Long-term projection of Myanmar economy by macro econometric model

Taguchi, Hiroyuki and Lar, Ni

Saitama University

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Chapter VII: Long-term Projection of Myanmar Economy by Macro Econometric Model

Hiroyuki Taguchi, Saitama University, and Visiting Researcher, ESRI

Ni Lar, Chiang Mai University, Thailand

The purpose of this chapter is to investigate the long-term growth prospects of Myanmar economy under such scenarios as intensifying investment and improving total factor productivity (TFP), to represent demand-management policies necessary to sustain its long-term economic growth, to provide strategic implications on the prerequisites to achieve an optimal growth path, and also to represent the sectoral breakdowns for GDP and labor projections. For these purpose, we construct a simple macro-econometric model as shown in Appendix 1 in detail, and conduct sectoral breakdowns by the methodology of using Thailand input-output tables as shown in Appendix 2.[1]

1. Long-term Growth Prospects

For investigating the long-term growth prospects of Myanmar economy, we look into the supply side of the economy, specifically, production function. This is based on our postulation that in early stage of development Myanmar is facing with "Supply Constraint" as her main feature of Macro-economic structure. As factors of production side, we herein focus mainly

[1] The main outcomes of Myanmar macro-economic projection in this Chapter was described in the Appendix of "Myanmar Comprehensive Development Vision (MCDV)" drafted by "Economic Research Institute for ASEAN and East Asia (ERIA)" – ERIA (2013). The MCDV was submitted to the Ministry of National Planning and Economic Development, Government of Myanmar, as final draft on August 22, 2013.

on the contributions of capital stocks and "total factor productivity" (TFP), since these are scarce factors in Myanmar's economy, and are related with such strategies as export-oriented growth, human resource development (HRD) and infrastructure deployment. For the capital formation, intensive investment is needed during a certain period from the quantitative perspective of the economy. At the same time, the TFP, which should be treated as policy target in Myanmar economic development in coming decades, should also be improved to pursue the efficiency of the economy from its qualitative perspective. Thus, we represent the following two scenarios: intensifying investment and enhancing TFP.

Scenarios for Intensifying Investment

The "investment" is a key economic variable in capital accumulation, regardless of the investors, i.e. private or public sectors. The investment is one of the supply-side factors as well as one of demand components. The investment flows create capital stocks, one of the production factors, in dynamic terms. Thus, the intensive investment contributes to the increase in the production capacities in the long run. Since the investment is usually equipped with technology, it also contributes to the enhancement of productivity growth.

The economic growth, therefore, requires the investment in any economies. Myanmar is not an exception. If Myanmar is going to attain export-oriented growth, in particular, it needs certain production capacities to export, thereby necessitating the intensive investment. When we see the economies of forerunners in the Mekong region, i.e., Thailand and Vietnam (see Figure 1), their intensive investments have led to their export-oriented economic structures as well as their high growth. Thailand experienced the periods with its intensive investment in the 1980-90s before the 1997 financial crisis, in which the investment ratio relative to GDP

reached around 40-50 percent. Thanks to its intensive investment, Thailand could attain high growth with around 10 percent as annual rate about the year of 1990, and raise its export ratio rapidly from around 40 percent in the 1990s to 70-80 percent in the 2000s, though its investment ratio has slowed down toward 20-30 percent after the financial crisis. Vietnam has also continued to raise its investment ratio beyond 30 percent in the 2000s, and in the parallel way it has recorded the rapid increase of its export ratio beyond 80 percent and growth rate around 7 percent in the 2000s. The Myanmar's investment ratio to GDP with around 30 percent, and its export rate with around 15 percent and its growth rate with around 7 percent[2] in 2012 have been still lower than those of the forerunners: Thailand in the 1990s and Vietnam in the 2000s. Thus, it appears to be an appropriate time for Myanmar to facilitate its investment intensively to attain its export-oriented growth.[3]

Then, we herein estimate the long-term growth prospect under the scenario with intensive investment. For this purpose, we let the variable of "investment" an exogenous one instead of an endogenous one in the usual model. This specification enables us to get the implication on the linkage between investment and GDP - how much investment should be created for capital accumulation as a policy target for long-term economic growth and development in Myanmar -, although this specification may ignore the endogenous mechanism in which GDP and other economic variables also affect the level of investment. Another practical reason is that there is no such classified data in Myanmar statistics as "private investment" that is usually endogenous, and "government investment" that is exogenous.

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[2] The growth rate in Myanmar here is based on the data of UNDB and IMF, not Myanmar's official data (Central Statistic Organization). The latter data are considered to be overestimated as we state in Appendix 1.

[3] The reasons why we think that Myanmar's economy will follow the economic paths of Thailand and Vietnam are: 1) three economies have similarities in population size as well as cultural and ethnic backgrounds, and 2) the penetration of international production network among three economies, which we suppose, may make their economic growth paths common among the economies.

Our assumption of "intensive investment" is that Myanmar will nearly follow the past experience of Thailand on the path of investment-GDP ratio. To be specific, Myanmar will raise the ratio from about 30% to 40% during the upcoming ten years toward 2020 and will let it peak out thereafter (Scenario I), just as Thailand had made the ratio grow from about 30% to 45-50% in about ten-year period before the financial crisis in 1997 (see Figure 2).[4] To clarify its impacts on economic growth, we also estimate the benchmark with constant investment-GDP ratio as a "Baseline" scenario.[5]

Table 1 reports the estimation outcomes: GDP per capita in 2035 will reach 2,236 USD in Scenario I, whereas it will stay at 1,533 USD under Baseline (the trends in GDP per capita and growth rate are shown in Figure 3); growth rate will attain 6.3 % with the contributions of capital 2.4 and TFP 2.7 in Scenario I, while it will only be 4.7 % with the contributions of capital 1.8 and TFP 1.7 in Baseline; incremental capital-output ratio (ICOR) will be getting worse at 3.6 in Scenario I than at 3.3 in Baseline.[6]

Regarding with the level of TFP, 2.7 in Scenario I, it is comparable with those of Thailand and Hong Kong during the two decades of 1970-1990 (see Figure 4). The worse ICOR in Scenario I implies that the volume effects of investment would be limited to enhance the growth and the improvement of investment quality would be needed. This consideration will be covered in the next Scenario II with TFP shift.

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[4] We assume rather gradual slope as Myanmar's investment-GDP ratio for 2011-35 compared with its slope in Thailand for 1981-2005, while making its 25-year averages the same at 33% between Myanmar and Thailand. It is because we suppose that Myanmar should not repeat the boom–bust cycle in the Thai-1997-crisis. We did not consider the case of Vietnam, since her investment and growth appear to have not reached a steady state yet.

[5] As for labor forces, we suppose 2.3% annual growth in 2011-20, and 1.3% in 2021-35 as a common assumption for Baseline, Scenario I and II. The decline of its growth is based on World Population Prospects: The 2010 Revision by Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

[6] There are many studies on ICOR, e.g. Patel (1968) and Sato (1971). In these studies, the general practice has been to use a fairly fixed ICOR, usually varying from 3 and 4, and relate it to a given, or a desirable, rate of growth.

