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A Macroeconometric Model of Myanmar

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Abstract

This paper has constructed a small macroeconometric model of Myanmar using annual time series data from 1980 to 2005. The model consists of 13 behavioural equations and 5 identities, and 18 endogenous and 5 exogenous variables. The individual equations are estimated by two-stage least-squares method (2SLS). Then, the dynamic simulation of the whole model is performed for 1990-2005. The tracking performance of the model on the historical data is evaluated based on the two measures: root mean square percentage error (RMSPE) and mean percentage error (MPE). Multipliers of some important variables are also examined by increasing 10 % of government consumption and exchange rate over the historical path. Finally, ex-post forecasting for 2006 and 2007 is carried out, and a comparison between forecasted and observed values is made. The results show that increase in government consumption boosts domestic income while devaluation increases the export demand.

Keywords: macroeconometric model, two-stage least squares, dynamic simulation, root mean square percentage error

1. Introduction

Econometric models play an important role in the areas of policy analysis and forecasting. By constructing econometric models, planners and policy makers measure and forecast the effects of policy changes on the economy as a whole. Thus, these models are very useful for them to decide an appropriate policy, either monetary policy or fiscal policy or policy mix, in order to maintain the sustainable economic growth, which is the most desirable condition of a country. Therefore, with different purposes, both developed and developing countries construct econometric models at various levels. According to Valadkhani (2004), early macroeconometric models for developed and developing countries were constructed by Tinbergen for the Dutch economy before World War II and Narasimham for India, respectively. And their models were mainly used for policy analysis. Following them, many other scholars modified their models and even constructed new models with the assumptions of new economic theories. Because of the availability of reliable time series data and the methodology advancement, more applications of macroeconometric models are seen in developed countries.

To a certain extent, nevertheless, developing countries have also constructed macro-econometric models with available resources. For instance, Cooray (1992), Musila (2002), Ra and Rhee (2005), Qin et al. (2007), and Dulbadrakh (2008) constructed the macroeconometric models for Sri Linka, Malawi, Nepal, China, and Mongolia, respectively. Needless to say, based on the assumptions, they employed different model specifications and estimation methods, and performed various simulations by changing the values of policy variables. Also in the literature of the modeling of Myanmar, there have been a few studies on macroeconometric model for the economy of Myanmar.

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Since 1988, Myanmar has been transforming from the centrally controlled economic system to the market oriented economic system. In line with the new economic system, the government has made several policy changes which affect both private and public sectors, and implemented a number of developmental projects throughout the country. However, some problems such as high inflation and currency depreciation are still disturbing the development of Myanmar. To identify and solve for the roots of these problems, an effective government policy should be employed, which in turn calls for a tool to estimate and analyze the effect of that policy. For the analytical tools, it is widely accepted that econometric modeling is the most appropriate tool for policy analysis. However, in the case of Myanmar, the planner may find it difficult quantifying the impacts of these policy changes and developmental projects on the economy in need of macroeconometric model. For instance, it would be rather difficult for them to analyze how much expansionary monetary policy would lead to increase in domestic income and price level.

It will be beneficial for policy makers if a macroeconometric model is built by using time series data of Myanmar. Therefore, the objectives of this paper are: (1) to construct a macroeconometric model, (2) to provide policy makers an insight of the economic performance of Myanmar, (3) to analyze the multiplier effects of policy variables on the economy, and (4) to provide policy recommendation to the policy makers to achieve the sustainable economic development.

2. Brief Overview of the Economy

In the history of economic development of Myanmar after its independence, the periods after 1990 were very significant in terms of economic growth, infrastructure development, and foreign trade. In 1988 when the new government, the State Law and Order Restoration Council, came to power the economic situation in Myanmar was in an unfavorable condition due to an unexpected event happened in that year. Thus, in order to recover the economic situation, the government introduced many economic reforms as well as other reforms. Firstly, the government abandoned centrally-planned economic policy which had been practiced for more than four decades, and officially adopted "market-oriented economic policy", with an invitation of domestic and foreign investors to participate in economic activities.

Accordingly, in the agriculture sector, the liberalization of prices and kinds of crops, which were controlled by the state in the past, was given to the private sector. As a subsidy, high-yield seeds, chemical fertilizers and diesel fuel needed to run the water-pump for the irrigation were also provided to increase the output. Not only was the attention paid to enhance the productivity, but also the expansion of the areas of arable land was carried out wherever it was possible. A number of dams especially for the irrigation of the summer crops were built throughout the country. The agriculture loans, which play an important role in farming especially for the poor farmers living in remote areas, were issued from the Agriculture Bank. Thus, the contribution of agriculture sector to the gross domestic product (GDP) substantially increased from 46.5 per cent in 1980 to 57.3 per cent in 1990 and further increased to 59.7 per cent in 2000.

In the manufacturing sector, with an introduction of a number of laws to regulate the systematic development of industries, reallocation of small and medium-sized firms to the newly developed industries zones, the promotion of cottage industries, invitation of private sector participation and removing the restrictions imposed on businesses, most of the manufacturing

industries were allowed to the private sector while some of the basic industries were still controlled by the state. In addition, with the purposes of separating the manufacturing industries from the local community to reduce the industrial pollution and the risk of fire, and as a final goal, aiming to the state be industrialized, the government developed the industrial zones outside of the towns where a relative number of small and medium-sized firms had existed. For all these industrial zones to be systematically developed, the Myanmar Industrial Development Committee (MIDC) was developed in 1995, from which the necessary guidelines to overcome the problems facing the private sector were provided, and also industrial exhibitions, seminars, and conferences on industrial promotion and technology transfers were often carried out. In addition, in order for the private investors to be able to tackle their financial difficulties, the MIDC developed the Myanmar Industrial Development Bank in 1996.

