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Educational Attainment and Its Contribution to Labor Productivity Growth in Thailand

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This article examines the contribution of educational attainment of Thailand's employed persons and labor productivity growth in three sectors and 15 sub-sectors during 2001–2010. Moreover, the analysis was based on secondary data from two sources: the Labor Force Surveys conducted between 2001–2010 by the National Statistical Office (NSO) and the National Economic and Social Development Board (NESDB). The findings reveal that, in average, employed persons in Thailand still have low educational attainment - only 6.9 years of schooling in 2010. The average growth rates of labor productivity during 2001–2010 fluctuated between -4.2 to 6.9% per year depending on the macro-economic circumstances with the mean value of 2.8% per year over the study period. Finally, the analysis reveals that education has significantly positive contribution to labor productivity growth; that is, one percent increase in mean years of schooling leads to 0.5521% increase in labor productivity.

Keywords: *educational attainment, mean years of schooling, labor productivity growth, Thailand*

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Introduction

Thailand has entered an ageing society since year 2000 when its proportion of the population in old-age group (age 60 and older) equaled 10.3% of the total population (United Nations, 2011). Meanwhile, the proportion of the population in working-age group (15–59 years old) has reached the peak of 66.6% of the total population in 2010 (United Nations, 2011) and is expected to constantly decline afterward. On the contrary, the proportion of the population in old-age group is constantly increasing. Based on the projection of the United Nations, Thailand's proportion of the population in working-age group is expected to decline to 65.9, 64.5 and 62.8% of the total population in 2015, 2020 and 2025, respectively, whereas those in old-age group will increase from 12.9% of the total population in 2010 to 15.3, 18.3 and 21.3% in 2015, 2020 and 2025, respectively (United Nations, 2011).

Such a demographic shift may cause a significant impact on the national economy and the standard of living of Thai people since the country has long relied on labor-intensive industry to drive its economic growth. The increasing proportion of the old-age group, normally regarded as dependent population, while proportion in the working-age group is falling, implies that Thailand has been losing its advantage in terms of labor quantity. This has had a negative effect on its labor-intensive industry. Other things being equal, Thailand may lose its competitive advantage, making it difficult or even impossible to create a sustainable economic and social development in an ageing society. To deal with this situation in the long run, Thailand must focus on developing capital-intensive industry since such industry normally creates higher added value than labor-intensive industry and is less affected by the shrinking proportion of the population in the working-age group. To successfully develop capital-intensive industry, however, the higher labor productivity is very essential since high-technology machineries and equipments in such industry must be coordinated with high-quality labors.

Based on the definition given by the International Labor Organization (ILO), labor productivity is defined as output per unit of labor input (ILO, 2013). A similar definition is given by Organisation for Economic Co-operation and Development (OECD); that is, labor productivity is the ratio between a volume measure of output (gross domestic product) and a measure of input use (the total number of hours worked or total employment) (Freeman, 2008). In other words, labor productivity

simply reflects labor quality in the nations. Labor productivity growth is very necessary for the economic growth and social development since it enables the nation to constantly create the economic growth and better standard of living, leading to the sustainable economic development despite the diminishing proportion of the population in the working-age group (Mahmud & Rashid 2006). Additionally, the higher labor productivity also leads to the better economic opportunity of labors, enabling them to earn higher income. This eventually helps reduce the problem of income inequality in the nation (Birchenall, 2001; Lanzi, 2007)

Education is considered as one of the most important determinants of labor productivity. Duryea and Pages (2002) and Razzak and Timmins (2007) found that the higher educational attainment led to the higher labor productivity in Latin America and New Zealand. Fallahi, Sojoodi, and Aslaninia (2011) and Ali, Tabari, and Reza (2012) also found the education to have the positive effects on labor productivity in Iran. Studies in some countries of Africa - Kenya, Tanzania and Uganda also found labor productivity and education to be positively related (Aggrey, Eliab & Joseph, 2010).

Labor productivity is determined by labor utilization as normally measured by hours worked. Aljuhani (2002) and Gomez - Salvador, Musso, Stocker, and Turunen (2006) found that labor utilization had the positive effect on labor productivity in Saudi Arabia and in the Euro Area, respectively. Besides, various studies identified several other factors that determine labor productivity. These include unemployment (Dritsakis, 2007), labor incentive (Guiteras & Jack, 2012), technological progress and ICT (Jajri & Ismail, 2009; Ceccobelli, Gitto, & Mancuso, 2012), and health and longevity (Knapp, 2007).