Scenarios for Enhancing TFP

The long-term growth prospects are closely linked with any of development strategies as long as those enhance the efficiency of the economy. The innovation of technologies, infrastructure development, institutional reformation, consolidated governance, industrial restructuring, human resource development, and any other strategies would contribute to brushing up the potential growth of economy, and all the factors could be reflected in the enhancement of total factor productivity, TFP. The TFP issue had ever attracted much attention in Asia by the argument of Krugman (1994) that there is nothing miraculous about the successes of Asia's tigers that grew by increasing only inputs, not TFP. As is reported in Figure 4, however, the contribution of TFP to long-term economic growth should not be ignored and would often be linked with economic performances in each country.

We then add one more scenario that includes the improvement of TFP. Specifically, we assume that Myanmar could shift the production function upward without any-input increases during the estimation period of 2011-2035 while keeping the trends in investment-GDP ratio under Scenario I (we call it Scenario II).

Table 1 again reports the estimation outcomes: GDP per capita in 2035 will reach 3,037 USD in Scenario II, which is beyond the level of Scenario I (the trend can also be confirmed in Figure 3); growth rate will further attain 7.6 % with the contributions of capital 2.8 and TFP 3.7 in Scenario II; ICOR will improve toward 3.2 from 3.6 in Scenario I.

The level of TFP, 3.7 in Scenario II appears to be rather higher than the average in Asian economies, but still lower than the level of recent China in 1990-2010. It should also be noted that the ICOR under this Scenario is recovered, thereby implying the improvement of

investment quality as well as its quantity.

2. Demand-Management for Sustainable Growth

Suppose that a robust growth were attained in the long-run under the favorable Scenario II, the question is whether the growth is consistent with the macro-balance of Myanmar economy. In other words, the problem is whether or not the necessary "intensive investment" will really be financed by financial resources in the sustainable ways. Here comes the necessity to carefully consider the demand side of the economy, especially external balance (gap between exports and imports), which is equivalent to the saving-investment gap. In this context, the controllability of money supply and price stability are key factors to manage the macro-balance, although these seem to be within the issues with short-run perspectives.

We now assume the two Sub-Scenarios under Scenario II in the previous section: the Sub-Scenario A assumes the 13 % annual growth of money supply, M1 during 2011-35, and Sub-Scenario B presumes its 20% growth. The world GDP volume is supposed to be 2.0% annual growth and the exchange rate is fixed at 802.9 Kyat per USD as common assumptions for Sub-Scenario A and B.

Table 2 reports main estimation outcomes as follows: CPI average percentage increase per year is 5.4 % in Sub-Scenario A, while it amounts to 11.4 % in Sub-Scenario B; export annual growth 16.5 is exceeding that of imports 15.4, thereby trade balance being a surplus at the latter estimation period in Sub-Scenario A, whereas import growth is far exceeding that of export, thereby trade deficit being enlarged extremely in Sub-Scenario B.

The important implication is that too high growth of money supply under Sub-Scenario B

would bring about serious repercussions: first, it would lead to two-digit inflation, which itself might threaten people's lives, and would give negative impacts on people's incentives for savings; second, what is the more serious would be that high domestic inflation would make price competitiveness to the world competitors lessen so that the exports grow less and the imports grow more. After all, trade balance would deteriorate, and as its identity relationship, the saving-investment gap would be getting worse. Thus, though there was the need for intensive investment under Scenario II, it might not be financed by domestic financial resources.

On the other hand, a proper management of money supply would cause less inflation under Sub-Scenario A, and could also keep the trade balance surplus through maintaining price competitiveness. As the result, the intensive investment could be financed by domestic savings. As Figure 5 shows, the intensive investment causes trade deficit at the initial stage due to the need for importing capital goods. The investment, however, enhances the capacity of supply to export with time lag, and finally makes the trade balance surplus at the later stage. Under Sub-Scenario A, the export ratio to GDP will reach more than 100 % of GDP, thereby export-oriented growth being attained under the combination of intensive investment and proper management of money supply. Under the Sub-Scenario, the aggregate demand will also be nearly matching the supply side of GDP, and thus the macro-balance consistency will hold under this scenario.[7]

3. Prerequisites to achieve an optimal growth path

[7] The model constructed here is a kind of the two-gap model in the sense that the demand-supply gap is not adjusted by price mechanisms. For the two-gap model, see Chenery and Strout (1966).

We now provide several strategic implications on the prerequisites to achieve an optimal growth path based on the model estimation above. The key macroeconomic directions can be focused on the following two: to intensify investment with careful demand management, and to improve TFP.

Regarding with the direction to intensify investment, the most important prerequisite is to secure financial resources for them in sustainable way. The financial resources come from domestic savings and external capital inflows. The major resources should be domestic savings rather than external finances since the large gap between investment and saving cannot be sustained for a long-term. To enhance the domestic savings, macro-economic stability is definitely needed, since high inflation discourages saving activity and international price competitiveness as we state in the previous section. Thus, careful management of demand, especially in terms of monetary control, should be an essential prerequisite. Another prerequisite for intensive investment is to develop financial frameworks to mobilize domestic savings and to intermediate between domestic saving and investment, e.g. the banking sector, equity and bond markets, etc.

As for the TFP improvements, any kinds of policies to enhance the efficiency of Myanmar economy can be the prerequisites for its improvements. Major contributions would come from innovation of technologies, infrastructure development, industrial restructuring, institutional reformation (regulatory reforms, privatization, capacity development for public sector, consolidated governance, etc.), human resource development (e.g. by reducing illiteracy, raising school participation rate, promoting Technical/ Vocational Education/ Training-TVET) etc. The combinations and sequences of these instruments should be carefully designed to enhance the overall TFP.

4. Sectoral Breakdowns for GDP and Labor Projections

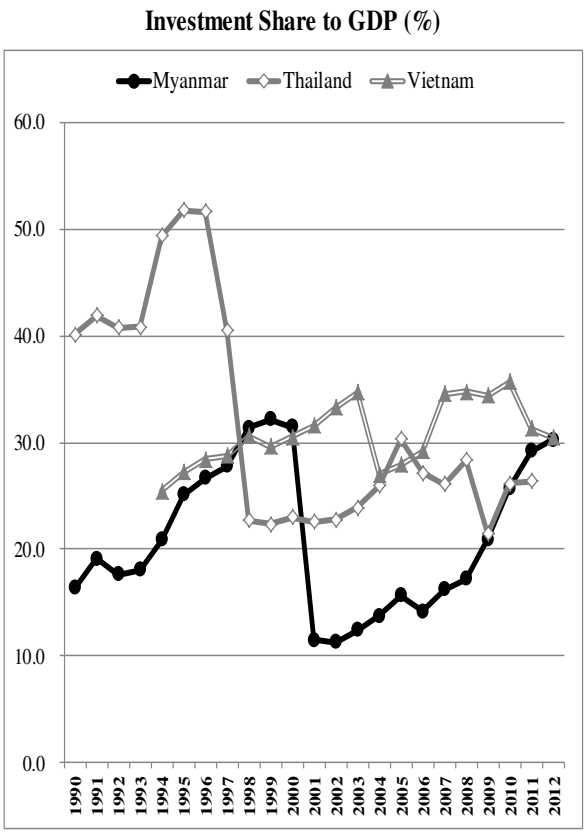
Based on the growth prospect in Scenario II of Table 1 in the previous section, we herein conduct sectoral breakdowns for GDP and labor projections. As we can observe from Figure 6, the present share of "industry" to GDP in Myanmar is still lower than those in Thailand and Vietnam, though it is in the process of catching-up, while the share of "agriculture" in Myanmar is still higher than those in Thailand and Vietnam. For the sectoral breakdowns, the input-output (I-O) table can usually be a useful instrument. Since the I-O table has not been available yet in Myanmar, the alternative way for the sectoral breakdowns is to use the I-O table of another economy in the time when the industrial structure is similar to that of the present Myanmar. We then choose Thailand as an analogical economy for Myanmar since the I-O table of Thailand is well-developed in retrospective terms. When we look at Figure 7, the share of "industry" to GDP in Myanmar in 2010 is nearly equivalent to that in Thailand in 1975. We thus apply Thailand I-O Table in 1975 to break down the industry of Myanmar in 2010. As for the projection of Myanmar industry in 2020, we use Thailand I-O Table in 1990, since the linear extension of the GDP share of "industry" in Myanmar towards 2020 is supposed to make it reach its level of Thailand in 1990.[8] The sectoral labor projection is derived consistently with the sectoral GDP projection by estimating a fixed GDP-labor coefficient in 2010. The concrete methodology of sectoral breakdowns will be shown in Appendix 2.