In the services sector, though the financial sector had been solely monopolized by the state in the past, the private sector was allowed to participate in banking and insurance businesses so as to speed up and smooth all the financial transactions as the country developed. Thus, a significant number of private banks emerged in the capital city of Yangon. Later, they expended their businesses by setting up the branches of banks in other states and divisions. But their main function was to deal with the transactions of domestic currency as the foreign exchange transaction was handled by the Myanmar Foreign Trade Bank (MFTB). To harmonize all-round development process, not only was the financial sector developed, but also other infrastructure developments were done at the same time. During that period, a great number of tall residential buildings, departmental stores, factories and hotels were developed in cities, especially in Yangon and Mandalay, the second capital city of Myanmar. This development was partly due to the mini-boom of construction sector and a huge amount of foreign direct investment (FDI) in the manufacturing sector and the tourism sector. According to the official statistics, the FDI mostly came from Singapore and South-Korea.

Due to the liberalization of trade and marketing, and the high output growth rates of the agriculture sector and the manufacturing sector, the trade sector could significantly contributed to the GDP. Registration of exporters and importers and setting up the companies and branches by foreigners were encouraged and allowed. As an incentive to the exporters, the retention rate was increased from 60 per cent of their export earnings to 100 per cent. Thus, the number of registered exporters and importers grew from 2,677 to 13,780 during the period of 1990/91 and 1999/2000. As a result, exports drastically increased from US$ 219 million in 1987 to US$ 897 million in 1995 and further to 1,309 million in 1999/2000. The most dominant items in exports were rice, pulses and beans, marine products, and garment. Rice export, which was sometimes restricted to the private sector, went up to over 1 million tons in 1994. Pulses and beans exports also jumped up from 200,000 metric tons in 1990/91 to over 769,000 metric tons in 1997/98. The garment exports, which had not been before, received only a value-added portion of the products as most of the materials required to produce garments had to be imported. Other export items like teak, natural gas, and gems also significantly contributed to the total foreign earnings. Thus, the composition of export items was still dominated by the primary products. Nonetheless, the total contribution from the exports would have increased more than the current amount if all the detailed statistics of border trade had been collected. The major trading partners of Myanmar were the Association of Southeast Asian Nations (ASEAN) member countries and other Asian countries like Japan and China.

Due to the above mentioned economic policies and good governance, favorable economic environment, and positive response of private sector to the incentives and liberalization, Myanmar achieved substantial economic growth along with macroeconomic stability within the country. According to the statistics of the International Monetary Fund (IMF), the GDP growth rate drastically increased from 3.1 per cent in 1989/91 to 7.7 per cent in 1992/94 and slightly decreased to 6.3 per cent in 1995/97. However, in 1998/99, the GDP growth rate of Myanmar slowed down to 5.6 in 1998/99. This was partly due to the Asian financial crisis which occurred in the mid of 1998.

Table (1): Selected Macroeconomic Indicators of Myanmar (1980-2005)

	1980s	1990s	2000-2005
GDP growth rate	2	6.1	9.2
GDP per capita (constant LCU)	1396.3	1523.1	2667
GDP per capita growth rate	-0.1	4.8	8.2
Composition of GDP (Production)			
Agriculture Share %	50.5	60	57
Industry Share %	12	9.7	10
Manufacturing Share %	9.2	7	7
Services Share %	37.6	30.2	33
Composition of GDP (Expenditure)			
Private Consumption %	74.06	77.87	82.24
Investment %	17.46	12.64	11.77
Government Consumption %	12.43	10.32	6.09
Exports %	5.68	1.21	0.33
Imports %	9.63	2.08	0.4
Gross domestic saving (% of GDP)	12.64	12.19	11.65
Fiscal Policy			
Deposit interest rate	1.5	10.01	9.54
Monetary Base			
Money Supply, M2 (% of GDP)	30.24	28.85	26.04
Others			
Trade (% of GDP)	13.83	2.9	0.6
Inflation (CPI %)	10.09	26.88	21.43

Source: Calculated using the data from the World Development Indicator and the United National Common Data Base

Though Myanmar had no well-developed financial markets, the crisis affected the economy of Myanmar through the depreciation of local currency (Kyat) and the shortage of

export demand from the trading partners. Therefore, the government had to adjust their economic policies being implemented by using fiscal policy.

3. Data and Methodology

As a common problem facing in modeling, the limitation of data not only restricts to the scope of the model but also calls for more sophisticated econometric techniques to extract the meaningful results from the data. This is also the case of Myanmar. In this study, the annual data from 1980 to 2005 are used. The data are obtained from the World Development Indicator (WDI), the United Nations Common Database (UNCDB), and the Central Statistical Organization (CSO) of Myanmar. Although the required data are taken from different sources, in order to maintain the data consistency, the data from the UNCDB are extensively used in this research. And it should be mentioned that where necessary, some econometric techniques are applied to overcome for the problem of missing observations.

As cited in Valadkhani (2004), Bodkin and Marwah (1988, p. 369) say that "it is much easier to see the forest when the tress are fewer." Thus, considering the features of a developing country, all the equations in the model are specified as simple as possible and estimated by two-stage least squares method (2SLS). All exogenous variables and lagged dependent variables are used as instrumental variables. As a common feature of time series data, it is expected that there may be a problem of serial correlation in some cases. To overcome this problem, the Cochrane-Orcutt procedure is applied. Then the whole model is simultaneously solved for dynamic simulation. The tracking performance of the model on the historical data is evaluated based on the values of the root mean square percentage error (RMSPE) and the mean percentage error (MPE).

