The Social Sciences 11 (21): 5275-5279, 2016
ISSN: 1818-5800

Evaluation of Bangkok Bomb by Long-Run Macro-Economic Model

Bundit Chaivichayachat
Department of Economics, Kasetsart University, 10900 Bangkok, Thailand

Abstract: The aim of this study is to construct a long-run relationship macro-economic model for Thai Economy and to apply the estimated model to evaluate the impact of Bangkok bomb on Thai economy. A structural model was set up by employing a national account system and balance of payments. There are 6 groups of equations in the structural model including domestic demand, aggregate supply, financial market, external sector, price adjustment mechanism and macroeconomic policy. The structural model consists of 16 behavioral equations and 12 identities. Each behavioral equation was assigned to find the cointegrating vector following the method of Johansen system cointegration test. Using the quarterly data during 1993-2015, the long-run relationship among the variable in each behavioral equation were estimated. All of the behavioral estimated equations in the model can be used to explain each part of Thai economy with statistical significance. The results of the ex-pose stochastic simulation and the Thiel's inequality coefficient indicate that the estimated model can capture the behavior of endogenous variable properly. It is only 7.4% of the error were generated. For the application, the estimated long-run macroeconomic model for Thai economy was employed to evaluate the impacts of Bangkok bomb. A seriously bomb in the middle of Bangkok in the early night of 17 August 2015 caused the number of foreign tourists and the foreign tourism revenue declined and slowdown output growth.

Key words: Macro-economic model, Thailand tourism, growth, tourists, bomb

INTRODUCTION

Simulation the impacts of economic shock including policies shock and exogenous shock, is one of many important task for the economists. Many types of macro-econometric model have been proposed such as Keynesian macro-economic model, Structural Vector Autoregressive (SVAR), Input-Output table (IO), Computable General Equilibrium Model (CGE) and Dynamic Stochastic General Equilibrium (DSGE) Model for describe the behavior of economic agents in various roles. Each kind of model can be applied for simulation based on the variety of assumptions and economic environments. The aim of this paper is to construct a long-run relationship macroe-conomic model for Thai economy of simulation the impact of various shocks byemployed the traditional Keynesian Model. There are many macro-economic model set up the model based on this concept including Bhattarai (2005), Greenslade and Hall (1996), Hunt *et al*. (2000), Wallis *et al*. (1984), Yildirim *et al*. (2011) and Zhi (2016). However, the weaknesses of this type of macro-economic model, discussed by Sargent (1981) were considered by including inconsistent behavior, the role of dynamic behavior and the behavior of individual economic agents in the model. The modern econometric techniques, Johansen system cointegration test (Johansen and Juselius, 1990) and stochastic simulation were approached into this model. Then, the estimated model can be used to evaluate the economic shocks in Thai economy.

MATERIALS AND METHODS

Structural model: The outline of structural model was arranged following the structure of the national account system and the balance of payments account, following Chaivichayachat (2014, 2015). There are 6 groups of equations including domestic demand, aggregate supply, financial market, external sector, price adjustment mechanism and macro-economic policy. The domestic demand was used to explain the behavior of private consumption and private investment. For the aggregate supply, the production function was estimated to calculate the actual output in Thailand. The potential output was calculated and then it is used to define the output-gap, the key factor for price adjustment mechanism. For the dynamic adjustment in the model, price adjustment was proposed to adjust the output gap and expectation on inflation. In financial market, the demand for money and the stock exchange index are the key factors in this study. The equations in the external sector were setup following the structure of balance of payments. The functions of exports, imports, tourism

Table 1: Variables in model

Variables	Sources
CUR (Current account balance)	BOT
TB (Trade Balance)	BOT
CI (Changes in Invetory)	NESDB
CP (Private Consumptions)	NESDB
CPI (Consumer Price Index)	MOC
CU (Capacity Utilization)	OIE,BOT
DD (Dometic Aggregate Demand)	Calculation
DY (Disposable Income)	Calculation
ER (Baht: USS)	BOT
ERR (Effective Real Exchange Rate)	BOT
EX (Exports of Goods and Services)	NESDB
FD (Financial Development Index)	Calculation
FDI (Net Foreign Direct Investment)	BOT
FP (Net Foreign Portfolio Investment)	BOT
FR (Foreign Reserves)	BOT
GDP (Gross Demestic Products)	NESDB
GG (Government Consumption)	NESDB
IF (Inflation)	BOT
IG (Govrnment Investment)	NESDB
IM (Imports of Goods And Services)	NESDB
IP (Private Investment)	NESDB
K (capital stock)	NESDB
LB (Labor Force)	NSO, BOT
M2A (Broad Money Supply)	BOT