In Thailand, Chansarn (2012) studied Thailand's labor productivity growth as effected by educational attainment measured in terms of the mean years of schooling during 2001–2010. He found that employees in industrial sector had the highest labor productivity growth whereas those in service sector had the lowest. Moreover, he found that labor productivity in the agricultural and service sectors was expected to increase by 8.4% if the employed persons in these two sectors had one more year of schooling, whereas in the industrial sector the increase would be as much as 28.9% if the employed persons had one more year of schooling.

This article aims to investigate three important issues related to educational attainment and labor productivity in Thailand. First, it examines Thailand's educational attainment of employed persons in three sectors and also in 15 sub-sectors. Second, it measures labor productivity growth in these three sectors and 15 subsectors in order to present the situation concerning labor productivity. Third, it investigates the contribution of educational attainment, as well as other related determinants, to labor productivity growth in Thailand with the aim of finding ways to promote labor productivity in the nation.

Data and Method

a) The Data

The following analysis uses the data obtained from two secondary sources. The first source is the Labor Force Survey conducted quarterly every year by the National Statistical Office (NSO, 2011). For analytical purpose here the data from 2001–2010 surveys are used. The data drawn from this source include number of employed persons in all sectors categorized by their educational levels, the number of unemployed persons, hours worked per week of employed persons and the percentage of employed persons who are available for additional work. The second source is the National Economic and Social Development Board (NESDB) which provides data on the real gross domestic product from all sectors (NESDB, 2011).

Employed persons in this analysis are classified by the three major sectors, agricultural, industrial, and service sectors. These three major sectors of employments are further divided into 15 subsectors which include: (1) agriculture, hunting and forestry; (2) fishing; (3) mining and quarrying; (4) manufacturing; (5) electricity, gas and water supply; (6) construction; (7) wholesale and retail trade, repair of motor vehicles motorcycles and personal and household goods; (8) hotel and restaurants; (9) transport, storage and communication; (10) financial intermediation; (11) real estate, renting and business activities; (12) public administration and defense and compulsory social security; (13) education; (14) health and social work; and (15) community, social and personal service activity. The first two subsectors are under 'agriculture', the next four are under 'industry', and the last nine are under 'service'.

b) Measurement and Analytical Tools

1) Educational attainment

For analytical purpose the educational attainment of employed persons is measured in terms of the mean years of schooling. Based on educational levels of Thailand, the mean years of schooling for each level can be determined as follows:

1. Employed persons who do not complete primary school (Grade six) are assumed to have no education, that is, zero year of schooling.

2. Employed persons who complete primary school (Grade six) are assumed to have 6 years of schooling.

3. Employed persons who complete lower secondary school (Grade nine) are assumed to have 9 years of schooling.

4. Employed persons who complete upper secondary school (Grade twelve), certificate of vocational education or certificate of teacher training are assumed to have 12 years of schooling.

5. Employed persons who complete certificate of higher vocational education or certificate of higher teacher training are assumed to have 14 years of schooling.

6. Employed persons who complete bachelor degree or higher are assumed to have 16.20 years of schooling[2].

Based on the mean years for each level above, the mean years of schooling for all employed persons as well as for those in each subsector can be obtained by using the weighted average method.

2 In the calculation, it is assumed that people who completed bachelor, master and doctoral degree have 16, 18 and 22 years of schooling, respectively. According to the population and household census in 2000, there were 2,930,335 people who completed bachelor degree or higher in Thailand. 2,691,613 people completed only bachelor degree, whereas only 210,136 and 28,586 people completed master and doctoral degrees, respectively (NSO 2000).

2) Labor productivity growth

Labor productivity and its growth rate during 2001–2010 constitute the first focus of this analysis. These are calculated based on the method used by the U.S. Bureau of Labor Statistics (2009). First, the level of labor productivity is measured in terms of labor productivity index which is calculated by the following formula:

$$\text{Labor productivity index } (LPI_{t,0}) = \left[\frac{Q_t/Q_0}{L_t/L_0}\right] \times 100 \quad (1)$$

Where $LPI_{t,0}$ is labor productivity index in the current year compared to the base year which is 2001; Q_t is real GDP in the current year; Q_0 is real GDP in the base year; L_t is number of employed persons in the current year; and L_0 is number of employed persons in the base year.