4. Model Specification

The macroeconometric model of Myanmar is a small-sized annual macroeconometric model in which not only the demand side but also the supply side of the economy is determined. The model consists of 13 behavioral equations and 5 identities. There are altogether 23 variables in the model: 18 endogenous and 5 exogenous variables, of which government consumption and exchange rate are policy variables. Taking into account of the limitation of the data, all the equations are specified as follows:

(1) Production

Production function is a usual Cobb-Douglas type. It relates output to inputs. More often, capital and labour are used as inputs in the production function. In this study, the data on real capital stock has to be estimated as there is no data on capital stock for Myanmar.[1] For the estimation of production function, output per labour is estimated by capital per labour, and it is expected that there is a positive relationship between these two variables.

$$YS/EMP=f(K/EMP)$$

(2) Employment

It is common to see that if economic activities of a country increase, demand for labour will also increase in order to produce more output for increasing demand for output. Therefore,

[1] We have estimated the initial period of capital stock as ,$k_0 = \sum_{I=-1}^{-7} INV_1$ and the values for other periods are shown in the identity.

employment level would be a positive function of nominal income, which is a proxy for economic activities of a country.

$$EMP=f(YD*PGDP/100)$$

(3) Real Private Consumption

Real private consumption is explained by nominal deposit interest rate and real disposable income. Here, disposable income is obtained by subtracting the tax revenue of government from domestic income. If deposit interest rate increases, current consumption becomes more expensive than future consumption. Thus, people will save more money instead of consuming in current period. Therefore, it is expected that real private consumption has a negative relationship with deposit interest rate. In contrast with deposit interest rate, when disposable income increases, private consumption will also increase as consumption smoothing provides people higher utility. Hence real consumption is assumed to be positively associated with real disposable income.

$$PC=f\{II, (YD-(TAX/PPC)\}$$

(4) Real Investment

Since the separate accounts of investment for public and private are not available, the investment at aggregate level has to be analyzed. It is generally assumed that real investment is dependent on real interest rate and real income. By theory, real investment will decrease if the cost of capital to be invested increases. However, in this study, the coefficient of real interest rate is found to be insignificant, indicating that real interest rate cannot explain the behavior of investment in Myanmar. Therefore, it was dropped, and only real income is used to estimate the real investment. It is assumed that if real income increases, real investment will also increase. Thus, real investment should be a positive function of real income.

$$INV=f(YD)$$

(5) Real Exports of Goods and Services

In general, exports volume of a country is highly dependent on its exports prices and income of foreign countries. But in this study, the coefficient of the income of foreign countries is found to be insignificant. This implies that the exports of Myanmar have little influence on international trade. Thus, relative price of home country to foreign country and capital per labour, a proxy for domestic capacity to produce more output, are used to explain the variation of the exports of Myanmar. Increase in relative price means that the export prices of home country become more expensive than prices in foreign countries. As a result, export demand from foreign countries will decrease. In contrast, if capital per labour increases, home country can export more than before. Hence, export demand may be a negative function of relative price and a positive function of capital per labour. As in other studies, it would be better if we could analyze the responsiveness of different groups of export items, e.g. SITC[2], to relative price and income of foreign countries, and thereby we could recommend which groups of export items should be exported more and which are not. However, due to the lack of disaggregate data on exports, we can analyze only at the aggregate level of exports.

$$X=f\{(PX/EI)*100/PW, K/EMP\}$$

[2] SITC=Standard International Trade Classification

(6) Real Imports of Goods and Services

Real imports are explained by relative price of import price to domestic price, and domestic real income. If relative price increases, the prices of foreign countries become higher than those in home country, so home country will import less. In contrast, if home country's real income increases, there will be more capacity for home country to import foreign countries' goods. Thus, real import is a negative function of relative price and a positive function of real domestic income. As in the case of real exports, the lack of disaggregate data blocks our wish to study at disaggregate level.

$$M=f\{PM/PGDP, YD\}$$

(7)Money Demand

Money demand is normally a function of real deposit interest rate and real income. If real deposit interest rate increases, people may realize that it is more beneficial for them to put their money in the bank rather than holding money at home. In contrast, if real income increases, people may want to hold more money for increasing financial transitions. Therefore, it is assumed that money demand has a negative relationship with real deposit interest rate and a positive relationship with real income. However, the coefficient of real interest rate was found to be insignificant. Thus, it was dropped and the money demand is estimated only with real income.

$$M2/PPC=f\{YD\}$$

(8) Nominal Deposit Interest Rate

Since the coefficients of money supply and real income were found to be insignificant, only inflation is used to explain the nominal deposit interest rate. It is assumed that if inflation goes up, nominal interest rate will also increase. Thus, nominal interest rate is specified as a positive function of inflation.

$$II=f(INF)$$

(9) Tax

Tax is the main revenue for the government and assumed to be dependent on nominal income. Thus, it is specified as a positive function of nominal income.

$$TAX=f(YD*PGDP/100)$$

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(10) Implicit Deflator of Private Consumption

Private consumption deflator shows the price changes of all consumer goods during a specified period of time. Although money supply and real income are used to explain the behavior of price levels in other studies, they cannot be used in the case of the price behavior of Myanmar as their coefficients were found to be insignificant. Therefore, private consumption deflator is assumed to be a positive function of GDP deflator.

