graph, those correlations are non-linear form. Log-linear model is likely the better model because it easier reflects non-linear functions i.e. quadratic and cubic functions. Furthermore, MWD test⁵ confirms that log-linear function is more appropriate than another since R-square of adjusted

³ Ad-hoc estimation framework is a method of estimating the relationship between explanatory and dependent variables of lagged-explanatory autoregressive model. This framework is used in the case when there is information for the number of lagged variables.

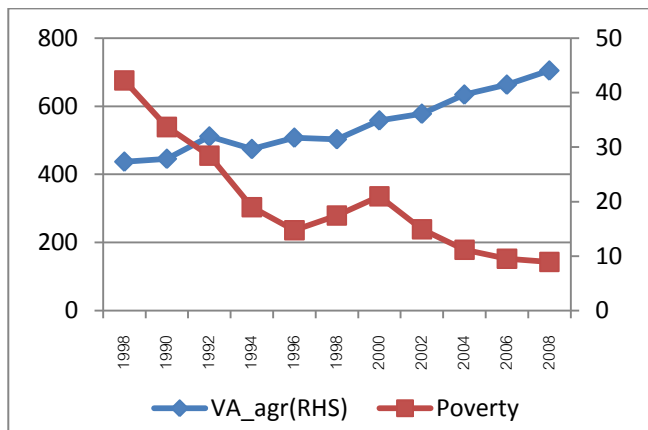
⁴ Autocorrelation problem is problem arisen in time series regression that there is some relation between the error terms across observations. Thus the error covariances are not zero. Durbin-Watson statistic of approximately 2 is the representative of no autocorrelation problem for the model.

⁵ MWD test is used to decide whether linear or log-linear model is the better-fitted in explaining the relationship of variables because R-square of those is incomparable (Gujarati and Porter, 2009).

linear model is less than one of log-linear model (Gujarati and Porter, 2009). Therefore, all estimations are done in log-linear functional form.

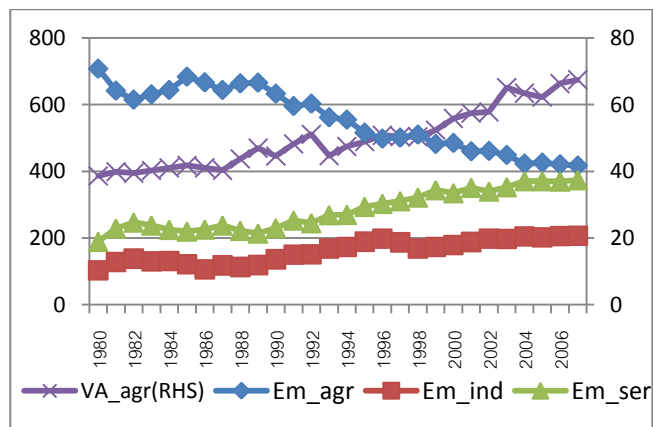
Figure 5: The correlation between the poverty incidence and agricultural productivity

a. The poverty rate and TFP in agriculture



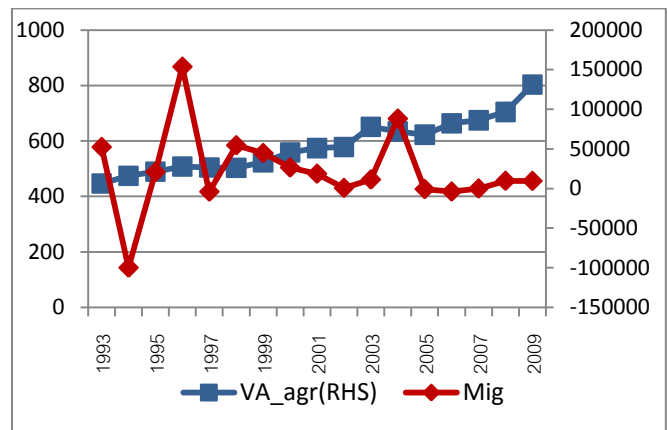
Source: World Bank. (2010) and NESDB. (2011)

b. The employment by economic activities and TFP in agriculture



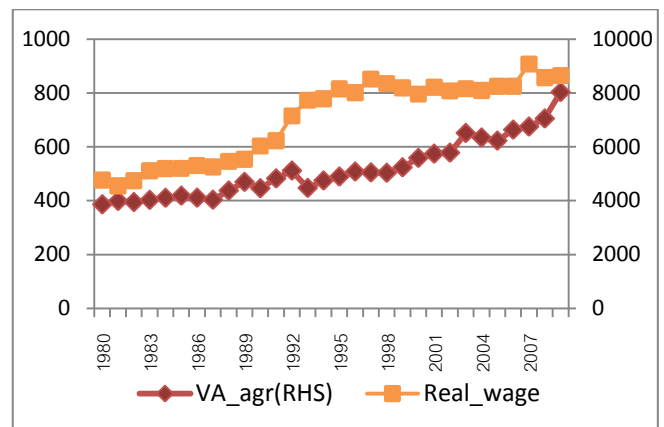
Source: World Bank. (2010)

