Fiscal and Monetary Policy Mixes Linkage to Thailand's Agriculture[1]

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การศึกษานี้เดินอยู่ในเส้นทางของท้องเรื่องความเชื่อมโยงไปข้างหน้าระหว่างนโยบายเศรษฐกิจมหภาคกับการเกษตร โดยในระดับมหภาค คำถามวิจัยที่ว่านโยบายผสมระหว่างการคลังและการเงินก่อประโยชน์แก่ภาคเกษตรไทยอย่างไรถูกค้นคว้าหาคำตอบ ขั้นตอนการวิจัยเริ่มด้วยการประมาณค่าพารามิเตอร์ในแบบจำลองเศรษฐกิจมหภาคที่มีการเชื่อมโยงกับสาขาเกษตร ผลการศึกษาหลักๆพบว่านโยบายเศรษฐกิจมหภาคเหล่านั้นมีผลกระทบต่ออัตราดอกเบี้ย อัตราแลกเปลี่ยน ดัชนีราคา และผลผลิตประชาชาติ ตัวแปรเหล่านี้ได้เชื่อมตัวแปรรายจ่ายรัฐบาลและปริมาณเงินไปสู่สาขาเกษตร หลังจากนั้นค่าพารามิเตอร์ที่ประมาณถูกใช้สำหรับการจำลองสถานการณ์ เมื่อจำลองสถานการณ์ว่ารัฐบาลเพิ่มรายจ่ายเพื่อการบริโภคและปริมาณเงินมีการขยายตัว ผลการจำลองแบบอยู่ในรูปของร้อยละการเปลี่ยนแปลงเมื่อเทียบกับสถานการณ์ปกติ ซึ่งสรุปได้ดังต่อไปนี้ การบริโภคอาหาร การส่งออกและการนำเข้าสินค้าในหมวดอาหารเพิ่มขึ้น อย่างไรก็ตามดุลการค้าในหมวดอาหารเกินดุลลดลง การจ้างงานในสาขาเกษตรลดลง สต็อกทุนในภาคเกษตรเพิ่มขึ้น ส่งผลให้ผลผลิตประชาชาติสาขาเกษตรเพิ่มขึ้น ผลการจำลองสถานการณ์มีนัยว่านโยบายเศรษฐกิจมหภาคมีผลอย่างไม่ตั้งใจไปสู่ภาคเกษตร แม้ว่าเงินไม่ได้ถูกอัดฉีดเข้าไปในสาขาเกษตรโดยตรง

คำสำคัญ: นโยบายผสมระหว่างการคลังและการเงิน, สาขาเกษตรกรรม, แบบจำลองเศรษกิจมหภาคที่มีการเชื่อมโยงกับสาขาเกษตร

ABSTRACT

This study has already been in line with the theme of forward linkage between macroeconomic policies and agriculture. As a macro level, how much fiscal and monetary policy mixes benefit to Thailand's agriculture is investigated. The procedure begins with the estimation of parameters in the macroeconomic-agricultural linkage model. The main results reveal that those policies have the impact on the interest rate, the exchange rate, price index and GDP. These variables link

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government expenditure and money supply to the agricultural sector. The estimated parameters are then utilized for policy simulation. When the increase in the government consumption spending coupled with acceleration in money supply growth is demonstrated, their impacts on agricultural sector are concluded in terms of percentage change from baseline value as follows. Food consumption, export and import increase. Nevertheless, surplus of trade balance for food is worsen. Employment in agricultural sector decreases, while capital stock in agricultural sector increases. Gross domestic production in agricultural sector subsequently increases. The replication results imply that the macroeconomic policies have an unintended effect on agriculture, although the money is not directly injected into the agricultural sector.

Key words: Fiscal and monetary policy mixes, Agricultural sector, Macroeconomic-agricultural linkage model.

1. Introduction

With respect to the sense of economic development, Thailand's agricultural sector has been strongly brought up by the government through various programs. With no doubt, the program that is a so-called agricultural policy has intended impacts on the agricultural sector. Nonetheless, Schuh (1976) succinctly stated that the agricultural economists have to give greater attention to monetary and fiscal policy if they want to understand developments in the agricultural sector. Moreover, Stamoulis *et al*. (1995) argued that the agricultural sector's performance is affected not only by policies specifically designed for it but also, and often more deeply, by policies affecting the overall macroeconomic environment, e.g. public sector deficits, inflation, interest rate and exchange rate. Apart from this, the research of agricultural economics in aspect of macroeconomics school has been rarely revealed in Thailand up to the present time. Accordingly, this study is begun by asking that how macroeconomics policies linkage to agriculture. Furthermore, how much fiscal and monetary policy mixes benefit to Thailand's agriculture is investigated.

2. Literature Review

There are basically two schools of thought namely structural and computable general equilibrium models in order to investigate the effects of monetary and fiscal policy on agriculture. The former view is derived from the first welfare theorem in the line of microeconomics theory. Its quantitative analysis is also in the form of non-parametric model. The latter view is come from the general equilibrium in the way of macroeconomics theory. Quantitatively,

the parametric model, which is a so-called econometric model, is also employed. The procedures of researches in line with the theme of structural model are comprised of three steps: consideration of macroeconomic school, structure of theoretical model, and estimation & policy simulation.

Firstly, the implications each of the macroeconomic schools of thought for linkages between general economy and agriculture are quite different. According to Keynesian view, the policies had impacts on real agricultural variables but the direction of their effects remained controversial. On the other hand, the neoclassical view indicated that those policies would not have any real impacts on agriculture variables. This is because all of macroeconomic variables and agricultural price response to a policy shock by the same proportion. For the Neo-Keynesian, the policies had real impacts on agriculture in the short run. The impacts of policies would disappear as prices of nonagricultural goods rise to their long-run equilibrium over time (Choe, 1989).

Secondly, the framework of macroeconomic is developed into the structural model. The model builders adapt two strategies to capture the interaction between macroeconomy and agricultural sector. The first one is that a satellite model is separated from the macroeconomics model in the sense of providing no estimates of endogenous variables but depended on the forecasts of variables created by the macroeconomics model. The second one is that the model considers agriculture as an industrial sector (Roop and Zeitner, 1977). Finally, the econometric theories are employed for estimation and policy replication. It is separated into static and dynamic econometric model.