$$PPC=f(PGDP)$$

(11) Implicit Deflator of Exports of Goods and Services

It is assumed that if domestic price levels increase, export price will also increase. Thus, export deflator is simply estimated by GDP deflator, and it is also expected that there is a positive correlation between these two variables.

$$PX=f(PGDP)$$

(12) General Deflator for GDP

GDP deflator shows the changes of general price levels over a specified period of time and depends on many factors. Here, import price and production level of a country are used to explain the variation of GDP deflator. It is assumed that if import price increases, overall domestic price level will also increase, and if output increases, overall domestic price level will decrease. Thus, GDP deflator may be determined as a positive function of import price and a negative function of production level.

$$PGDP=f(YS/EMP, PM)$$

(13) Consumer Price Index

Consumer price index shows price changes of a set of consumer goods during a specified period of time. It is often used as an indicator of inflation. As in the previous price equations, money supply and real income cannot explain the price behavior of Myanmar as their coefficients were found to be insignificant. Therefore, consumer price index is simply a positive function of GDP deflator.

$$CPI=f(PGDP)$$

5. Estimation

Firstly, all the variables are tested for unit root problem by employing the Augmented Dickey-Fuller (ADF) test. The null hypothesis of this test is that the series has unit root problem. For the ADF test, intercept and trend are chosen for all series and the maximum number of lags is determined by the Schwarz Information Criterion. The results of the unit root test are presented in Table (2).

Table (2): Augmented Dickey-Fuller Test Statistics

Variable	Level	First Difference	Second Difference
CPI	14.23	3.8	-17.32***
E	-2.14	-3.21	-4.33**
EI	-2.14	-3.21	-4.33**
EMP	-1.87	-4.55***	-8.44***
G	0.14	-5.96***	-6.96***
I1	-1.85	-3.07	-5.04***
INF	-1.31	-9.64***	-4.80***
INV	4.31	-1.42	-4.21**
K	3.51	2.87	-1.88
M	-1.52	-5.20***	-6.76***
M2	3.34	4.21	0.64
PC	3.03	-2.35	-7.76***
PGDP	6.49	3.36	-0.63
PM	-2.45	-3.72**	-5.96***
PM$	-3.12	-3.31*	-4.79***
PPC	14.25	3.75	-5.99***
PW	-2.24	-3.46*	-5.05***
PX	-1.3	-4.97***	-5.27***
SDC	-1.99	-4.38**	-8.64***
TAX	3.98	3.91	0.87
X	-1.84	-3.80**	-6.44***
YD	5.86	-1.43	-6.21***
YS	5.86	-1.43	-6.21***

Note: *, **, and *** indicate the significance level at 10%, 5%, and 1%, respectively.

As shown in the table, integrated orders are found to be different among series. That is, ten series are stationary at first difference {I(1)} while nine series are stationary at second difference {I(2)}. As unusual cases, K, M2, PGDP, and TAX are not stationary even at second difference. However, we have attempted to estimate the individual equations, assuming that the series in the cointegrating equations have the same integrated order.

Then, individual equations are estimated by two-stage least squares method. In some cases, serial correlation problem, a common feature of time series data, is found. Thus, whenever

it is necessary, the Cochrane-Orcutt procedure is employed to overcome such kind of problem and to improve the explanatory power of the regression model. Using the initial estimated coefficients, all the individual equations are simultaneously solved in the model. The estimation results of individual equations are presented and interpreted below. The t-statistics are given in parentheses and presented below the corresponding estimated coefficients. In addition, the values of degree of freedom adjusted $\bar{R}$-square ($\bar{R}^2$), standard error of regression (SE), Durbin-Watson statistics (DW), and the sample period covered in estimation (SP) are also presented.

(1) Production

$$\ln(YS/EMP)_t = 0.322 + 0.917 \ln(K/EMP)_t + 0.851\ AR(1)$$
$$(0.319)\ (9.556) \qquad\qquad (23.761)$$

$\bar{R}^2$=0.988 SE=0.034 DW=1.742 SP=1981-2005

By the above result, the coefficient of capital-labour ratio is highly significant at 1% level and has an expected sign. If the capital-labour ratio increases by 1%, the output per labour will increase by 0.917%. This implies that the amount of capital is not limited in Myanmar, and only 0.083% of total output is generated by labour. In fact, the coefficient of capital per labour is very large compared to the size and the capacity of the economy of Myanmar. The similar specification can also be seen in Yaganumah (2008). In his study, he estimated this kind of production function for the economy of Ghana, and found that only 0.25% of the total output of the economy is generated by capital while the other 0.75% is driven by labour.

(2) Employment

$$\ln(EMP)_t = 2.196 + 0.049 \ln(YD*PGDP/100)_t + 0.787\ AR(1)$$
$$(13.290)(4.365) \qquad\qquad (6.888)$$

$\bar{R}^2$=0.980 SE=0.017 DW=1.646 SP=1981-2005

In line with theory, employment level is found to be dependent on economic activities which are represented by nominal gross domestic income. This dependency is highlighted by the highly significance of the coefficient of domestic income. However, the magnitude of the income coefficient looks quite small. That is, one per cent increase in nominal income can generate only 0.05% of employment.