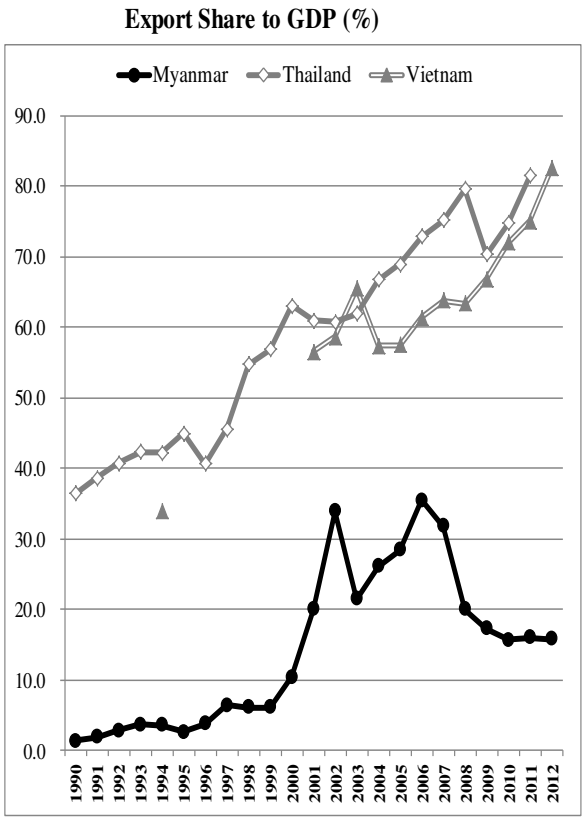
[8] One more reason to use Thailand I-O Table in 1990 for Myanmar industry in 2020 is that in the macro-economic framework in MCDV, it is assumed that the investment-GDP ratio in Myanmar will reach 40 percent in 2020, which is equivalent to its level in Thailand in 1990.

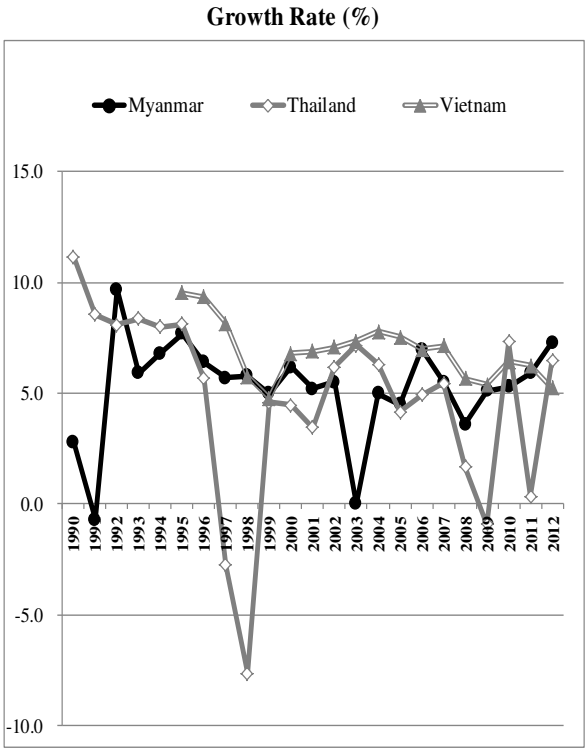
Table 3.1 reports the sectoral breakdowns for GDP projection in terms of the share of GDP. It tells us that the "agriculture, forestry and fishing" sector indicates its decline from 37.8 percent in 2010 to 10.3 percent in 2020; the "industry"-sector shows its increase from 24.3 percent to 41.2 percent; and the "service"-sector shows its increase from 37.9 percent to 48.6 percent. Table 3.2 represents the sectoral breakdowns for labor projection in terms of million persons. According to the growth prospect in Scenario II of Table 1, the labor will grow by 2.3 percent annually for 2011-20, which is the same rate as the one during the past ten years. The growth will be declined to 1.3 percent for 2021-35, following the slowdown of population growth projected by the United Nations.[9] When we focus on the upcoming decade for 2011-20, the labor force will increase from 30.96 million in 2010 to 38.92 million in 2020 by 7.96 million. In the sectoral breakdowns, we should emphasize as follows. First, the "industry"-sector and "service"-sector show the labor increases by 8.33 and 9.44 million respectively, whereas the "agriculture, forestry and fishing" sector indicates its decline by 9.81 million. Second, among the "industry"-sector, the "manufacturing" signifies the larger increase by 5.31 million. Third, within the "manufacturing" sector, the "textile" and "machinery" reveal the lager increases by 1.17 and 1.38 million respectively.

[9] World Population Prospects: The 2010 Revision, by Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