The rest of this part is devoted to the survey of empirical evidences. Beginning with the case of U.S. agriculture, in the early 1980s the agricultural economist paid more attention on the effects of macroeconomic policy on agriculture. This is because the international markets have experienced a severe cyclical downturn. In addition, the important structural changes have taken placed in the world economy if one compares the early 1980s to 1960s. Meanwhile, during such time a restricted monetary policy and an expansionary fiscal policy contributed strongly to the severe downturn in agriculture. The literatures, which have been in line with this theme, are Paarlberg *et al*. (1984), Kitchen *et al*. (1987) and Just (1990).

Paarlberg *et al*. (1984) is in the form of Keynesian school, structural modeling in the way of satellite model and using static macroeconometric model. They demonstrated alternative scenario, the acceleration in U.S. money growth between mid 1982 and early 1984, and the increase in the federal deficit. As the simulation results, the increase in U.S. income and the rising value of the dollar have raised U.S. import demand and, as a result, foreign exports and income increase. This

increase in income has had a positive impact on demand for agricultural goods that had at least partly offset the dampening effect of the highly valued dollar.

Kitchen *et al*. (1987) simulated the relationship between macroeconomic policy and U.S. agriculture by linking two econometric models: a macroeconomic model and an agricultural model called Food and Agricultural Policy Simulator. It is annual model including wheat, corn, sorghum, barley, oats, soybeans, soybean meal, soybean oil, cotton, rice, beef, chicken, eggs, turkeys and dairy. Under the alternative scenario of higher money growth and lower budget deficits, the main simulation results were summarized as follows. Agricultural demand increased. Consumer food expenditures increased. Meanwhile, agricultural production, net farm income and farmland values increased.

Just (1990) formulated a model of the U.S. corn, sorghum and soybeans that included the role of U.S. agricultural policies and related livestock markets. Meanwhile, the macroeconomic effects of monetary and fiscal policy are estimating using the FAIRMODEL model of the U.S. macroeconomy. The specification of these equations bases macroeconomic phenomena on microeconomic foundations. The main results revealed that an increase in government expenditures had a positive effect on most agricultural prices immediately but that the effect could turn negative for some commodities in the second year.

Owing to the initiated literature, the procedures of Paarlberg *et al*. (1984) are straightforward. The scope of their study remains the concept of aggregate agriculture instead of commodity aspect. On the one hand, the frameworks of Kitchen *et al*. (1987) and Just (1990) are rather sophisticated. The simulation results of these literatures are also reliable in the way of various agricultural products. Nonetheless, they could have two weakness points. Firstly, the simulation results were based on the annual time series data despite the action of monetary policy basically needed to employ the quarterly data. Therefore, these literatures may not perform well for macroeconomic policy makers. Secondly, with respect to the dynamic approach, their econometric model having no beneficial use in the concept of impulse response. In fact, the impacts of monetary policies are theoretically taken for a longer quarter. Hence, Vector autoregression model (VAR) would be suitable rather than ordinary regression model.

Additionally, the review of previous literature in the case of developing countries is presented as follows. In the case of Tanzania and Malawi, Lopez *et al*. (1991) formulated a simple structural model to provide insights about the quantitative importance of the various channels by which government policies had affected the agricultural exportable sector. Their simulation result indicated that fiscal policies were not neutral with respect to the structural of agricultural production. Although

their results support to the Keynesian's proposition, the theoretical model of this study is deficient in the macroeconomic theory. The variable of government spending only represents as a fiscal policy.

Wongsak (2001) developed a small-scale macroeconomic model for Thailand. The simulation results indicated that the demand for labor and GDP in agricultural sector increase owing to the fiscal policy as well as monetary policy. According to the theoretical model, this study is derived from Keynesian perspective. The model also considers the agriculture as the industrial sector. This way rather differs from the previous literature, i.e. Paarlberg *et al*. (1984), Kitchen *et al*. (1987) and Just (1990). Nonetheless, this study concentrated on only two agricultural variables so that the other variables, i.e. food export and consumption are questionable.

3. Conceptual Framework and Structural Model

Tracking down the previous literatures, the framework was outlined in Figure 1. It was schematically represented the linkages underlying the effects of fiscal and monetary policy mixes on agricultural sector. Let agricultural sector be a satellite of macroeconomy. Accordingly, the framework was separated into two blocks. The first block depicted the forward linkage among government consumption spending, money supply and macroeconomic variables. Based on the traditional Keynesian school, both of government expenditure and money supply were also treated as an exogenous variable. Keynesian view stated that they directly and indirectly affected GDP, price level, and interest rate *ceteris paribus*. They further affected the value of domestic currency. These variables, which is a so-called "transmission variable", transfer from the first block to the second block.

The second block presented the relationship between transmission variables and main aggregate variables in agricultural sector. These agricultural variables were comprised of food consumption, food export & import, employment & capital stock and gross domestic production in agricultural sector. The relationship between transmission variable and agricultural variable is presented as follows.

i) GDP would have positive impact on the food consumption and import.

ii) Price level would affect the food consumption and import via CPI for food and nonfood.

iii) Exchange rate would affect the food export.

iv) Interest rate would relate to the capital stock and employment in agricultural sector via a capital rental rate.

v) Price level would relate to the capital stock and employment in the agricultural sector via a farm price index.

vi) Interest rate and price level would relate to gross domestic production in the agricultural sector via labor and capital stock.

Such framework developed two theoretical models. First block developed the structural model of estimating impacts of government consumption spending and money supply on macroeconomics variables. Second block developed the structural model of estimating impacts of transmission variable on aggregate variable in agricultural sector according to In and Mount (1994). The complete model, which is so-called macroeconomic-agricultural linkage model, is then formulated (Table 1).