(3) Real Private Consumption

$$(PC)_t = 26372.16 - 723.14\ (I1)_t + 0.30\ (YD-(TAX/PPC))_t + 0.41\ (PC)_{t-1}$$
$$(2.22)\ \ (-2.23)\ \ (4.47) \qquad\qquad (2.26)$$

$\bar{R}^2$=0.993 SE=4100.814 DW=1.524 SP=1982-2005

All the coefficients are statistically significant and have expected signs. For the short run, one unit increase in nominal interest rate will lead to 723.14 unit decreases in private consumption, and the marginal propensity to consume is 0.30. Here also, the marginal propensity to consume for Myanmar is quite low compared to its per capita income and general price level

For the long run, the coefficients of nominal interest rate and real disposable income are 1225.66 and 0.51, respectively.

(4) Real Investment

$(INV)_t$=-39367.24+ 0.38 $(YD)_t$+ 0.66 AR(1)
(-6.71) (19.87) (4.13)
$\bar{R}^2$=0.989 SE=4323.811 DW=1.258 SP=1981-2005

As we expected, the coefficient of real income is significant and has an expected sign. By the estimation result, one million increases in real income will lead to 0.38 million increase in real investment.

(5) Real Exports of Goods and Services

$(X)_t$= 14515.55 - 14872.09 $((PX/EI)*100/PW)_t$ + 0.218 $(K/EMP)_t$ + 0.640 AR(1)
(-1.783) (-1.854) (2.699) (11.479)
$\bar{R}^2$=0.845 SE=1511.501 DW=2.308 SP=1982-2005

All the coefficients are significant and bear expected signs. One unit increase in relative price is associated with 14872.09 unit decrease in export demand. On the other hand, one unit increase in capital-labour ratio will lead to 0.218 unit increase in export volume.

(6) Real Imports of Goods and Services

$(M)_t$= 2781.40 - 778.00 $(PM/PGDP)_t$ - 0.004 $(YD)_t$ + 0.821 $(M)_{t-1}$
(2.582) (-2.636) (-2.093) (6.109)
$\bar{R}^2$=0.662 SE=865.843 DW=2.709 SP=1983-2005

The coefficient of the relative price of imports is significant and has an expected negative sign which implies that if relative price of imports increases by one unit, then the domestic import demand will decrease by 778 units. However, the coefficient of real domestic income has an unexpected negative sign though it is significant. Although other explanatory variables like domestic demand and foreign-exchange reserve were tried to incorporate into this equation, the better result did not come up. Moreover, if this real domestic income was dropped, the other variables were found to be insignificant and had unexpected signs. Finally, other specifications were performed but only unusual results appeared. There may be two reasons for having a negative sign of domestic income coefficient. The first is the fact that higher income elasticity of the domestic supply of import substitution leads the income elasticity of import demand to a negative value. The second is the effect of omitted variables such as foreign exchanges and import barriers[3].

[3] For more detail, see Magee (1975)

(7) Money Demand

$(M2/PPC)_t = 360.64 + 0.0007\ (YD)_t$
(10.399) (5.641)
$\bar{R}^2$=0.559 SE=75.060 DW=1.413 SP=1981-2005

By the above result, one unit increase in real income is associated with 0.0007 unit increase in money demand.

(8) Nominal Deposit Interest Rate

$(I1)_t$=-0.222 + 0.088 $(INF)_t$ + 0.811 $(I1)_{t-1}$
(-0.264)(1.758) (7.778)
$\bar{R}^2$=0.858 SE=1.592 DW=1.650 SP=1982-2005

The coefficient of inflation is significant and bears an expected sign. One unit increase in inflation is associated with 0.088 unit increase in nominal deposit interest rate.

(9) Tax

$(TAX)_t$=-44863.26+0.04 $(YD*PGDP/100)_t$+ 0.89 AR(1)
(-0.40) (4.42) (3.95)
$\bar{R}^2$=0.954 SE=23315.67 DW=1.086 SP=1981-2005

As we expected, income coefficient has a positive sign and is significant. One million increase in income is associated with 0.04 million increase in tax revenue.

(10) Implicit Deflator of Private Consumption

$(PPC)_t$=-37.24+1.05 $(PGDP)_t$+ 0.39 $(PPC)_{t-1}$
(-2.02) (6.36) (3.12)
$\bar{R}^2$=0.997 SE=57.732 DW=1.822 SP=1982-2005

In fact, this equation is a kind of bridge equation. One unit increase in gross domestic product deflator will lead to 1.05 unit increase in private consumption deflator. By the magnitude of the coefficient of GDP deflator, there is a one-to-one relationship between GPD deflator and private consumption deflator.

(11) Implicit Deflator of Exports of Goods and Services

$(PX)_t$=28.653+ 0.009 $(PGDP)_t$+ 0.734 $(PX)_{t-1}$
(1.817) (2.374) (5.676)
$\bar{R}^2$=0.731 SE=11.181 DW=1.516 SP=1982-2005

Export deflator is found to be dependent on domestic price level, which is highlighted by the significance of the coefficient of GDP deflator. If domestic price level increases by one unit, export price will also increase by 0.009 unit.

(12) Implicit General Deflator for GDP

$(PGDP)_t$=-1281.539+ 0.103 $(YS/EMP)_t$+ 3.148 $(PM)_t$-0.387AR(1)
(-16.028) (12.411) (3.885) (1.897)
$\bar{R}^2$=0.983 SE=85.729 DW=1.710 SP=1981-2005

By the estimation result, one unit increase in import price will lead to 3.148 unit increase in GDP deflator. However, inconsistent with the theory, the coefficient of output per labour has an unexpected sign though it is highly significant.

(13) Consumer Price Index

$(CPI)_t$=-13.383+0.786 $(PGDP)_t$+0.414 $(CPI)_{t-1}$
(-0.704) (5.909) (3.296)
$\bar{R}^2$=0.993 SE=67.809 DW=1.316 SP=1982-2005

By the result, the coefficient of GDP deflator is significant and has an expected sign. One unit increase in GDP deflator will lead to 0.786 unit increase in consumer price index.

