Chapter 4

Social Infrastructure Needs on Human Capital: Education and Government Services

1. Introduction

The World Bank [1] has noted that Thailand's economy has grown up continuously since 2014, owing to the recovery of domestic demand in line with and the US as well as EU markets. Thailand's export growth has been modest and lagging behind several Asian countries, due partly to a decline in competitiveness. The World Bank has further noted that further improvements in competitiveness will be important for sustained economic growth and rising incomes for the Thai people. The World Bank has pointed out the importance of raising the quality of education for all will help increase the skills and productivity of the labor force. It is a key to improving Thailand's competitiveness.

From statistics, Thailand has made great progress in expanding *basic education.* This can be judged from the 'mean years of schooling' (UNDP's Human Development Index). However, from now the key lies in how to raise the quality of education series to maximize students' potential in joining Thailand's skilled workforce.

The fact is that almost 1/3 of Thai 15-year-old students are "functionally illiterate." They lack the skills needed to manage daily living and employment tasks that require reading skills beyond a basic level to compete in the '21st Century Skills'[2]. The inequality of resource allocation is skewing particularly acute for small village schools, which face teacher shortages and have less than one teacher per classroom. All educators in Thailand acknowledged that the small village schools are also severely under-resourced making it difficult to deliver quality education. Not only because they have a poor and inadequate supply of teaching materials, poor physical infrastructure but most importantly they do not have experienced teachers with sufficient qualification for the education for the '21st Century's skills'.

[1] The World Bank, Thailand Economic Monitor – June 2015: Quality Education for All. http://www.worldbank.org/en/country/thailand/publication/thailand-economic-monitor-june-2015

[2] They are 'Collaboration and teamwork, Creativity and Imagination, Critical thinking, Problem-solving' Flexibility and adaptability, Global and cultural awareness, Information literacy Leadership. See https://www.envisionexperience.com/.../13-essential-21st-century-skills-for-todays-stude...

In this part of the analysis, we would like to estimate the need for soft infrastructure to promote the buildup of human capital. It is inclusive of education and health investment. In this chapter, we concentrate on education investment in quality rather than the physical quantity in line with the above remarks by the World Bank.

We build a simple model to project the number of students at each education level. This follows the conceptual framework in Chapter 3. In addition, we will project the need for the related physical infrastructure in education services such as a number of schools and related facilities. With unit cost, we will estimate the cost of infrastructure investment.

The last section is an estimation of social infrastructure need for the public services. We have applied the database of Office of the Civil Servant Commission (OCSC) to prove the declining demand for public personnel, thus, the physical infrastructure. The study has pointed out the replacement by shifting to human capital investment in quality rather than quantity. This is consistent with the demand for physical schooling social infrastructure which would need to be replaced by investment in the quality of both structures as well as students' modern facilities to reach the baseline of 21st Century Skills formation for further sustainable development in Thailand.

2. What Determine the Social Infrastructure Needs in Education?

The key determinations in estimation the education needs from the *supply side* comprise variables such as the single-year age population trend, the assumption on structural change of ***enrolment ratios*** of schooling over time. With certain assumption on drop-out of a school system, survival rate, the *labor pool* can be determined by *population out of school with age greater than 15-year-old.*

On the *demand side*, given the labor force participation rate as a function of equilibrium *wage rate* in labor market, labor demand and employment is determined by economic growth and development. In our study, level of economic development is represented by *GDP per capita* as a proxy of all other variables.

In our study, we begin from the demand for labor from our model projection for OECD (2017)[3]. That is to project the labor demand by 'Occupation- Education' in order to justify the demand for social infrastructure related to human capital investment. The answer is to find the future demand for 'skills and unskilled labor' overtime.

[3] Puttanapong N., Limskul K., and Bowonthumrongchai T. (2017), A Study on Macroeconomic Impacts of Immigration Using a SAM-Based CGE model, submitted to OECD (2017), *How Immigrant Contributed to Thailand's Economy*. https://www.oecd.org/migration/how-immigrants-contribute-to-Thailand-s-economy-9789264287747-en.htm

The matrix of occupation-education was retrieved from the labor force survey (NSO) and rebasing to 2015 to represent a structure of employment in Thailand. The total demand for labor by occupation is 38.50 million persons. Here, it is noted that the demand for labor by occupation with primary education and less than elementary is 15.84 million persons. The labor demand by secondary, vocational and tertiary education is 9.74 million, 3.09 and 5.82 million persons respectively. The demand for labor by occupation-education may change over time according to their respective wage gap by such dimension.

Table 4.1: Matrix of Demand for Labor by Occupation-Education Level 2015 (persons, adjusting for presentation)

Occupation/Education 2015	Primary and lower	Secondary	Vocational	Tertiary and upper	Total
Managers	270,717	324,012	172,387	754,918	1,522,034
Professionals	28,014	98,141	94,447	1,941,403	2,162,005
Technicians and associate professional	115,728	28,8487	338,896	1,002,062	1,745,173
Clerical support workers	61,608	375,511	329,975	687,171	1,454,265
Service and sales workers	2,935,984	2,666,577	833,996	924,718	7,361,275
Skilled agricultural, forestry and fishery workers	8,897,664	2,725,675	361,766	205,505	12,190,610
Craft and related trades workers	2,070,668	1,447,727	592,276	203,226	4,313,897
Plant and machine operators and assemblers	1,468,509	1,821,829	366,571	101,162	3,758,071
Elementary occupations	2,602,176	1,162,083	153,336	79,294	3,996,889
Total	15,848,892	9,747,959	3,090,314	5,820,165	

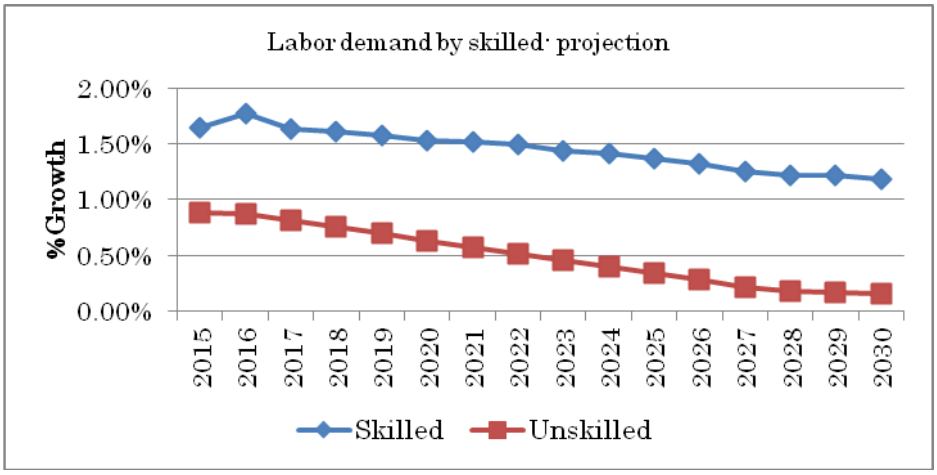
Note: (1) Primary and below= primary education and less than elementary; Secondary = lower + upper secondary general stream + post-secondary academic and teacher training; Vocational = upper secondary vocational + post-secondary vocational; tertiary and upper = Bachelor degree academic+ Higher technical education + teacher training+ Master and Doctor Degree respectively. (2) The matrix does not cover non-education, non-education and unknown. Thus, grand total row sum of employed persons by education is not consistent with total column sum of employed persons by occupations.

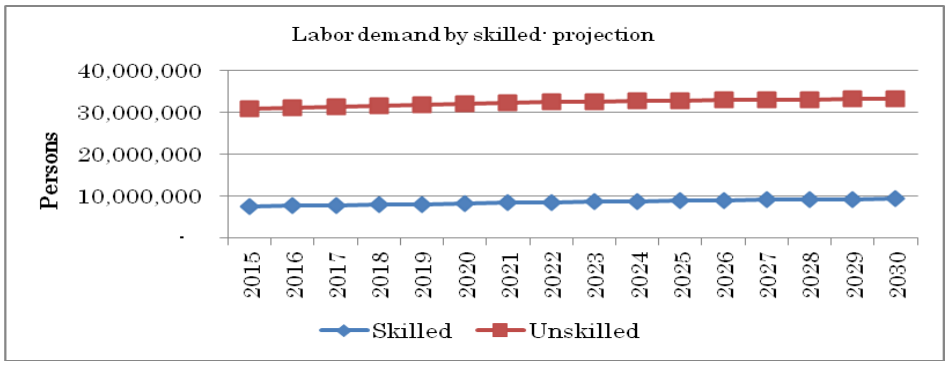
Pattanapong N., et., al. (2017) has predicted the demand for skills and unskilled labor using their CGE model. Their baseline forecast has shown that demand for labor by skills has increased gradually over time in the range of not exceeding 1.0 percent or from 5 to 10 million persons during 2015-2030. The demand for labor is driven by

average growth rates of GDP of 2.93 percent in 2015 to 3.03 and 3.49 percent by end of 2020 and 2030 respectively. Here, the real stock of capital accumulation is assumed to growth 0.82 percent in 2015 to 1.15 and 2.16 percent by end of 2020 and 2030 respectively.

It is hypothesized that if capital deepening would be assumed with larger growth magnitude, demand for skills-unskilled labor would have to change with consistent manner.

Figure4.1: Labor Demand Projection by Skills





Source: Pattanapong N., et., al. (2017)

It is expected that the need for skills labor would be highly demanded. In other words, Thailand would need higher level of human capital accumulation (i.e., by education level) to drive economic growth and development. Thus, the social capital investment would be required to push up sufficiency and efficiency of physical capital stock. Thailand will desperately need both hard, soft infrastructure as well as social infrastructure.

On the supply side, a simple projection of the number of students by education level is based on the population projection (a single year age group), the assumption on *enrollment ratio* by age group. However, on the demand side, a number of student in school is rather a function of expectation of employment signal in the labor market. There is a *time lag* between demand signal in the labor market and household's education investment in school.

The educational system in Thailand may need to shift to quality and ability of students instead of quantity achievement as in the past. The declining total fertility and demand for labor for knowledgeable society would demand the increased ability to compete with other countries.

System of Equations

The following mathematical model is the conceptual framework for our 'Demand for Social Infrastructure' in case of education services.

Demand for Labor

LD-by-education = f{ *wage-by-education , GDP, General- price-level*} (1)

Assuming continuous mapping exists, the inverse demand for labor is found as:

Real_Wage-by- education = f^{-1} {GDP, LD-by-education} (2)

Supply of Labor

Labor Force = *Population at out of school system age >15* (3)

LS-by-education = *Labor Force * survival rate* (4)

LS-by-education = h {*wage-by-education, Labor Force Participation Rate-by-education*Labor force, CPI*} (5)

Equilibrium in the labor market

Equilibrium condition: **LD** = **LS**= **L*** (6)

W***-by-education** = W(L^*, *GDP, General Price Level*) (7)

Determination of Demand for Schooling

No.-students = *Pop-by-enrolled-age*enrollment-ratio* (8)

Where,

Enrollment-ratio = ER{*GDP/Pop, lagged* L^*, *general price level, other exogenous factors*} (9)

Demand for Social infrastructure: SI

SI=SI{ *No.-students, conversion-factor-student-physical*} (10)

Cost of Social Infrastructure investment: SI_F(t)

Determined from Capital Stock Formation

$$\mathbf{SI\_F(t)} = \text{SI\_F}\{SI, SK(t-1), dep\_rate\}$$

$$\mathbf{SK(t)} = SK(t-1) - dep\_rate * SK(t-1) * + SI\_F(t) \quad (11)$$

The educational system in Thailand mainly focuses on quality, equality, and ability of students to build a knowledge society, and competitiveness. This is to invest in social infrastructure for qualified students, with equality in education services across area and classes.

The forecasted number of students is used as a basis for an approximation of a number of teachers and school personnel needed and school facilities. Furthermore, a requirement of school facility between areas is allocated by applying a standard ratio provided by Ministry of Education. The required space on school facility is determined by the forecasted number of students and teachers.

2.1. Population Growth, Enrollment and Students Projection by NESDB

The population at each enrolled age ratio has been projected to decrease along the declining trend of total fertility rates since 1980. The NSO reports that enrolled population with age range of 0-21 year has been declining from 62.3 percent of total population in 1980 to 29.8 and 20.0 percent in 2010 and 2040 respectively.

For future projection, Thai enrollment age in school is assumed to be declining by NESDB (2013)[4]. The projection is fundamentally based on *the supply side.* It does not explicitly take into account the labor demand by production sector in the labor market. In the last decades, Thailand has relied on labor-intensive technology in her production. Labor demand required a cheap wage for labor-intensive development epoch.

