

Executive Summary

1. The Significance of the Study

The ADB in her publication on the “Infrastructure for a Seamless Asia” in 2009¹ has point out high investment demand for Asia’s economic infrastructure (power, water and sanitation, transport and telecommunication) from 2010 to 2020. The costs of hard and technical infrastructure for Asia are estimated to be 8 trillion USD approximately. Following the Sustainable Development Goals (SDGs) and updates on social and economic environment of the region, the ADB has extended the estimate for the period from 2016 to 2030. An updated figure on the demand for hard and technical infrastructure needs in a report “*Bridging the Gap: Infrastructure Needs in Asia*” in February 2017, has pointed large gap of infrastructure needs. It has provided strong policy recommendations as basis for financial needs for investment.

The purpose of our research is to estimate the investment demand of social infrastructure in Thailand up to 2030. This is to find appropriate research methodology on social infrastructure demand estimation and forecasting to be learned by other Asian countries.

The scope of research thus covers mainly the social infrastructure for education, and health system in Thailand. In addition, we would also estimate the demand for low income housing needs and affordability to serve for the long-term urbanization in Thailand. In our research, we have intension to add estimation on the demand for government facilities along side with the urbanization and decentralization in Thailand as well.

We have followed the guideline of JICA and ADB for the “micro” and “macro” approaches and adapting for Thailand’s economic and social context. For macro approach, we have learned from ADB, applying multiple regression models by Fay and Yepes² (2003). We have link the equation with human development’s hypothetical target noted by the UNDP (2016) for our macro approach

¹ ADB (2009), Seamless Asia, cited the methodology by Fay and Yepes “Investing in infrastructure: what is needed from 2000 to 2010?” World Bank Policy Research Working Paper 3102, July 2003
<http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-3102>

2. The Findings and Consolidation of Social Infrastructure Demand

2.1 Micro Approach on Social Investment Needs

2.1.1 Social Investment Needs in a schooling system

We have followed the guideline in micro approach as well as schooling space needed in basic education and vocational education in Thailand. We have found that the space requirement is projected to be 197.56 million square meters in 2020. The declining population and school intake in Thailand are foreseeable to have less demand for space. It would decline to 81.05 million square meters in 2040 respectively. This is very clear for a general stream of education except for the vocational education. The spacious laboratory, workshops, as well real-world situation of training on modern industrial machinery, mechanical cum electronic, applied electronics, powers, motors vehicles and etc. are very important to raise the labor productivity for the industry. More importantly, the pneumatics and robotics etc would be new to Thailand to make a serious investment. The rail system engineer and technicians are badly needed in Thailand for her drive to be center of communications and transportation of the CLMV and Thailand.

Table 1: 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

In such situation, we can conclude that the cost of construction investment in physical periphery i.e., buildings and facilities can be *reduced*. Instead, the construction investment for new building and facilities should be replaced by the modern building which serves for the grooming of skills for the 21st Century. The targets of educational achievement are not just credential but also to prepare proper human resource. The institutional arrangement, inequality of schools facilities and equipments, teacher's skills and abilities to deliver quality classrooms are needed. It can be financed from this cost

saving.

The consolidating source of funds is in consultation with the Treasury Department, Ministry of Finance. The Ministry of Finance would issue the long-term bond for an investment fund to cover the cost. Table 1 is the *cost saving* estimate, if the consolidation of the public asset is assumed i.e., a negative investment while vocational education would still need the new investment of 16,501 million baht in modernizing school systems.

2.1.2 Social Investment Needs in Public Services

We have tested the hypothesis of the human capital mode of the declining civil servants workforce under the trend of aging population. We foresee the declining need of space for working and conducting services for the people at large. Table 2, depicts the scenario of declining needs for space in the face of declining employment in the public administration in general. We further project the office space requirement for service tasking. It is found that the magnitude of space needed is 22.078 in 2020; 23.203 and 24.388 million square meters by end of 2025 and 2030.