Table 2: Structural model

Variables	Sources
M2aUS (Broad Money Supply)	FED
MW (Average Wage)	NSO, BOT
OP (Trade Openness Index)	Calculation
PH (Housing Price Index)	BOT
PM (Imports Price Index)	MOC, BOT
PUS (Consumer Price Index (US))	IMF
PX (Exports Price Index)	MOC, BOT
R (Interbank Rate)	BOT
RF (World Interest Rate)	BOT
RL (MLR)	BOT
RP (Policy Rate)	BOT
RT (Time Deposits (6 months))	BOT
RUS (Fed Funds Rate)	FED
SI (SET Index)	SET
TC (Corperate Tax)	FPO
TCE (Effective Corperate Tax)	Calculation
TF (Foreign Tourist)	TOT
TP (Personal Income Tax)	FPO
TR (Foreign Tourism Revenue)	BOT
TT (Time Trend)	Calculation
UL (Unemployemebnt Rate)	NSO, BOT
YGAP (Output Gap)	Calculation
YP (Potential Output)	Calculation
YUS (Gross Domestic Products (US))	IMF

revenue and nominal exchange rate were constructed to characterize the openness of Thai economy. For the tourism revenue, the function was set up following Chaivichayachat (2015, 2016). The last group of equations was devoted for the macroeconomic policy transmission. The equation involving the government budget; tax revenue, government expenditure and public debt were designed for fiscal policy channel. For the monetary policy, the interest rate channel was assigned to transmit the impacts of changing policy rate to market rates which are saving rate, loaning rate and interbank rate. Based on this structure, there are 16 functions of endogenous variables. Each function was organized by modern economic theory and recently empirical works. The structural model consists of 16 behavioral equations and 12 identities:

- AD = DD + CUR
- DD = CP + IP + GE + CI
- CP = f (DY, PH, SI, RS, ER, FD, IF, CP(-1))
- IP = f (CI, RL, SI, YI, TBE, FD)
- CUR = TB + SB
- TB = EX - IM
- EX = f (YW, ERR, PX)
- IM = f (PM, Y, ER)
- YP = (GDP×100)/CU
- Log(GDP) = f (log(CA), log(LB), T)
- UL = f (Y, MW)
- YGAP = YP-GDP
- ULR = UL/LB
- M2A = f (GDP, RT, PC, FD)
- SI = f (R, Y, IP, SIE, PE, ER, FP)
- FD = M2a/GDP
- FDI = f (Y, MW, ER, OP, R, YW, CA)
- FP = f (Y, PE, RE, ER, YF, SI, R-RW)
- TR = f (Y, YW, RP, GT, ER, OP, TR)
- ER = f (R, RF, Y, YUS, M2A, M2AUS)
- ERR = (ER×WP)/CPI
- OP = (EX+IM)/GDP
- CPI = f (YGAP, OP, UL)
- YD = GDP - TP
- TCE = TC/GDP
- RS = f (I, S, FD, M2a, RP)
- RL = f (I, S, FD, M2a, RP)
- RI = f (I, S, FD, M2a, RP, RF, PE)

All of the variable names were listed in Table 1 and 2.

RESULTS AND DISCUSSION

Estimation and ex-pose stochastic simulation: Each behavioral equation was assigned to fine the cointegrating vector following the method of Johansen system cointegration test. The quarterly data during 1993 to 2015 were collected from Bank of Thailand (BOT), Ministry of Finance (MOF), Ministry of Tourism and Sports (MOTS) and Office of the National Economic and Social Development Board (NESDB). The long-run relationship among the variable in each behavioral equation were estimated. The estimated model was solved by stochastic simulation to explore the performance of the estimated model.