Note that immigrant workers are not included in employed persons in this study since we assume that immigrant workers in Thailand are mostly unskilled labors and have very low productivity so that the quantity of output produced by them is negligible.

Using the value of $LPI_{t,0}$ the growth rates of labor productivity are calculated by the following formula.

$$\text{Growth rate of labor productivity} = \left[\frac{LPI_{t,0}}{LPI_{t-1,0}}\right] \times 100 \quad (2)$$

3) Contribution of education to labor productivity

The goal of this study is to understand the contribution of educational attainment to labor productivity growth in Thailand. To achieve this goal, the fixed effects and random effects regression analyses will be performed. This regression analysis is appropriate for the kind of data used which are the panel data from 15 subsectors during 10 year period. Based on the literature reviews, the regression model to be estimated is generally identified as the following.

$$lpit = \beta_0 + \beta_1 ed_{it} + \beta_2 unem_{it} + \beta_3 util_{it} + \beta_4 incen_{it} + \beta_5 t + \mu_{it} \quad (3)$$

where lp = labor productivity measured in terms of labor productivity index presented in natural logarithm, ed = educational attainment measured in terms of mean years of schooling presented in natural logarithm, unem = unemployment rate,

util = labor utilization measured in terms of hours worked per week of employed persons presented in natural logarithm, incen = labor incentive measured in terms of percentage of employed persons who are available for additional work, t = time trend, and μ = residual term. In the notation lpit, i denotes each subsector and t denotes the time period, t = 1, 2, …, 10. Note that the time trend is included in the model because the analysis uses time-series data. However, health and longevity of the employed persons and technological progress are not included in the model due to unavailability of data in the sub-sector level.

4) Fixed effects regression analysis

With the panel data of 15 sub-sectors during 10 year period, there is an unobserved effect of each sub-sector which also affects labor productivity, causing pooled ordinary least squares (OLS) estimators to be biased and inconsistent. Such bias is called heterogeneity bias caused by omitting a time-invariant unobserved effect (Wooldridge, 2003). In this study, such unobserved effect is sub-sector fixed effect. Suppose that the variable ai presents all unobserved, time-invariant factors that affect the dependent variable lpti. The fixed effects regression model with unobserved effect, ai, can be presented as the following.

$$lp_{it} = \beta_0 + \beta_1 ed_{it} + \beta_2 unem_{it} + \beta_3 util_{it} + \beta_4 incen_{it} + \beta_5 t + a_i + \mu_{it} \quad (4)$$

Note that the fixed effects regression analysis is appropriate for estimating panel data if the unobserved effect, ai, is correlated with one or more of explanatory variables in the model. But if ai is uncorrelated with explanatory variables in all time periods, random effects regression analysis is more appropriate (Wooldridge 2003).

5) Random effects regression analysis

Under the concept of random effects regression, ai is uncorrelated with explanatory variables. Therefore, in this case, sub-sector is instead considered as random effect. That is,

$$Cov\ (x_{it}, a_i) = 0,\ t = 1, 2, \ldots, 10,\ i = 1, 2, \ldots, 15 \quad (5)$$

Where x_j denotes explanatory variable j, j = 1, 2, …, 5. In this case, ai is considered as a part of residual term, called composite error time (v_{it}) as $v_{it} = a_i + \mu_{it}$. Therefore, the random effects model can be identified as the following:

$$lpit = \beta_0 + \beta_1 ed_{it} + \beta_2 unem_{it} + \beta_3 util_{it} + \beta_4 incen_{it} + \beta_5 t + v_{it} \quad (6)$$

Because, a_i is in the composite error in each time period, the v_{it} are serially correlated across time. That is,

$$Corr\ (v_{it}, v_{is}) = \frac{\sigma_a^2}{(\sigma_a^2 + \sigma_\mu^2)}, t \neq s \quad (7)$$

where σ_a^2 is the variance of a_i and σ_μ^2 is the variance of μ.