The NESDB projection may obtain information from the fact that majority of the labor force and supply has passed only a primary education or lower. This had constituted to cheap wage cost during the past decades. As income per capita rises, household starts to invest in the higher level of human capital, especially in education. Thus, it is rational to assume that in the coming decades, higher *human capital investment in Thailand will be the key determinant of future development.* As a result, it is *hypothesized* that *declining* enrollment ratio in primary education (both net and gross),

[4] VaPattanapong P., Prasartkun P., and Panpoung S. ed., (2013), Policy Implication of the Population Projection in Thailand 2010-2040, Population and Social Research Institute, Mahidol University, Submitted to the National Education and Social Development Board.

increasing enrollment ratios in secondary and tertiary education is consistent with the path towards sustainable growth and development.

Table4.2: Population with Enrolled Age 0-21 Year, 1980-2040

	1980	1990	2000	2010	2020	2030	2040
Enrolled Age Population ('000 persons)	44,825	54,549	60,916	63,790	65,996	66,174	63,864
Pre-kindergarten (0-2 year)	6,663	2,593	2,581	2,279	2,097	1,776	1,443
Kindergarten (3-5 year)	3,327	2,913	3,057	2,409	2,171	1,871	1,534
Primary (6 - 11 year)	7,091	6,840	6,132	5,203	4,462	4,016	3,362
Lower Secondary (12 - 14 year)	3,511	3,601	3,074	2,750	2,351	2,138	1,831
Upper Secondary (15 - 17 year)	3,393	3,403	3,153	2,781	2,482	2,196	1,927
Higher Education (18 - 21 year)	3,928	4,574	4,252	3,577	3,500	2,970	2,703
Enrolled Age Population (0 - 21 year)	27,913	23,924	22,249	19,000	17,063	14,966	12,800
Enrolled Age Population (3 - 21 year)	21,250	21,331	19,668	16,721	14,966	13,190	11,357
Percentage distribution of enrolled age population, % by age range							
Pre-kindergarten (0-2 year)	14.90	4.8	4.2	3.6	3.2	2.7	2.3
Kindergarten (3-5 year)	7.40	5.3	5.0	3.8	3.3	2.8	2.4
Primary (6 - 11 year)	15.80	12.5	10.1	8.2	6.8	6.1	5.3
Lower Secondary (12 - 14 year)	7.80	6.6	5.1	4.3	3.6	3.2	2.9
Upper Secondary (15 - 17 year)	7.60	6.2	5.2	4.4	3.8	3.3	3.0
Higher Education (18 - 21 year)	8.80	8.4	7.0	5.6	5.3	4.5	4.2
Enrolled Age Population (0 – 21) year, % of total	**62.30**	**43.9**	**36.5**	**29.8**	**25.9**	**22.6**	**20.0**
Enrolled Age Population (3 – 21) year	**47.40**	**39.1**	**32.3**	**26.2**	**22.7**	**20.0**	**17.8**

Note: based on the assumptions as follows: (1) Enrolment ratios of primary, secondary of both stream education is 100.00% (2) The ratio between vocational: general stream in secondary education is assumed to be 60:40 in 2018 and beyond until 2040. (3) Graduation rates from primary-secondary education are assumed to hold as base year 2010/2014. (4) Diploma vocational applied from projection of Ministry of Education.

Source: National Statistical Office for the year 1980-2000 and National Economic and Social Development Board for the year 2010-2040.

Table 4.3: Number of Students by Education Level, 1980-2040

(1,000 persons)	2010	2011	2012	2017	2022	2032	2040
Pre-Primary (3-5 year)	1,797	1,806	1,897	2,226	2,116	1,803	1,534
Primary (6 - 11 year)	5,067	4,992	4,872	4,324	4,163	3,661	3,159
Lower Secondary (12 - 14 year)	2,802	2,662	2,511	2,239	1,945	1,793	1,579
Upper Secondary (15 - 17 year)	2,068	2,107	2,105	2,093	1,915	1,693	1,509
General Stream	1,314	1,368	1,390	938	747	660	589
Vocational Stream	754	739	715	1,154	1,169	1,032	921
Diploma Vocational	400	381	335	592	754	661	592
Higher Education (18 - 21 year)	1,757	1,812	2,170	2,258	2,245	2,208	2,165
University First year (18-year-old)	578	793	790	807	784	731	662

Note: National Statistical Office for the year 1980-2000 and National Economic and Social Development Board for the year 2010-2040

Table 4.4: Labor Force by Education Level 2006-2011

(1,000 persons)	2006	2007	2008	2009	2010	2011
All	36,429	36,942	37,700	38,427	38,643	38,922
Primary and Pre-Primary (3-11 year)	21,743	21,560	21,443	21,364	21,268	20,661
Lower Secondary (12 - 14 year)	5,205	5,459	5,764	5,948	6,087	6,241
Upper Secondary (15 - 17 year)						
General Stream	3,177	3,404	3,625	3,816	4,018	4,141
Vocational Stream	1,192	1,221	1,241	1,333	1,333	1,341
Diploma Vocational	1,386	1,470	1,566	1,661	1,701	1,795
Higher Education (18 - 21 year)	3,726	3,827	4,061	4,304	4,238	4,742

Source: National Statistical Office, Labor Force Survey

As population projection has shown a declining total fertility rate, it also induced a declining trend of *the new entrant*s into the labor force. The cheap wage episode has ended. However, as capital deepening was ineffective in Thailand owing to risk and

uncertainty of investment climate in Thailand. As a result, industrial development in Thailand has to rely on *foreign migrants* as the main source of labor supply until wage gap between national and foreign labor would be gradually narrowed down.

We have shown that the trend of labor demand by skills is rising in Thailand over the next decades. In fact, labor force surveyed by the National Statistical Office (NSO) has shown that the population out of school and labor pool has their education level consistent with the trend assumed by NESDB. Especially, a labor force with vocational education and tertiary has been increased during 2006-2011. The labor force with primary education and lower has been declining over the period.

2.2 Testing of Hypothesis on Relationship between the Economic Development and Enrollment Ratios

In this part of the study, we would like to test the *hypothesis that gross enrollment rates of the population with primary education is declining* with economic development. In addition, as a country rises towards middle-high income level there is an increasing trend of secondary and tertiary education level's enrollment ratios. The econometric estimate here cannot reject the null hypothesis as well as its 'sign' of the relationships mentioned earlier with significance level.

The scattered plot of panel data below depicts a hypothetical direction of economic development level measured by logarithmic of GDP per capita and gross enrollment ratios. The population who would be grossly enrolled in primary education level at their age range (not a single year age group) would be expected to decline as a country is having a higher level of development. Consistently, a rising income per capita would also induce rising enrollment ratios of secondary and tertiary education.

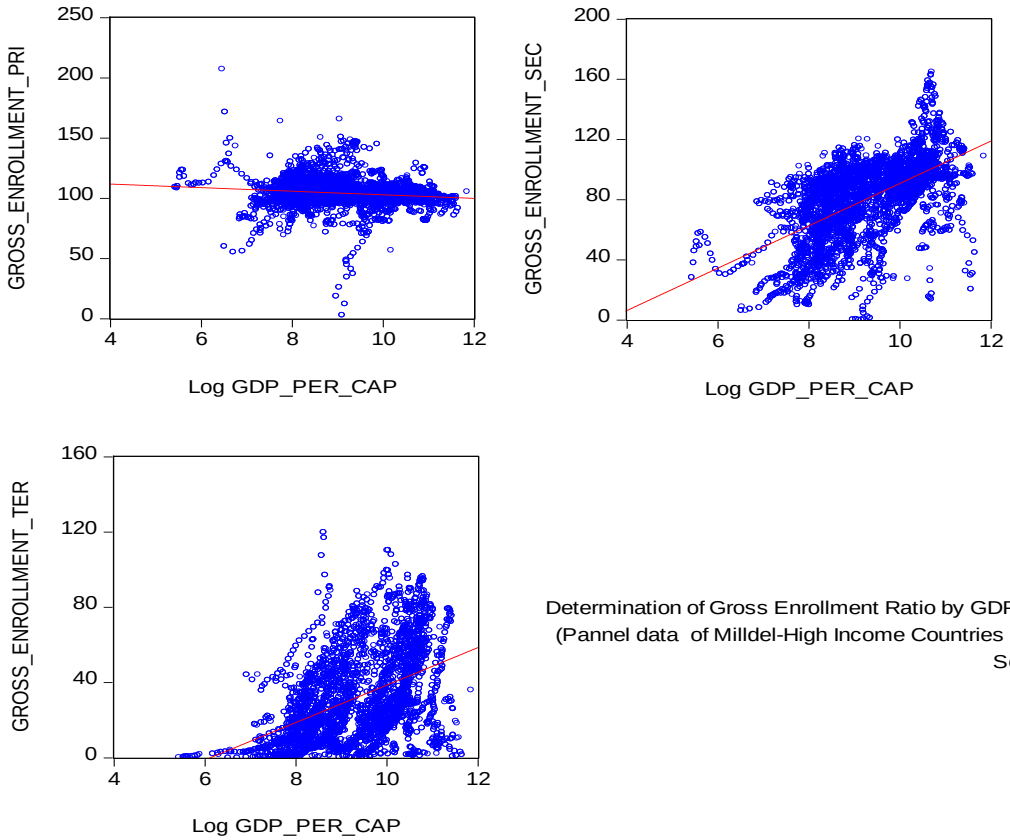
The speed of adjustment towards equilibrium enrollment ratios is shown in below. The magnitude of response of enrollment ratios in primary education to the growth of per capita income is -1.29 percent of average ratio. The speed of population enrolled in primary education in school that is likely to decline per one percentage point of per capita income increases is period -0.01 percent[5].

Accordingly, the enrollment ratios of secondary and tertiary education are estimated to increase 14.29 and 9.94 percent with respect to the growth of income per capita respectively. The speed of rising human capital intensity (measured by enrollment ratios of secondary and tertiary education) would be growing at 0.208 and 0.198 percent

[5] This is by estimation of a double logarithmic function equation. It is not shown in Table

over time. This is a speed of human capital accumulation towards sustainable economic development in the long-run.

Figure 4.2: Determination of Gross Enrollment Ratio by GDP per capita.



Determination of Gross Enrollment Ratio by GDP per capita
(Pannel data of Milldel-High Income Countries 1960-2015)
Source: WB

Table 4.5: Determination of Gross Enrollment Ratio by GDP per capita

Enrollment Ratios	Constant Term	log(GDP_ per capita)	AR(1)	R^2/ Pearson Statistic	D.W./AIC	Estimation Model
Primary Education	115.6881 (68.37)	-1.293798 (-7.19)	-	R^2 =98.47	AIC =7.42;	Generalized Linear Model (N=2821)
Secondary Education	69.24 (3.85)	3.918 (2.24)	0.957 (167.91)	R^2 =0.977	D.W. =1.75	Ordinary Least Square (N=2321)
Secondary Education	50.77 (14.74)	14.29 (39.14)		Pearson Statistic	AIC =8.88	Generalized Linear Model

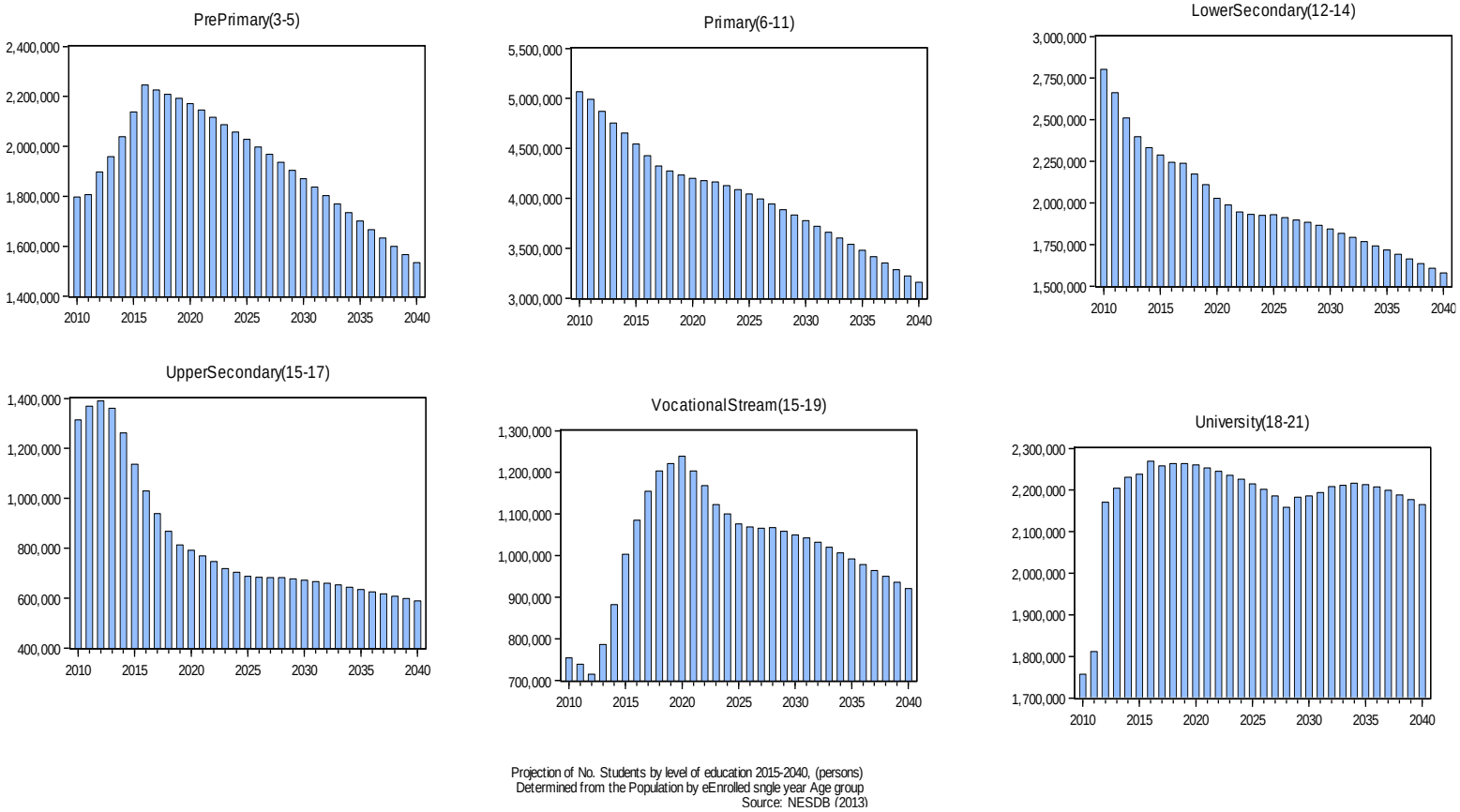
				390.41		(N=2517)
Tertiary Education	-114.33 (-4.27)	3.70 (3.61)	1.01 (450.53)	R^2 =0.987	D.W. =1.20	Ordinary Least Square (N=2500)
Tertiary Education	-60.71 (-17.51)	9.94 (26.98)		Pearson Statistic 442.01	AIC =8.92	Generalized Linear Model (N=2821)