Figure 1 Comparison of Investment and Export Shares to GDP, and Growth Rate







Source: ADB Key Indicators and author's estimate for Myanmar's Export

Figure 2 Assumption of Investment Ratio to GDP for Scenario I

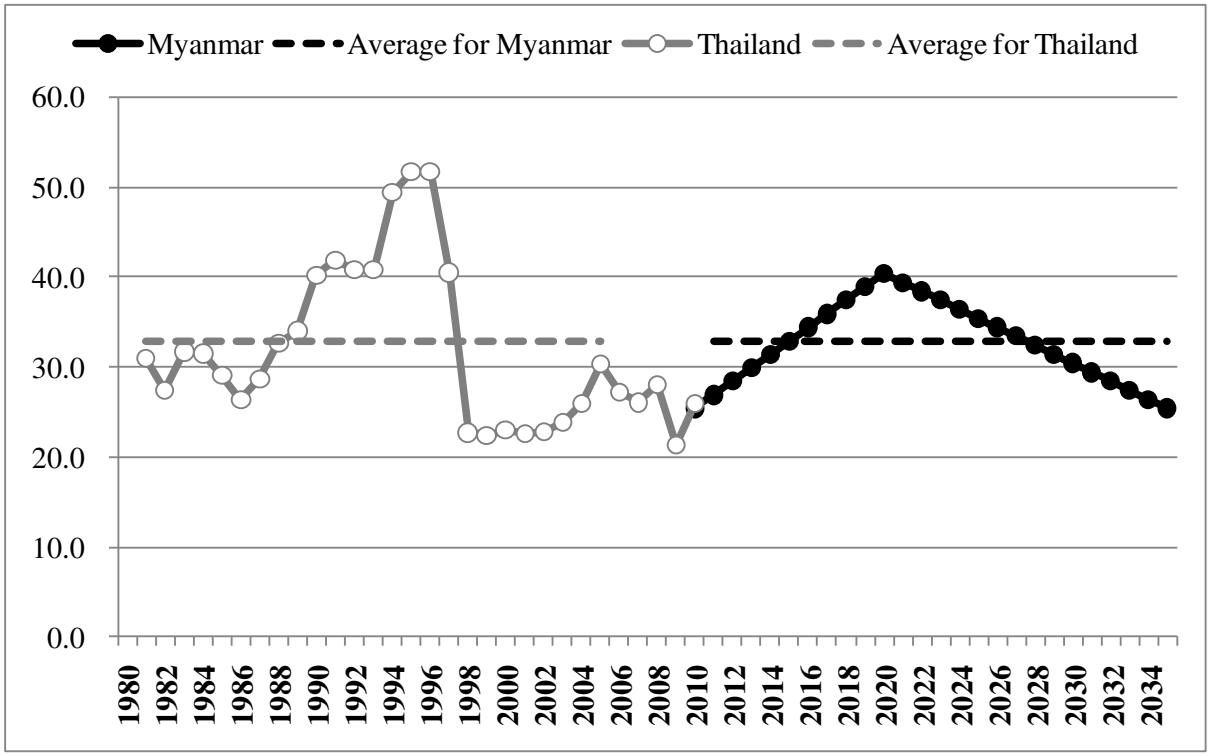


Table 1 Long-term Growth Prospect

Assumption	Baseline <Constant IV>	Scenario I <Intensive IV>	Scenario II <Intensive IV + TFP>
Investment (IV) & TFP	Constant Investment Ratio = 25% (2011-35)	Raising Investment Ratio = 40% (2020 at its peak)	Scenatio I + TFP shift = 0.06 point (2011-35)
Labor	Annual Growth: 2.3% (2011-20); 1.3% (2021-35)		
Estimation Results			
GDP per capita ($, 2035)	**1,533**	**2,236**	**3,037**
Annual Growth (%, 2011-35)	**4.7**	**6.3**	**7.6**
Capital Contribution	*1.8*	*2.4*	*2.8*
Labor Contribution	*1.2*	*1.2*	*1.2*
TFP	*1.7*	*2.7*	*3.7*
ICOR	**3.3**	**3.6**	**3.2**

Figure 3 GDP per capita and GDP Growth under Baseline, Scenario I and II

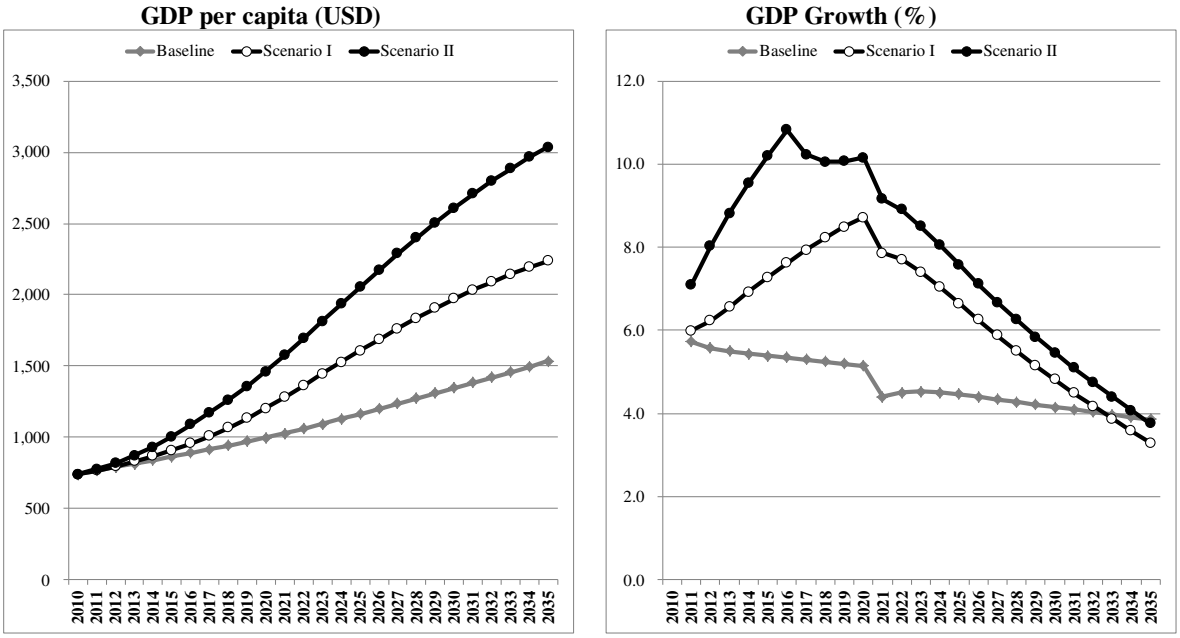
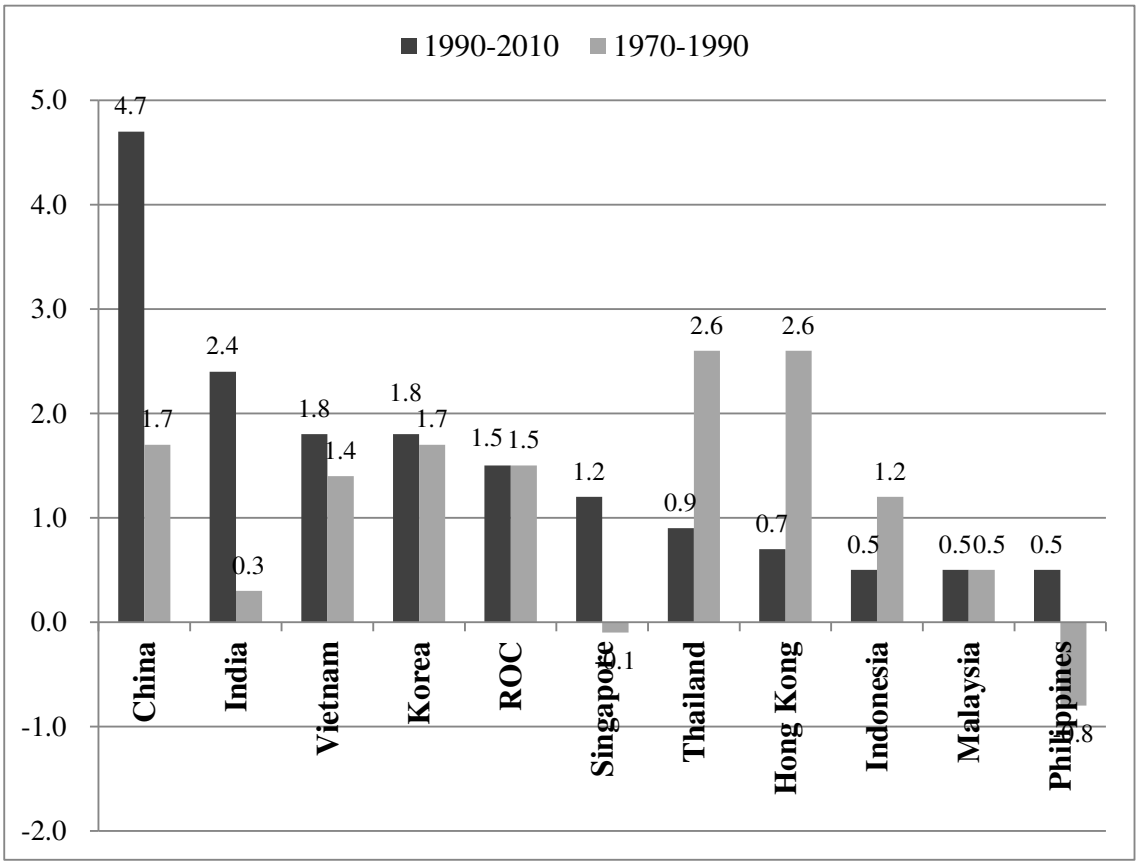