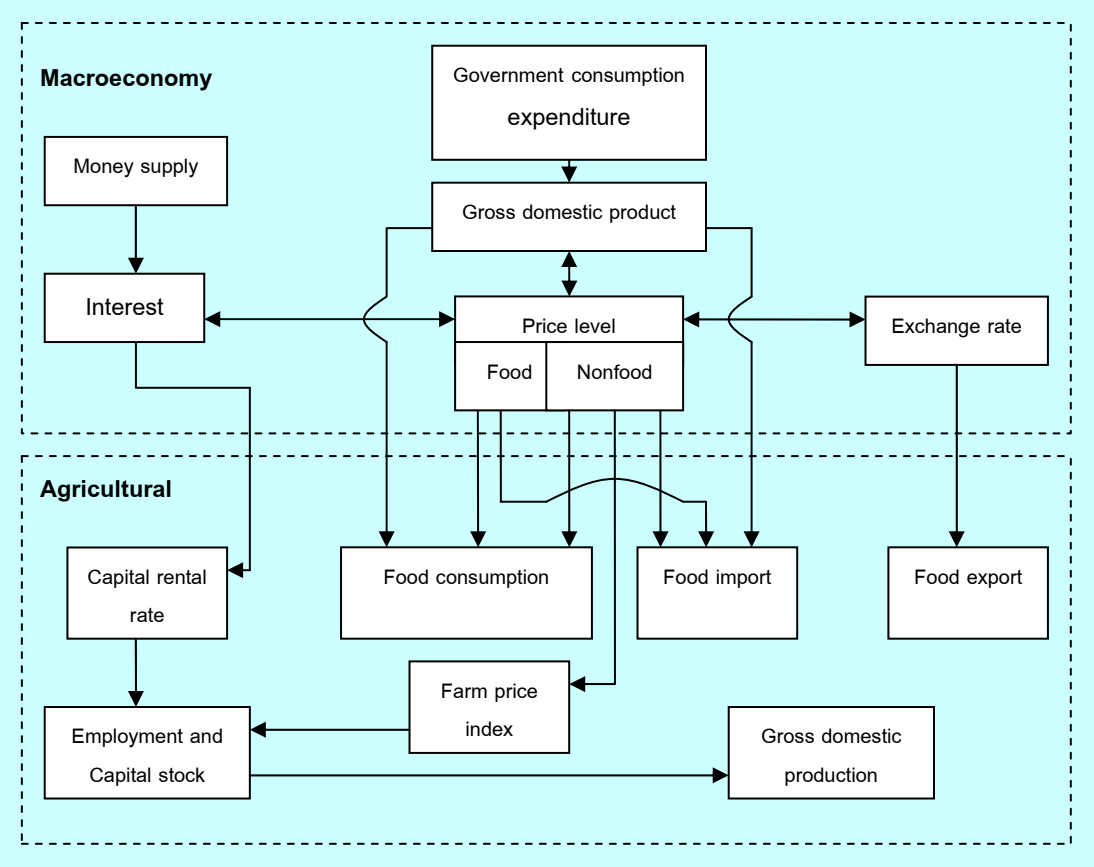

Figure 1 Conceptual framework

4. Method and Procedure

This study was comprised of three steps: estimations of equations, formulation of complete model and policy simulation.

Step1: Estimations of equations. The simultaneous equations (Eq.(1) to Eq.(7)) were estimated by two-stage least squares method. The endogenous variables consisted of Y, C, Yd, T, I, Ex and Z. The exogenous variable consisted of G, Sd, E, R, Yf and Pimp. Other behavioral equations were estimated by ordinary least squares method (Table 1). The scope of this analysis was based on time series data during the first quarter of 1997 to the third quarter of 2004. The main sources of data sets were Bank of Thailand and Office of the National Economics and Social Development Board (Appendix table).

Step 2: Formulation of complete model. The whole model consisted of 6 identity equations (Eq.(1), (3), (8), (12), (17), (19)) and 16 behavioral equations. It also contained 22 endogenous (Y, C, Yd, T, I, Ex, Z, P, Pna, Pa, Rn, R, E, Ca, Cfa, Exa, Ta, Pfarm, Ptil, Na, Ka, Ya) and 13 exogenous variables (G, Sd, Yf, Pimp, Rninb, Rf, Ms, Paw, Pfa, Pfna, Pka, δ, Wa). The baseline was solved by Gauss-Seidel algorithm for the entire period. The model was evaluated by simulation errors.

Table 1 Macroeconomic-agricultural linkage model

Structural model	Equation
Macroeconomic Model	
$Y_t = C_t + I_t + G_t + Ex_t - Z_t + Sd_t$	…(1)
$C_t = f(Yd_t)$	…(2)
$Yd_t = Y_t - T_t$	…(3)
$T_t = f(Y_t)$	…(4)
$I_t = f(R_t, Y_t)$	…(5)
$Ex_t = f(E_t, Yf_t)$	…(6)
$Z_t = f(Y_t, Pimp_t, Ex_t)$	…(7)
$P_t = 0.6394Pna_t + 0.3606Pa_t$	…(8)[1]
$Pna_t = f(R_t, Pimp_t, Y_t)$	…(9)
$Pa_t = f(Paw_t, Pna_t)$	…(10)
$Rn_t = f(Rninb_t, Ms_t, Y_t)$	…(11)
$R_t = Rn_t - (P_t - P_{t-4})/P_{t-4}$	…(12)
$E_t = f((R_t-Rf_t), (Ex_t-Z_t))$	…(13)
Agricultural Sector Model	…(14)
$Ca_t = f(Pa_t, Y_t, Pfa_t, Pna_t, Pfna_t,)$	…(15)
$Cfa_t = f(Pfa_t, Y_t, Pfna_t, Pa_t, Pna_t,)$	…(16)
$Exa_t = f(Yf_t, E_t)$	…(17)
$Ta_t = Exa_t - Cfa_t$	…(18)
$Pfarm_t = f(Paw_t , Pna_t)$	…(19)[2]
$Ptil_t = Pka_t\{(R_t + \delta_t - (Pka_t - Pka_{t-4})/Pka_{t-4}) \}$	…(20)
$Na_t = f(Wa_t, Pfarm_t, Ptil_t)$	…(21)
$Ka_t = f(Ptil_t, Pfarm_t, Wa_t)$	…(22)
$Ya_t = f(Na_t, Ka_t)$	

Note: [1]The coefficient of equation (8) is drawn from Bank of Thailand.

[2]The depreciation rate is assumed to be 10 percent per year.

Variable identification: see Appendix Table.

Step 3: Policy simulation. Keeping all other things constant, the government consumption spending and money supply was played as a shock variable in the alternative scenarios. The 5, 10 and 15 percent increases in these shock variables were respectively set up for scenario I, scenario II, and scenario III for every quarter over the first quarter of 1998 to the third quarter of 2004. The simulated value of alternative scenario is then solved by Gauss-Seidel algorithm. Fortunately, the procedures were incorporated in EViews software.