6) The Hausman Test

Whether fixed effects or random effects regression models will be accepted depends on the Hausman test which tests whether or not the unobserved effect, ai, and the explanatory variables are correlated (Wooldridge, 2003). If they are correlated, the fixed effects model (FE) is appropriate since random effects model is biased and inconsistent. On the contrary, if they are uncorrelated, the random effects model (RE) is preferable. The null hypothesis (H_0) and the alternative hypothesis (Ha) for the Hausman test are:

H_0: unobserved effect, ai, and explanatory variables are uncorrelated (choose RE)

Ha: unobserved effect, ai, and explanatory variables are correlated (choose FE)

Results

a) Number of employed persons

According to Table 1, there were 32.7 million employed persons in Thailand in 2001. The number of employed persons constantly increased over the study period and equaled 38.1 millions in 2010. Most of employed persons are in agricultural sector of which the number of employed persons ranges from 14.9 to 15.9 million over the period of this study, accounting for about 42% of the total employed persons in 2010. Almost the same number of persons (15 million) is employed in the service sector, accounting for 39.2%. Employed persons in industrial sector are of the smallest proportion (7.3%).

Table 1: The number of employed persons (million) in Thailand categorized by their sectors

Sector		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Agricultural	Numbers	14.9	15.1	14.7	14.9	15.2	15.2	15.3	15.8	15.4	15.9
	percentage	45.6	45.0	43.0	42.4	42.6	42.6	42.1	42.5	40.7	41.7
Industrial	Numbers	6.4	6.6	7.1	7.3	7.4	7.3	7.4	7.3	7.4	7.3
	percentage	19.4	19.7	20.8	20.7	20.7	20.4	20.3	19.7	19.6	19.1
Service	Numbers	11.4	11.8	12.4	13.0	13.0	13.2	13.7	14.1	15.0	15.0
	percentage	35.0	35.3	36.2	36.9	36.7	37.0	37.6	37.9	39.6	39.2
Total Number		32.7	32.7	33.5	34.2	35.2	35.6	35.8	36.4	37.2	37.9

Source: NSO (2011)

Remarks: Agricultural sector includes agriculture, hunting and forestry and fishing. Industrial sector includes mining and quarrying, manufacturing, electricity, gas and water supply and construction. Service sector includes wholesale and retail trade, repair of motor vehicles , motorcycles and personal and household goods, hotel and restaurant, transport, storage and communication, financial intermediation, real estate, renting and business activities, public administration and defense and compulsory social security, education, health and social work and community, social and personal service activity.

It is worth noting that the proportion of employed persons in agricultural sector decreased gradually but steadily from 45.6% in 2001 to 41.7% in 2010. In contrast, the proportion of employed persons in service sector continuously increased from about 35% in 2001 to 39.2% in 2010, while in industrial sector the proportion shows a fluctuation over the period, that is, constantly increased from 19.4% in 2001 to 20.8% in 2003 before dropping to 19.1% in 2010.

b) Educational attainment

Educational attainment is measured in terms of number of years of schooling of employed persons. This is presented in Table 2. The findings reveal that educational attainment of employed persons in Thailand is still low. On average, they had only 5.4 years of schooling in 2001, indicating that most of them did not even complete primary school. However, ten years later the educational attainment of employed persons increased to 6.9 years in 2010, implying that on average employed persons completed primary school.

Table 2: Educational attainment as measured by mean mears of schooling (years)