This implies that we would have a cost saving of 58.00 billion baht owing to declining civil servants and public personnel in 2020. We, however, would need to invest in office space of 9.135 billion and 1.401 billion baht that would be needed in excess of previous periods as shown below.

For example, the excess of physical need can be assimilated into other type of social infrastructure such as modern office IT and improving the consolidated system of ‘Big Data’ on human resources and assets of the government bureaus and the comptroller auditing system in disbursement.

Table 2: The Scenario of Public Employment Reduction and Cost Saving of Public Need of Social Infrastructure

Scenario	At end of 2020	At end of 2025	At end of 2030
employment in Public Admin 1,000 persons	1,577 reduced from a baseline of 2,087	1,657	1,742
(Year % change.)	-3.1	1.0	1.0

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Office space requirement, (1,000) sq. Meter.	22,078	23,204 or + 1,126 from 2020	24,388 or + 1,184 from 2025
Construction investment needed in million baht	-58,001.69 (negative sign is <i>cost saving</i>) <i>owing to</i> <i>reduction in</i>	valuation at 8,113 baht per sq. meter = + 9,135 million baht of investment cost	valuation at 8,113 baht per sq. meter = +1,401 million baht of investment cost

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

2.1.3 Social Investment Needs in Urban Low Income Housing

The excess demand for a house in the urban area (95 percent of total excess demand) during 2020-2037 amounts to 2,157.07 thousand units. With the assumption of poor households shares 30 percent of the demand (based on our model forecast), the low-income housing need would be 647.121 thousand units over the mentioned period. In other words, excess demand for low-income housing is 38,065.94 units per year on average. It is an extension of the NHA's long-term plan for low-income housing during 2019 which is 44,000 units. Assuming low-income townhouse price of 600,000 baht a unit we would require an investment cost of 22,839.56 million baht per year.

Table 3: Total Households, Housing Inventory and Housing Start 2009-2037

	2020	2025	2030	2035	2037
Total household (1,000 units)	22,535	23,599	23,603	23,882	23,991
1. Intact household share	100.03%	103.90%	90.28%	74.96%	70.10%
2. one person household share	23.60%	25.56%	34.09%	42.25%	45.04%
3. single head household share	39.06%	40.90%	46.02%	55.19%	58.04%
4. others household share	0.06%	0.06%	0.06%	0.06%	0.06%
Urban household (1,000 units)	8,648	9,839	10,671	11,649	12,045
Rural household (1,000 units)	13,887	13,761	12,932	12,233	11,945
Housing start (HS) :Total = 1+2+3+4 (1,000 units)	463.94	(253.79)	1,149.23	569.51	323.91
Housing start (HS) :<u>urban</u> = 1+2+3+4 (urban) (1,000 units)	415.53	264.20	503.57	547.64	426.13

Note: (...) indicates negative numbers. Housing inventory is stock adjustment annually, While housing start is regarded as the changing of inventory each period after taking into account The housing withdrawal owing to dismantle or causing fire etc. and has to be cleared from the inventory.

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In order to estimate the cost of social investment from our micro-analysis low income housing needs in urban area during 2020-2037, we estimate the unit value of house price by extrapolating from Table 7.8, it assumes government's unit cost of house on average is 0.99 million baht in 2020. It increases to 1.86 and 2.23 million baht per unit in 2035 and 2037 respectively. Total cost of investment during 2020-2037 is in sum 3,487.7e billion baht for all urban households. Now, if we assume proportion of poor urban households to be 30 percent, we arrive at the cost of investment for low income housing in urban area of 1,046.32 billion baht. If the proportion of low income households is 16 percent, the social cost of investment is 558.04 billion baht.