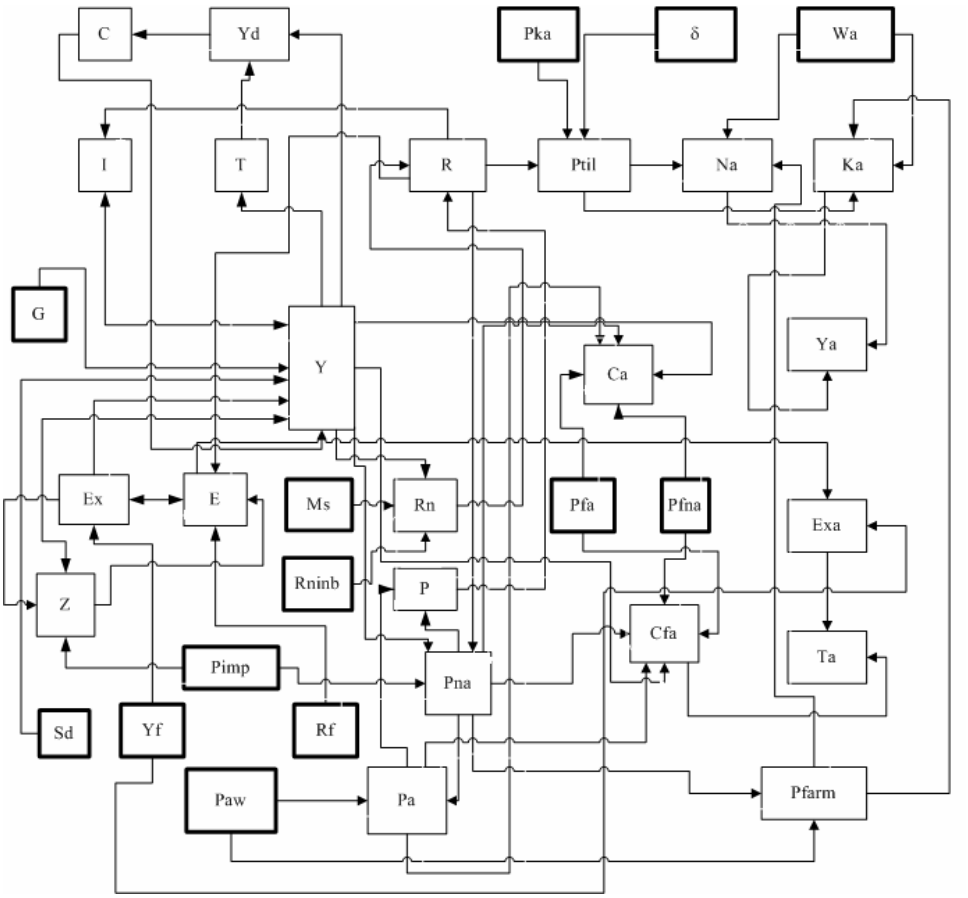

Figure 2 Transmission channels of shock variables (G and Ms) run through agricultural variable

Note: ▭ = Exogenous variable and ▭ = Endogenous variable

Table 3 Simulation errors of major endogenous variables

Dynamic-deterministic simulation (1998:QI to 2004:QIII)			
Major endogenous variables	**Mean error (%)**	**RMSE (%)**	**Theil inequality coefficient**
Expenditure on GDP	1.207	2.126	0.011
Private consumption	1.900	2.844	0.014
Nation investment	1.010	4.077	0.019
Export of goods and services	1.415	2.169	0.013
Import of goods and services	1.939	3.613	0.018
Nominal interest rate	-1.533	5.256	0.028
Real effective exchange rate	-2.982	3.744	0.018
Consumer price index	-0.052	0.983	0.005
Consumer price index for nonfood	0.746	1.574	0.008
Consumer price index for food	-1.266	2.207	0.011
Private consumption for food	1.674	2.658	0.013
Food export	4.133	7.769	0.042
Food import	7.653	10.616	0.057
Employment in agricultural sector	-0.112	1.345	0.007
Capital stock in agricultural sector	0.221	0.621	0.003
Gross domestic production in agriculture	4.989	5.874	0.031

Note: Mean error = $\frac{1}{n}\sum_{t=1}^{n}\left(\hat{y}_t - y_t/y_t\right)*100$, RMSE (Root mean square error) = $\sqrt{\frac{1}{n}\sum_{t=1}^{n}\left(\hat{y}_t - y_t/y_t\right)*100}$, Theil inequality coefficient = $\frac{\sqrt{\frac{1}{n}\sum_{t=1}^{n}\left(\hat{y}_t - y_t\right)^2}}{\sqrt{\frac{1}{n}\sum_{t=1}^{n}\hat{y}_t^{\,2}} + \sqrt{\frac{1}{n}\sum_{t=1}^{n}y_t^{\,2}}}$

5. Result and Discussion

The estimation results of macroeconomic-agricultural linkage model have more presentation in the Appendix Table 2. Afterward, it is evaluated by the simulation errors of system (Table 3). These errors represent as the comparison between baseline and actual value. The root mean square error of major endogenous variables reveal that theirs values vary between approximately 1 and 10 percent. Consequently, Theil Inequality coefficients are less than or equal to 0.057. They indicate that the system of complete model is appropriate for policy simulation.

As the simulation results, the expanded government consumption spending coupled with acceleration in money supply growth significantly affects the macroeconomic variables: real GDP, price level, real interest rate, and real effective exchange rate. And then, these transmission variables affect the endogenous variables in agricultural sector. Theirs impacts on key economic indicators of agricultural sector are summarized in Table 4.