Sector	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
(1)	3.1	3.3	3.4	3.6	3.5	3.6	3.8	4.1	4.3	4.4
(2)	3.8	3.9	4.1	3.8	3.7	4.5	4.4	4.4	4.3	4.7
Agricultural	**3.2**	**3.3**	**3.4**	**3.6**	**3.5**	**3.6**	**3.8**	**4.1**	**4.3**	**4.4**
(3)	5.6	6.2	5.9	5.8	6.1	6.1	5.9	7.4	6.4	8.0
(4)	6.8	6.9	7.1	7.4	7.6	7.7	7.8	7.7	7.7	8.1
(5)	10.1	10.7	11.3	11.2	10.8	10.9	11.2	11.7	12.2	12.3
(6)	4.9	5.0	5.0	5.1	5.2	5.4	5.6	6.0	5.9	6.0
Industrial	**6.4**	**6.5**	**6.7**	**6.9**	**7.0**	**7.1**	**7.3**	**7.3**	**7.3**	**7.6**
(7)	6.6	6.7	7.0	7.3	7.1	7.4	7.5	7.9	8.0	8.1
(8)	5.4	5.6	5.7	6.0	6.0	6.1	6.2	6.5	6.8	6.9
(9)	6.6	6.7	7.2	7.0	7.4	7.9	8.3	8.0	8.2	8.4
(10)	13.9	13.6	13.8	14.2	14.2	14.2	14.4	14.3	14.4	14.4
(11)	9.8	9.7	9.5	10.2	10.2	9.9	10.1	9.9	10.1	10.5
(12)	11.6	12.0	12.2	12.1	12.0	12.2	12.1	12.4	12.5	12.4
(13)	12.9	13.0	12.9	13.3	13.4	13.1	13.4	13.7	13.7	13.7
(14)	11.3	11.3	11.2	11.8	11.9	11.3	11.6	11.8	11.8	12.2
(15)	6.1	6.1	6.7	6.6	6.9	7.2	7.4	7.6	7.8	8.3
Service	**7.8**	**7.9**	**8.1**	**8.3**	**8.4**	**8.5**	**8.8**	**8.9**	**9.1**	**9.3**
Overall	**5.4**	**5.5**	**5.8**	**6.0**	**6.0**	**6.2**	**6.4**	**6.6**	**6.8**	**6.9**

Source: Author's calculation based on NSO (2011)

Remarks: (1) is agriculture, hunting and forestry sector; (2) is fishing sector; (3) is mining and quarrying sector; (4) is manufacturing sector; (5) is electricity, gas and water supply sector; (6) is construction sector; (7) is wholesale and retail trade, repair of motor vehicles motorcycles and personal and household goods sector; (8) is hotel and restaurants sector; (9) is transport, storage and communication sector; (10) is financial intermediation sector; (11) is real estate, renting and business activities sector; (12) is public administration and defense and compulsory social security sector; (13) is education sector; (14) is health and social work sector and; (15) is community, social and personal service activity sector.

When this is considered by each major sector, it is found that employed persons in service sector had the highest educational attainment with an average of 9.3 years of schooling in 2010. This implies that, on average, workers in this sector completed lower secondary level. Employed persons in industrial sector had lower educational attainment than those in service sector, with only 7.6 years of schooling in 2010. The lowest educational attainment is found among employed persons in agricultural sector; on average they had only 4.4 years of schooling in 2010 which indicates that

they did not complete even primary school. This situation of low educational attainment is considered an important labor problem for Thailand.

When considered by sub-sector, the findings reveal that only employed persons in 5 out of 15 sub-sectors had more than 12 years of schooling. These are the employed persons in financial intermediation, education, public administration and defense and compulsory social security, electricity, gas and water supply, and health and social work sectors. Employed persons in financial intermediation sector have the highest educational attainment with an average 14.4 years of schooling in 2010, indicating that most of employed persons in this sector completed at least the certificate of higher vocational education.

Educational attainment of employed person in education sector is the second highest, followed by public administration and defense and compulsory social security, electricity, gas and water supply and health and social work sectors. The mean years of schooling for these groups are 13.7, 12.4, 12.3, and 12.2 years, respectively, that is, they completed at least upper secondary school. Employed persons in real estate, renting and business activities sector, on average, had 10.5 years of schooling, implying the lower secondary education.

In a number of service subsectors, educational attainment of employed persons is low, about 7-8 years. These include those employed in the following subsectors: transport, storage and communication, community, social and personal service activity, wholesale and retail trade, repair of motor vehicle and motorcycle and personal and household goods, manufacturing, mining and quarrying and hotel and restaurants sectors. The lowest educational attainment (with average ranging from 4-6 years) is found among workers in agriculture, hunting and forestry, fishing and construction sectors, indicating that most of them had some primary education or just completed it.

c) Growth of labor productivity

The growth rates of labor productivity in 15 subsectors are presented in Table 3. The findings reveal that the overall growth rate of labor productivity of all sectors during 2001–2010 equaled 2.8% per year with the standard deviation of 3.0%, reflecting very high volatility. During 2001–2002 the growth rate of labor productivity was 2.8% per year; it increased to the level higher than 3.0% per year

during 2002–2006. The global financial crisis caused by the sub-prime mortgage crisis in the US in 2007 caused Thailand's growth rate of labor productivity to fell sharply to 0.4% per year during 2007–2008 and reached a negative level of -4.2% per year during 2008–2009. However, when the situation was better during 2009–2010 the growth rate of labor productivity rose sharply to 6.9% per year.