Figure 4 TFP Growth in Selected Asia Economies



Source: APO Productivity Database 2012.01

Table 2 Demand Management under Scenario II

Assumption	Sub-Scenario A <Controlled Money>	Sub-Scenario B <Expanded Maney>
Money Supply (M1)	Annual Growth Rate = 13% (2011-35)	Annual Growth Rate = 20% (2011-35)
World GDP Volume	Annual Growth Rate: 2.0% (2011-35)	
Exchange Rate	Constant at 802.9 Kyat per USD (2011-35)	
Estimation Results		
CPI (%, Annual Rate 2011-35)	5.4	11.4
Exports (%, Annual Rate 2011-35)	16.5	8.3
Imports (%, Annual Rate 2011-35)	15.4	20.2
Trade Balance / GDP (%, 2035)	0.4	-298.2

Figure 5 Trends in Export- and Import- Ratio to GDP in Sub-Scenario A

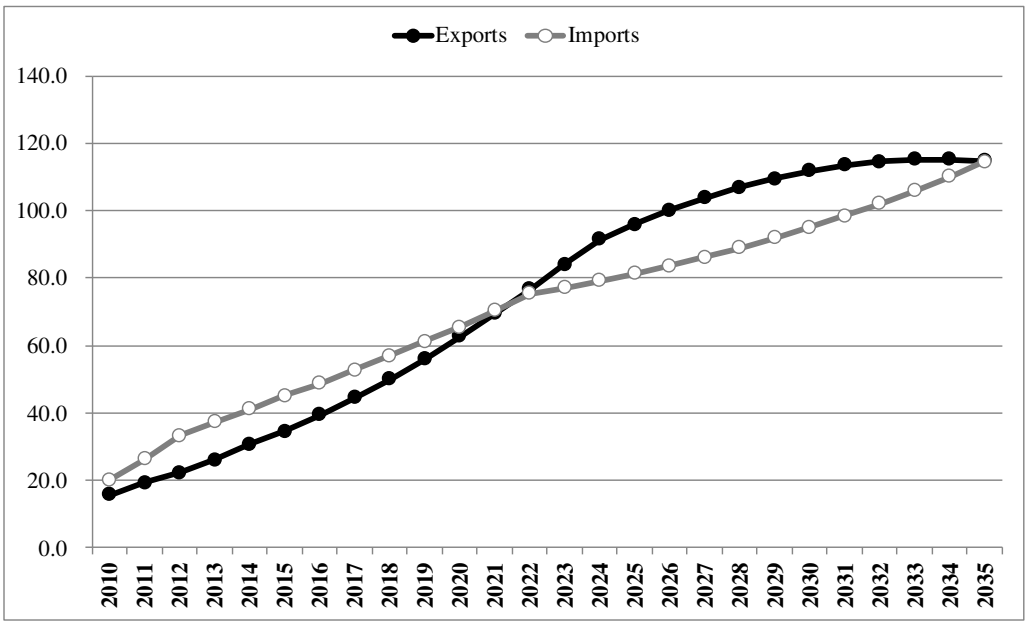
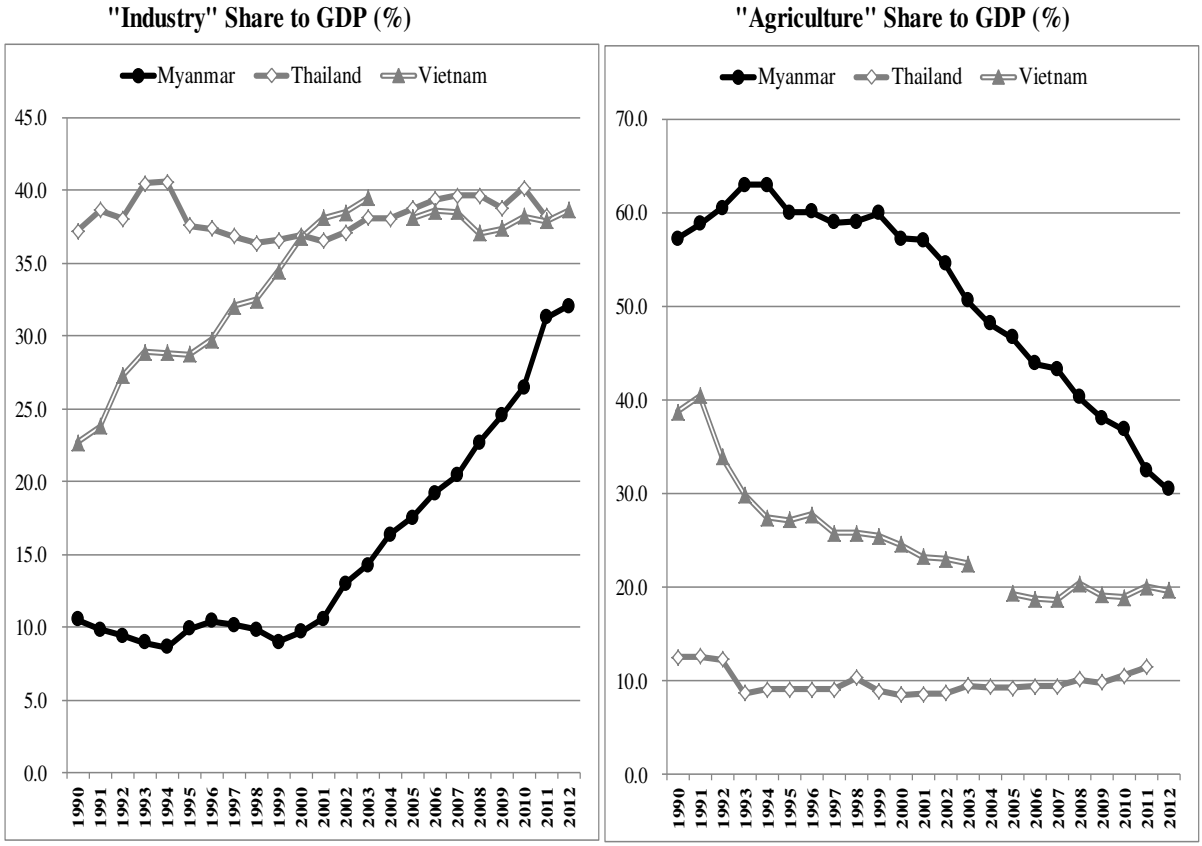
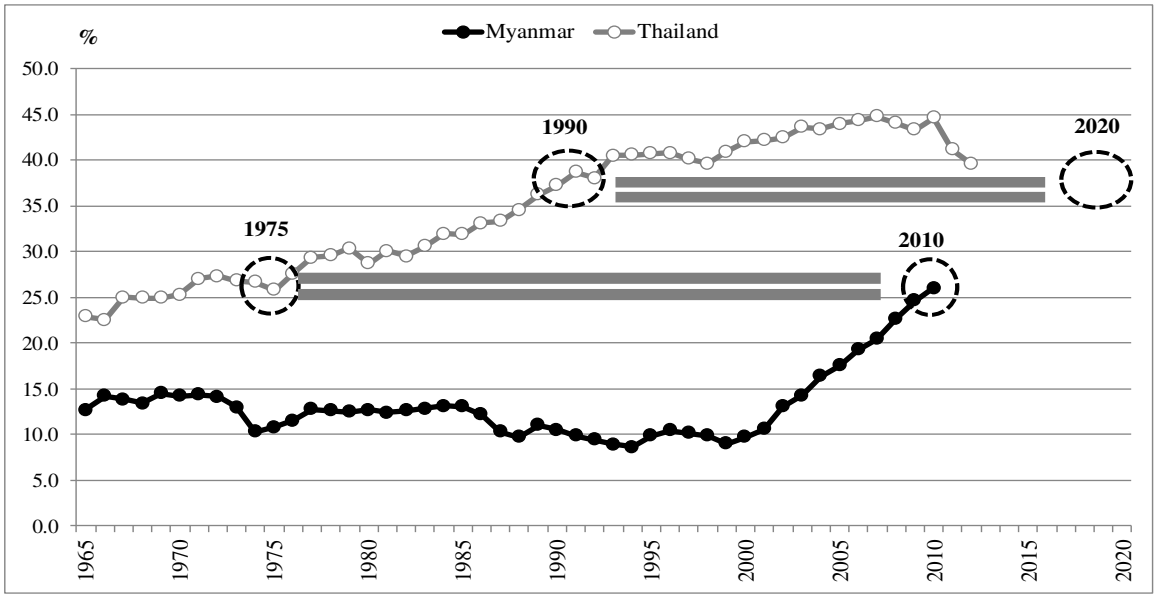