Table 3: AIC and trace statistic

Function	Lag length criteria		Cointegrating Vector (CV)	
	AIC	Lag length	Trace Stat.	No. of CV
Private **Consumption**	61.94	8	9.62	7
Private Investment	103.37	5	55.17	4
Exports of goods and services	41.31	4	127.01	2
Imports of goods and services	53.61	5	102.96	2
Production	20.48	4	77.01	1
Unemployement	50.29	5	44.80	1
Money Supply	50.67	4	39.97	3
Set Index	83.18	8	29.09	5
Foreign direct **Investment**	66.99	5	41.65	3
Foreign portfolio **Investment**	62.12	8	13.29	6
Foreign tourism **Revenue**	68.01	4	36.29	5
Nominal **Exchange rate**	78.83	3	62.93	5
Consumer price **Index**	36.16	4	62.85	1
Time deposit rate	26.93	3	58.19	1
MLR	24.81	3	21.37	3
Interbank rate	23.81	3	40.63	2

Estimation: Using the quarterly data during 1993-2015, the long-run relationship among the variable in each behavioral equation was estimated. Kwaitkowski-Phillips Shmidt Shin (KPSS) statistics indicates that all variables in 16 functions for endogenous variables are stationary after taking the first difference, called I(1). All of them are satisfied the necessary condition for identification of cointegration vector. Table 3, lag length criteria, based on Akaike Information Criterion (AIC) was used to specify Vector Autoregressive (VAR) for each function. The Trace statistic was employed for the hypothesis testing for the number of significance cointegrating vector.

Following the optimal lag length and the maximum likelihood method, the selected unnormalized cointegrating vector for each function were estimated. Then, the significance unnormalized cointegrating vectors for each variable will selected and normalized by the first variable in the vector in order to represent the long-run relationship among the variables in each function. The results shown that all of the estimated behavioral equations in the model can be used to explain each part of Thai economy with statistical significance and following concept of long-run relationship. The estimated model is.

Aggregate demand:

- $AD = DD + CUR$
  $DD = CP + IP + GE + CI$
- $CP_t = 824124.9 + 0.37297DY_t + 4816.43243PH_t + 72.48649SI_t - 17418.6RT_t + 34321.2FD_t - 3303.9ER_t$
- $IP_t = 34787.3 - 2.125CI_t - 23566.93PH_t + 149.49324SI_t - 46041.1TCE_t + 5.16892 (GDP_t - GDP_{t-1}) + 40.13514FDI_t$
- $CUR = TB + SB$
- $TB = EX - IM$
- $EX_t = -451527.1 + 59.30636WGDP_t + 186703.64 (Er_t \times USP_t)/CPT_t - 12896.879PX_t$
- $IM_t = -1146853.9 - 395.889PM_t + 1.23GDP_t + 97078.776 (ER \times USP_t)/CPI_t$

Aggregate supply:

- $YP = (GDP \times 100)/CU$
- $Log (GDP)_t = 10.4107 + 0.7121 \log (LB)_t + 0.7164 \log (K)_t$
- $UL_t = 2002.32668 - 0.00101GDP_t + 0.06142MW_t$
- $YGAP = YP-GDP$
- $ULR = UL/LB$

Financial sector:

- $M2A_t = -12654608+ 3.81683GDP_t - 261240.1RT_t + 2047094.55RT_t + 59204.5CPI_t$
- $SI_t = -563.4684 - 174.96139RI_t + 0.00002GDP_t + 0.00929IP_t + 31.965ER_t + 0.00463FP_t$
- $FD = M2a/GDP$

External sector:

- $FDI_t = -26215.6 + 0.10308GDP_t - 0.3806MW_t + 342.75023ER_t + 0.4911WGDP_t$
- $FP_t = 9783.6 + 0.00032GDP_t + 115.44858SI_t + 355.655RI_t - 949.487USFED_t$
- $TR_t = -6413.85 + 0.002196GDP_t + 5.201005CPI_t/WP_t + 20.705787ER_t + 1396.684OP_t + 0.269898WGDP_t + 1.913712NFT_t$
- $ER_t = 257.05422 - 0.53429RI_t - 0.00002GDP_t - 0.00001M2A_t - 7.40146CPI_t 8.2444USGDP_t - 0.05539USM2_t$
- $ERR = (ER \times WP)/CPI$
- $OP = (EX+IM)/GDP$