Note: (1) Z-Statistic in the bracket for GLM and t-statistic for OLS.

The PISA report by OECD (2015) has emphasized the quality improvement of education by reducing the inequality of Thai education system. OECD stressed that inequality in *instruments and types of equipment* for learning has a clear relationship with *PISA score* (indicating education quality outcome). In science literacy, it is reported by PISA 2015 that the 15-year-olds in Thailand score 421 points compared to an average of 493 points in OECD countries. Girls perform better than boys with a statistically significant difference of 9 points (OECD average: *3.5 points higher for boys)* on average, 15-year-olds score 415 points in mathematics compared to an average of 490 points in OECD countries. Girls perform better than boys with a statistically significant difference of 3 points (OECD average: 8 points higher for boys). Thailand has shown an average performance in reading of 15-year-olds of 409 points, compared to an average of 493 points in OECD countries. Girls perform better than boys with a statistically significant difference of 31 points (OECD average: 27 points higher for girls).

Thai student has low evaluation performance in reading among countries judged by PISA score. Girls have done better than boy students. The performance in problem-solving in terms of mean score in 'collaborative problem-solving performance' was also low for boys and girls students in Thailand. The change between 2006 and 2015 in the index of social inclusion within schools is one of the largest among PISA-participating countries and economies. The difference in science performance, among students within schools, associated with a one-unit increase in the PISA index of economic, social and cultural status (ESCS) is one of the *smallest* among PISA-participating countries and economies. The variation in science performance associated with the socio-economic status of students, as measured by the PISA index of economic, social and cultural status (ESCS) decreased strongly between 2006 and 2012, compared to other PISA-participating countries and economies (-6.5 %, rank 52/52).

Figure 4.3: Demand for Education of Population at Enrollment Age



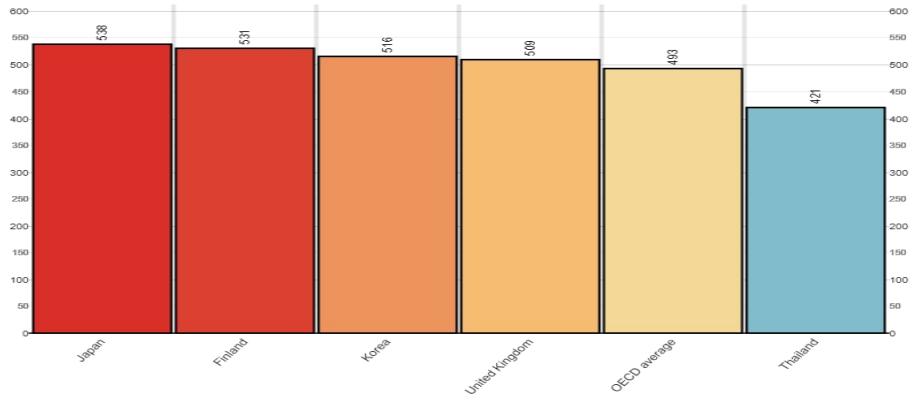
Note: Assumption on Enrollment Ratio is given exogenously.

Source: NESDB (2013).

Before accounting for students' and schools' PISA index of economic, social and cultural status (ESCS), science performance is higher in public schools than in private schools. (28 PISA Score, rank 3/58). After accounting for students' and schools' PISA index of economic, social and cultural status (ESCS), science performance is higher in public schools than in private schools (41 PISA Score, rank 6/58). In Thailand, a high share of students is in the bottom two deciles of international economic, social and cultural status (ESCS), compared to other countries and economies participating in PISA. (55.1 %, rank 4/69) In Thailand, a low share of students is in the top two deciles of international economic, social and cultural status (ESCS), compared to other countries and economies participating in PISA. (7.9 % rank 61/69). Compared to the share non-disadvantaged low performers in science, the share of disadvantaged low performers in science is one of the lowest among countries and economies participating in PISA. (1.7 Ratio, rank 66/68). The variation within schools in science performance is weakly associated with students' and schools' socio-economic status, as measured by the PISA index of economic, social and cultural status (0.3 %, rank 62/67).

Thai Student Performamce Benchmarking with PISA (2015):[6]

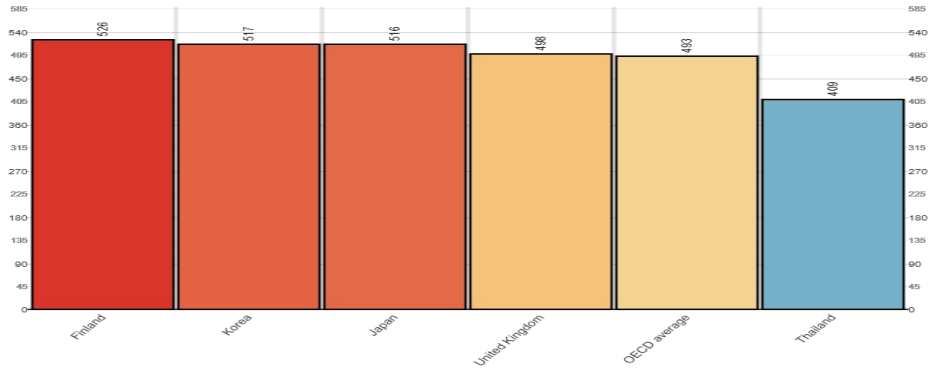
Science: Singapore outperforms all other participating countries/economies in science. Japan, Estonia, Finland, and Canada, in descending order of mean performance, are the four highest-performing OECD countries. Below is to benchmark Thailand with selected forerunners.



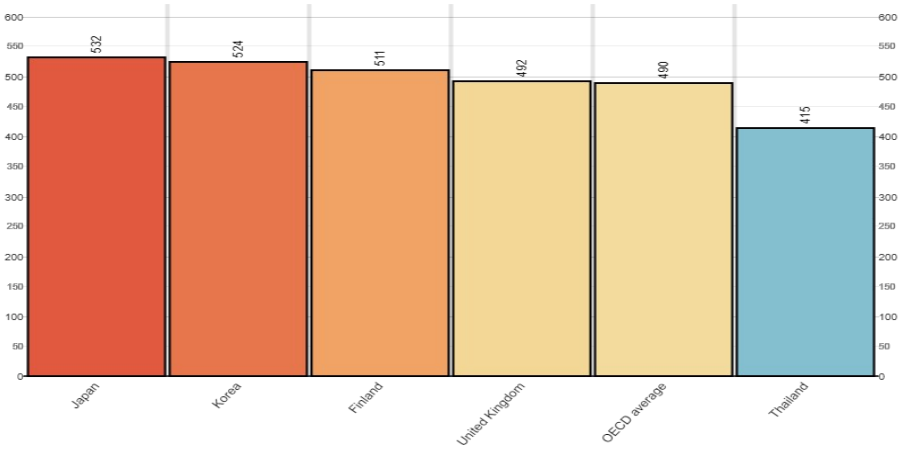
Reading: Singapore, Hong Kong (China), Canada and Finland are the

6 "Education GPS, *OECD*, 3/23/2018, 5:42:42 PM http://gpseducation.oecd.org. Accessed March 2018.

highest-performing countries and economies in reading.



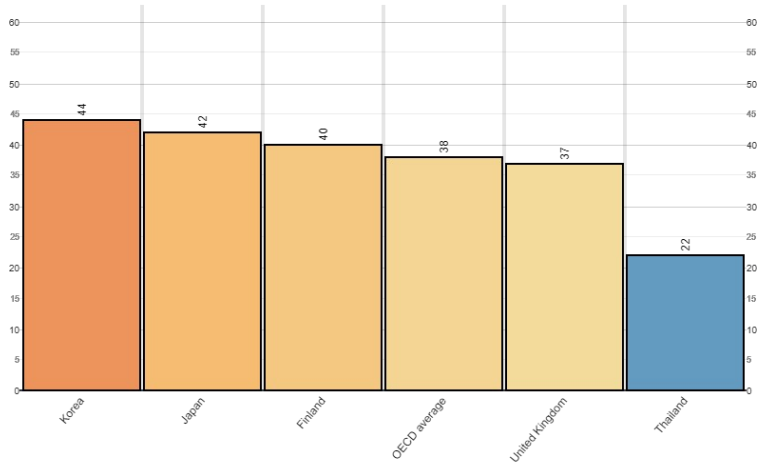
Mathematics: Asian countries/economies outperform all other countries in mathematics. Singapore scores highest in the mathematics of all participating countries and economies: 564 points more than 70 points above the OECD average of 490 points. Three countries/economies score below Singapore, but higher than any other country/economy in mathematics: Hong Kong (China), Macao (China) and Chinese Taipei. Japan is the highest-performing OECD country, with a mean mathematics score of 532 points.



Equity: *PISA defines equity in education as providing all students, regardless of gender, family background or socioeconomic status, with high-quality opportunities to benefit from education. Defined in this way, equity implies neither that everyone should achieve the same results, nor that every student should be exposed to identical approaches to teaching and learning. Rather, it refers to creating the conditions for minimizing any adverse impact on student's socio-economic status or immigrant background on their performance.* Canada, Denmark, Estonia, Hong Kong (China) and Macao (China) achieve high performance and high in education opportunities.

Socio-economically disadvantaged students across OECD countries are almost three times more likely than more advantaged students not to attain the

baseline level of proficiency in science. On average across OECD countries, advantaged students score 88 points higher in science than the disadvantage. **Between 2006 and 2015 no country or economy improved its performance in science and its equity levels simultaneously**.



If Thailand would like to achieve higher 'education quality' better allocations of educational resources for underprivileged schools has to be done first. Currently, the resources allocation is skew to students from middle class and well-to-do family in an urban area more than their rural counterpart.

To achieve the goals, Ministry of Education needs to target on the development of teacher, teaching process, and evaluation process on students. Moreover, students are required to develop skills to analyze, be creative, be responsible, and work as a team. The development process may be done with the help of technology.