Table 4: Estimated Cost of Social Investment on Urban Low Cost Housing

Cost of Social Investment (1,000 Million Baht)									
Year	Urban Housing Start (Units)	Unit Cost (Million Baht)	Value of Urban House (thousand Million Baht)	Assumptions on Poor Household Proportion					
				poor 40%	poor 30%	poor 25%	poor 20%	poor 15%	poor 16%
2020	415.53	0.99	409.85	163.94	122.96	102.46	81.97	61.48	65.58
2025	264.2	1.24	327.61	131.04	98.28	81.90	65.52	49.14	52.42
2030	503.57	1.55	780.53	312.21	234.16	195.13	156.11	117.08	124.89
2035	547.64	1.86	1,018.61	407.44	305.58	254.65	203.72	152.79	162.98
2037	426.13	2.23	951.12	380.45	285.34	237.78	190.22	142.67	152.18
All	2,157.07	1.57	3,487.73	1,395.09	1,046.32	871.93	697.55	523.16	558.04

Note: 1) unit cost is extrapolated from Table 6.9; 2) Urban housing start is from our model; 3) value of urban house is (3)=(1)x(2); 4) value of urban house by proportion of poor (4)= proportion x (3) respectively.

2.1.4 Social Investment Needs in Health Services

In this study, we propose the projection model of healthcare services in Thailand. The budget request has been shifted from supply side where ministerial request yearly budget based on the size of hospital in terms of beds numbers of in-patients to a demand-side. The public health service philosophy has been substantially changed in 2002. The health system is called the 'Universal Coverage Scheme' (UCS) is

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implemented nationwide for major of population who are not covered by other system. The service was managed by the *National Health Security Office*.

The philosophy of management is to separate supervision of supply and demand for healthcare. The healthcare *demand* by all clients will be consolidated under the supervision of NHSO as a clearinghouse of all health care purchasers.

Clearly, the UCS system has empowered any Thai's accessibility to fundamental healthcare service. Conceptually, the *total cost* of supply provision has been equated with demand-side projection, assuming an equilibrium between demand and supply of health service, where 'average cost of provision= average buying price of health service per capita'. The demand-side was calculated from the given population cohort weighted by probability of illness of in-out patients, less success rate in precautionary effort. The total buying budget, conceptually, cover the new capital investment and maintenance cost.

Recently, the stochastic influence of 'non-communicable disease, NCD' has distorted the demand price and cost of supply unexpectedly. As a result, the *ex-post* demand price is lower than the average cost has created wide *margin of gap*. The marginal cost of service delivery has been rising. Some public hospitals are overload with patients. This has reduced the welfare of personnel, especially the medical doctors. It is a hot debate in Thailand among practitioners, NPO and general public of the UCS.

A consolidated demand under the UCS has been claimed to improve social welfare of the Thais households on health accessibility. Problems still remain on the supply side and personnel's welfare i.e., medical doctors and others, as well as capital investment of hospitals owing to the rising marginal cost of supply provision, uneven congestion of demand and spatial inequality of service supply.

The size of social infrastructure need in this scheme in the coming decade in terms of health budget is 233.096 billion baht in 2020 and 366.559 billion baht in 2030 respectively.

Here, the capital investment is projected to be 36.52 and 54.07 billion baht in two mentioned periods. In fact, the UCS budget of 147.233 billion baht is in fact the

demand side investment in human health.

Table 5: Projected Total Budgets for Healthcare (unit: million baht)

	Universal Healthcare	Salary and Compensation	Capital Investment	Total
2020	147,233.61	49,333.43	36,529.52	233,096.56
2025	185,017.60	63,731.83	44,443.74	293,193.18
2030	230,154.16	82,332.53	54,072.61	366,559.30

Note: 1) The projected budget covers new capital investment and maintenance as well. 2) This is a minimum demand for health services under UCS. It can be inflated further with international wage of medical doctor to represent its shadow rate of return to human capital investment in part with international price. Services of the medical doctor and nurse are 'tradable services' in part with developed countries. It can be adjusted by a 'PPP' weight to arrive at the 'true cost' of medical personnel's wage. This is left for further analysis.