Table 4 Result of policy replication

Unit : Million baht at constant price

Agricultural sector	Baseline value	Replicated value	% Change
a. 2% increase in government consumption expenditure and money supply			
Private consumption for food	102,975.43	103,552.94	0.57%
Food export	67,548.57	67,617.59	0.10%
Food import	14,280.43	14,369.76	0.66%
Trade account	53,268.00	53,247.98	-0.04%
Employment (thousand persons)	13,835.29	13,832.12	-0.02%
Capital stock	431,698.71	432,140.81	0.10%
Gross domestic production	78,140.14	78,377.60	0.31%
CPI for food (1988=100)	199.63	199.80	0.09%
b. 4% increase in government consumption expenditure and money supply			
Private consumption for food	102,975.43	104,125.29	1.13%
Food export	67,548.57	67,685.00	0.20%
Food import	14,280.43	14,458.00	1.32%
Trade account	53,268.00	53,227.14	-0.08%
Employment (thousand persons)	13,835.29	13,829.14	-0.04%
Capital stock	431,698.71	432,571.57	0.20%
Gross domestic production	78,140.14	78,609.00	0.61%
CPI for food (1988=100)	199.63	199.97	0.17%
c. 8% increase in government consumption expenditure and money supply			
Private consumption for food	102,975.43	105,257.00	2.24%
Food export	67,548.57	67,814.71	0.38%
Food import	14,280.43	14,631.86	2.61%
Trade account	53,268.00	53,183.00	-0.17%
Employment (thousand persons)	13,835.29	13,823.86	-0.08%
Capital stock	431,698.71	433,402.86	0.40%
Gross domestic production	78,140.14	79,057.00	1.19%
CPI for food (1988=100)	199.63	200.31	0.35%

Note : The figures represent as the average value from the first quarter of 1998 simulation year through the third quarter of 2004.

Source: Author's computation

Effect on food consumption expenditure: On the average, although the increase in government consumption spending and money supply lead to the increase in consumer price index for food as well as real GDP, the food consumption expenditures increase over the three simulation years. This is because the absolute value of own-price elasticity of food consumption is obviously less than the real income elasticity regarding the estimation result of behavioral equation. Therefore, the damage of food consumption expenditure that is derived from inflation is not severe.

Effect on food import and export: On the average, the increase in government consumption expenditure and money supply leads to the increase in food import over the simulation years through real GDP as an important transmission variable. At the same time, the expansion of these policy variables leads to increase food export over the simulation years through the transmission variable of real effective exchange rate. Unfortunately, the increased food import has heavy impetus rather than the increased food export. It negatively affects the trade account for food. Nevertheless, up to now Thailand has been known as agricultural exporter. Thus, its damage has just resulted in the surplus of trade account.

Effect on gross domestic production in agriculture: On the average, owing to expansion of government consumption expenditure coupled with money supply, the farm price index increases despite the fact that the capital rental rate decreases. It leads to the capital stock in agricultural sector obviously increases over the simulation years. On the other hand, the employment in agricultural sector decreases because the effect of farm price elasticity of labor demand is dominated by the effect of cross-price elasticity. As a consequence, the gross domestic production in agricultural sector increases through the channel of two inputs. It is further stated that the inflation is advantage for gross domestic production.

As comparing with the related literatures, the simulation results of this study are overall consistent with Kitchen *et al*. (1987), Paarlberg *et al*. (1984) and Just (1990) in the way that the macroeconomic policies have significantly unintended effects on the agricultural sector. More specifically, Thailand's agricultural GDP impacts of fiscal and monetary policy mix conformed to the inference of Wongsak (2001).

Quantitatively, the benefits of Thailand's agricultural sector, which are gained from the fiscal and monetary policy mix, are not prominent (Table 4). The simulation results should be noticed that the food consumption and import impacts of expansionary policy are more benefit rather than gross agricultural production. This is because the policy variables: government expenditure and money supply affect gross domestic production in the agricultural sector through several distant channels. Furthermore, the macroeconomic-agricultural linkage model is based on the basic Keynesian

perspective. This school of thought is strongly believed in the way of demand management in the short run instead of the supply management in the long run.

On the one hand, the food export impact of fiscal and monetary policy mix seems to be questionable. It should be further discussed as follows. With respect to transmission channel, the real effective exchange rate (REER) links the government consumption spending and money supply to the food export. When the expansionary fiscal policy combined with acceleration in money supply growth is utilized, on the average, REER decreases over the simulation year or in other word the Thai Baht depreciates. This incident leads to raise the food export. Nevertheless, Thai Baht can be appreciated according to the standard Mundell-Fleming model.

When the expansionary fiscal and monetary policy mix is utilized, the real GDP and domestic interest rate raises. Increase real GDP lead to increase import of goods & services. The current account is subsequently worsen *ceteris paribus*. At the same time, the increase in domestic interest rate lead to the increase in capital inflow, and the capital account is then improved *ceteris paribus*. Owing to these incidences, the domestic currency can be appreciated or depreciated with the flexible exchange rate regime. Firstly, if the impetus of worsening current account is dominated by the force of improving capital account, then the increase in demand for foreign currencies will be less than the increase in supply of foreign currencies. It leads to an appreciation in the domestic currency in order to the balance of payment account condition. In other word, the exchange rate declines regarding the equilibrium of foreign exchange market. Secondly, if the impetus of worsening current account is greater than the force of improving capital account, then the increase in demand for foreign currencies will be greater than the increase in supply of foreign currencies. It leads to a depreciation in the domestic currency for balancing payment account condition. That is the exchange rate raises with the equilibrium of foreign exchange market.

In sum, notwithstanding the theoretical model indicates that the exchange rate can increase or decrease, the empirical evidence of this study has already been investigated. On the average, the simulated result of this study can be declared that is consistent with the second case as mentioned earlier.

6. Summary

Agricultural sector would affect not only by the policies specifically designed for it but also by the fiscal and monetary policy mix. It leads this article to the question of how much this macroeconomic policy advantages to Thailand's agricultural sector. Based on the previous literatures, the framework is outlined. It is schematically represented the linkages underlying the effects of government spending and money

supply on agricultural sector. Let agricultural sector be an outside of macroeconomic model. Therefore, the framework of this study is divided into two blocks. The first block depicts the forward linkage among government consumption expenditure, money supply and macroeconomic variables. The second block depicts the relationship between macroeconomic variables and key economic indicators of agriculture. These agricultural variables consist of food consumption, food export & import, employment & capital stock and gross domestic production in agricultural sector. The estimation results of behavioral equations consign the complete model to wholly satisfactory results of policy simulation. The estimated parameters are then utilized for policy simulation. When the increase in the government consumption expenditure coupled with acceleration in money supply growth is demonstrated, their impacts on agricultural sector are concluded in terms of percentage change from baseline value as follows. Food consumption, export and import increase. However, surplus of trade balance for food is worsen. Employment in agricultural sector decreases, while capital stock in agricultural sector increases. Gross domestic production in agricultural sector subsequently increases.