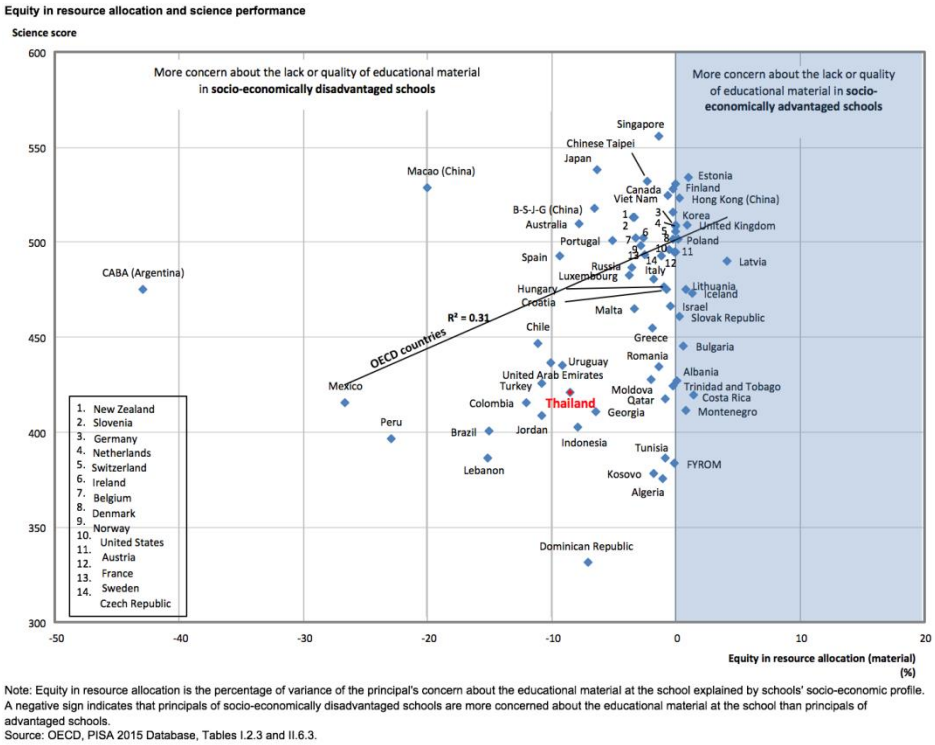
Also, the equality to access in education is another important thing that government is paying attention especially for low income or poor people. This is to promote and enforce Thai children to compile with compulsory education. Lastly, the effectiveness of education service provision can be achieved through the efficient allocation of social resources, having good governance.

The study by World Bank (2018)[7] has pointed out role of institutional alignment and sound administrative system (Overview, page 2) in deliverying goods-quality education core of knowledge and skills rather than just credentials. Sufficient education facilitations, textbook and teachers with coherent curriculum can expect students to engage in meaningful classroom interactions that produce learning. The study also negate the solid correlation between public spending and learning

[7] *"World Bank. 2018. Growing Smarter : Learning and Equitable Development in East Asia and Pacific. World Bank East Asia and Pacific Regional Report;. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/29365 License: CC BY 3.0 IGO."* URI http://hdl.handle.net/10986/29365. Accessed March 26, 2018.

outcome if it is not a quality spending. Singapore and Vietnam have surpassed other ASEAN countries in performances of learning. Thailand has been underperformed as she could not manage education inputs efficiently despite public spending on education is significantly over 4 percent of GDP, 20 percent of the annual budget, teachers earn 25 percent more than GDP per capita. It was clear in World Bank report (2018, Overview, page 16) that top performing system in Japan in the past decades had their central government subsidized local government aiming to equalize public resource across unevn spatial dimension. For nine-year compulsory education, local government fund two-thirds of the cost of teachers' salaries, and central government subsidized thre remaining third to help '*equalize the quality of teachers* across municipalities and schools'. As result, disadvantaged schools have the same share of qualified teachers as advantaged school and more teachers per student.

Figure 4.4: It is a matter of Equity in Educational Resource Allocation



Note: Equity in resource allocation is the percentage of variance of the principal's concern about the educational material at the school explained by schools' socio-economic profile. A negative sign indicates that principals of socio-economically disadvantaged schools are more concerned about the educational material at the school than principals of advantaged schools.
Source: OECD, PISA 2015 Database, Tables I.2.3 and II.6.3.

Source: OECD (2016), PISA 2015 Results (Volume II): Policies and Practices for Successful Schools, PISA OECD Publishing, Paris http://dx.doi.org/10.1787/97/89264267510-en

Table 4.6: Comparison of Selected Indicators of Education 2015

Indicator	Finland	United Kingdom	Japan	Korea	OECD average	**Thailand**
Shortage of educational material (mean index)	0.09	0.04	0.72	0.42	0.00	0.34
Cumulative expenditure per student aged 6 to 15 by educational institutions (equivalent USD using PPPs)	101,527	114,920	93,200	79,517	N/A	27,220
Shortage of educational material (mean index)	0.09	0.04	0.72	0.42	0.00	0.34
Shortage of education staff (mean index)	0.00	-0.12	0.49	0.19	-0.01	0.27
Equity in staff allocation between schools (difference in the index of a	**-0.04**	**-0.36**	**-0.13**	**0.24**	**-0.34**	**-0.33**

shortage of education staff between socioeconomically advantaged and disadvantaged school)						
Students attending government or public schools (**15 year-olds,** %)	95.5	94.2	68.2	66.3	83.5	86.1
Class size in language-of- instruction class	19	24	36	31	26	37
Student-teacher ratio in the school	10.30	14.67	11.52	15.09	13.06	19.77
Science teachers with a university degree (**ISCED level 5A**) **and a major in science in schools attended by 15-year-old students** (%)	86.6	93.2	N/A	88.6	73.8	87.0
Teachers attended a programme of professional development in the previous three months (%)	51.6	80.6	34.8	69.1	50.9	73.0
Mean index of school autonomy (**percentage of tasks for which the schools have considerable responsibility**)	74.7	91.5	73.3	66.3	71.3	90.0
Coverage of the national 15-year-old population in PISA (**2015**)	0.97	0.84	0.95	0.92	N/A	0.71
Student performance in science (**mean score**)	531	509	538	516	493	421
Indicator	**Finland**	**United Kingdom**	**Japan**	**Korea**	**OECD average**	**Thailand**
Average trend in science performance (**score-point change per three-year period between 2006 or later and 2015**)	-11	-1	3	-2	-1	2
Student performance in maths (**mean score**)	511	492	532	524	490	415
Top performers in reading (**percentage of students scoring at Level 5 or 6**)	13.7	9.2	10.8	12.7	8.4	0.3
Low performers in collaborative problem solving (**percentage of students scoring below Level 2**)	18.1	22.4	10.1	12.9	28.1	54.1

Relative performance in collaborative problem solving after accounting for performance in science, reading and mathematics (difference between observed and expected performance, in score points)	7	12	23	20	3	2
Average time per week spent learning in regular lessons, in hours	24.2	26.5	27.5	30.3	26.9	31.8
Students who expect to complete a university degree (%)	27.1	41.8	58.7	75.3	44.2	68.9
Disadvantaged students being enrolled in a vocational track (%)	0.0	0.7	38.6	27.8	19.6	21.4
Students who fall in the bottom 20% of international economic, social and cultural status index (ESCS) (%)	2.1	4.6	7.9	6.5	12.1	55.1
Students who fall in top 20% of the international economic, social and cultural status index (ESCS) (%)	32.7	34.6	11.4	9.5	27.2	7.9
Low performers in science among disadvantaged students (in the bottom quarter of the economic, social and cultural status index (ESCS) (%)	19.7	25.7	17.2	23.2	34.0	56.2

Indicator	Finland	United Kingdom	Japan	Korea	OECD average	**Thailand**
Top performers in science among disadvantaged students (in the bottom quarter of the economic, social and cultural status index (ESCS) (%)	6.8	4.4	5.9	4.6	2.5	0.1
Low performers in science among advantaged students (in the top quarter of the economic, social and cultural status index (ESCS) (%)	4.5	7.2	3.4	7.0	9.3	28.4
Top performers in science among advantaged students (in the top quarter of the economic, social and cultural status	25.4	22.1	25.7	20.2	15.8	1.5

index (ESCS) (%)						
Increased likelihood of disadvantaged students (in the bottom quarter of ESCS) scoring below Level 2 in science, relative to non-disadvantaged students (3 other quarters of ESCS)	2.61	2.17	2.89	2.38	2.78	1.70

Source: OECD (2016), PISA 2015 Results (Volume II): Policies and Practices for Successful Schools, PISA, OECD Publishing, Paris http://dx.doi.org/10.1787/97/89264267510-en

The above mentioned education figure has to be qualified with transparent allocation process with monitoring of duplication of students numbers in each school. There may be a duplication of student's number record in the registration of 117,431 persons in the Basic Education System in Thailand as of 2017.

Furthermore, the NESDB[8] has reflected the concern of the government on human quality improvement with education investment. That is the cabinet cautious on the *mismatching* of investment in education discipline which does not being required by the labor market.

3. Forecast Number of Students and Social Infrastructure Needs

In order to project the number of social infrastructures needed by Thai education system over time, we firstly assumed parameters as shown below. The assumptions are based on the data which available in the past. The methodology can be either apply the past record with some foresting value by any model[9] to project future parameters and applying to project the future value of required variables *pro rata.* Alternatively, we can set own scenarios for future parameterization. The latter can be based on the assumption which the modeler treats what would be 'Policy parameters'. The 'normative assumption' vs. a 'positive assumptions' may be different but should be explainable to the reader.

[8] NESDB note no.1111/054 January 2018.

[9] This is, for example, the ARIMA model, or other simple trend models which is available from any standard software such as Eviews.

In this chapter, we intentionally apply the 'positive assumption' or the constant of parameterization process from past period as our hypothetical assumption in our forecasting. This is to see how heuristic the result would be soundly obtained. This can be named as a 'Baseline forecasting Path' for our purpose. Given, the unit cost we may be able to identify the cost of investment in education in our study. This is consistent with the 'microeconomic approach by JICA'. Here, we treated the overall *pro rata* projection where the maintenance and replacement investment is inclusive in the projection.

Table 4.6: Data sources for projection

Data	Sources	Unit
Demographic Projection	NESDB; 2013 Thailand population projection	Thousands of people
Schooling age interval	Office of Basic Education Commission, Ministry of Education	-
Enrollment rate	Office of the Permanent Secretary Ministry of Education; 2015 School enrollment rate	%
The proportion of upper secondary student	Ministry of Education	%
Student/teacher ratios	• For primary and secondary school; Ministry of Education, Ministry of Public Health, Queensland Independent School, Silpakorn University • For undergraduate level; Office of the Higher Education Commission: OHEC.	Ratio

Table 4.7: Number of Students and schools by Level of Education

	Education Year				
	2011	**2012**	**2013**	**2014**	**2015**
Number of Schools	**31,255**	**31,116**	**31,021**	**30,922**	**30,816**
Main Schools	30,945	30,832	30,753	30,667	30,537
Subsidiaries	310	284	268	255	279
No. of Schools By Level					

Primary	21,693	21,436	21,293	21,167	21,300
Lower Secondary	6,994	6,974	6,988	6,974	6,965
Upper Secondary	2,517	2,548	2,544	2,544	2,551
No. of Students (persons)	**7,608,543**	**7,397,961**	**7,243,713**	**7,114,804**	**6,980,871**
Pre-Primary	1,010,700	980,825	921,489	900,666	890,328
No. Student-Room ratio	1.16	1.16	1.16	1.16	1.15
Primary	3,461,367	3,386,853	3,329,922	3,291,578	3,244,395
No. Student-Room ratio	1.17	1.17	1.17	1.17	1.17
Lower Secondary	2,036,863	1,901,340	1,829,744	1,789,585	1,767,833
No. Student-Room ratio	1.32	1.31	1.31	1.31	1.30
Upper Secondary	1,099,613	1,128,943	1,162,558	1,132,975	1,078,315
No. Student-Room ratio	1.36	1.36	1.36	1.36	1.34
No. Student-Room ratio	1.21	1.21	1.21	1.21	1.21
Total No. of Class rooms	**355,229**	**353,944**	**346,302**	**346,342**	**344,699**

Source: Ministry of Education

Table 4.8: Classroom Size Distribution

School Size	**Student per room**	**No. of Schools**
Size no.1	Less than 20 persons	1,059
	21 - 40	2,488
	41 - 60	3,388
	61 - 80	3,515
	81 - 100	2,768
	101 - 120	2,359
Sub Total		**15,577**
Size no.1	121 - 200	6,791
Size no. 3	201 - 300	3,547
Size no. 4	301 - 499	2,310
Size no. 5	500 - 1,499	1,899
Size no. 6	1,500 - 2,499	390

Size no. 7	more than 2,500	302
All		**30,816**

The forecasted number of students is used as a basis for an approximation of the number of teachers and school personnel needed and school facilities. Furthermore, a requirement of school facility between areas is differently distributed; we, therefore, apply a standard ratio provided by Ministry of Education. The required space on school facility is determined by the forecasted number of students and teachers.

Table 4.9: The assumption on student-teacher ratio

Education level	Number of students (per 1 teacher)
Primary school	25
Secondary	20
Vocational school (Classroom)	30
Vocational school (Operation labs)	15

For undergraduate level, we have applied the requirement ratio of college professors according to majors and professions. We have estimated the proportion of college students in each major by using the survey from OHEC[10] in 2016.

The parameters mentioned above will be used as starting value for needs project in this study. Together with these parameters, we will use also the cost per square meter of school building and facilities construction announced by the Ministry of Education as our benchmark as well. (See Tabel 4.11 below).