Source: Authors' calculation

2.2 Macro-Economic Approach

The macro approach shown in Table 6 below has concentrated in the construction of residential investment. The amount of social infrastructure of this category will cost 333.8 billion baht in 2020 and tend to increase substantially to 386.9 billion baht in 2025 and 444.7 billion baht in 2030 respectively. Schools and hospital are lower in their investment cost as far as construction is concerned. However, we have found that the non-construction social investments are still needed to be fulfilled in the schooling and hospital system services. The modern classrooms, laboratory, and modern medical types of equipment are needed in our simulation for schools and hospital. This will be allocated from the public source of non-construction investment in capital formation. The magnitude of non-construction for schooling system would be 10.25 billion baht in 2525 and 20.98 billion baht in 2030 respectively. This is what we have termed it as social infrastructure investment in knowledge for human capital built up towards 21st Century Skills.

Table 6: Macro Approach to Social Infrastructure Investment Need 2020-2-30, measured in current price (Billion baht)

Description	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Gross fixed capital formation: Construction (scenario1)	1,318.15	1,358.48	1,399.70	1,441.63	1,484.30	1,527.79	1,572.05	1,617.04	1,662.74	1,709.10	1,756.07
Social Infrastructure RESIDENTIAL	333.8	344.0	354.4	365.1	375.9	386.9	398.1	409.5	421.0	432.8	444.7
Social Infrastructure SCHOOL	36.3	37.4	38.5	39.7	40.9	42.1	43.3	44.5	45.8	47.1	48.4
Social Infrastructure HOSPITAL	20.1	20.7	21.3	21.9	22.6	23.3	23.9	24.6	25.3	26.0	26.7
OTHER building	32.0	32.9	33.9	35.0	36.0	37.1	38.1	39.2	40.3	41.5	42.6
Other Non-Building	896.0	923.5	951.5	980.0	1,009.0	1,038.5	1,068.6	1,099.2	1,130.3	1,161.8	1,193.7
Change in Gross fixed capital formation: Construction Changed from baseline	18.84	39.00	61.70	86.18	110.77	135.81	162.11	189.69	218.24	247.62	277.84
Social Infrastructure RESIDENTIAL	4.77	9.88	15.62	21.82	28.05	34.39	41.05	48.03	55.26	62.70	70.36
Social Infrastructure SCHOOL	0.52	1.07	1.70	2.37	3.05	3.74	4.46	5.22	6.01	6.82	7.65
Social Infrastructure HOSPITAL	0.29	0.59	0.94	1.31	1.69	2.07	2.47	2.89	3.32	3.77	4.23
OTHER building	0.46	0.95	1.50	2.09	2.69	3.29	3.93	4.60	5.29	6.01	6.74
Other Non-Building	12.81	26.51	41.94	58.58	75.30	92.32	110.20	128.95	148.35	168.33	188.87
Social Infrastructure Investment Need, (scenario 1)	1,244.07	1,282.14	1,321.05	1,360.62	1,400.89	1,441.94	1,483.71	1,526.18	1,569.30	1,613.05	1,657.39
Non-construction											
Public	248.81	256.43	264.21	272.12	280.18	288.39	296.74	305.24	313.86	322.61	331.48
Education	99.53	102.57	105.68	108.85	112.07	115.35	118.70	122.09	125.54	129.04	132.59
Health	119.43	123.09	126.82	130.62	134.49	138.43	142.44	146.51	150.65	154.85	159.11
Residential	4.98	5.13	5.28	5.44	5.60	5.77	5.93	6.10	6.28	6.45	6.63
Social Infrastructure Investment Need, Additional	17.78	36.81	58.23	81.34	104.54	128.17	153.00	179.03	205.97	233.71	262.23
Non-construction,											
Public	3.56	7.36	11.65	16.27	20.91	25.63	30.60	35.81	41.19	46.74	52.45
Education	1.42	2.94	4.66	6.51	8.36	10.25	12.24	14.32	16.48	18.70	20.98
Health	1.71	3.53	5.59	7.81	10.04	12.30	14.69	17.19	19.77	22.44	25.17
Residential	0.07	0.15	0.23	0.33	0.42	0.51	0.61	0.72	0.82	0.93	1.05

Source: Model simulation in this study; see system model and applying national accounts of Thailand