According to the simulation results, the fiscal and monetary policy mix has an unintended effect on Thailand's agriculture, although the money is not directly injected into the agriculture. The simulation results indicate that this spending can flow to the agricultural sector via several channels. Nevertheless, it should be noticed that the agricultural economic impacts of macroeconomic policy are rather trivial particularly gross production impacts, although the policy variables are increased by 8 percent. This is because these impacts come from several distant channels. Within the economic effects, the food consumption impacts of policy are relatively outstanding. This is because the structural model is focused on the demand management in the short-run periods regarding the Keynesian view.

7. Limitation of the study

As earlier seen in the section of literature review, although two limitations of previous research-- the concept of aggregate level instead of commodity aspect as well as dynamic response of macroeconomic policies--have already been criticized, this article can not go further with this shortcoming due to the preliminary version. Therefore, these issues will rekindle the future research of Thailand. In addition, the shortcoming of this study concerns the modeling approach as follows.

The function of gross domestic production faced with the constraint of two factor inputs: labor and capital stock. It would be questionable because the other factor inputs such as rainfall and fertilizer should be considered. Apart from this, the agricultural production is occasionally generated the state of being polluted, especially the contamination of soil, water, or the atmosphere

by the discharge of harmful substances. This externality affects negatively the macroeconomy.

The supply of labor in agricultural sector is restricted to be inelasticity with respect to the wage. Theoretically speaking, in the consumption sector, the household agent seeks an optimal consumption plan over the infinite time horizon. The optimal demand conditions for commodities are then derived. Meanwhile, the optimal demand conditions for financial asset and optimal level of leisure are derived. In other words, the supply of labor is eventually established. Nonetheless, the modeling of labor supply is rather sophisticated. It should be further investigation for the future research.

With respect to the theoretical mocroeconomic model, the modeling approach has to face with the considerable choice of macroeconomic school. The future study may formulate the model regarding the new macroeconomic school of thought. It is conceptually derived from the microfoundation such as New Classical School and New Keynesian School.

References

Boot, C. G., W. Feibes, and J. H. C. Lisman. 1967. Further Comments on the Derivations of Quarterly Figures from Annual Data. *Applied Statistics*. 16: 65-67. cited Inthisang, J. 998. *The Economic Fluctuation and Its Origin in Thailand*, Master of Art Thesis in Economics, Thammasat University.

Choe, Y. C. 1989. A survey of Macroeconomics and Agriculture. *Master of Science Thesis in Agricultural Economics*, Michigan State University.

Just, R. 1990. Analyzing the Effects of U.S. Macroeconomic Policy on U.S. Agriculture Using the USAGMKTS Model [online]. Avaliable : www-wds.worldbank.org. 2007.

In F. and T. Mount. 1994. Dynamic Macroeconomic *Linkages to the Agricultural Sector*. England: Avebury.

Kitchen, J., S. Langley, R. Monaco, and J. M. Price. 1987. Effects of Monetary and Fiscal Policy on U.S. Agriculture. *Agricultural Information Bulletin*, No. 517, United States Department of Agriculture.

Lopez, R., R. Ali, and B. Larsen. 1991. How Trade and Economic Policies Affect Agriculture: A framework for Analysis Applied to Tanzania and Malawi. [online]. Availiable: www-wds.worldbank.org. 2007.

Paarlberg, P. L., A. J. Webb, A. Morey, and J. A. Sharples. 1984. Impacts of Policy on U.S. Agricultural Trade. International Economics Division, USDA.

Piampiti, S. 1985. *Demographic Techniques*. Bangkok: Pappim Inc. (in Thai) cited Charoenkittayawut, S. 2001. *The Impacts of Changes in Government Expenditure on Macroeconomic Variables in Thailand*. Master of Science in Economics, Kasetsart University. (in Thai)

Roop, J. M. and R. H. Zeitner. 1977. Agricultural Activity and the General Economy: Some Macromodel Experiments, *American Journal of Agricultural Economics* 59 (1): 117-125.

Schuh, G. E. 1976. The New Macroeconomics of Agriculture, American Journal of Agricultural *Economics* 58 (5): 802-811.

Stamoulis, K. et al. 1995. Agricultural Development in the Economy-Wide Context: Approaches to Policies and Strategies, In N. Alexandratos. (ed.). World Agriculture: Towards 2010 An FAO Study. England: John Wiley and Sons, 257-293.

Wongsak, S. 2001. The Impact of Macroeconomic Policy on Agricultural Sector of Thailand. *Master of Science in Economics, Kasetsart University*.
(in Thai)

Appendix Table 1 Variable identification

Variable	Unit	Explanation	Source of data
Y	Million baht	Gross domestic product at 1988 price.	Office of the National
C	Million baht	Private consumption expenditure at 1988 price.	Economics and Social
I	Million baht	National investment at 1988 price.	Development Board,
G	Million baht	General government consumption expenditure at 1988 price = compensation of employees (wages & salaries and pay & allowance of members of the armed forces) + purchases from enterprises and abroad (military and civilian purposes) - purchases by households and enterprises.	www.nesdb.go.th
Ex	Million baht	Exports of goods and services at 1988 price.	www.nesdb.go.th
Z	Million baht	Imports of goods and services at 1988 price.	www.nesdb.go.th
T	Million baht	Taxes revenue at 1988 price.	Calculated
		Taxes revenue at current price.	Bank of Thailand,
E	1994=100	Real effective exchange rate. (Trade-weighted broad-21)	www.bot.or.th
Yf	Billions	Real gross domestic product of the United States of America.	www.economagic.com
Pimp	1995=100	Import price index in terms of baht;	Bank of Thailand, www.bot.or.th
Rn	Per cent per annum	Minimum lending rate. Interest rate as quoted by the 4 largest banks and by the 5 largest commercial banks since January 2000. Interbank overnight lending rate.	Bank of Thailand
Rninb	Per cent per annum		Bank of Thailand
Ms	Million baht	Narrow money supply at 1988 price.	Calculated
		Narrow money supply at current price.	Bank of Thailand
Rf	Per cent per annum	Real foreign interest rate. (1) Federal funds rate (2) %Change of consumer price index for all urban consumers: all items: index 1982-84 =100: SA	Calculated www.economagic.com
P	1988=100	Headline consumer price index.	Rebasing from
		Headline consumer price index (2002=100).	2002=100
Pna	1988=100	CPI for non-food and alcoholic beverages.	Bank of Thailand
		CPI for non-food and alcoholic beverages (2002=100).	Rebasing from
Pa	1988=100	CPI for food and non-alcoholic beverages.	2002=100
		CPI for food and non-alcoholic beverages (2002=100).	Bank of Thailand
Paw	1995=100	World agricultural price index. Comprising rice, shrimp, rubber, sugar, cassava, maize, coffee, soybeans, palm, tobacco, cotton and sorghum.	Rebasing from 2002=100 Bank of Thailand
Pfna	1995=100	Import price indices of nonfood.	Bank of Thailand
Pfa	1995=100	Import price indices of food, beverages & tobacco, animal &vegetable oils and fats	