Table 4.10: The Student – Professor Requirement Ratio of college students as classified by major

Major	Proportion, %	Number of students (per 1 professor)
General Programme	1.22	18

[10] Office of the Higher Education Commission

Education	4.54	15
Humanities and Arts	8.85	25
Social Sciences, Business, and Law	42.54	25
Science, Mathematics, and Computing	12.41	20
Engineering, Manufacturing, and Construction	13.13	20
Agriculture and Veterinary	3.18	20
Health and Welfare	6.76	8
Services	4.33	25
Others	3.01	18

Source: Office of Higher Education, Thailand

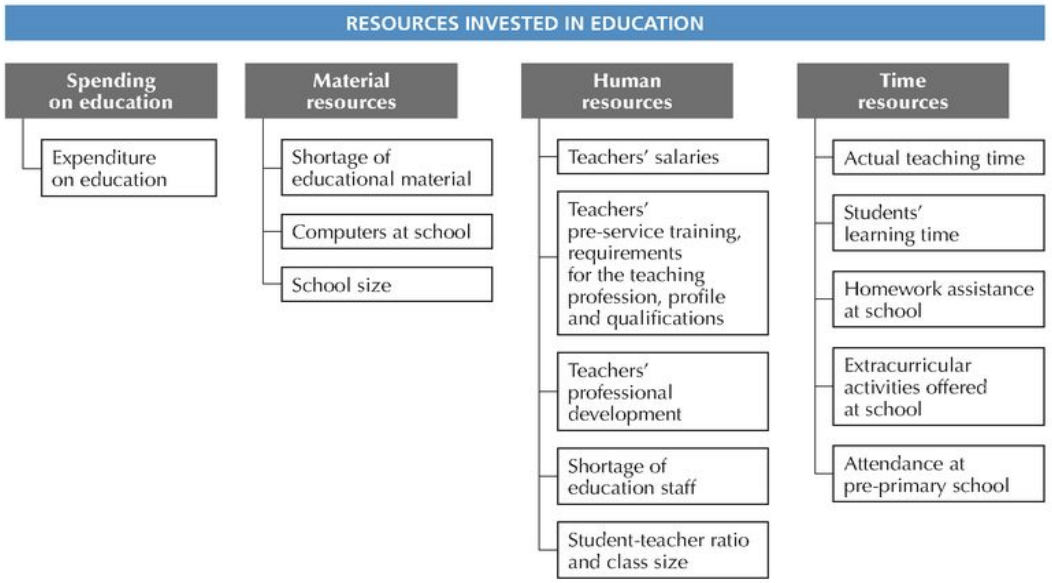
Applying ratio of teacher/student ratio for each major to calculate the number of college professors required we estimate *required school facility space* accordingly. We'll follow the Ministry of Education's standard for educational space demand and Ministry of Public Health's standard for the least space required for the school facility. Finally, we estimate the amount of space required for the school facility. The projection of budget for education section as a basis for the cost of the social infrastructure facility needed following the official guideline. As a result of declining fertilities, numbers of students at every educational level are expected to decline as well. This implies that the number of school personnel and total physical space needed will be declining.

However, as Thailand has had her PISA score and ranking much below an average of OECD. Thailand would not be able to build learning society with the '21st Century's skills' even though she would dream of in decades to come. Thus, to increase Thai's human skills we, therefore, need to invest in social investment other than just buildings, and hard infrastructure but also on soft infrastructure as well as social ones. Thailand has limited resources to be allocated to so many social programs every budget year.

Thus, we would like to propose a social infrastructure investment programme where physical buildings and laboratory would be maintained for minimum requirement but we would rather invest more in soft infrastructure like knowledge creation path. We mean the big data and information system of knowledge accessibility; invest in human knowledge in schools and university, a concentration of science and mathematical base of our student's achievement by PISA's recommendation. The more equitable allocation of educational resources throughout across income classes is necessary.

The OECD report (cf. PISA 2015) has emphasized the 4-dimension of social investment resources needed in education namely: spending on education or expenditure on education; material resource shown by shortage of educational materials, computer at schools, and school size; human resource investment needs showing by teachers' salaries, pre-services training's requirement for teaching profession profile and qualifications, teachers' professional development, shortage of educational staffs, students-teacher ratios and class size; and time resources which is actual teaching time, students' learning time, homework assistant at school, extracurricular activities offered at schools, and attendance at pre-primary school respectively.

Figure 4.5: Resources Need for Social Investment in Education



Source: OECD (2016), PISA 2015 Results (Volume II): Policies and Practices for Successful Schools, PISA, OECD Publishing, Paris
http://dx.doi.org/10.1787/97/89264267510-en

In our study, we have only projected the human resource needs, as well as physical space, needs *pro rata*. It is just part of the whole story. Our projection has

shown the declining needs for human resources in an undergraduate level of education requires some qualifications. As the number of population in schools decline, the intake to undergraduate or university level will be declining as well.

However, it would also imply that the physical number of instructor or human headcount would be *replaced* by the *soft infrastructure* on skills formation, management, information, and science and engineering facilities at the right faculty. The bid data accessibility would be tools to help for those deep learning of philosophy, geography, history, the spatial dimension of large database and software on maps and search engines etc.

As the world would come close to each other, the communication via media with multi-languages would require high-level software, thus, learning ability towards '21st Century Skills' can be improved among the Thais. This can raise understanding of own society, culture, history, and the world at large as its citizens.

Hereafter, we would try to estimate the social infrastructure needs in the schooling system. For basic education, lower secondary education (general stream), most of the facilities are more or less similar. They comprise main learning building, office building for general operation, and other facilities in schools. The official regulation of standard types, construction format, as well as fair price is sampling and shown below.

In order to be simple in estimation, we calibrate construction cost per square meter of the schooling system. These are *office building* for operation, *learning building,* and *facilities.* The cost is inclusive of related facilities and types of equipment. Thus, it is a lump sum unit value of school infrastructure investment.

The office building for operation is approximately 8,113.94 baht per square meter, 7,222.85 baht per square meter for learning building, and 8,146.56 baht per square meter for facilities construction. We use this unit value to estimate the cost of investment in constructions.

It should be noted here that the physical space need above means new buildings would be also needed as well. More importantly, some of the old buildings have to be dismantled as it has reached its assets' lifetime while some other buildings have to be rebuilt and maintenance for further use until the end of its lifetime of asset.

Table 4.11: Standard Designated Construction Building and Facilities for Schooling System

A. Office Bldg			
Types	Floor Area (sq. Meters)	Baht per (sq. Meters)	Imputed Bldg Value (Baht)
Type11	2,939.00	7,287.72	21,418,600
Type12	2,465.00	7,500.20	18,488,000
Type13	2,670.00	7,541.20	20,135,000
Type14	987.00	10,126.65	9,995,000
Average	2,265.25	8,113.94	17,509,150.00

Note: Type1 comprises concrete office building with air condition and/or fans , toilets, meeting rooms etc.

Table 4.11: Standard Designated Construction Building and Facilities for Schooling System (continued)

B. Learning Bldg			
Types	Floor Area (sq. Meters)	Baht per (sq. Meters)	Imputed Bldg Value (Baht)
Type21	324.00	7,030.86	2,278,000
Type22	229.50	7,124.18	1,635,000
Type23	306.00	7,019.61	2,148,000
Type24	382.00	7,023.56	2,683,000
Type25	459.00	7,104.58	3,261,000
Type26	230.00	8,139.13	1,872,000
Type27	306.00	8,437.91	2,582,000
Type28	244.00	8,303.28	2,026,000
Type29	320.00	8,518.75	2,726,000
Type210	630.00	6,473.02	4,078,000
Type211	783.00	6,398.47	5,010,000
Type212	936.00	6,279.91	5,878,000
Type213	635.00	10,992.13	6,980,000
Type214	791.00	10,418.46	8,241,000
Type215	630.00	6,914.29	4,356,000
Type216	630.00	7,163.49	4,513,000
Type217	630.00	7,390.48	4,656,000

Type218	630.00	7,668.25	4,831,000
Type 219	783.00	7,300.13	5,716,000
Type220	936.00	7,160.26	6,702,000
Type221	162.00	2,981.48	483,000
Type222	902.40	6,981.38	6,300,000
Type226	1,353.40	6,873.80	9,303,000
Type227	1,579.20	6,857.90	10,830,000
Type228	1,052.80	7,284.38	7,669,000
Type229	1,504.00	6,668.88	10,030,000
Type230	1,804.80	6,625.11	11,957,000
Type231	2,105.60	6,672.21	14,049,000
Type232	384.00	5,864.58	2,252,000
Type233	1,338.00	5,627.06	7,529,000
Type234	2,088.00	8,381.70	17,501,000
Type237	3,596.00	7,451.89	26,797,000
Average	896.40	7,222.85	6,464,750.00

Note: Type2 comprises concrete office building with lighting, blackboard, tables and chairs, fire extinguish tube, board, shelfs and cabinet for books etc.,

Table 4.11: Standard Designated Construction Building and Facilities for Schooling System (continued)

C. School Facilities			
Types	Floor Area (sq. Meters)	Baht per (sq. Meters)	Imputed Bldg Value (Baht)
Type31	200.00	5,270.00	1,054,000
Type38	532.00	5,562.03	2,959,000
Type311	1,840.00	6,838.04	12,582,000
Type313	796.00	6,925.88	5,513,000
Type315	77.00	7,585.71	584,100
Type319	507.00	9,124.26	4,626,000
Type324	17.50	15,720.00	275,100
Average	567.07	8,146.56	3,941,885.71

Note: Type3 comprises concrete office canteen, toilets, training rooms, lodging for teachers and for students, dormitory with facilities, sport and playground, water tanks, fences etc.

Source: Ministry of Education, Thai Government

Table 4.13: Hypothetical Physical Space Required by Basic and Vocational Education (Square Meters)

Year	Primary Education (sq. Meters)	Lower Secondary (sq. Meters)	Upper Secondary Vocational Stream (sq. Meters)	Upper Secondary General Stream (sq. Meters)
2016	48,851,854	33,062,109	6,415,682	18,193,782
2017	48,099,776	32,477,224	6,499,717	17,947,024
2018	47,345,749	31,907,832	6,576,414	17,735,247
2019	46,747,964	31,383,091	6,652,061	17,531,245
2020	46,252,969	30,818,899	6,726,308	17,335,569
2021	45,808,711	30,330,889	6,903,010	16,880,158
2022	45,350,480	29,935,273	7,020,822	16,592,070
2023	44,933,224	29,593,521	7,142,549	16,304,397
2024	44,572,736	29,304,430	7,273,798	16,004,793
2025	44,266,449	29,064,720	7,421,938	15,678,836
2026	43,784,312	28,784,305	7,520,966	15,469,639
2027	43,280,171	28,517,124	7,594,739	15,317,897
2028	42,756,582	28,256,018	7,652,355	15,201,690
2029	42,207,654	28,000,363	7,691,214	15,124,495
2030	41,625,217	27,753,771	7,705,040	15,097,307
2031	41,004,283	27,422,956	7,766,836	14,976,224
2032	40,376,791	27,086,914	7,834,742	14,845,285
2033	39,741,058	26,740,876	7,911,880	14,699,125
2034	39,095,542	26,381,314	7,999,496	14,536,346
2035	38,439,874	26,005,036	8,098,959	14,355,606
2036	37,774,333	25,609,713	8,211,894	14,155,426
2037	37,100,045	25,208,248	8,327,042	13,956,937
2038	36,418,759	24,799,596	8,445,964	13,757,613
2039	35,732,756	24,384,013	8,569,923	13,555,696
2040	35,044,823	23,962,662	8,700,233	13,349,574

Table 4.13: Hypothetical Cost and Saving of Investment in Physical Investment (Million Baht)

Year	Primary Education (Million Baht)	Lower Secondary (Million Baht)	Upper Secondary Vocational Stream (Million Baht)	Upper Secondary General Stream (Million Baht)
2016-2040	-99,726	-65,724	16,501	-34,989

The *pro rat*a estimated space required for basic education has shown declining needs, given the required space per person ratio. The change in space needs, if *positive* means incremental investment need if *negative* means cost saving in physical investment. This cost saving can be diverted to other educational facilities such as science lab, computer lab, big data, software, etc. for general education stream. For the vocational education, we still need to build new building inclusive of workshop facilities for training and each discipline. Using the average unit cost of construction of buildings cum facilities, we have found that it can be cost saving in investment if 're-allocation of budget' in basic education can be managed. We propose that schools can be managed in the same location. Schools assets and management can be consolidated for nearby location not beyond the assumed distance for feasible commuting of students. That is to say, in a selected location, the new school would be built with proper size and facilities which served for the 21st Century Skills. Thus, school assets would be kept to match with a number of declining students, and teachers, but more of technology and modern mode of educational types of equipment.

The foregoing analysis concentrates heavily on the physical capital development and related facilities. The social infrastructure investment has centered on physical capital. It is, however, necessary but not sufficient to lead Thailand to sustainable development target. In fact, the investment in human capital is a binding constraint for Thailand. This is pointed out by PISA that the material resource, spending on education, human resource, and time resource are four dimensions of the necessary resources in education development. Here, the human resource weights significantly in Thai social infrastructure. The time resources utilized by both students and teachers, instructors are not less important in Thailand. This would be future study.