Considering by major sectors, the results reveal industrial sector to have the highest average growth rate of labor productivity at 4.1% per year during the study period with the high standard deviation of 5.4% per year. The growth rate in this sector was negative only once in 2008–2009, at -6.9% per year. Almost throughout the period of 10 years covered in this analysis the growth rates of labor productivity of the industrial sector remained higher than 3.0% per year except in the period of 2002–2003 when it was only 1.8% per year. In agricultural sector the average growth rate of labor productivity showed a noticeable fluctuation. During was the study period it was 1.3% per year with very high volatility (standard deviation equaled 6.0). It was negative at -0.5% per year in 2001–2002, thereafter sharply increased to 14.7% per year during 2002–2003 before falling to a negative level again during 2003–2005. Between 2005–2009, the growth rates of labor productivity in this sector ranged from 0.6 to 4.3% per year; thereafter it drastically decreased to -5.1% per year during 2009–2010.

Table 3: Growth rates of labor productivity (% per year)

Sector	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	Mean	Std. Dev.
(1)	-0.6	14.9	-4.6	-5.0	4.0	0.9	1.1	3.2	-6.2	0.9	6.0
(2)	7.8	13.4	-7.4	17.8	0.2	2.7	8.3	-1.0	8.1	5.5	7.3
Agricultural	-0.5	14.7	-3.8	-3.5	4.3	0.6	1.2	3.6	-5.1	1.3	6.0
(3)	38.4	-23.1	-16.7	24.2	-16.9	-1.4	40.5	-27.2	49.3	7.5	28.8
(4)	3.6	4.2	8.0	2.2	7.8	4.2	7.9	-6.5	14.0	5.0	5.3
(5)	2.3	-6.4	5.2	10.3	4.7	12.3	-10.4	5.8	-2.3	2.4	7.1
(6)	-1.3	-8.3	-2.0	9.0	3.4	1.0	-11.8	-4.9	11.4	-0.4	7.2
Industrial	3.0	1.8	5.3	4.2	6.6	4.0	4.5	-6.9	14.2	4.1	5.4
(7)	-3.6	-1.7	-0.7	7.6	2.4	4.0	-4.1	-5.6	2.1	0.0	4.1
(8)	-1.7	-7.8	7.3	0.8	8.9	2.3	0.2	-11.4	13.1	1.3	7.4
(9)	5.3	-2.7	7.2	5.4	4.7	6.7	-1.4	-7.8	9.6	3.0	5.3
(10)	23.4	8.4	8.6	10.9	-5.7	-5.7	7.1	0.2	10.8	6.5	8.6
(11)	2.6	-1.8	-6.1	4.0	2.7	-5.4	1.4	-7.4	12.5	0.3	5.9

Table 3 (cont.)

Sector	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	Mean	Std. Dev.
(12)	5.5	1.0	0.3	-7.6	-6.7	-1.4	-0.4	-3.3	-10.5	-2.6	4.7
(13)	2.9	-1.3	2.7	0.2	4.8	6.6	-1.8	-1.7	-4.1	0.9	3.3
(14)	4.5	-16.3	-11.8	9.1	7.5	-6.8	1.2	-5.8	4.2	-1.6	8.4
(15)	4.1	6.1	7.1	5.5	2.5	-12.6	-3.8	-4.6	25.7	3.3	10.0
Service	1.3	-1.2	1.8	4.6	3.0	1.6	-1.6	-6.6	4.9	0.9	3.6
Overall	2.8	5.0	3.3	3.4	4.4	3.1	0.4	-4.2	6.9	2.8	3.0

Source: Author's calculation based on NSO (2011)

Despite the highest education of employed persons, the service sector had the lowest average growth rate of labor productivity during 2001–2010 which equaled 0.9% per year with the high standard deviation of 3.6% per year. During the period of 2001–2002, the growth rate in this sector equaled 1.3% per year; thereafter it became negative at -1.2% per year during 2002–2003. However, during 2003–2007 the growth rates in this sector remained positive until the global economic meltdown in 2007 caused by the financial crisis in the US during 2007–2009. After that, it impressively increased to 4.9% per year during 2009–2010.