c. The migration to urban area and TFP in agriculture



Source: World Bank. (2010), Department of Provincial Administration. (2011) and author's calculation

d. The purchasing power and TFP in agriculture



Source: National Statistical Office. (2011), World Bank. (2010), Bureau of Trade and Economic Indices. (2011) and author's calculation

The data are collected in annual basis range from 1980 – 2009⁶ (the most updated data) because, during 1980s, economic attention was shifted from agriculture to industry as the end of the land surplus (Siamwalla, 1996). There are totally 28 observations however some estimates have lower observations because of the available data. With the annual data, it can get rid of the seasonal problem but not for the data trend and cycle. That's, some variables possibly fluctuate in every certain year, which fluctuation does not result from the

⁶ The most up to date value-added per worker in constant year 2000 is in 2008. The data in 2009 comes from the linear estimation against time.

explanatory variables. Thus, Hodrick - Prescott Filter (HP Filter) is applied as it can remove the trend in the data before operating estimations.

The study justifies the significant of the model and coefficients according to 95% significant level. The computed t-values of each coefficient must be greater than 1.96. The sign of the coefficient should tag along with theory that will be explained later. Additionally, R-square of the model should close to 100 percent. Durbin-Watson statistic is expected to be above 1 as it reflects no autocorrelation problem exists in the model.

From above, the estimations in each poverty aspect are similar. Autoregressive model with one-lagged explanatory variable is adopted in log-linear form. Nevertheless, some estimation would be adjusted differently from others because of data available and in aiming to get the best-fitted model in particular estimation.

In the first estimation, monetary poverty measured by national poverty line is expected to have a direct impact from TFP through income and wages in long-term period (Agriculture and Natural Resources Team (DFID) and Thomson 2004). As most of the poor are in agricultural sector, an improvement in agricultural TFP would contribute to get higher commodity quantities. *Ceteris paribus*, farmers and workers in agricultural sector will get the higher income as a consequence. Part of the poor would be successful in escape from the trap. This study expects to get the negative relationship between them. However, the effect of TFP on the poverty may have some lag from an adoption of the new technique to the farm. Thus, the study assumes two-year lag as an appropriate time lag. The main reason for two-year lag instant of one-year lag is that data for Thai poverty rate measured by national poverty line is collected every 2-year. The model is shown as following.

$$\ln(POOR_t) = a_1 + b_1 \ln(VA_AGR_t) + c_1 \ln(VA_AGR_{t-2}) + d_1 \ln(POOR_{t-2}) + \varepsilon_{1t}$$

where $POOR_t$ = the poverty rate measured by national poverty line at period t;

$POOR_{t-2}$ = two-year lag value of poverty rate measured by national poverty line at period t;

VA_AGR_{t-2} = two-year lag value of total factor productivity;

a = constant term; b = productivity elasticity of poverty rate;

c = one-year lag productivity elasticity of poverty rate;

d = parameter or sensitivity of the lag dependent variable;

ε_{1t} = error term.

The second estimation is an employment separated by economic activities. TFP in agriculture directly affects employment in overall economy because each worker has capacity to produce greater number of outputs with the same levels of inputs. In other word, the same number of outputs can be produced by employing less number of workers in agricultural sector. Inputs are used productively. That's why TFP in agriculture causes unemployment in

agricultural sector. Then, unemployed workers in agriculture would normally shift to other sectors instead. Employment in other sectors would increase. On the other hand, Agriculture and Natural Resources Team (DFID) and Thomson (2004) recognized the employment opportunity in Indian agriculture from adopting new technologies which require labors in handling the new capitals. From their study, an employment in agriculture should increase and other employment should reduce while TFP in agriculture is better. Analytically, the pattern of TFP in agriculture on employment in each sector remains ambiguous. It is possible to be either one from both. Particular country and the range of time involve in assessing sign pattern. Therefore, the evaluation in Thailand case is below.

$$\ln(EM_{it}) = a_{2i} + b_{2i}\ln(VA_AGR_t) + c_{2i}\ln(VA_AGR_{t-1}) + d_{2i} \ln(EM_{i,t-1}) + \varepsilon_{2it}$$

where EM_{it} = a sectoral employment rate in unit of percentage;

$EM_{i,t-1}$ = one-year lag sectoral employment rate in unit of percentage;

VA_AGR_{t-1} = one year lag value of total factor productivity;

a_{2i} = constant term; b_{2i} = productivity elasticity of employment;

c_{2i} = one-year lag productivity elasticity of employment;

d_{2i} = parameter or sensitivity of lag dependent variable;

ε_{2it} = error term;

$i = 1$ is agriculture sector, 2 is industry sector and 3 is service sector.