3. Consolidation of Social Investment Needs in Thailand

The consolidation of social infrastructure investment's cost is shown below to be at the 5-6 percent of GDP in the case of construction. We have estimated the non construction elements like modern technology facilities for schooling system at all level, the high technology of health equipments and machinery, the modern housing facilities for aged citizen and modern office machinery and human facilitations etc. Besides, as we have noted in the study, the human capital built-up in Thailand would desperately need the non-physical capital but rather to raise the skills of our human resource towards the 21st Century Skills. Thus, the total investment would be amounted to 1-2 percent in additional to the physical building and facilities. This is amounted to social cost of infrastructure of 6-7 percent of GDP on average 2020-2030.

Table 7: Consolidation of Social Infrastructure Investment, Thailand 2020-2030

(measured in current prices, billion baht)						
Description	2020	2021	2022	2023	2024	2025
(1)Gross domestic product	18,933.31	19,953.09	21,037.56	22,169.57	23,346.01	24,600.05
(2) Social Investment (construction)	1,318.15	1,358.48	1,399.70	1,441.63	1,484.30	1,527.79
as % of GDP	6.96	6.81	6.65	6.50	6.36	6.21
(3) Social investment (non construction)	248.81	256.43	264.21	272.12	280.18	288.39
as % of GDP	1.31	1.29	1.26	1.23	1.20	1.17
(4) Total social investment	1,566.96	1,614.91	1,663.91	1,713.75	1,764.48	1,816.18
as % of GDP	8.28	8.09	7.91	7.73	7.56	7.38
	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>2029</u>	<u>2030</u>	
(1)Gross domestic product	25,897.94	27,256.47	28,676.89	30,139.08	31,643.02	
(2) Social Investment (construction)	1,572.05	1,617.04	1,662.74	1,709.10	1,756.07	
as % of GDP	6.07	5.93	5.80	5.67	5.55	
(3) Social investment (non construction)	296.74	305.24	313.86	322.61	331.48	
as % of GDP	1.15	1.12	1.09	1.07	1.05	
(4) Total social investment	1,868.79	1,922.28	1,976.60	2,031.71	2,087.55	
as % of GDP	7.22	7.05	6.89	6.74	6.60	

The macro approach has concentrated in the construction of residential investment. The amount of social infrastructure of this category will cost 333.8 billion baht in 2020 and tend to increase substantially to 386.9 billion baht in 2025 and 444.7 billion baht in 2030 respectively. Schools and hospital are lower in their investment cost as far as construction is concerned.

However, we have found that the non-construction social investments are still needed to be fulfilled to the schooling and hospital system services. The modern class rooms, laboratory and modern medical equipments are needed in our simulation too for schools and hospital.

This will be allocated from the public source of non-construction investment in capital formation. The magnitude of non-construction for schooling system would be 10.25 billion baht in 2525 and 20.98 billion baht in 2030 respectively. This is what we have termed it as social infrastructure investment in knowledge for human capital built up towards 21st Century Skills.

The consolidate source of funds is through initiation of consultation with the Treasury Department, Ministry of Finance. Land asset after consolidation would be returned to the kingdom for other purpose. In exchange for that consolidation willingness, the ministry of finance would issue the long-term bond for investment fund. In order to avoid a 'crowding-out' of public investment, part of the finance can be from public-private coordination and from *international long-term source of fund*.

4. Macro-economic Impacts of Investment in Social Infrastructure

We have applied the CGE model showing the macro economic impact of the hypothetical investment in social infrastructure on Thai Macro Economy 2020-2030. In model simulation, the growth of HDI's component is estimated to raise the Total Factor Productivity or a shift parameter in the production function in the model.

In addition, the labor productivity is assumed to grow as HDI component like mean years of schooling, expected year of schooling, life expectancy are assumed to grow and will drive the productivity shift in the production. The HDI target will give rise to solution to replace the unskilled labor from neighboring countries in the long-run. The physical capital investment in couple with human capital investment will hypothetically raise the labor productivity towards sustained growth in the long-run 2020-2030.