Figure 6 Comparison of Industry- and Agriculture- Share to GDP



Notes: "Industry" is composed of Mining, Manufacturing, Construction and Electricity-Gas-Water.
Source: ADB Key Indicators

Figure 7 Industry- Share to GDP in Myanmar and Thailand



Notes: "Industry" is composed of Mining, Manufacturing, Construction and Electricity-Gas-Water.
Source: World Development Indicators, World Bank

Table 3.1 Sectoral Breakdowns for GDP Projection (share % of GDP)

%	2010	2020	2020 - 2010
Agriculture, Forestry and Fishing	37.8	10.3	-27.6
Industry	24.3	41.2	16.9
Mining	0.7	1.5	0.8
Manufacturing	18.8	29.4	10.6
Food	7.7	6.9	-0.8
Textile	2.7	4.9	2.2
Paper	1.4	1.9	0.5
Chemical, Petroleum and Rubber	2.7	3.2	0.5
Non Metallic Products	0.5	1.9	1.4
Metal Products	1.1	1.4	0.3
Machinery	1.8	5.9	4.1
Other Manufacturing	0.9	3.3	2.4
Electricity, Gas and Water	0.3	2.6	2.3
Construction	4.5	7.7	3.2
Services	37.9	48.6	10.7
Total	100.0	100.0	

Table 3.2 Sectoral Breakdowns for Labor Projection (million persons)

million persons	2010	2020	2020 - 2010
Agriculture, Forestry and Fishing	17.48	7.67	-9.81
Industry	4.68	13.01	8.33
Mining	0.29	1.00	0.71
Manufacturing	3.52	8.83	5.31
Food	1.31	1.90	0.59
Textile	0.61	1.78	1.17
Paper	0.25	0.55	0.31
Chemical, Petroleum and Rubber	0.62	1.20	0.58
Non Metallic Products	0.09	0.52	0.43
Metal Products	0.18	0.38	0.20
Machinery	0.32	1.69	1.38
Other Manufacturing	0.13	0.79	0.65
Electricity, Gas and Water	0.06	0.93	0.87
Construction	0.82	2.25	1.44
Services	8.79	18.23	9.44
Total	30.96	38.92	7.96

Appendix 1: Description for Macro-economic Model

This Appendix 1 is for describing the structure of the macro-economic model used for presenting the long-term economic prospect in the text above, which includes the data description and the list of estimated equations.

Data Description

The sample data basically cover the period from 1980 to 2010 in terms of annual base. The most important assumption on data selection is that "GDP at constant prices" (YS) should follow the growth rate estimated by UNDP and IMF (2012), not Central Statistical Organization (CSO), Government of Myanmar. It is because the growth rates by CSO after 1999 are said to be overestimated. ADB (2012) argues that Myanmar's official growth figures have been deemed overstated and rather unreliable given the country's poor statistical capacity and use of outdated methodologies by referring to Myint (2009). It also points out that various production indicators, presumably correlated with GDP growth, show weaker growth: electricity sales (in kilowatt hours) to households and commercial premises grew on average by 4.5 percent per annum during 2002–2009 and cement sales by 1.8 percent per annum during 2004–2009. On the other hand, UNDP and IMF (2012) present their own, rather conservative GDP-growth estimate: averaging 4.8 percent growth during 2000–2010, although official growth data records 12.1 percent growth during that period.

The data for "investment" (IV) is computed by multiplying YS by investment ratio relative to GDP (IVY). The investment rate (IVY) is estimated by dividing "Expenditure on GDP at constant prices" by "Gross domestic capital formation at constant prices" in ADB Key

Indicators with various issues. The data for "export" (EX) and "import" (IM) are estimated originally since their data by CSO are said to be underestimated due to using official (overvalued) exchange rate to convert their US dollar values into local-currency values. First, the local currency values of export and import at constant prices in CSO data are converted into their US dollar values by official exchange rate in International Financial Statistics (IFS) of International Monetary Fund (IMF). Second, the US dollar values are again converted into their local-currency ones by the market exchange rate instead, which is calculated by using World Economic Outlook (WEO) Database of IMF with various issues.[10] Third, the ratios of export and import relative to GDP are computed by dividing their re-estimated local-currency values by the GDP at constant prices in CSO data. Finally, the data for EX and IM is computed by multiplying YS by the re-estimated ratios of export and import to GDP. The data for "consumption" is obtained by subtracting IV and EX-IM from YS.

The data for "capital stock" (KR) is estimated following the equation in Appendix 1 -Table 1, in which the depreciation ratio is obtained from its ratio in the 1970s of Thailand, 4.5 percent. The initial capital stock is estimated under the assumption that the incremental capital output ratio (ICOR) is equal to capital output ratio following the Harrod-Domar Growth model.[11] The average ICOR in Myanmar in the 2000s estimated by CSO data is 1.0, and the initial capital stock is calculated by multiplying GDP in 1981 by the ICOR (1.0).