For the third estimation, the growth of urbanization will follow an increasing or a decreasing trend of net migration from rural areas to urban areas. With the rapid growth of urbanization, problems in environment, population density, and job available for the new comers were established because of an inappropriate preparation for the migration to the urban areas. These problems from migration would lead to the poverty incidence in urban area. The migrants could not find jobs, inhabits and etc (Dixon, 1999). An extension in TFP in agriculture possibly stops the trend of migration because staying in the rural area does not distort the chance for getting jobs. On the other hand, an improvement in agricultural TFP contributes the utilization of inputs and resource allocation to be more effective for the economy as a whole. There are the left workers from agriculture seeking the new job opportunity in urban areas. The migration would then probably have the positive impact to TFP in agriculture. Therefore, the correlation of migration and poverty would be difference in particular country. Their pattern for Thailand's case is also unique.

As there is no data for the migration from rural to urban areas available, the difference between the moving-rate and the moving-out rate in the same big city is calculated as the representative of migration to urban areas. In Thailand's case, the study picks the capital city (Bangkok) and three big cities (Song Khla, Nakorn Rachasima and Chiang Mai) to be the

representative of urban cities because those cities have high population density and high number of the population.

$$\ln(MIG_t) = a_3 + b_3 \ln(VA_AGR_t) + c_3 \ln(VA_AGR_{t-1}) + d_3 \ln(MIG_{t-1}) + \varepsilon_{3t}$$

where MIG_t = net migration in the number of persons;

MIG_{t-1} = one-year lag net migration in the number of persons;

VA_AGR_{t-1} = one year lag value of total factor productivity;

a = constant term; b = one-year lag productivity elasticity of migration;

c = one-year lag productivity elasticity of migration;

d = parameter or sensitivity of lag-dependent variable; ε_{3t} = error term.

Last, the purchasing power can be represented as an average real wage per month per capita of total labor force⁷. Although the wage or income from works without concerning an increase in price of the commodity, it does not guarantee people will have income to purchase higher quantities of goods and services in everyday life. Moreover, an increase in a purchasing power intimates the population living wealthier. Growing in TFP has two linkages to increase the purchasing power. The first linkage, TFP would enhance the quantities of commodity sold, which implicitly raises income or wage. The second one is a reduction in price at least in the short-run from the surplus in supply.

$$\ln(REAL_WAGE_t) = a_4 + b_4 \ln(VA_AGR_t) + c_4 \ln(VA_AGR_{t-1}) + d_4 \ln(REAL_WAGE_{t-1}) + \varepsilon_{4t}$$

where $REAL_WAGE_t$ = the total average real wage per month per capita;

$REAL_WAGE_{t-1}$ = one-year lag total average real wage per month per capita;

VA_AGR_{t-1} = one-year lag value of total factor productivity;

a = constant term; b = productivity elasticity of real wage;

c = one-year lag productivity elasticity of real wage;

d = parameter or sensitivity of lag dependent variable;

ε_{4t} = error term.

⁷ An average real wage per month per capita of total labor force is calculated from the average wage per capita per month in the agricultural, industrial and service sectors divided by consumer price index with base year 2007. The data is on an annual basis.

IV. Results

This section combines four sub-sections inside according to the poverty aspects; monetary poverty in aggregate, employment by economic activities, migration from rural area and purchasing power. The outcomes from estimations in detail are available in an appendix section. The criteria for a justification of the model, which has already discussed before, is that the statistical significant of the model is analyzed on the basis of 99% confidence level by using F-test. Furthermore, the estimated coefficients are statistical significant in t-test 95% confidence level. For this section, the result will be analyzed as follow.

Impact on Monetary Poverty in Aggregate

Refer to table 1; the model has the goodness of fit R-square 99.99% which is closely to 100%. Durbin-Watson statistic is 2.177. It implies that there is no autocorrelation problem in the model. The estimate values are best. For the estimated coefficients, all estimators are significant at 95% confidence level because every computed t-statistics of estimated coefficient are greater than 1.96.