Price adjustment:

- $CPI_t = 11.19761 + 0.00039YGAP_t - 0.00071UL_t + 56.57853OP_t$

Policy setp:

- $YD = GDP - TP$
- $TCE = TC/GDP$
- $RT_t = 11.00552 - 4.93223FD_t - 0.00000M2A_t + 0.42161RP_t$
- $RL_t = 6.27682 - 0.76919FD_t - 0.000000M2A_t + 0.42479RP_t$
- $RI_t = -3.4257 - 0.40699FD_t - 0.000000M2A_t + 1.05795RP_t$

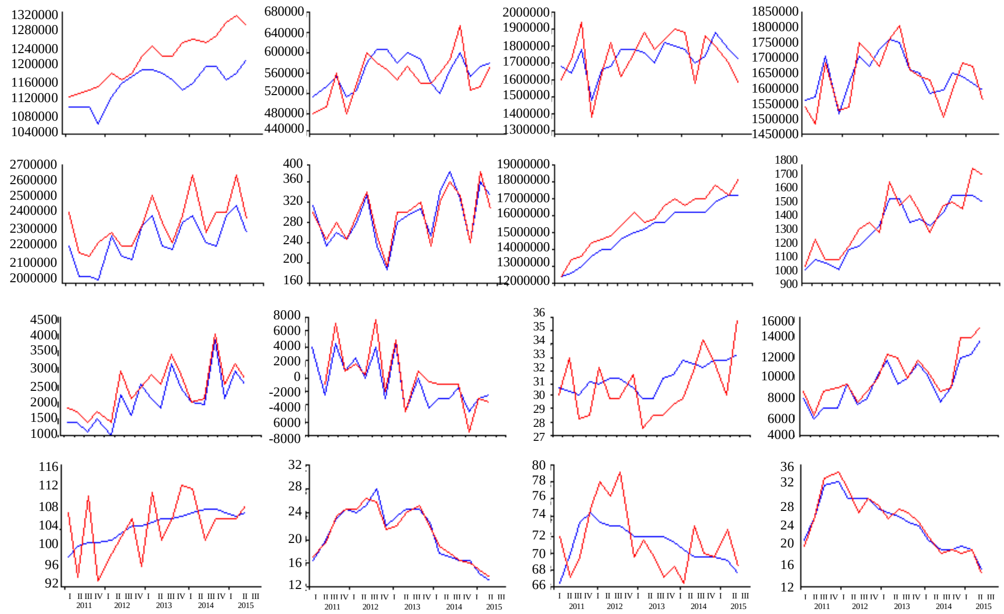

Fig. 1: Ex-pose stochastic simulation

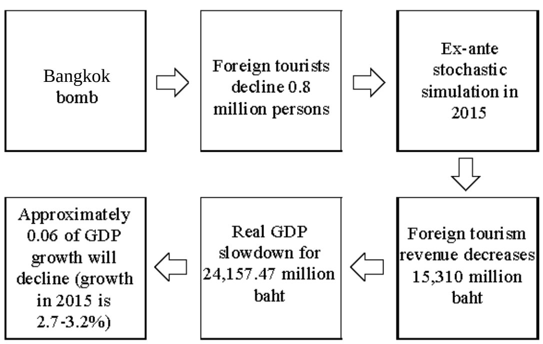

Fig. 2: Impact of bangkok bomb to Thai economy

Ex-pose stochastic simulation: The estimated long-run behavioral equations and the identity equations were solved simultaneously by the simulation technique called stochastic simulation in order to evaluate the performance of the estimated model. This simulation technique allows the estimated parameter distributed randomly. The results of the ex-pose simulation generated by the stochastic simulation (Fig. 1). The estimated model explains the behavior of endogenous variable properly. All simulated paths move closely to the actual value. Table 4, the Theil's inequality coefficients (U) lie between 0.0109-0.1245. The average U statistic for all endogenous variables is 0.0739. It is only 7.4% of the error which are generated in ex-pose simulation basis.