Appendix Table 1 (Continued)

Variable	Unit	Explanation	Source of data
PfarmP	2002=100	Farm price index.	Bank of Thailand
ka	2002=100	Producer price index by machinery & equipment, electrical equipment and transport equipment products.	Bank of Thailand
			Bank of Thailand
			Bank of Thailand
Wa	Baht per month	Average wages were deflated by farm price indices.	Calculated
		Annual data set: 1997 to 1998.	National Statistics Office
		Quarter 1 of 1997 to Quarter 4 of 1998.	Manipulated[1]
		Round 1 (February), Round 2 (May), Round 3 (August), Round 4 (November): 1999-2000.	National Statistics Office
		Quarter 1 of 2001 to Quarter 3 of 2004.	
Na	Million	Employment in agricultural sector.	
		Round 1 (February) :1997.	Bank of Thailand
		Round 2 (May) :1997.	Manipulated[2]
		Round 3 (August) :1997.	Bank of Thailand
		Round 4 (November): 1997.	Manipulated[2]
		Round 1 (February), Round 2 (May), Round 3 (August), Round 4 (November): 1998 to 2000.	Bank of Thailand
		Quarter 1 of 2001 to Quarter 3 of 2004.	
Ka	Million Baht	Private capital stock of agricultural sector at 1988 price.	
		Annual data set.	www.nesdb.go.th
		Quarterly data set.	Manipulated[1]
Ca	Million Baht	Private consumption for food (meat, fish, fruit, vegetable, oils and fats)+(dairy products)+(grain mill products, other food products)+(beverages)+(tobacco products) at 1988 price.	www.nesdb.go.th
Ya	Million Baht	Gross domestic product originating from agriculture, hunting, forestry and fishing at 1988 price.	www.nesdb.go.th
Exa	Million Baht	Export: (food) +(beverages and tobacco) + (animal and vegetable oils and fats) at 1988 price.	Calculated
		Data set at current market price	www.bot.or.th
Cfa	Million Baht	Import: (food) +(beverages and tobacco) + (animal and vegetable oils and fats) at 1988 price.	Calculated
		Data set at current market price	www.bot.or.th

Note: [1]It was manipulated by Boot Technique (Boot *et al*. 1967 cited Inthisang, 1998).

[2]It was manipulated by Demographic Techniques (Piampiti 1985 cited Charoenkittayawut, 2001).

Appendix Table 2 Result of estimated structural model

a. Impacts of government consumption expenditure on macroeconomics variables			
	$\overline{R}^2$	**S.E. of Regression**	**LM(2) test**
Two-Stage Least Squares Method Eq.(1): Expenditure on GDP $Ysa_t = Csa_t + Isa_t + Gsa_t + Exsa_t - Zsa_t + Sdsa_t$			
Eq.(2): Private Consumption Csa_t = -110,444 + 0.79$Ydsa_t$ + [AR(1)=0.87] (-4.04)*** (21.53)***	0.998	1,747.236	0.849(0.654)
Eq.(3): Disposable Income $Ydsa_t = Ysa_t - Tsa_t$			
Eq.(4): Tax Revenue Tsa_t = -129,018 + 0.30Ysa_t (-2.88)*** (7.34)*** +[AR(1)=0.44,AR(2)=-0.30,AR(3)=0.71, MA(1)=0.82, MA(2)=0.55,BACKCAST=1997:4]	0.991	1,402.291	0.524 (0.770)
Eq.(5): National Investment Isa_t = -161,454 – 48,909.25R_t + 0.42Ysa_t (-3.30)*** (-0.42) (7.46)*** + [AR(3)=0.73,AR(4)=-0.35,MA(1)=0.99] $r_{R,Ysa}$ = -0.86	0.973	4,460.678	1.681 (0.431)
Eq.(6): Export of Goods and Services $Exsa_t$ = -590,567 – 3,338.16E_t + 134.73Yf_t (-3.99)*** (-3.26)*** (19.421)*** + [AR(4)=-0.11,MA(3)=-0.99,BACKCAST=1998:1]	0.988	7,873.011	3.300 (0.192)
Eq.(7): Imports of Goods and Services Zsa_t = -170,029 + 0.37Ysa_t - 132.47$Pimp_t$ + 0.58$Exsa_t$ (-3.78)*** (2.67)*** (-1.41) (3.841)*** + [AR(1)=0.83,AR(4)=-0.24,MA(4)=-0.97,BACKCAST=1998:2] $r_{Pimp,\ Ysa}$ = 0.68, $r_{Pimp,\ Exsa}$ = 0.65	0.998	2,870.934	4.320 (0.115)