Table 1 : Impact on monetary poverty in aggregate

Dependent variable: $\ln(\text{POOR}_t)$	
	Est. Coeff. (t-ratios)
Constant	-8.5494 (-32.9135)
$\ln(\text{VA_AGR}_t)$	6.7800 (10.0596)
$\ln(\text{VA_AGR}_{t-2})$	-5.7065 (-8.6236)
$\ln(\text{POOR}_{t-2})$	1.4463 (139.9123)
N (observations)	10
R^2	0.9999
Adjust R^2	0.9999
S.E. of regression	0.0019
Durbin-Watson stat	2.1771

The result from the estimation parallels with analysis in the previous section and Agriculture and Natural Resources Team (DFID) and Thomson (2004). That is, agricultural TFP takes two years before reducing the poverty of the economy as a whole. Before that, TFP in agriculture would increase the poverty because the farmers must invest in order to improve agricultural productivity. Since the poorest 20% of the population are in agricultural sector, an improvement in agricultural TFP would generate the higher income directly for the poor in the long-run. From the estimated model, 1% increase in two-year lag TFP in agriculture can reduce the poverty rate in monetary term by 5.7065%.

Impact on Employment by Economic Activities

Impacts of agricultural productivity on employment in each economic activity are provided in table 2. Agricultural productivity in both current and lagged values is insignificant in explaining the employment in agricultural sector at 95% confidence level, but employment in other sectors is likely significant. All three models have the goodness of fit at roughly 99.8%, which ensures the capacity of explanatory variables at the same time in measuring the relationship with the employment. However, there are autocorrelation problem remaining in all models which might cause the exact values of coefficients to be varied from the estimation. However, the evaluation still provides the tendency of influence of productivity on employment in Thailand during 1981-2007.

Table 2: Impact on employment by economic activities

	Dependent variable: ln(EM_AGR _t)	Dependent variable: ln(EM_IND _t)	Dependent variable: ln(EM_SER _t)
	Est. Coeff. (t-ratios)	Est. Coeff. (t-ratios)	Est. Coeff. (t-ratios)
Constant	0.6945 (1.0709)*	0.010500 (0.0468)	0.2415 (1.0273)*
ln(VA_AGR _t)	0.3723 (0.5225)*	-2.7724 (-3.1099)	-2.4973 (-2.4219)
ln(VA_AGR _{t-1})	-0.4613 (-0.6624)*	2.7480 (3.0302)	2.3732 (2.3665)
ln(EM _{t-1})	0.9578 (13.7524)	1.0801 (26.3063)	1.1808 (15.6064)
N (observations)	27	27	27
R ²	0.9986	0.9980	0.9984
Adjust R ²	0.9985	0.9977	0.9981
S.E. regression	0.0065	0.0022	0.0017
DW stat	0.0767	0.1743	0.0906
Note	* t-ratios is insignificant.		

In this part, impacts on employment in each economic activity are analyzed simultaneously in expected that the unemployment in one sector would mainly transform to the employment in another sector within the economy. The difference in percentage of increase in employment in one sector and unemployment in another sector would be the great. According to table 2, TFP improvement in agriculture will cut down the employment in presentation of the employment situation in the economy whether employment within the economy is more or less. As the agricultural productivity is higher, employment in agricultural sector would increase while the others would decline. Considering the lagged value, the result is parallel to Agriculture and Natural Resources Team (DFID) and Anne Thomson (2004)'s study by using India as the case study. The employment in agricultural sector drops and unemployed labors in the sector would shift to non-agricultural sectors because agricultural sector required less labors in producing the same quantity of outputs. The resources are used productively. Agricultural sector releases unnecessary inputs and the

productive outputs to support other sectors. In other word, the capital-labor ratio in this sector rises. Jha (2006), who studied the pattern of employment and agricultural productivity in India, suggested that an increase in labor productivity in agriculture would decline employment in agricultural sector. The lagged value indicates that the overall employment form the improvement of TFP would rise the employment in overall economy as total percentage of increase in employment in non-agricultural sectors is higher than one of decrease in employment in agricultural section. Therefore, poverty situation in this aspect gets better as agricultural productivity is higher.

Impact on Migration from Rural area

In the case of migration from rural areas, data since 1994-2009 are collected to track the force of TFP in agriculture on migration. Table 3 presents that the model is likely acceptable as all computed t-values for all coefficients are significant at 95% confidence level and the goodness of fit (R-square) is practically equivalent. However, there is an autocorrelation problem in some degree since the DW stat is less than 2.