Considering by subsectors, mining and quarrying sectors had the highest average growth rate of labor productivity during 2001–2010 which equaled 7.5% per year. However, it seems that this figure was meaningless since the standard deviation was extremely high at 28.8% per year. Financial intermediation sector had the second highest average growth rate of labor productivity which equaled to 6.5% per year, following by fishing, manufacturing, community, social and personal service activity, transport, storage and communication, electricity, gas and water supply and hotel and restaurants sectors with the average growth rates of 5.5, 5.0, 3.3, 3.0, 2.4 and 1.3% per year, respectively. Similarly, the growth rates of labor productivity was also high in community, social and personal service activity, electricity, gas and water supply and hotel and restaurants sectors but with the very high volatility as measured by the standard deviation they are hardly significant. The growth rates in financial intermediation, fishing and transport, storage and communication sectors are fairly significant considering the lower standard deviations relative to their mean values.

Labor productivity in education, agriculture, hunting and forestry, real estate, renting and business activities and wholesale and retail trade, repair of motor vehicles

motorcycles and personal and household goods sectors is considered low and insignificant since the average growth rates in these four sectors during 2001–2010 were lower than 1.0% per year with the very high standard deviations. In the remaining sub-sectors (construction, health and social work and public administration and defense and compulsory social security) labor productivity is also insignificant with the negative average growth rates of -0.4, -1.6 and -2.6% per year and the very high standard deviations.

d) Contribution of educational attainment to the growth of labor productivity

The results of the fixed and random effects regression analyses in Table 4 reveal slightly different regression coefficients from fixed and random effects models. Based on the Hausman Test statistic, the fixed effects model seems to be more appropriate than the random effects model. According to Table 4, Hausman Test statistic equals 19.46 with the *p*-value of 0.0016 (see remarks 2). This indicates that the subsector unobserved effect and explanatory variables in the model are correlated, causing random effects model to be biased and inconsistent. Consequently, the Fixed Effect model is selected. Based on the coefficient of determination of 0.3514, the regression resulting from the Fixed Effect model can explain the total variation in the labor productivity which is the dependent variable in this study by 35.14%.

In the Fixed Effect model, the regression coefficient of educational attainment measured in terms of mean years of schooling equals 0.5781 which is statistically significant at 5% level. This indicates that educational attainment has a significantly positive contribution to labor productivity growth. That is, one percent increase in mean years of schooling of employed persons will lead to 0.5781% increase in labor productivity in Thailand during the study period, 2001-2010.

The regression coefficient (-1.4061) of labor utilization measured as hours worked per week of employed persons is also statistically significant at 5% level. This indicates that labor productivity growth is negatively determined by labor utilization. That is, one percent increase in hours worked per week will lead to 1.4061% decrease in labor productivity. The findings indicate no significant relationship between labor productivity growth and the other factors, including unemployment rate, labor incentive as measured by percentage of employed persons who are available for additional work and time trend.

Table 4: Results from regression analysis

Variable	Fixed Effects Model			Random Effects Model		
	Coefficient	Std. Error	t-Stat	Coefficient	Std. Error	t-Stat
ed	0.5781*	0.2047	2.82	0.0830	0.1037	0.80
unem	0.0257	0.0144	1.79	0.0280	0.0143	1.95
util	-1.4061*	0.4836	-2.91	-1.2273*	0.3819	-3.21
incen	-0.0030	0.0125	-0.24	-0.0084	0.0122	-0.69
t	0.0085	0.0051	1.68	0.0173*	0.0039	4.41
constant	8.7689*	1.9888	4.41	9.0723*	1.5065	6.02
R2	0.3514			0.3170		

Remarks: 1. *indicates statistical significance at 5% level.
2. Hausman Test statistic equals 19.46* with *p*-value of 0.0016.
3. Dependent variable is labor productivity index in natural logarithm form [ln(lp)].
4. Number of observations is 150.

Discussion

This study sheds more light on the situation regarding educational attainment in Thailand. The findings clearly point out important problem regarding education in Thailand's labor force since most of employed persons are unskilled labors with an average of only 6.9 years of schooling. The low educational attainment leads to the low human capital of the nation. This finding suggests, among other things, that development of the capital-intensive industry is still difficult to realize. The problem remains serious for agricultural sector where employed persons have only about 4 years of schooling in 2010. Although in industrial and service sectors employed persons have higher education, most of them are still regarded as unskilled labors.