4. Demand for Social Infrastructure: The General Public Services

4.1 Introduction

In this section, we would like to estimate the demand for social infrastructure to facilitate the service provision by the general government. The analysis is confined to the physical space needed central and regional government excluding the local government dimension. The Office of Civil Service Commission (OCSC) has started to formalize the modern civil service structure to turn from personal's Rank Classification in 1975 to be 'Position Classification, PC' in 2008. In other words, the single classification has been turned to a multi-classification scheme after evaluation of ability consistent with the private human resource market.

In this section, we would like to test the hypothesis that declining population growth, rising trend of human quality needs in Thailand, rising wage in the private sector has put a constraint to the Thai civil servant for the future intake and brain drain from the public sector to private sector in the labor market.

4.2 Brief Structure of Supply of Civil Servant System in Thailand

In 2013, there are 2.19 million persons (5.56% of total labor force and 3.38% of total population) who are private employees. In addition, 1.27 million persons or 58.09 percent are civil servants, permanent and temporary employees are 8.83 and 18.67 percent respectively. The rests are wage earners 14.41 percent respectively.

The civil servant of 2.17 million persons comprises educational instructors and related personnel of 34.36 percent and those belong to respective ministries of 28.86 percent (excluding those who belong prime minister office); police officers 16.57 percent; high education instructors and personnel 2.5 percent; parliament officers 0.24 percent; judicial related personnel of 0.62 percent; personnel from independent bureau under the constitution 1.35 percent; personnel under the BMR 2.84 percent and local autonomous government 12.66 percent respectively.

The distribution of civil servants 823,689 persons who belong to the central and regional government in 2013 was altogether 366,955 persons (44.5 %), while the rest belong to the local government respectively. It is noted that ministry of agriculture and agricultural cooperative has a number of personnel 16.89 percent, while the ministry of health has its personnel of 46.27 percent accordingly. This means most of government services deliveries to her citizens are located in the provincial area as well as localities.

However, as Thai population is aging while agricultural GDP is declining, it can be postulated that size of the civil servant of the ministry of agriculture would be declined as well. The social infrastructure for conducting health services will be on the contrary increased along with aging. But as we have shown in other chapters that health service will be covered by the universal health care service from the demand side other than the supply provided by the ministry of health, we can postulate that the number of health personnel under the ministry of health would be declining as well.

The health personnel demand may be shifted to local hospital and local sanitary centers, automated and long distance health consultation etc. In short, the number of personnel of central government would be reduced while it is not clear if the regional hospital would be privatized or belong to local government entities. In the meantime, regional and provincial health supply would still be dominance in Thailand. Thus, the modern hospital system would still be needed to be built with modern medical equipment and facilities.

The age distribution of civil servants are as follows: those with under 35 years old was 21.56 percent; while 50.57 percent has an age range of 35-49 year old, and 27.87 has aged over 50 years old respectively. The aging ministry which has its personnel with age over 50 years old is the ministry of agriculture 44.77 percent, the ministry of education 43.42 percent ministry of social development and human security 41.42 percent accordingly. The rest of ministries have their personals with age 35-49 and less than 35 years old. It is without a doubt that these ministries will have aging personnel concentration if no new recruitment of younger generations would not be considered in the next 10 years.

The education level of 1.27 million civil servants is noted as follows: university graduation 61.17 percent, master degree 16.38 percent and lower than undergraduate degree

19.53 percent and graduation with Ph.D. degree of only 2.92 percent respectively. It may be concluded that the civil servants are knowledge intensive system as far as background is counted. The OCSC is very conscious to grade up her civil servant knowledge content by further recruiting 7.52 percent of knowledge personnel while reducing the non-knowledge personnel.

4.3 Regression Analysis of the Inverse Supply Function of Public Service

We estimate the 'earning function' or the 'Inverse Supply function of public services personnel' given the following variables' definition:

```
SALARY =C(9) + C(1)*YSCHOOLING + C(2)*WYEAR + C(3)*POSITION_CLASSIFICATION +
         C(4)*(LOCAL_UNIVERSITY) + C(5)*DAY*LOCALTRAINING*TRAIN_WORKSHOP +
         C(6)*DAY*LOCALTRAINING*TRAIN_VISIT +
         C(7)*DAY*(1-LOCALTRAINING *TRAIN_WORKSHOP +
         C(8)*DAY*(1-LOCALTRAINING)*TRAIN_VISIT
```

YSCHOOLING	Year of schooling
WYEAR	Work experiences
LOCAL_UNIVERSITY	Dummy of university location)local =1)
DA	Length of human capital investment in days
LOCALTRAINING	Dummy of Local training site (local=1)
TRAIN_WORKSHOP	Training workshop
TRAIN_VISIT	Education trip

Figure 4.6: Profiles of Determinants of Human Capital Investment

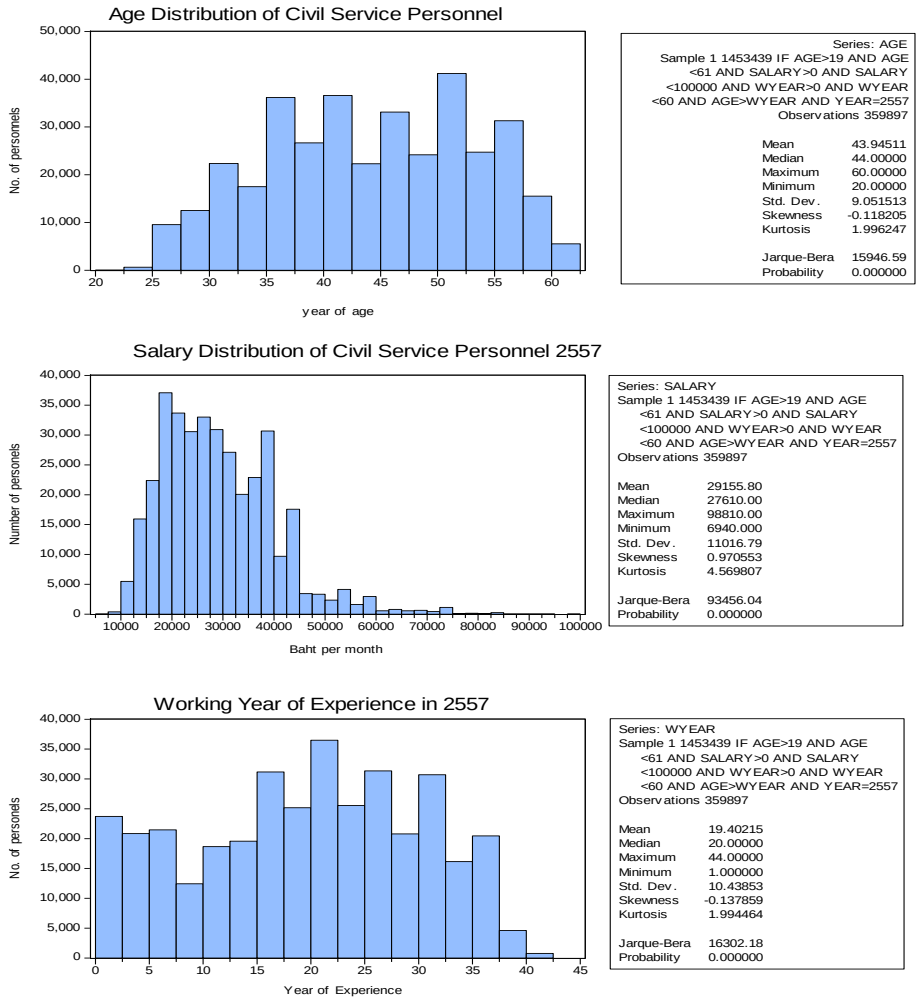


Table 4.14: Definition of Variables Used in the Model

Variables	Definition / Description	Units/Notes
SALARY	Salary of a civil servant as a proxy of return of human capital investment	Baht per month
POSITION_CLASSIFICATION	The position of civil servants as a proxy of human capital for t<= 60-year-old	Dummy with code level 12, 13, 14,
AGE	Age of civil servant	year
GENDERX; SEX	male and female gender of a civil servant	male =0 ; female = 1
YSCHOOLING	Years of schooling as a proxy for human capital investment	years, such as undergraduate level =16 years
WYEAR	working experiences	years of work

Table 4.15: Covariance Analysis

Sample: 1 1453439 Included observations: 1418266 Balanced sample (list wise missing value deletion)

Covariance	POSITION_CLASSIFICATION	AGE	SEX	SALARY	WYEAR	YSCHOOLING
POSITION_CLASSIFICATION	4.386101					
AGE	1.318343	78.46727				
SEX	0.029518	-0.636577	0.229785			
SALARY	7386.763	72511.62	-440.0400	1.23E+08		
WYEAR	1.952922	80.06679	-0.425744	85949.96	98.91415	
YSCHOOLING	1.177260	-0.963311	0.004361	3821.205	-1.270954	3.086011

Correlation	POSITION_CLASSIFICATION	AGE	SEX	SALARY	WYEAR	YSCHOOLING
POSITION_CLASSIFICATION	1.000000					
AGE	0.071063	1.000000				
SEX	0.029403	-0.149915	1.000000			
SALARY	0.318368	0.738886	-0.082860	1.000000		
WYEAR	0.093760	0.908822	-0.089301	0.780064	1.000000	
YSCHOOLING	0.319989	-0.061905	0.005178	0.196343	-0.072745	1.000000

SSCP	POSITION_CLASSIFICATION	AGE	SEX	SALARY	WYEAR	YSCHOOLING
POSITION_CLASSIFICATION	6220659.					
AGE	1869760.	1.11E+08				
SEX	41865.00	-902835.1	325896.9			
SALARY	1.05E+10	1.03E+11	-6.24E+08	1.74E+14		
WYEAR	2769763.	1.14E+08	-603817.9	1.22E+11	1.40E+08	
YSCHOOLING	1669668.	-1366232.	6184.613	5.42E+09	-1802550.	4376784.

t-Statistic	POSITION_CLASSIFICATION	AGE	SEX	SALARY	WYEAR	YSCHOOLING
POSITION_CLASSIFICATION	-----					
AGE	84.84428	-----				
SEX	35.03154	-180.5759	-----			
SALARY	399.9576	1305.886	-99.01921	-----		
WYEAR	112.1533	2594.361	-106.7763	1484.716	-----	
YSCHOOLING	402.2256	-73.86453	6.167074	238.4685	-86.86252	-----

Probability	POSITION_CLASSIFICATI	AGE	SEX	SALARY	WYEAR	YSCHOOLING

	ON					
POSITION_CLASSIFICATION	-----					
AGE	0.0000	-----				
SEX	0.0000	0.0000	-----			
SALARY	0.0000	0.0000	0.0000	-----		
WYEAR	0.0000	0.0000	0.0000	0.0000	-----	
YSCHOOLING	0.0000	0.0000	0.0000	0.0000	0.0000	-----

Note: Covariance= measure of dispersion; Correlation = measure of relations; Sum of squared crossed-product (SSCP); t-statistic measure of significance; Probability of rejection Null Hypothesis

Table 4.16: Model (1) Earning function or Inverse Supply function of Civil service Personnel (data use 2011-2014)

Dependent Variable: SALARY			
Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-17662.33	132.8148	0.0000
WYEAR	888.73	0.52517	0.0000
YSCHOOLING	1600.18	8.236445	0.0000
SEX	-420.81	10.98112	0.0000
Y2555	2676.26	14.6992	0.0000
Y2556	1753.66	14.71059	0.0000
Y2557	3757.17	14.69304	0.0000
ECON_MINISTRY	2779.81	162.9037	0.0000
SOC_MINISTRY	759.67	144.3563	0.0000
YSCHOOLING*ECON_MINISTRY	-159.43	10.19787	0.0000
YSCHOOLING*SOC_MINISTRY	4.13	9.035767	0.6472
R-squared	0.6895		
F-statistic	314904.10		
Prob (F-statistic)	0.000000		
Durbin-Watson stat	1.379399		

If Wyear (+) : experiences increase one year implies an increase of salary of 888.73 baht per month; YSCHOOLING (+) increases one year means salary increase 1,600.18 baht per month. Female civil servant received 420 baht per month less than male.

If he or she belongs to the ministries which administering economic development and growth 'ECON_MINISTRY' would obtain 2779.81 baht per month compared with 759.67 baht per month for social related ministries 'SOC_MINISTRY'.