Table 3: Impact on migration from rural area

Dependent variable: $\ln(\text{MIG}_t)$

	Est. Coeff. (t-ratios)
Constant	3.0468 (17.4500)
$\ln(\text{VA_AGR}_t)$	-5.0326 (-5.3345)
$\ln(\text{VA_AGR}_{t-1})$	4.8875 (5.1426)
$\ln(\text{MIG}_{t-1})$	0.8316 (59.0355)
N (observations)	16
R^2	0.9993
Adjust R^2	0.9991
S.E. of regression	0.0023
Durbin-Watson stat	1.5558

It is obvious that the result from the estimation in migration is consistent with the case of industrial and service employment in the previous section. Migration to urban areas at first reduces while the employment in each sector varies to the change in TFP in agriculture. The reason is that urban people normally work with the industry or get service jobs as the main occupation while the farming or fishing is in the rural sector. When there is demand for labor in agricultural sector, rural people who seek for a job do not need to move out of the area to urban city. That's why migration would decline. Moreover, this pattern might come from the cause of the registration to migration in and out of the cities. Most of labors even they move to live in urban areas for work their names still register at their home town. That is, they may rent the lodgings or apartment, which does not require them by law to move into the urban

areas. Furthermore, an informal employment that is hidden in national income and the collection, such as motorcycle and restaurant in the pathway, would be probably another reason because most migrants are easily employed in informal sector (Webster, 2005). Conversely, for the lagged value, agricultural productivity would then increase the migration to urban area at 4.8875% as the demand for labor declines. Therefore, the governors of urban cities must prepare for huge migration from rural area by creating job opportunity, reforming sanitary and communication in order to prevent the rapid emerging of slum.

Impact on Purchasing Power

There is a strong connection between current and lagged variables of total factor productivity in agriculture with consumers' purchasing power. All explanatory variables are able to explain the purchasing power at 99.94%. However, there is autocorrelation problem existing in the model. Table 4 indicates that an increase in TFP in the previous period would increase purchasing power in the current period by 3.1348%. Additionally, the purchasing power would reduce by 3.0582% from the effect of current agricultural productivity.

Table 4: Impact on purchasing power

Dependent variable: $\ln(\text{REAL_WAGE}_t)$

	Est. Coeff. (t-ratios)
constant	-0.2065 (-2.0390)
$\ln(\text{VA_AGR}_t)$	-3.0582 (-6.8530)
$\ln(\text{VA_AGR}_{t-1})$	3.1348 (6.7130)
$\ln(\text{REAL_WAGE}_{t-1})$	0.9800 (90.1872)
N (observations)	29
R^2	0.9994
Adjust R^2	0.9993
S.E. of regression	0.0054
Durbin-Watson stat	0.2100

In overall, the purchasing power would increase as the percentage difference between the current and lagged variables is positive sign. In consumers' view, it seems that goods and services especially for agricultural commodities become cheaper as the commodities are more productive while the price of goods and services remains stable. In the eyes of farmers and workers in agricultural factors, they can produce more outputs than before. If they sell exactly equal commodity quantities to the market and they keep the left for their consumption, then the commodity price and quantity in the market stay the same even as famers do not need to purchase these commodities and shift the consumption to other goods and services. However, it can be done in the sense that quantities of outputs are unchanged whereas the outputs are more productive. Therefore, they can consume more outputs with the

same commodity price and income because of the left from farm. It entails the higher quality of life for the population and implicitly causes the poverty to decline.

V. Policy Recommendation

In the previous section, the study observes the capacity of agricultural productivity on the poverty in all four aspects. Agricultural productivity can reduce the poverty because agricultural people get the higher income from their outputs. Overall employment increases as the job creation in industrial and service sectors are higher than unemployment in agricultural sector. The labor allocation is more effective. Consumers and producers in the economy have higher purchasing power as the goods and services have the better quality and higher quantities. According to the result, policy makers should emphasize on agricultural productivity in expect of poverty reduction for the economy as a whole. Referred to measurement of agricultural productivity section, Patmasiriwat and Suewattana (2010) and Suphannachart and Warr (2010) suggests the various factors that probably results in an improvement of agricultural productivity such as education, and research and development in agricultural sector.

The citizens no matter living in or out of the cities should get the fair distribution of quality and quantity of the education system form the public. The education would play the major role in creative thinking and new productive pattern of working for cropping, farming, fishing and etc. Educated people can mixed the traditional style of agricultural working and the new one in order to get the better way without relying on the government to support output at high price and resource at low price. Moreover, agricultural research and extension expenditure from the public is also important for the professors to discover the better plant's and animal's species for producers, consumers and environment in the way that producers are not able to do those works by themselves. Policy makers should encourage academic people and practical people such as farmers to work together because the academic works can ultimately pass into actions. Additionally, international agricultural researches would be provided and spillovers within the country. Agricultural people could then pick and choose the methods that match with their resources and geography.