The data for "labor forces" (LB) and "Money Supply (M1)" (MN) are retrieved from ADB Key Indicators with various issues, and the data for "Consumer Price Index" (CP) and "World GDP Volume" (WY) come from IFS of IMF. The exchange rate (market rate) is computed by

[10] The market exchange rate can be computed by dividing "Gross domestic product, current prices, National currency" by "Gross domestic product, current prices, U.S. dollars".
[11] See Harrod (1939) and Domar (1946).

WEO database as shown by Note 8. GDP as aggregate demand (YD) is the sum of CN, IV and (EX-IM), and the trade balance (CB) is defined as (EX-IM) divided by YS. GDP per capita (YPC) is calculated by the formula in Appendix 1 -Table 1, where 741.67 is the GDP per capita (US dollar) in 2010 in WEO database (October, 2012); 20,946 is GDP at constant prices (billion Kyat) in 2010 in CSO data; and 30.96 is labor forces (million persons) in 2010 in ADB Key Indicators 2012. TFPS signifies the shift of TFP in production function by 0.06 for the Scenario II during 2011-2035.

The sample data created by the fore-mentioned methods are attached in Appendix 1 -Table 2 for the reference.

Model Description

For the simulation, we construct a rather simple model including ten equations, which are divided into production block and expenditure block. In usual macro-econometric models, the GDP on production (supply-side) and the GDP on expenditure (demand-side) would be adjusted through price-mechanism; the GDP supply-demand-gap would be reflected in the price-determination, and the price effects caused by the GDP gap would be fed back to the GDP demand through real balance of money supply. In this model, however, such a price mechanism is not incorporated, since the prices like consumer price index have not been sensitive to the GDP gap, and thus the price mechanism has not yet been working well. Then, this model focuses the GDP determination only on the production side by sacrificing the price-adjustment mechanism on demand-side in the short-run, just because the purpose of simulations lies in showing the long-term growth prospect. Alternatively, the GDP gap can be checked in the ex post sense after the simulation so that we can judge whether the simulated

scenario is realistic one or not from the supply-demand perspective. In this sense, this model appears to be a kind of the two-gap model as shown in Note 7. At the stage when the mechanism works, however, that mechanism should be incorporated in the model-building.[12]

The more detailed description of mode-construction is presented as follows. For the stochastic estimation, the variables take a logarithmic form. The figures in the parentheses in the second line of the estimated equation denote the T-value, and "*", "**" and "***" shows the probability to reject null-hypothesis on the existence of each coefficient by 90, 95 and 99 percent, respectively. The "AR" is auto-regressive model, the "RR" is the Adjusted R-squared, the "DW" is the Durbin-Watson statistics, and the "EP" is the estimation period.

<Production Block>

- Production Function

ln(YS/LB)=(0.484+TFPS)+0.347*ln(KR/LB)+0.535*ln(YS(-1)/LB(-1))+0.822*AR(1) --- (1)

(0.614) (2.541)** (3.732)*** (9.863)***

RR=0.96, DW=2.00, EP=1983-2010

The production function above is a usual Cobb-Douglas type that related output per labor to capital per labor. The coefficient, 0.347, signifies the capital's share whereas (1-0.347) means the labor's share. In this equation, LB and TFPS is exogenous while YS and KR is endogenous.

- Capital Stock

[12] An advanced macro-model to contain price mechanism has ever been constructed such as Aung (2009).

KR = (1 - 0.045) * KR(-1) + IV --- (2)

The capital stock is defined by the previous-time one, depreciation ratio and investment. The depreciation ratio is obtained from its ratio in the 1970s of Thailand, 4.5 percent. The initial capital stock is calculated by multiplying GDP in 1981 by the ICOR as we stated in the data description. The IV is determined by the next equation (3).

- Investment

IV = YS * IVY --- (3)

The investment is defined by multiplying GDP by investment ratio to GDP. The investment ratio is exogenously determined.

- GDP per capita

YPC = 741.67 * (YS/ 20,946) / (LB/ 30.96) --- (4)

The GDP per capita is calculated by the GDP per capita in 2010 (741.67 U.S. dollar) and the growths of GDP and labor force as we stated in the data description.

<Expenditure Block>

- Consumption per labor

ln(CN/LB) = -0.286 + 1.020 * ln(YS/LB) - 0.024 * ln(CP) + 0.099*AR(1) --- (5)

(-0.285) (6.260)*** (-1.965)* (0.483)

RR=0.76, DW=1.96, EP=1983-2010

The consumption per labor is determined by GDP per labor and Consumer Price Index (CP). The CP is determined by the equation (8), mainly money supply.

- Export ratio to GDP

ln(EX/YS)=-33.118+0.525*ln(IVY(-4))+6.449*ln(WY)-1.324*ln(CP/ER)+0.322*AR(1) (6)

(-44.464)*** (4.853)*** (43.400)*** (-19.899)*** (1.458)

RR=0.99, DW=2.16, EP=1987-2010

The export ratio to GDP is determined by investment ratio (IVY) with four-year lags, world GDP (WY) and real exchange rate (CP/ER). The IVY, WY and ER are exogenously determined and CP is decided by the equation (8).

- Import ratio to GDP

ln(IM/YS) = -3.247 + 0.735 * ln(IVY(-2)) + 0.734 * ln(CP) + 0.879*AR(1) --- (7)

(-2.074)* (2.174)** (1.880)* (6.461)***

RR=0.95, DW=1.28, EP=1984-2010

The import ratio to GDP is determined by investment ratio (IVY) with two-year lags and Consumer Price Index (CP). The IVY is exogenously determined and CP is decided by the equation (8).

- Consumer Price Index

ln(CP) = 9.859 + 0.972 * ln(MN/YS) + 0.192*AR(1) --- (8)

(61.665)*** (50.272)*** (1.010)

RR=0.99, DW=2.00, EP=1982-2010

The Consumer Price Index is determined by money supply (MN) and GDP, which is the modified formula of "Quantity Theory of Money" under the assumption of constant income velocity. MN is exogenously determined.

- GDP as demand aggregation

YD = CN + IV + EX – IM --- (9)

The GDP as demand aggregation is identified as we noted in data description.

- Trade balance to GDP

CB = (EX - IM) / YS * 100 --- (10)

The trade balance to GDP is identified as we noted in data description.

Appendix 1 -Table 1 Data Description

Variables		Description	Data Sources
YS	endogenous	GDP; 2005/6 price; bil. kyats	Estimated by growth rate of IMF(2012) and UNDP
CN	endogenous	Consumption; 2005/6 price; bil. kyats	YS-IV-(EX-IM)
IV	endogenous	Investment; 2005/6 price; bil. kyats	IV = YS* IVY
IVY	exogenous	Investment ratio to GDP	ADB Key Indicators
EX	endogenous	Export; 2005/6 price; bil. kyats	Estimated by authors
IM	endogenous	Import; 2005/6 price; bil. kyats	Estimated by authors
KR	endogenous	Capital Stock; 2005/6 price; mil. kyats	KR = (1-0.045)*KR-1 + IV Depreciation 4.5%: Thailand (1970s)
LB	exogenous	Labor Force; mil. persons	1981-2010: ADB Key Indicators
CP	endogenous	Consumer Price Index; 2010=100	IFS (IMF)
MN	exogenous	Money Supply M1; 2010=100	ADB Key Indicators
WY	exogenous	World GDP Volume; 2010=100	IFS (IMF)
ER	exogenous	Exchange Rate (market rate); kyat per USD	WEO (IMF)
YD	endogenous	GDP as aggregated demand	CN+IV+EX-IM
CB	endogenous	Trade Balance	(EX-IM)/YS
YPC	endogenous	GDP per capita	741.67 * (YS/ 20,946) / (LB/ 30.96)
TFPS	exogenous	TFP shift by 0.06 (2011-35) for Scenario II	