Table 8: Impact of Hypothetical Investment in Social Infrastructure on Thai Macro Economy 2020-2030

Macro Variables (measured in billion baht)					
Description	2020	2021	2022	2023	2024
Change in Real Gross Domestic Product	8.6	17.8	28.7	41.0	54.9
Change in Real Export	3.2	6.8	11.2	16.3	22.2
Change in Real Government Expenditure	1.7	3.3	5.1	7.0	9.0
Change in Gross Fixed Capital Formation	2.4	5.0	8.1	11.8	16.1
Change in Real Import	2.8	6.0	9.8	14.3	19.5
Change in Private Consumption Expenditure	3.8	8.0	12.9	18.6	25.1
	2025	2026	2027	2028	2029
Change in Real Gross Domestic Product	70.4	87.9	107.7	129.9	155.0
Change in Real Export	28.9	36.7	45.8	56.2	68.2
Change in Real Government Expenditure	11.1	13.3	15.6	18.0	20.7
Change in Gross Fixed Capital Formation	20.9	26.5	32.9	40.2	48.6
Change in Real Import	25.5	32.5	40.5	49.8	60.6
Change in Private Consumption Expenditure	32.3	40.5	49.8	60.4	72.3

	2030				
Change in Real Gross Domestic Product	183.1				
Change in Real Export	82.0				
Change in Real Government Expenditure	23.5				
Change in Gross Fixed Capital Formation	58.1				
Change in Real Import	72.9				
Change in Private Consumption Expenditure	85.7				

Note: Direct summation of right -hand real expenditure change is not matched to change in real GDP owing to the study did not add the change in investment in the table. Besides, the change has to be weighted by GDP share.

5. Methodological Notes for Further Analysis by Other Asian Countries

We have our final notes for further applications of these proposed methodologies by other Asians fellows as follows:

(1) The study should start with clearing all data at the macroeconomic level. Especially, researchers have to request the time series data on capital stock and gross fixed capital formation (GFCF) or investment by construction types. What we need is the GFCF on social investment especially the school, hospital, resident construction value in current prices. If this is not available, the researcher may try to use published data from developing countries that have a higher epoch of development and re-estimate as a proxy.

(2) It is recommended that estimation would be started from the Investment demand function as done in our study and by ADB. The simultaneous equation system can be tried to link the investment with HDI. The scenarios can be tried to estimate the social infrastructure. See Chapter 3 in this study.

(3) The micro approach can be benchmarked with an international study such as PISA for the education. The health system study researcher has to study the current supply-side oriented first. The researcher can try to estimate the demand-side approach following the experience of the Universal Health Coverage in Thailand as a case study.

(4) Data on population forecast can be obtained from the international organization like the WPF, IMF, and WB etc. Most of developing Asians have their own projections. The data on household types would be needed as well. Data on income growth can be estimated from national level using the National accounts data and translating it to the household level at a monthly frequency. The data at micro level on housing stock, inventory, schools building by types and age is not easy to find in developing countries. However, the ratio method can be a guess using projection number of students by level.

(5) This study does not require high-level econometric knowledge. On some skills to manage the readymade econometric software is sufficient to do the task. In the low-income housing need and affordability, it runs on MS Excel or any spreadsheet just to understand the notation and get ready for data inputs. In fact, all

micro approach can be managed on spreadsheets without difficulty. Only some impact analysis using the counterfactual as 'what if we need HDI to reach this target level, then what will be the macroeconomic impact?' this can be done easily with any macroeconomic model where the current state of the art is easily done and explained by and 'tube' lesson in the standard media or even hand telephone.

(6) Only some researchers who are really serious to get through with full strength, they can consult with us to decide whether to go on with such modeling to get a result from the large-scale macro-econometric model and/or the Dynamic General Equilibrium Model (CGE). It has been used in part of this study. But not knowing techniques and complications will not depress the willingness to do simple estimate and projection of the social infrastructure by any Asian's countries.