Evaluation of Bangkok bomb: For the application, the estimated long-run macroeconomic model for Thai economy was employed to evaluate the impacts of Bangkok bomb. A seriously bomb in the middle of Bangkok in the early night of 17 August 2015 caused the number of foreign tourists in the third quarter of 2015 declined approximately 10% (0.8 million foreign tourists). The declining in the number of foreign tourists induced the foreign tourism revenue drop by 15,310 million baht. Finally, following the stochastic simulation for 2015, the impacts of Bangkok bomb will cause the output decrease by 24,157.47 million baht or 0.06 of output growth. Thus, the economic growth of Thai economy in 2015 is 2.7-3.2 (Fig. 2).

Table 4: Theil's inequality coefficient by ex-pose stochastic simulation

Variables	U	Percentage of error
CP	0.0574	5.74
IP	0.9480	9.48
EX	0.0978	9.78
IM	0.0598	5.98
LOG (GDP)	0.0681	6.81
UL	0.0912	9.12
M2A	0.0109	1.09
SI	0.1245	12.45
FDI	0.0766	7.66
FP	0.7970	7.97
TR	0.0689	6.89
ER	0.1112	11.12
CPI	0.0703	7.03
RT	0.0922	9.22
RL	0.2840	2.84
RI	0.0504	5.04
Average	0.0739	7.39

CONCLUSION

This study setup a structural model for evaluate the economic shock for Thai economy based on national account, balance of payment and modern economic theory, named as structural long-run macro-economic model. Each behavioral equation was estimated for the long-run relationship by employing quarterly data during 1993-2015 and following the method of Johansen system cointegration test. The ex-pose stochastic simulation indicated that the estimated model can be applied to evaluate the shocks in exogenous variable and policy. For the application of the model, the economic impacts of a seriously bomb in the middle of Bangkok in the early night of 17 August 2015 was evaluated. After the bomb, the declining in the number of foreign tourists induced the foreign tourism revenue drop and slowdown the output growth.

REFERENCES

Bhattarai, K.R., 2005. Keynesian models for analysis of macroeconomic policy. Business School, University of Hull, Hull, England.

Chaivichayachat, B., 2014. Impacts of Thai Baht on tourism, sectoral final demand and sectoral output in Thailand. Int. J. Bus. Manage. Study, 1: 17-21.

Chaivichayachat, B., 2015. Impacts of changing in macroeconomic factors on foreign tourism revenue and sectoral output in Thailand. Int. J. Bus. Manage. Study., 2: 65-66.

Chaivichayachat, B., 2016. Policy promoting tourism, foreign tourism revenue and economic growth in Thailand: causality and response patterns. Int. J. Appl. Bus. Econ. Res., 14: 3937-3957.

Greenslade, J.V. and S.G. Hall, 1996. Modelling economies subject to structural change: The case of Germany. Econ. Modell., 13: 545-559.

Hunt, B., D. Rose and A. Scott, 2000. The core model of the Reserve Bank of New Zealand's forecasting and policy system. Econ. Modell., 17: 247-274.

Johansen, S. and K. Juselius, 1990. Maximum likelihood estimation and inference on cointegration: With applications to the demand for money. Oxford Bull. Econ. Stat., 52: 169-210.

Sargent, T.J., 1981. Interpreting economic time series. J. Political Econ., 89: 213-248.

Wallis, K.F., M.J. Andrews, N.F. Bell, P.G. Fisher and J.D. Whitley, 1984. Models of the UK Economy: A Review by the ESRC Macroeconomic Modelling Bureau. Oxford University Press, Oxford, UK., ISBN:9780198285014, Pages: 158.

Yildirim, E., K. Lopcu and S. Cakmakli, 2011. An open economy new Keynesian macroeconomic model: The case of Turkey. Econ. Bus. Finance, 26: 37-56.

Zhi, T., 2016. The theory and models of keynesian disequilibrium macroeconomics. Int. J. Econ. Manage. Sci., 5: 2-6.