Table 4.17: Model (2) Earning Function or Inverse Supply Function of Civil Service Personnel In 2557

Dependent Variable: SALARY
Method: Least Squares
Date: 08/19/15 Time: 12:53
Sample: 1 1453439 IF AGE>19 AND AGE<61 AND SALARY>0 AND SALARY<100000 AND WYEAR>0 AND WYEAR<60 AND AGE>WYEAR AND YEAR=2557
Included observations: 357434

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-25348.40	81.93187	-309.3839	0.0000
YSCHOOLING	438.1599	5.396000	81.20088	0.0000
WYEAR	765.6643	0.816798	937.3968	0.0000
POSITION_CLASSIFICATION	2088.559	4.772625	437.6122	0.0000
SEX	-667.3262	17.45822	-38.22419	0.0000

R-squared	0.798086	Mean dependent var	29177.26
Adjusted R-squared	0.798084	S.D. dependent var	11005.66
S.E. of regression	4945.401	Akaike info criterion	19.85032
Sum squared resid	8.74E+12	Schwarz criterion	19.85047
Log likelihood	-3547584.	Hannan-Quinn criter.	19.85036
F-statistic	353194.3	Durbin-Watson stat	1.830734
Prob(F-statistic)	0.000000		

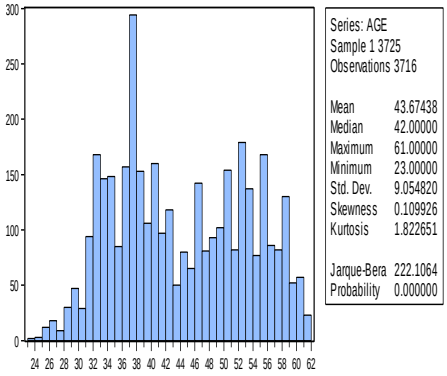
Table 4.18: Model (3) Elasticity at means of each variable (Standardized coefficients)

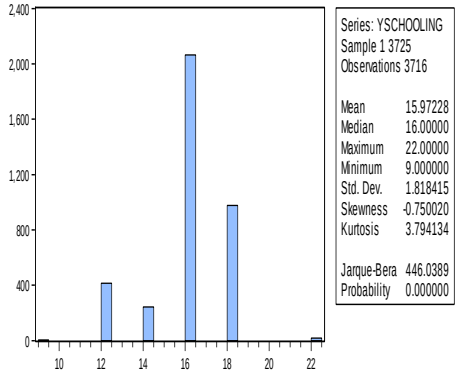
Scaled Coefficients
Date: 08/19/15 Time: 12:54
Sample: 1 1453439 IF AGE>19 AND AGE<61 AND SALARY>0 AND SALARY<100000 AND WYEAR>0 AND WYEAR<60 AND AGE>WYEAR AND YEAR=2557
Included observations: 357434

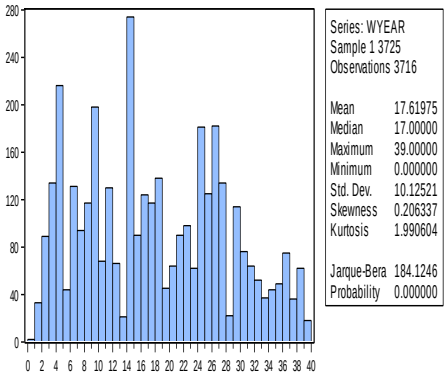
Variable	Coefficient	Standardized Coefficient	Elasticity at Means
C	-25348.40	NA	-0.868772
YSCHOOLING	438.1599	0.071625	0.239229
WYEAR	765.6643	0.725499	0.509361
POSITION_CLASSIFICATION	2088.559	0.390752	1.135041
SEX	-667.3262	-0.028928	-0.014858

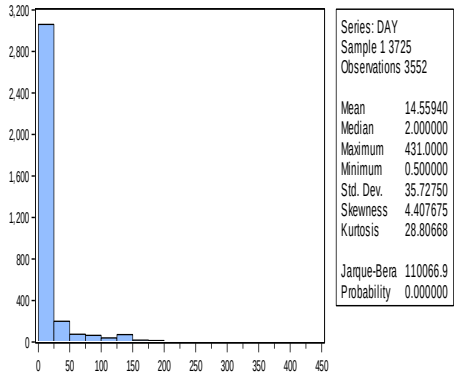
Notes: (1) standardized coefficients are point estimates of coefficients after adjusted by a standard deviation of the dependent variable.
(2) Elasticity at means is point estimates of dependent variable after scaled by mean or the regressor.

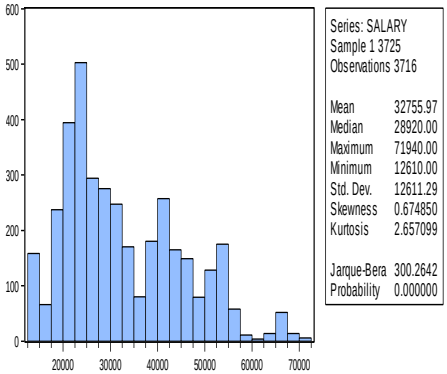
Figure 4.7: Age education Work Experiences and Salary of Civil Servant











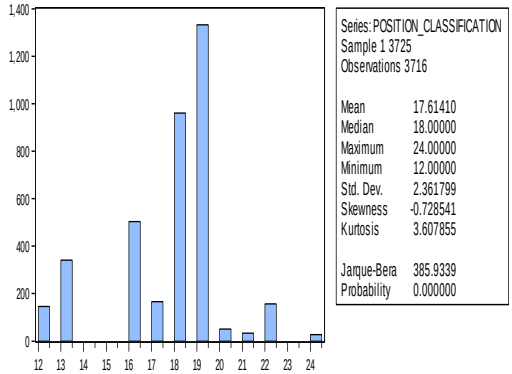


Figure 4.8: Binary Relationship between Variables of Civil Servants

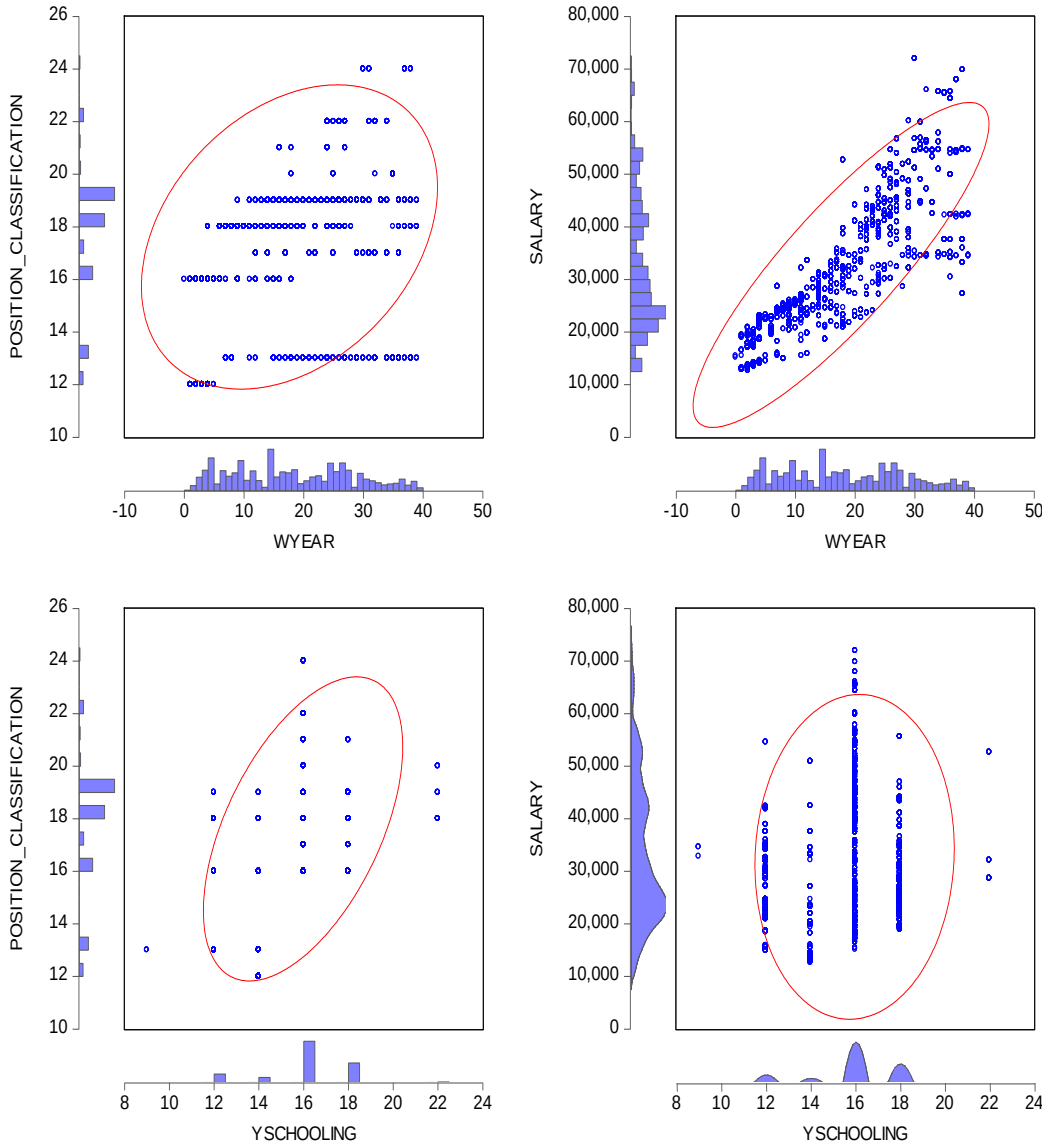


Table 4.19: Human Capital Investment

Origin of University ย				
Year of schooling		Foreign	Domestic	Total
	9	0	3	3
	12	0	414	414
	14	0	242	242
	16	205	1859	2064
	18	305	670	975
	22	18	0	18
	Total	528	3188	3716

Measures of Association: Phi Coefficient=0.360131; Cramer's V= 0.360131; Contingency Coefficient = 0.338829; Test Statistics: Pearson X2 with degree of freedom = 5, value =481.9441, Prob.=0.0; Likelihood Ratio G2 with degree of freedom=5, value = 490.3374, Prob.=0.0.

Table 4.19: Human Capital Investment (continued)

Type	Frequency	%	Accumulate	%
Training	3357	90.12	3357	90.12
Education Trip	54	1.45	3411	91.57
Seminar	273	7.33	3684	98.90
Meeting	41	1.10	3725	100.00
All	3725	100.00	3725	100.00

Table 4.19: Human Capital Investment (continued)

	Training	Education Trip	Seminar	Meeting	All
0.5	767	6	205	28	1,006
1.0	1	0	7	0	8
2.0	888	5	34	4	931
3.0	340	6	9	4	359
4.0	150	5	10	1	166
5.0	114	11	0	2	127
6.0	8	11	0	0	19
7.0	44	5	1	0	50
8.0	28	2	0	0	30
9.0	51	0	6	0	57
10.0	38	0	0	2	40
11.0	48	1	0	0	49
12.0	52	1	0	0	53
13.0	12	0	0	0	12
14.0	8	0	0	0	8
15.0	19	0	0	0	19
16.0	67	0	0	0	67
17.0	5	0	0	0	5
18.0	10	0	0	0	10
19.0	1	0	0	0	1
Total	2,651	53	272	41	3,017

Note: Phi Coefficient 507553.0;Cramer's V293036.0;Contingency Coefficient 452594.0;
Test Statistics (1) Pearson X 2with degree of freedom =57; value=2096.777; Prob.=0000.0,
(2) Likelihood Ratio G 2with degree of freedom =57; value =4120.462; Prob.=0000.0

Table 4.19: Human Capital Investment (continued)

	Destination		
	Foreign	Domestic	All
Training	56	3301	3,357
Education Trip	11	43	54
Seminar	3	270	273
Meeting	0	41	41
All	70	3,655	3,725

The civil servants have engaged in human capital investment on average 14.5 days with 84.94 percent, not over 20 days. The engagements are training, education trip, seminar, and meeting respectively. Mostly, the activities are in Thailand. We, therefore, estimate the model of human capital investment with training and other short-term

investment as follows:

Table 4.20: Result of Testing of hypothesis H0: C(i)= 0; i=1,2,3,….9

	Coefficient	Std. Error	t-Statistic	Prob.
constant	-25737.02	848.0579	-30.34818	0.0000
YSCHOOLING	1202.791	61.47796	19.56458	0.0000
WYEAR	1055.304	9.617122	109.7318	0.0000
POSITION_CLASSIFICATION	1166.349	46.70874	24.97069	0.0000
(LOCAL_UNIVERSITY)	-245.3998	225.6256	-1.087642	0.2768
DAY*LOCALTRAINING*TRAIN_WORKSHOP	19.03371	2.148968	8.857141	0.0000
DAY*LOCALTRAINING*TRAIN_VISIT	514.9100	135.9648	3.787082	0.0002
DAY*(1-LOCALTRAINING) *TRAIN_WORKSHOP	25.83331	11.11629	2.323915	0.0202
DAY*(1-LOCALTRAINING)*TRAIN_VISIT	257.4321	125.2429	2.055463	0.0399
R-squared	0.875338	Mean dependent var		33030.34
Adjusted R-squared	0.875056	S.D. dependent var		12605.60
S.E. of regression	4455.748	Akaike info criterion		19.64431
Sum squared resid	7.02E+10	Schwarz criterion		19.65999
Log likelihood	-34790.90	Hannan-Quinn criter.		19.64991
F-statistic	3101.845	Durbin-Watson stat		0.300965
Prob(F-statistic)	0.000000			

It is found that human capital investment either long-term such as years of schooling, experiences of work, a position of work have a positive relationship with salary to identify the inverse supply function of civil servants services. Interestingly, that who have graduated from local university has a negative relationship with salary (left-hand variable representing the marginal productivity of supply response to right-hand variables). This may imply that the return to human capital investment is rationally valued since the cost of investment is higher abroad.