After estimating all equations, serial correlation problem of residual terms is also tested by the Breusch-Godfrey test with lag one. By this test, all equations are free from serial correlation problem, except exports, tax, implicit deflator for private consumption, and consumer price index equations (the results are not presented in this study). Since all series are not stationary at level, we need to test whether they are cointegrated or they have long-run relationship or not. The cointegration of individual equations can be confirmed by testing whether the residuals of estimated equations have unit root problem or not. The unit root problem is tested by the ADF test. In this setting, only intercept term is included, assuming that there is no trend in residuals. The results (which are not presented due to the limitation of space) show that all residuals are stationary at level. The absence of unit root in residuals implies that the corresponding equation is cointegrated. Therefore, there is long-run relationship among variables in cointegarting equations.

To sum up, all the coefficients are significant and have expected signs except for the real income in import equation and the output per labour in GDP deflator equation. In addition, in some cases, the magnitude of some coefficients is different from those in other studies. Almost all individual equations have high explanatory power. However, high explanatory power of individual equations does not necessarily mean that the simulation result of the whole model will be good. Surely, low explanatory power and misspecification of some equations in the model, and unexpected signs of some coefficients not only affect the performance of simulation but also lead to contradicting results.

5.1 Identities Used in the Model

$$YD=PC+G+INV+X-M+SDC$$
$$PM=PM\$*EI*100$$
$$EI=(E/6.276^{4})*100$$
$$INF=((CPI_t-CPI_{t-1})/CPI_{t-1})*100$$
$$K_t=(0.95*K_{t-1})+INV_t$$

5.2 List of Variables Used in the Model

5.2.1 Endogenous Variables

CPI=Consumer Price Index (1990=100)
EI=Exchange Rate Index (1990=100)
EMP=Total Employment (in millions)
I1=Deposit Interest Rate (annual %)
INF=Inflation (CPI growth rate)
INV=Real Aggregate Investment (kyat in millions)
K=Estimated Real Capital Stock (kyat in millions)
M=Real Imports of Goods and Services (kyat in millions)
M2=Money Supply (kyat in millions)
PC=Real Private Consumption (kyat in millions)
PGDP=General Deflator for GDP (1990=100)
PM=Implicit Deflator of Imports of Goods and Services (1990=100)
PPC=Implicit Deflator of Private Consumption (1990=100)
PX=Implicit Deflator of Exports of Goods and Services (1990=100)
Tax=Government Revenue from Tax (kyat in millions)
X=Real Exports of Goods and Services (kyat in millions)
YD=Real GDP (kyat in millions)
YS=Real Total Output (kyat in millions)

5.2.2 Exogenous Variables

E=Official Exchange Rate of Local Currency per U.S. Dollar (period average)
G=Real Government Consumption (kyat in millions)
PM$=Implicit Deflator of Imports of Goods and Services in U.S. Dollar (1990=100)
PW=World Consumer Price Index (1990=100)
SDC= Statistical Discrepancy (kyat in millions)

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[4] Base year's value

6. Simulation, Multiplier Analysis, and Forecasting

After estimating individual equations, the whole model is run for dynamic simulation over the last sixteen-year period, 1990-2005, to see the model's tracking performance on the historical data. The performance of a model can be evaluated by examining whether the model is able to track the turning points of the historical data, and calculating several measures. Here, two measures, root mean square percentage error (RMPSE) and mean percentage error (MPE), are used to evaluate the performance of our model. The figures of dynamic simulation for the endogenous variables of behavioral equations are presented in Figure (6.1). By the figure, output, money supply, private consumption deflator, GDP deflator, and consumer price index are able to track the historical data very well while the series of employment, private consumption, investment, nominal interest rate and tax are somewhat over and/or under estimated. However, the overall tracking performance of exports, imports and export deflator is not so good as they miss major turning points. Although the performance of those equations can be improved by incorporating dummy variables in order to capture the effects of sudden changes in some years, it is difficult to give the reasons for dummy variables as there were economic or political changes in those years. In addition to providing the figures of the simulation of the endogenous variables of the behavioral equations for the visual judgment, the results of RMPSE and MPE are also provided in Table (3). As shown in Table (3), most variables have the values of RMPSE in an acceptable range of about 3% to 38%. However, for the tax variable, it has very high RMPSE of 81%. The values of MPE describe the bias of the prediction of our model. That is, negative entries present upward bias and positive entries show downward bias. As in the case of RMPSE, most variables have acceptable values of MPE, except tax variable.

Table (3): RMPSE and MPE of Selected Variables (1990-2005)

Variable	RMPSE	MPE	Variable	RMPSE	MPE
YS	2.940	0.327	II	37.912	-15.657
EMP	2.521	0.471	TAX	81.321	-30.120
PC	8.552	3.815	PPC	20.320	-0.861
INV	21.727	4.108	PX	10.302	0.320
X	33.069	8.323	PGDP	15.792	-3.439
M	13.485	-10.561	CPI	18.805	-2.000
M2	17.923	2.334			

Note: RMSPE and MPE are computed as follows:

$$RMPSE = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\frac{Y_t^s - Y_t^a}{Y_t^a}\right)^2} * 100 \; ; MPE = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{Y_t^s - Y_t^a}{Y_t^a}\right) * 100$$

where Y^s=simulated values, Y^a=observed values, and T=number of simulated periods

On average, while imports, interest rate, tax, private consumption deflator, GDP deflator, and consumer price index are over predicting the historical data, the other variables are under predicting.