Besides an investment in human capital, the physical capital should be highlight simultaneously. It is the crucial materials in both production and transportation. Government should issue the project reform that can reduce the obstacles in the agricultural process. Irrigation in dry season is very important for agriculture as well as a good drainage system is the protection for flood in agricultural areas. Infrastructure such as roads can deduct the transaction costs for the logistic. Micro finance is another concern in order for farmers to have money in investing in the productive activities i.e. watering equipment and organic fertilizers.

VI. Concluding Remarks

The analysis in this paper indicates that agriculture is the crucial source of poverty reduction in Thailand besides its capacity in contribution to economic growth as the various studies have done. It confirms that, in the present day, despite of the fact that the value added share of GDP and agricultural TFP growth in this sector are lower than other sectors, agriculture is still dynamic and important, but not characterized as the stagnant (Warr, 2006). The resource will be utilized productively as agricultural TFP improvement. The sector will then release unnecessary inputs and the productive outputs to support other sectors while the quantities of outputs within the sector are remaining. The effects to the higher employment in industrial and service sectors as well as the reduction in agricultural employment are the critical evidence as an agricultural TFP growth.

The results from this study demonstrate that TFP in agriculture would shrink the poverty in the way that the poverty rate or the number of the poor population declines. The employment in the overall economy increases as an improvement in agricultural TFP because one unit of agricultural TFP raises the employment in both industrial and service sectors rather a drop in agricultural employment. Moreover, agricultural TFP would stop urbanization problems because it diminishes the migration from rural areas. The population would have the better standard of living from the higher purchasing power. However, influences take one period of time in effective to the poverty reduction.

VII. References

- Agriculture and Natural Resources Team; Thomson, Anne. (2004), **Agriculture, growth and poverty reduction**. UK: Agriculture and Natural Resources Team of the UK Department for International Development (DFID) and Oxford Policy Management.
- Brimble, Peter J. (1987), **Total Factor Productivity Growth at the Firm Level in Thailand: A Challenge for the Future**. Bangkok: Faculty of Economics, Thammasat University.
- Bureau of Trade and Economic Indices. (2011), **Consumer Price Index**. Retrieved April 20, 2011, from Bureau of Trade and Economic Indices:
http://www.indexpr.moc.go.th/price_present/tableIndexCpi_y_bot.asp
- Department of Provincial Administration. (2011), **Move in**. Retrieved April 22, 2011, from Department of Provincial Administration:
<http://www.dopa.go.th/newweb/index.php?name=service&file=statservice>
- Department of Provincial Administration. (2011), **Move out**. Retrieved April 22, 2011, from Department of Provincial Administration:
<http://www.dopa.go.th/newweb/index.php?name=service&file=statservice>
- FAO. (2011), **Exports: Countries by Commodity 2008**. Retrieved May 2, 2011, from FAO:
<http://faostat.fao.org/site/342/default.aspx>
- FAO. (2008), **The State of Food Insecurity in the World 2005**. Rome: Publishing Management Service