In terms of individual subsector, there seems to be potential for developing capital-intensive industry to become the primary sources of the economic growth in a number of subsectors, especially among those where workers have educational attainment of 12 years of schooling or more. These include financial intermediation, education, public administration and defense and compulsory social security, electricity, gas and water supply and health and social work sectors. Agriculture, hunting and forestry, fishing and construction sectors seem to have the most adverse impact from the shrinking proportion of the population in working-age group while most employed persons in these sectors still have very low education.

Theoretically, higher educational attainment can lead to the greater labor productivity. Findings from this study lend partial support to this statement. On the one hand, our results demonstrate that in subsectors where employed persons have high education, labor productivity tends to be high such as in financial intermediation and electricity, gas and water supply sectors. This analysis also show low labor productivity in subsectors where employed people have low education, such as in agriculture, hunting and forestry and construction sectors. On the other hand, some sub-sectors, particularly public administration and defense and compulsory social security, health and social work and real estate, renting and business activities sectors that have workers with high education are found to have low labor productivity growth. This is probably due to the fact that production structure of these sub-sectors still relies heavily on the quantity rather than quality of the labors working with high-technology machineries and equipments. As such, education is not very useful in these sub-sectors. The other reason may have to do with effect of other factors not included in this analysis such as global economic crisis during the period of this study.

On the contrary, some subsectors still have high labor productivity growth despite low education of labor. These include manufacturing, mining and quarrying, hotel and restaurants and fishing sectors. The findings seem to suggest that these subsectors which are labor-intensive industries still benefit from the quantity of labors and are not much affected by low education although this situation is not likely to last long. In the long run, when the shrinking population in the working-age group results in reducing number of working-age people, the subsectors with low education may be severely affected, eventually causing the lower labor productivity and output.

On contribution of education to the growth of labor productivity, this analysis shows that one percent increase in mean years of schooling can lead to 0.5521% increase in labor productivity. Although this is consistent with results from previous studies, our findings reveal that labor productivity growth tends to decrease as the labor utilization increases. The finding like this has been reported by Golden (2012) who found that the higher labor utilization measured by hours worked of employed persons could lead to the greater labor productivity only in case of short hours worked (less than 35 hours per week). If employed persons are already highly utilized and have long hours worked in the first place, the longer hours worked (higher utilization) would instead cause the labor productivity to diminish. This is understandable since

the longer hours worked will cause output to increase but with a decreasing rate, implying the diminishing marginal product of labor. Generally, longer hours worked could causes fatigue, risks and time conflicts that interfere both the quality of non-work life and on-the-job performance, causing labor productivity to decline (Golden 2012). According to the calculation based on data from NSO (2011), the average hours worked of employed persons in Thailand equals 44.38 hours per week (8.88 hours per day). This suggests that employed persons in Thailand are already highly utilized and have long hours worked. That is why the higher labor utilization leads to the lower labor productivity growth as noted in our analysis above.

Conclusion

This study shows that the educational attainment is very important for Thailand's economic opportunity since it is proved to have a significant contribution to labor productivity growth. This growth, in turn, can enable the country to develop capital-intensive industry to avoid the impact of the shrinking labor force which is likely to happen in the near future. With the capital-intensive industry and high education attainment of the labor force, Thailand can sustain economic growth in the long run even with diminishing proportion of population in the working-age group that is most likely to happen in the future. Based on the findings from this study, the government needs to develop knowledge and capital-intensive industries, especially in subsectors with high education so that employed persons with high educational attainment will be efficiently capitalized, leading to the higher labor productivity growth and finally the higher economic growth.

To facilitate this, the government also needs to find appropriate policies to promote education in the nation in order to enhance labor productivity not only by extending compulsory education but also by improving public health services and promoting job training. Finally, the service sector will be very vital for Thailand's economic prosperity in an ageing society since employed persons in this sector have high educational attainment and it is knowledge-intensive which normally creates the higher added value and is less affected by ageing population. Therefore, the knowledge and capital-intensive industry development in service sector is needed so that employed persons with high education in this sector will be fully utilized, leading to the sustainable development of the country in the aging era.

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