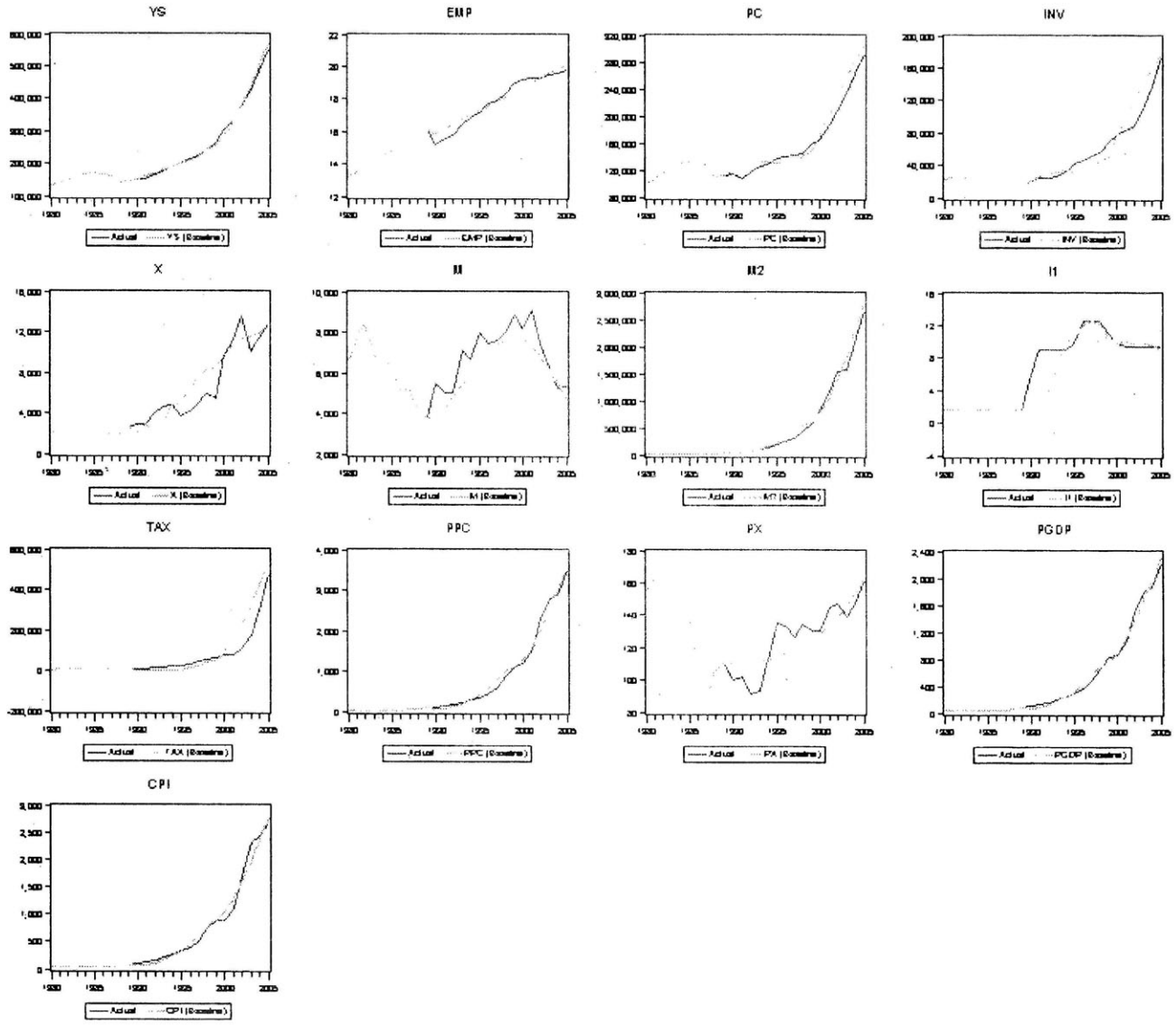

Figure (1): Simulation of Endogenous Variables

One of the objectives of this study is to examine the impact of government policies on the economy, i.e. fiscal policy and exchange rate policy. This objective can be achieved through multiplier analysis. Multiplier is obtained by dividing with a magnitude of shock, change in policy variable, to the difference between the base-run and the policy simulation values of an endogenous variable. The base-run simulation values of endogenous variables are its values in the system for "given actual values of exogenous variables" while the policy simulation values of endogenous variables are its values in the system for "given exogenous variables after a certain shock is introduced." The magnitude of shock is arbitrarily determined. Thus, we subjectively increase government consumption (G) and official exchange rate (E) by 10% over their historical time paths, and analyze the effects of the changes of these policy variables on other variables. The responses of selected variables to these policy shocks are presented in Table (4) and (5).