- Gujarati, Damodar N. Porter, Dawn C. (2009), **Basic Econometrics**. Singapore: McGraw-Hill/Irwin.
- Jha, Brajesh. (2006), **Employment, Wages and Productivity in Indian agriculture**. University of Delhi Enclave, India.
- National Economics and Social Development Board. (2011), **Poverty and Income Distribution**. Retrieved April 22, 2011, from National Economics and Social Development Board: <http://www.nesdb.go.th/Default.aspx?tabid=322>
- National Economics and Social Development Board. (2008), **Poverty Examination Report 2007**. Retrieved May 20, 2011, from National Economic and Social Development Board: http://www.nesdb.go.th/portals/0/tasks/eco_crowd/Poverty%202007.pdf
- National Statistical Office. (2011), **Labour Force Survey**. Retrieved April 20, 2011, from National Statistical Office: http://web.nso.go.th/eng/stat/lfs_e/lfse.htm
- Nidhiprabha, Bhanupong. (2005) **Dynamism of the Thai Agriculture**. *East Asian Economic Perspectives*, Vol. 12, no.2, August.
- Office of Agricultural Economics. (2011), **Main agricultural products**. Retrieved April 22, 2011, from Office of Agricultural Economics: http://www.oae.go.th/ewt_news.php?nid=9704
- Office of Agricultural Economics. (2011), **Main agricultural exports and Imports**. Retrieved April 22, 2011, from Office of Agricultural Economics: http://www.oae.go.th/oe_report/export_import/export.php
- Patmasiriwat, Direk. and Suewattana, Saketdao. (2010), **Sources of agricultural productivity growth 1961-1985: Analysis from Thailand Development Research Institutes' Model**. *วารสารเศรษฐศาสตร์สังคมศาสตร์*, ปีที่ 8, ฉบับที่ 1, มีนาคม, สถาบันวิจัยเพื่อการพัฒนาประเทศไทย.
- Poapongsakorn, Nipon. Ruhs, Martin. Tangjitwisuth, Sumana. (1998), **Problems and Outlook of Agriculture in Thailand**. Bangkok: Thailand Development Research Institute.
- Siamwalla, Ammar. (1996), **Thai Agricultural: From engine of growth to sunset status**. *TDR Quarterly Review*, Vol.11, no.4, December, 3-10.
- Suphannachart, Waleerat. and Warr, Petter. (2010), **Total Factor Productivity in Thai Agriculture: Measurement and Determinants**. *ARE Working Paper No.2553/1*, Department of Agricultural and Resource Economics, Faculty of Economics, Kasetsart University, Bangkok
- Thailand Development Research Institute. (1988), **Dynamics of Thai Agriculture, 1961-1985**. Agricultural and Rural Development Program, October.
- Thirtle, Colin; Lin, Lin; Piesse, Jenifer. (2003), **The Impact of Research Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia, and Latin America** Conference of the International Association of Agricultural Economists. August
- Timmer, C. Peter. (2003), **Agriculture and Pro-Poor Growth**. Development Alternatives, Inc. and Boston Institute for Developing Economies. July
- Tinakorn, Pranee; Sussanskarn, Chalongsob. (1988), **Total Factor Productivity Growth in Thailand: 1980-1995**. Bangkok: Thailand Development Research Institute.

- Tinakorn, Pranee. (2001), "Total Factor Productivity Growth in Thailand." **Measuring Total Factor Productivity: Survey Report** (June): 192-214.
- Urban Environment and Area Planning Division. (2011), **Community's Definition**. Retrieved May 24, 2011, from Urban Environment and Area Planning Division: <http://www.onep.go.th/uap/definition.htm>
- Warr, Peter (2006), **Productivity Growth in Thailand and Indonesia: How Agriculture Contributes to Economic Growth**. *Working Paper in Economics and Development Studies* N. 200606, Center for Economics and Development Studies, Department of Economics, Padjadjaran University, Bandung, Indonesia.
- Webster, Douglas. (2005), **Urbanization: new driver, new outcomes**. In *Thailand Beyond the Crisis*, Chapter 10
- World Bank. (2010), **World Bank Data Base**. Retrieved April 22, 2011, from World Bank: <http://data.worldbank.org/country/Thailand>

VIII. Appendix I: Data Sources

- Average wage: National Statistical Office. (2011)
- Agricultural value added per worker (constant 2000 US dollar): World Bank. (2010)
- Consumer Price Index (2007 = 100): Bureau of Trade and Economic Indices. (2011)
- Employment in agriculture, industrial and service (percent of total employment): World Bank. (2010)
- Immigration and moving out within Thailand (unit of persons): Department of Provincial Administration. (2011)
- Poverty rate measured by national poverty line: National Economics and Social Development Board. (2011)

IX. Appendix II: Results from Estimations

Table 5: Autoregressive model with poverty rate as a dependent variable

Dependent Variable: LOG(POOR)
Method: Least Squares
Date: 05/23/11 Time: 21:54
Sample (adjusted): 1990, 1992, 1994, 1996,1998, 2000, 2002, 2004, 2006, 2008
Included observations: 10 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.549389	0.259753	-32.91348	0.0000
LOG(VA_AGR)	6.779770	0.673959	10.05962	0.0001
LOG(VA_AGR (-1))	-5.706455	0.661727	-8.623585	0.0001
LOG(POOR (-1))	1.446265	0.010337	139.9123	0.0000
R-squared	0.999991	Mean dependent var		2.811135
Adjusted R-squared	0.999987	S.D. dependent var		0.514011
S.E. of regression	0.001884	Akaike info criterion		-9.421269
Sum squared resid	2.13E-05	Schwarz criterion		-9.300235
Log likelihood	51.10634	Hannan-Quinn criter.		-9.554043
F-statistic	223217.5	Durbin-Watson stat		2.177144
Prob(F-statistic)	0.000000			

Table 6: Autoregressive model with agricultural employment as a dependent variable