In conclusion, the regression analysis points out clearly that the supply of public services by civil servants as shown by the 'inverse supply function of a civil servant as a function of right-hand variables'. The left-hand variable 'salary' represents the marginal productivity of civil servant. It is an index of return to human capital investment by various determents on the right-hand sides. In other words, the supply function is 'normal' and passes the test of a return to human capital investment.

As population aging will be in effect in near future for the next 10-20 years. This means that private sector would offer a higher wage to the workforce. As a result, there may be a brain drain from the civil servant workforce to the private sector. Thus, the planning strategy for Thailand on the social infrastructure demand is rather opposite to what we have firstly postulated. Thailand in the next decade would rather need the human capital investment facilities as well as the investment in the human knowledge itself. This is to meet the challenges of Skill of the 21st Century.

The planning target is therefore to reduce the number of public services personnel both civil servants and others. On the contrary, it is necessary to raise the quality of human

capability through the knowledge base investment process. Thus, on

We have applied our macro-econometric model to perform forecasting scenarios of aggregate demand components as follows:

Table 4.21: Macroeconomic Forecast 2015-2020

	2015	2016	2017	2018	2019	2020
GDPR (Baseline)	11,342,828	11,563,480	11,810,901	12,089,282	12,407,79	12,780,
(% chg.)	1.68	1.95	2.14	2.36	2.63	3
PCER (Baseline)	6,056,269	6,155,578	6,266,665	6,391,384	6,533,77	6,699,
(% chg.)	1.41	1.64	1.8	1.99	2.23	2.54
GFCFR	2,922,714	2,963,227	3,005,145	3,050,948	3,102,49	3,161,
(% chg.)	1.5	1.4	1.4	1.5	1.7	1.9
EXGSR	8,296,806	8,332,258	8,462,491	8,596,210	8,736,01	8,882,
(% chg.)	0.3	0.4	1.6	1.6	1.6	1.7
IMGSR	7,614,825	7,646,676	7,833,444	8,124,511	8,387,11	8,634,
(% chg.)	-0.7	0.4	2.4	3.7	3.2	2.9

Source: This is the Quarterly Macro econometric Model for Thailand constructed in our study.

4.4 Estimate the Demand for Social Infrastructure: Public Services Space

We use the macro model to project the employment demand 2015-2020 of the public sector services (inclusive of the defense and social security, as noted in the database of Labor Force Survey). The projected 'office space requirement' is estimated by multiplying the projected public services personnel with 'office space ratio per one officer'. The parameter assumes that each officer will require a 'cubicle space' of *80 usable square feet* (USF) following the U.S. General Services Administration. It is however proposed to be 12-14 square meters per person for business space[11].

Table 4.22: Data sources for the calculation

Data	Source	Unit
Demographic Projection	NESDB; 2013 Thailand population projection	Thousands of people
Thai Government Agency Information 2009, civil servants	Electronic Government Agency (Public Organization)	Thousands of people
Required space for officers (1)	U.S. General Services Administration = 80 USF	Usable Square Feet per person
Required space for officers (2)	http://www.realcommercial.com.au	12-14 square meter per person

[11] http://www.realcommercial.com.au

cost of construction investment	this study	8,113.94 baht per sq. meter

The office space needed for the public services in the scenarios has declined as expected. Here, the rationalization of public employees (both civil servant and defense services personnel) would give rise to the reduced office space as shown below. The cost reduction of construction investment in a government building does not mean there will be no new construction of buildings and their modern facilities. In opposite, it means the manpower reduction either by mandatory or by market forces may give rise to the reduction either way. The civil servant personals

Table 4.23: The Scenario of Public Employment Reduction and Cost Saving of Public Need of Social Infrastructure

employment in Public Admin (1,000 persons)	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
(Baseline)	1,8	1,848.	1,899.8	1,955	2,018.2	2,087.6
(Year % change.)	2.6	2.6	2.8	3	3.2	3.4
(Scenario)	1,777	1,757	1,721	1,676	1,627	1,577
(Year % change)	1.2	-1.1	-2.1	-2.6	-2.9	-3.1
Office space requirement, sq. Meter.	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
(1) Baseline in 1,000 sq. Meter	25,222	25,883	26,597	27,383	28,255	29,226
(2) Scenario in 1,000 sq.Meter	24,878	24,598	24,094	23,464	22,778	22,078
Construction *cost saving* million baht	2,794.44	10,428.04	20,310.81	31,795.29	44,438.43	58,001.69

Note: construction *cost saving* = base line office space need (1) minus the scenarios (2)

5. Conclusion and Policy Recommendations

The foregoing analysis has implied for policy formulation in the social infrastructure demand to facilitate the education and public services as follows;

(1) The education system in Thailand when benchmarking with an international standard like PISA has shown that Thailand was far behind the target of development towards the 21st Century Skills.

(2) The demand for social infrastructure has two dimensions which are modern infrastructures as necessary and human capability investment sufficient condition for a new era of economic and social development in Thailand. The current global trend has shifted social investment in human capability and skills as a necessary condition rather than the sufficient condition as mentioned. The analysis has proved that shifting priority has produced

a 'cost saving' in building investment. This can help further investment in social infrastructure. The analysis of public services is similarly assessed and arrives at the same conclusion.

(3) The present budgetary system which heavily concentrates on current expenditure, not the capital investment is not consistent with this new vision. The policy implication of this is how to redesign the budgetary system in Thailand. This is current budgetary allocation, as well as the long-term investment from financial market both domestic and world financial market. If the debt-service ratio has been proved to provide sustainable economic and social development in the long-run.

Appendix Table A1: Number Of Institutions (The Formal School System) By Jurisdiction In Whole Kingdom: Academic Year 2006-2014

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total	**38,318**	**38,527**	**38,455**	**38,347**	**38,376**	**38,383**	**38,455**	**38,010**	**38,069**
Ministry of Education	**36,650**	**36,712**	**36,288**	**36,039**	**36,016**	**35,960**	**36,026**	**35,595**	**35,446**
1. Office of the Permanent Secretary	**3,798**	**3,899**	**3,915**	**3,968**	**4,025**	**4,107**	**4,167**	**4,001**	**3,951**
(Office of the Private Education Commission[1/])									
1.1 Private General Education Schools	3,306	3,371	3,367	3,401	3,450	3,679	3,709	3,543	3,506
1.1.1 General Education	3,040	3,086	3,079	3,111	3,450	3,162	3,185	3,032	
1.1.2 Islamic Teaching and General Education	266	285	288	290		517	524	511	
1.2 Private Vocational Education Schools	411	417	424	418	421	428	458	458	445
1.3 Private Special Education Schools	15	15	16	19	20	-	-	-	-
1.4 Private Welfare Education Schools	73	96	118	130	134	-	-	-	-
(General Education and Vocational Education)									
2. Office of the Basic Education Commission	**32,288**	**32,262**	**31,821**	**31,508**	**31,424**	**31,286**	**31,286**	**31,021**	**30,922**
2.1 General Education	32,200	32,169	31,728	31,415	31,331	31,193	31,193	30,927	30,828
2.2 Special Education	43	43	43	43	50	43	43	51	51
2.3 Welfare Education	45	50	50	50	43	50	50	43	43
3. Office of Vocation Education Commission	**404**	**404**	**404**	**415**	**415**	**415**	**421**	**421**	**421**
3.1 Technical Colleges	109	109	109	109	110	110	114	120	120
3.2 Industrial & Community Colleges	144	144	144	144	142	142	142	137	137

3.3 Business Administration & Tourism Colleges	3	3	3	3	3	3	3	3	3
3.4 Commercial Colleges	5	5	5	5	5	5	5	5	5
3.5 Arts and Crafts Colleges	2	2	2	2	2	2	2	2	2
3.6 Polytechnic Colleges	54	54	54	53	53	53	52	52	52
3.7 Vocational Colleges	36	36	36	36	36	36	37	37	37
3.8 Technology and Management Colleges	-	-	-	11	11	11	13	12	12
3.9 Agricultural and Technology Colleges	43	43	43	43	43	43	43	43	43
3.10 Golden Jubilee Royal Goldsmith College	1	1	1	1	1	1	1	1	1
3.11 Industrial and Ship Building Colleges	3	3	3	3	3	3	3	3	3
3.12 Fishery Colleges	3	3	3	4	4	4	4	4	4
3.13 Agricultural Engineering Training Centers	1	1	1	1	1	1	1		
Vocational Education College								1	1
3.14 Science Based Technology Vocational College	-	-	-	-	1	1	1	1	1
4. Office of the Higher Education Commission	**159**	**146**	**147**	**147**	**151**	**151**	**151**	**151**	**151**
4.1 Demonstration Schools [2/]	(41)	(52)	(60)	(60)	(60)	(57)	(57)	(57)	(57)
4.2 Community College [3/]	18	1 (18)	1 (19)	1 (18)	1 (20)	1 (20)	1 (19)	1(19)	1(19)
4.3 Institutions of Higher Education	141	145	146	146	150	150	150	150	150
4.3.1 Public Institutions of Higher Education	78	78	78	78	79	79	79	79	79
4.3.2 Private Institutions of Higher Education	63	67	68	68	71	71	71	71	71
Organizations under the supervision of the Ministry of Education :	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
5. Mahidol Wittayanusorn School									

	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Other Organizations	**1,668**	**1,815**	**2,167**	**2,308**	**2,360**	**2,423**	**2,429**	**2,415**	**2,623**
6. Ministry of Interior	**546**	**691**	**1,046**	**1,187**	**1,225**	**1,290**	**1,292**	**1,292**	**1,481**
7. Ministry of Social Development and Human Security :	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
8. Bangkok Metropolitan Administration :	**437**	**437**	**437**	**437**	**437**	**438**	**438**	**438**	**440**
8.1 Department of Education	435	435	435	435	435	436	436	436	438
8.2 Department of Medical Services	2	2	2	2	2	-	-	-	-
8.2 Bangkok Metropolitan University	-	-	-	-	-	2	2	-	-
8.2 Navamindradhiraj University	-	-	-	-	-	-	-	2	2
9. Ministry of Public Health :	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**
Office of the Permanent Secretary :Praborommarajchanok Institute	37	37	37	37	37	37	37	37	37
10. Ministry of Transport	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
10.1 The Merchant Marine Training Centre	1	1	1	1	1	1	1	1	1
10.2 The Civil Aviation Training Centre	1	1	1	1	1	1	1	1	1
11. Ministry of Defense	**11**	**13**	**15**	**15**	**15**	**16**	**16**	**16**	**16**
12. Ministry of Culture	**16**	**16**	**16**	**16**	**19**	**16**	**16**	**16**	**16**
12.1 Bunditpatanasilpa Institute	1	1	1	1	2	1	1	1	1
12.2 Colleges of Dramatic Arts	12	12	12	12	12	12	12	12	12
12.3 Colleges of Fine Arts	3	3	3	3	5	3	3	3	3
13. Ministry of Tourisms and Sports	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**
13.1 Office of Sports and Recreation									

	28	28	28	28	28	28	28	28	28
13.1.1 Sport Schools	11	11	11	11	11	11	11	11	11
13.1.2 Physical Education Colleges	17	17	17	17	17	17	17	17	17
14. The Bureau of National Buddhism :	**396**	**396**	**399**	**400**	**410**	**414**	**414**	**405**	**403**
Scripture Schools for General Education	396	396	399	400	410	414	414	405	403
15. Organizations Under the Prime Minister	**192**	**192**	**184**	**183**	**184**	**179**	**183**	**178**	**197**
15.1 Royal Thai Police :	192	192	184	183	184	179	183	178	**197**
15.1.1 Border Patrol Police General Headquarters	191	191	183	182	183	178	182	177	196
15.1.2 Police Cadet Academy	1	1	1	1	1	1	1	1	1

1/ There is some redundant information with the number of schools that open for both general and vocational education

2/ The number of institutions under the office of the higher education commission not includes the number of demonstration schools because of the demonstration schools are considered the department of universities instead of the institutions

3/ The number of institutions under the office of the higher education commission

Note: Agricultural Engineering Training Centers the Name was Changed Vocational Education College (In the academic year 2013)

Source: Office of the Permanent Secretary, Ministry of Education