Table (4) Results of Multiplier Analysis: Fiscal Policy

Year	YD	PC	INV	TAX	M	M2	PX	CPI	PGDP
1990	2.67	0.68	1.01	0.23	0.02	1.23	0.00002	0.002	0.002
1991	2.86	0.83	1.08	0.54	0.07	3.51	0.00007	0.005	0.005
1992	2.70	0.76	1.02	0.88	0.09	6.32	0.00013	0.009	0.009
1993	2.86	0.85	1.08	1.16	0.08	8.35	0.00019	0.012	0.011
1994	3.58	1.29	1.36	1.85	0.09	13.25	0.00031	0.019	0.016
1995	4.18	1.64	1.58	2.26	0.07	16.49	0.00040	0.023	0.020
1996	4.79	1.98	1.82	2.88	0.04	19.17	0.00046	0.026	0.022
1997	5.56	2.43	2.11	3.85	0.02	23.65	0.00054	0.030	0.025
1998	6.17	2.77	2.34	4.87	0.00	28.33	0.00063	0.034	0.029
1999	6.70	3.08	2.54	5.75	-0.02	33.36	0.00073	0.039	0.033
2000	7.47	3.52	2.83	8.35	-0.05	43.97	0.00090	0.047	0.039
2001	8.11	3.87	3.07	11.39	-0.07	55.12	0.00105	0.054	0.044
2002	8.73	4.23	3.31	14.79	-0.09	67.62	0.00121	0.060	0.049
2003	8.69	4.20	3.30	17.08	-0.10	73.82	0.00123	0.060	0.048
2004	8.71	4.20	3.30	19.33	-0.11	80.12	0.00124	0.060	0.048
2005	8.75	4.21	3.32	21.38	-0.12	85.91	0.00125	0.060	0.048

Table (5): Results of Multiplier Analysis: Exchange Rate Policy

Year	YD	PC	TAX	X	M	M2	PX	CPI	PGDP
1990	0.03	-0.18	0.23	0.23	0.03	1.62	0.00003	0.003	0.003
1991	-0.37	-0.40	0.24	0.21	0.04	2.34	0.00005	0.004	0.003
1992	-0.33	-0.39	0.26	0.23	0.05	2.73	0.00007	0.004	0.003
1993	-0.04	-0.20	0.32	0.21	0.04	3.09	0.00009	0.005	0.004
1994	0.30	0.03	0.47	0.19	0.03	4.02	0.00011	0.006	0.005
1995	0.68	0.25	0.63	0.20	0.03	5.22	0.00014	0.008	0.006
1996	0.89	0.40	0.94	0.17	0.02	6.99	0.00018	0.010	0.009
1997	1.00	0.48	1.27	0.15	0.01	9.02	0.00022	0.012	0.011
1998	1.13	0.56	1.62	0.14	0.00	11.18	0.00028	0.015	0.012
1999	1.26	0.63	1.80	0.15	0.00	12.57	0.00032	0.016	0.013
2000	1.33	0.68	2.40	0.14	-0.01	14.65	0.00035	0.017	0.014
2001	1.38	0.71	3.17	0.13	-0.01	17.28	0.00039	0.019	0.015
2002	1.54	0.80	4.05	0.14	-0.02	20.75	0.00044	0.021	0.016
2003	1.84	0.95	5.57	0.17	-0.02	26.64	0.00052	0.025	0.020
2004	2.14	1.10	7.12	0.19	-0.03	32.68	0.00061	0.028	0.022
2005	2.29	1.19	8.26	0.20	-0.04	36.83	0.00066	0.030	0.023

It is found that all the variables presented in Table (4) have positive responses to the increase of government consumption though real imports have negative responses from 1999 to 2005. As in the case of the shock of government consumption, it is also found that all the variables presented in Table (5) have positive responses to the increase of exchange rate although real income and real private consumption have negative responses in the first four years, and real imports has negative responses in the last six years.

As a final goal of model construction, forecasting is also carried out. At this stage, the future values of exogenous variables are obtained prior to forecasting. There are several ways to obtain historical growth of exogenous variables. Some scholars obtain these values from the government reports while some employ econometric techniques to extrapolate the historical path. In this study, the required future values of all exogenous variables are generated by the first order autoregressive model. Then, the ex-post forecasting is performed for the years 2006 and 2007. The forecasted values and observed values of some essential variables are presented in Table (6). By the results, it is found that the forecasting ability of our model is quite satisfactory though there is a bit higher deviation for real investment and real imports. By the values of deviation, our model underestimates the observed values, on average.

Table (6): Comparison between Forecasted and Observed Values (2006-2007)

Variable	Year	Observed value	Forecasted value	% Deviation
YD	2006	621000	606974.1	-2.26
	2007	655000	648165.2	-1.04
PC	2006	321000	328505.9	2.34
	2007	339000	350222.9	3.31
INV	2006	228000	190862.4	-16.29
	2007	241000	206486.8	-14.32
X	2006	14181.01	14143.9	-0.26
	2007	15338.38	15373.81	0.23
M	2006	5989.53	3963.017	-33.83
	2007	6371.01	3148.536	-50.58

7. Conclusion

Using annual time series data from 1980 to 2005, this study has constructed a small macroeconometric model of Myanmar. The model consists of 13 behavioral equations and 23 variables. Individual equations in the model are specified in simple way due to the limited number of explanatory variables. In order to improve the efficiency, two-stage least squares method is used to solve the whole model. By the estimation results, almost all coefficients have expected signs and are significant. However, the magnitude of some coefficients is somewhat different from the existing coefficients and sometime contradicts the theory. In addition, the inclusion of coefficient which has an unexpected sign deteriorates the overall performance of the model. Nevertheless, we can conclude some implications from the results of estimation and policy scenarios can be concluded as follows:

(1) Interest rate cannot explain the investment behavior of Myanmar, and also money supply cannot explain the domestic price level.

(2) Increase in government consumption boosts domestic income and investment.

(3) Devaluation of official exchange rate raises domestic income as well as exports.

Finally, there may be some weaknesses and shortcomings in estimation and specification. In addition, it is not considered the structural changes of the economy of Myanmar in the model. The task may be performed in future studies. However, this study can at least provide some information on the economy of Myanmar to the policy makers.

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