Dependent Variable: LOG(EM_AGR)
Method: Least Squares
Date: 05/23/11 Time: 22:02
Sample (adjusted): 1981 2007
Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.694537	0.648533	1.070935	0.2953
LOG(VA_AGR)	0.372291	0.712576	0.522458	0.6063
LOG(VA_AGR (-1))	-0.461347	0.696445	-0.662431	0.5143
LOG(EM_AGR (-1))	0.957756	0.069643	13.75240	0.0000
R-squared	0.998647	Mean dependent var	3.997038	
Adjusted R-squared	0.998471	S.D. dependent var	0.167419	
S.E. of regression	0.006547	Akaike info criterion	-7.083690	
Sum squared resid	0.000986	Schwarz criterion	-6.891714	
Log likelihood	99.62981	Hannan-Quinn criter.	-7.026605	
F-statistic	5659.778	Durbin-Watson stat	0.076710	
Prob(F-statistic)	0.000000			

Table 7: Autoregressive model with industrial employment as a dependent variable

Dependent Variable: LOG(EM_IND)
Method: Least Squares
Date: 05/23/11 Time: 22:10
Sample (adjusted): 1981 2007
Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010500	0.224166	0.046840	0.9630
LOG(VA_AGR)	-2.772366	0.891468	-3.109889	0.0049
LOG(VA_AGR (-1))	2.747982	0.906871	3.030180	0.0060
LOG(EM_IND (-1))	1.080071	0.041058	26.30628	0.0000
R-squared	0.997961	Mean dependent var	2.763706	
Adjusted R-squared	0.997695	S.D. dependent var	0.201714	
S.E. of regression	0.009685	Akaike info criterion	-6.300488	
Sum squared resid	0.002157	Schwarz criterion	-6.108512	
Log likelihood	89.05659	Hannan-Quinn criter.	-6.243404	
F-statistic	3751.661	Durbin-Watson stat	0.174377	
Prob(F-statistic)	0.000000			

Table 8: Autoregressive model with service employment as a dependent variable

Dependent Variable: LOG(EM_SER)
Method: Least Squares
Date: 05/23/11 Time: 22:13
Sample (adjusted): 1981 2007
Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.241537	0.235117	1.027305	0.3150
LOG(VA_AGR)	-2.497266	1.031100	-2.421942	0.0237
LOG(VA_AGR (-1))	2.373155	1.002794	2.366544	0.0268
LOG(EM_SER (-1))	1.180822	0.075663	15.60641	0.0000

R-squared	0.998362	Mean dependent var	3.336788
Adjusted R-squared	0.998148	S.D. dependent var	0.197279
S.E. of regression	0.008490	Akaike info criterion	-6.563933
Sum squared resid	0.001658	Schwarz criterion	-6.371957
Log likelihood	92.61310	Hannan-Quinn criter.	-6.506849
F-statistic	4671.973	Durbin-Watson stat	0.090607
Prob(F-statistic)	0.000000		

Table 9: Autoregressive model with net migration as a dependent variable

Dependent Variable: LOG(MIG)
Method: Least Squares
Date: 05/23/11 Time: 22:23
Sample (adjusted): 1994 2009
Included observations: 16 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.046792	0.174601	17.45004	0.0000
LOG(VA_AGR)	-5.032619	0.943414	-5.334475	0.0002
LOG(VA_AGR (-1))	4.887453	0.950379	5.142633	0.0002
LOG(MIG (-1))	0.831563	0.014086	59.03553	0.0000

R-squared	0.999290	Mean dependent var	11.71521
Adjusted R-squared	0.999112	S.D. dependent var	0.075517
S.E. of regression	0.002250	Akaike info criterion	-9.143110
Sum squared resid	6.08E-05	Schwarz criterion	-8.949963
Log likelihood	77.14488	Hannan-Quinn criter.	-9.133219
F-statistic	5626.421	Durbin-Watson stat	1.555789
Prob(F-statistic)	0.000000		

Table 10: Autoregressive model with real wage as a dependent variable

Dependent Variable: LOG(REAL_WAGE)

Method: Least Squares

Date: 05/23/11 Time: 22:29

Sample (adjusted): 1981 2009

Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.206549	0.101298	-2.039014	0.0522
LOG(VA_AGR)	-3.058226	0.446259	-6.853031	0.0000
LOG(VA_AGR (-1))	3.134775	0.466972	6.712978	0.0000
LOG(REAL_WAGE (-1))	0.980002	0.010866	90.18717	0.0000
R-squared	0.999427	Mean dependent var	8.848019	
Adjusted R-squared	0.999358	S.D. dependent var	0.211631	
S.E. of regression	0.005363	Akaike info criterion	-7.491143	
Sum squared resid	0.000719	Schwarz criterion	-7.302551	
Log likelihood	112.6216	Hannan-Quinn criter.	-7.432078	
F-statistic	14525.47	Durbin-Watson stat	0.209970	
Prob(F-statistic)	0.000000			