Appendix Table 2 (Continued)

a. Impacts of government consumption expenditure on macroeconomics variables			
	$\overline{R}^2$	**S.E. of Regression**	**LM(2) test**
Ordinary Least Squares Method Eq.(8): Consumer Price Index $P_t = 0.6394Pna_t + 0.3606Pa_t$			
Eq.(9): CPI for Nonfood and Alcoholic Beverages $Pna_t = 144.79 + 0.0082Pimp_t - 85.55R + 2.92\times10^{-5}Ysa_t$ (10.26)*** (0.47) (-3.58)*** (1.68)* + [AR(2)=0.47,MA(1)=1.13,MA(2)=0.51,MA(3)=0.51, MA(4)=0.39] $r_{Pimp,R} = -0.71$, $r_{Pimp,Ysa} = 0.68$	0.988	0.738	1.059 (0.589)
Eq.(10): CPI for Food and Nonalcoholic Beverages $Pa_t = 91.83 + 0.20Paw_t + 0.60Pna_t$+ [AR(1)=0.88] (1.40) (1.50)* (1.52)*	0.923	2.337	0.973 (0.615)
Eq.(11): Nominal Interest Rate $Ln(Rn_t) = 7.21 + 0.40Ln(Ysa_t) - 1.15Ln(Mssa_t) + 0.16Ln(Rninb_t)$ (1.08) (0.45) (-2.45)*** (5.12)*** + [AR(1)=0.72,AR(2)=-0.04] $r_{Ln(Ysa),Ln(Mssa)} = 0.95$, $r_{Ln(Ysa),Ln(Rinb)} = -0.44$	0.985	0.039	0.435 (0.804)
Eq.(12): Real Interest Rate $R_t = Rn_t - (P_t - P_{t-4})/P_{t-4}$			
Eq.(13): Real Effective Exchange Rate $E_t = 72.46 + 77.08(R_t - Rf_t) + 3.32\times10^{-5}(EXsa_t - Zsa_t)$ (5.96)*** (1.53)* (0.34) + [AR(1)=0.82,AR(2)=-0.40, MA(4)=0.94,BACKCAST=1997:3] $r_{(R-Rf),(EXsa-Zsa)} = 0.45$	0.754	2.050	4.087 (0.130)

Appendix Table 2 (Continued)

b. Impacts of macroeconomic variables on agricultural variables			
	$\overline{R}^2$	**S.E. of Regression**	**LM(2) test**
Ordinary Least Squares Method			
Eq.(14): Private Consumption for Food			
$Casa_t$ = -19,668 - 67.84Pa_t + 0.11Ysa_t + 54.93Pfa_t + 348.90Pna_t	0.987	803.330	2.452
(-2.25)***(-1.85)** (32.84)*** (2.17)*** (4.30)*** - 30.31Pfna			(0.293)
(-1.74)**			
Eq.(15): Food Import			
$Cfasa_t$ = -5,345-25.61Pfa_t+0.01Ysa_t+28.68$Pfna_t$- 81.63Pa_t	0.957	545.586	3.715
(-0.58)(-1.23) (1.65)* (2.51)*** (-2.01)**			(0.156)
+ 144.29Pna_t + [AR(1)=0.56,MA(1)=0.997]			
(1.82)**			
$r_{Pfa,Pna}$ = -0.76, $r_{Y,Pna}$ = 0.78, $r_{Y,Pa}$ = 0.71			
Eq.(16): Food Export			
$Exasa_t$ = 48,324 + 4.58Yf_t - 346.49E_t	0.950	1,498.486	3.970
(1.52)* (1.77)** (-2.29)***			(0.137)
+ [AR(3)=0.11,MA(1)=1.60,MA(2)=1.61,MA(3)=0.96,			
BACKCAST=1997:4]			
Eq.(17): Trade Balance of Food			
$Tasa_t$ = $Exasa_t$ – $Cfasa_t$			
Eq.R18: Farm Price Index			
$Pfarm_t$ = -217.21 + 1.31Pwa_t + 1.43Pna_t + [AR(1)=0.49]	0.874	3.893	0.517
(-4.38)*** (7.60)*** (5.41)***			(0.772)
Eq.(19): Capital Rental Rate of Agricultural Sector			
$Ptil_t$ = Pka_t (R_t + δ_t – (Pka_t - Pka_{t-4})/Pka_{t-4})			

Appendix Table 2 (Continued)

b. Impacts of macroeconomic variables on agricultural variables			
	$\overline{R}^2$	**S.E. of Regression**	**LM(2) test**
Ordinary Least Squares Method			
Eq.(20): Employment in Agricultural Sector			
$Nasa_t$ = 13,222 - 0.04$Wasa_t$ + 5.25$Pfarm_t$ + 27.09$Ptil_t$			
(16.78)***(-0.24) (1.59)* (0.95)	0.830	89.272	0.031
+ [AR(1)=0.45,AR(2)=0.26,AR(3)=-0.41,MA(4)=-0.94,			(0.985)
BACKCAST=1997:4]			
$r_{Wasa,Pfarm}$ = -0.51, $r_{Pfarm,Ptil}$ = -0.64			
Eq.(21): Capital Stock in Agricultural Sector			
$Kasa_t$ = 111,620 - 334.39$Ptil_t$ + 206.70$Pfarm_t$ + 0.98$Wasa_t$			
(8.95)*** (-2.276)*** (6.370)*** (1.035)	0.987	1,099.871	1.793
+ 0.69$Kasa_{t-1}$			(0.408)
(31.374)***			
$r_{Wasa,Pfarm}$ = -0.51, $r_{Pfarm,Ptil}$ = -0.64			
Eq.(22): Gross Domestic Production in Agricultural Sector			
$Yasa_t$ = -211,314 + 3.49$Nasa_t$ + 0.56$Kasa_t$			
(-2.097)*** (3.77)*** (2.42)***	0.970	1,085.214	0.444
+ [AR(1)=1.53,AR(2)=-0.70,MA(3)=0.85,BACKCAST=1997:3]			(0.801)

Note: -Ysa, Csa, Isa, Gsa, Exsa, Zsa, Sdsa, Tsa, Mssa, Yasa, Casa, Exasa, Cfasa, Nasa, Kasa and Wasa represent as the time series data that smoothly adjusted by four-quarter moving average. Variable Names: See Table 4. Ln is abbreviated for natural logarithm.

-The asterisk *, ** and *** denote statistical significance at the 0.15, 0.10 and 0.05 level, respectively.

-AR(n) and MA(n) stand for autoregressive order (n) and moving average order (n), respectively.

-$r_{X1,X2}$ represents as the correlation coefficient between X_1 and X_2.

- $\overline{R}^2$ is represented as the adjusted R-squared.

-Lagrange Multiplier test (LM test): The Obs*R-squared statistic reports with its p-value. If the reported statistic is insignificant then we will not reject the null hypothesis, which implies the residuals of model is not serial correlation (1 and 2 lagged period) at the level of confidence interval as mentioned by p-values in parenthesis.

Source: Author's Estimation