Appendix 1 -Table 2 Sample Data

FY	YS	CN	IV	EX	IM	KR	LB	CP	MN	WY	ER
1980						7,086		0.6		37.0	6.6
1981	7,086	5,569	1,546	8	37	8,313	14.4	0.6	0.2	37.9	7.3
1982	7,470	5,921	1,583	8	41	9,522	14.9	0.6	0.2	38.1	7.9
1983	7,796	6,463	1,358	9	34	10,451	14.9	0.6	0.2	39.1	8.1
1984	8,180	6,979	1,227	8	33	11,207	15.2	0.7	0.2	41.0	8.6
1985	8,417	7,133	1,307	7	29	12,010	15.5	0.7	0.2	42.6	8.2
1986	8,325	7,260	1,080	8	24	12,550	15.7	0.8	0.3	44.1	7.1
1987	7,992	6,961	1,049	7	24	13,034	15.6	1.0	0.2	45.6	6.5
1988	7,081	6,128	965	8	20	13,412	15.9	1.1	0.3	47.6	6.5
1989	7,343	6,393	958	10	18	13,766	16.2	1.4	0.4	49.3	6.7
1990	7,548	6,455	1,237	100	244	14,383	16.5	1.7	0.6	50.9	58.3
1991	7,495	6,246	1,432	141	324	15,168	17.0	2.2	0.8	52.6	84.0
1992	8,222	6,928	1,451	236	392	15,937	19.0	2.7	1.1	54.8	99.3
1993	8,708	7,475	1,570	325	663	16,790	19.5	3.6	1.4	56.1	119.7
1994	9,300	7,632	1,942	331	605	17,976	20.0	4.4	1.8	58.5	113.2
1995	10,016	7,984	2,512	265	746	19,679	20.5	5.5	2.4	60.6	110.0
1996	10,657	8,374	2,837	407	961	21,631	22.0	6.5	3.2	62.9	159.8
1997	11,264	8,830	3,132	720	1,418	23,789	22.5	8.4	4.2	65.4	240.4
1998	11,918	9,141	3,736	729	1,688	26,455	23.1	12.7	5.4	66.8	249.2
1999	12,513	9,375	4,024	768	1,654	29,288	23.7	15.0	6.7	69.3	258.1
2000	13,289	9,253	4,181	1,378	1,523	32,151	24.3	15.0	9.0	72.6	286.7
2001	13,980	12,520	1,607	2,802	2,949	32,311	24.9	18.2	12.5	74.2	547.8
2002	14,749	11,615	1,666	4,998	3,529	32,523	25.6	28.5	18.0	76.1	829.9
2003	14,749	12,269	1,825	3,162	2,507	32,884	26.4	39.0	21.2	78.7	737.2
2004	15,487	11,701	2,124	4,045	2,384	33,529	26.9	40.7	26.5	82.5	859.2
2005	16,184	11,725	2,537	4,593	2,671	34,557	27.4	44.5	34.8	86.2	1,025.0
2006	17,316	12,777	2,453	6,152	4,065	35,455	28.0	53.4	44.1	90.5	1,162.0
2007	18,269	13,756	2,963	5,804	4,254	36,822	29.3	72.2	57.3	95.0	1,156.3
2008	18,926	16,197	3,254	3,777	4,301	38,419	30.0	91.5	61.0	97.2	917.5
2009	19,892	15,529	4,167	3,431	3,236	40,857	30.5	92.8	75.7	95.8	918.4
2010	20,946	16,533	5,321	3,291	4,199	44,340	31.0	100.0	100.0	100.0	802.9

Appendix 2: Methodology of Sectoral Breakdowns for GDP and Labor Projections

This Appendix 2 is for describing the methodology of sectoral breakdowns for GDP and labor projections by using Thailand I-O tables. It takes two steps as follows.

At the first step as shown in Appendix 2 – Table 1, we fix the industrial details in labor force and GDP[13] in the benchmark year of 2010 to obtain the GDP-labor coefficient. For the industrial classification except the details of "manufacturing", the data are retrieved from those of Central Statistical Organization (CSO), Government of Myanmar. Regarding with the breakdowns of "manufacturing", we adapt the sector-share in Thailand I-O Table in 1975, i.e., the share of "value added" for sector-GDP and the share of "wages and salaries" for sector-labor force. We then obtain the GDP-labor coefficient through dividing labor force by GDP in labor force in each sector.

At the second step as shown in Appendix 2 – Table 2, we estimate the industrial GDP in Myanmar in 2020. We first get the total GDP in 2020 from Scenario II of Table 1, and then divide it by industrial sector share of "value added" in Thailand I-O Table in 1990. The industrial labor force in 2020 is obtained by multiplying industrial GDP by the GDP-labor coefficient at the first step (The number of industrial labor force is controlled by the total of labor force in 2020 in Table 1 assumption).

[13] The GDP here is "GDP at constant prices in 2005/6".

Appendix 2 -Table 1 GDP – Labor Coefficient in 2010

2010	Labor. (mil.)	GDP (bil.kyat)	Coef. (Emp/mil.GDP)
Agriculture, Forestry and Fishing	17.48	7,927	2.21
Mining	0.29	151	1.95
Manufacturing	3.52	3,937	
Food	1.31	1,615	0.81
Textile	0.61	564	1.08
Paper	0.25	294	0.84
Chemical, Petroleum and Rubber	0.62	565	1.10
Non Metallic Products	0.09	113	0.80
Metal Products	0.18	225	0.81
Machinery	0.32	370	0.85
Other Manufacturing	0.13	191	0.70
Electricity, Gas and Water	0.06	52	1.06
Construction	0.82	943	0.87
Services	8.79	7,936	1.11
Total	30.96	20,946	

Notes: The labor in 2010 is based on CSO and Thai IO 1975 for manufacturing. The GDP in 2010 is based on CSO and Thai IO 1975 for manufacturing.

Appendix 2 -Table 2 Estimate of Labor in 2020 Based on GDP – Labor Coefficient

2020	GDP (bil.kyat)	GDP*Coef.	Labor (mil.)
Agriculture, Forestry and Fishing	5,328	11.75	7.67
Mining	790	1.54	1.00
Manufacturing	15,262	13.51	8.83
Food	3,578	2.91	1.90
Textile	2,523	2.73	1.78
Paper	1,010	0.85	0.55
Chemical, Petroleum and Rubber	1,664	1.84	1.20
Non Metallic Products	999	0.80	0.52
Metal Products	728	0.59	0.38
Machinery	3,037	2.59	1.69
Other Manufacturing	1,723	1.21	0.79
Electricity, Gas and Water	1,335	1.42	0.93
Construction	3,982	3.45	2.25
Services	25,195	27.91	18.23
Total	51,892	59.59	38.92

Notes: The GDP in 2020 is based on Scenario II of Table 1 and Thai IO 1990. The labor is controlled by its total of Table 1 assumption, and divided by the share of "GDP*Coef".

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