Study on Consumption, Investment, Import, Export and Economic Growth Evidence from Fujian Time Series Data from 1981 to 2013

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Abstract

Based on economic growth theory of modern economic theory, with Fujian Province as object of study, panel data from 1981 to 2013 is selected in this paper. Besides, VAR model is established. Co-integration test, Granger causality and impulse response function are used for quantitative analysis on correlation between consumption, investment, import, export and economic growth in Fujian Province. With Eviews8 software as analytical tool, the empirical study conducts analysis from the perspective of econometrics and tests the stationarity of unit root data; determines optimal lag intervals through VAR model analysis on different lag intervals; determines the existence of co-integration relationship of data through Johansen co-integration test; tests the causality of data with Granger causality test; conducts stationarity test by establishing VAR model; studies the variation trend of influence of consumption, investment and import and export on economic growth in the next ten years through impulse response. The author reveals long-term stable balance among consumption, investment, import, export and economic growth in Fujian Province as well as bidirectional causal relationship between consumption and economic growth. For a short term, household consumption is of relatively strong positive impact effect on economic gain, which is served as major impetus of economic growth. Domestic investment is of relatively obvious promotion for economic growth in a short term and of certain negative effect on economic growth in a long term. Import and export have significant function for promoting economic growth and profound influence in Fujian as coastal city. On this basis, the author proposes some policies and recommendations for macroeconomic regulation and control in Fujian Province.

Keywords: Investment, Consumption, Import, Export, Economic Growth, VAR

1. Introduction

Since the reform and opening up, as one of the powerful provinces of economy in eastern coastal regions, Fujian Province has changed greatly in economy and social visage. To maintain and even improve the speed of economic development, it is necessary to master the motive force of economic development and its change accurately so as to establish more scientific policies for stabilizing growth, grasp the function of investment, consumption and import and export for promoting economic growth of Fujian accurately and understand the change track and trend of its promoting ability, which have important theoretical and realistic significances for the smooth economic transition in Fujian Free Trade Pilot Area, the comprehensive expansion of communication and cooperation with countries along Maritime Silk Road and the construction of core area along Maritime Silk Road in the 21st century.

2. Literature Review

The Wealth of Nations published by British political economist Adam Smith in 1776 criticized mercantilism and established economic theory of liberalism, *i.e.* advocating market mechanism and opposing economic theory and policy system with human economic interference [1]. British economist David Ricardo published Political Economy and Taxation Principles and put forward comparative benefit theory in 1817 [2]. Xiaomei Tang (2011) conducted empirical analysis on the influence of consumption, investment and value of import and export in China on GDP growth and put forward the direct influence of investment, consumption and import and export on stable and healthy development of national economy. ZhangJie and QinXin (2012) conducted empirical study on the relationship of consumption, investment and import and export with economic growth in China and considered that Chongqing should pay attention to expand domestic demand, establish relevant policies for encouraging export and the investment of fixed assets and considering the relationship with economic growth during the establishment of import policies [3]. Wu Xiangyou (2013) conducted dynamic study on the relationship between investment, consumption and import and export promoting economic growth of Fujian Province and economic growth, made the conclusion of enhanced promoting function and weakened investment function of Fujian consumption and considered that Fujian was in the period of economic transition and excessive interference of the government was not required [4].

According to domestic and foreign relevant literature, though many economists and scholars have studied the correlation between GDP and its influencing factors, most of them studied the co-integration relationship between single factor and economic growth and few conducted comprehensive research. In terms of research method, most of them used traditional static method. However, the development trend of economic growth is dynamic and unsteady in fact and traditional econometric research methods lack reliability. In view of this, this paper studies the correlation among consumption, investment, import, export and economic growth in Fujian through its dynamic time sequence data from 1981 to 2013 and co-integration technology analyzing multivariate causality and studies the influence of consumption, investment, import and export on economic growth through theoretical and empirical analysis.

3. Mathematical Models

3.1. Vector Auto Regression Model

VAR model is an unstructured model, *i.e.* the relationship between variables is not based on economic theory. This VAR model was put forward by Sims who promoted the wide application of dynamic analysis on economic system. It has become one of the mainstream models in the current world [5]. It is mainly used to predict and analyze dynamic impact of random disturbance on system, including positive and negative effect of impact, its scale and duration. Vector auto-regression model is adopted to analyze variables [6]. The models are established as follows:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + B_0 X_t + \cdots + B_r X_{t-r} + \varepsilon_t \tag{1}$$

In Formula (1), Y_t is k-dimensional endogenous variable; Y_{t-i} (i=1,2,•••, p) is lagged endogenous variable; X_{t-i} (i=0,1,…,r) is exogenous variable or lagged exogenous variable; p and r are lagged orders of endogenous variable and exogenous variable, respectively; A_i and B_r represent corresponding coefficient matrix; ε_t represents residual error term of the model.

3.2. Johansen Co-Integration Test

Johansen Co-integration test, also called (Johansen-Juselius test and put forward by Johansen and Juselius, is one that tests the regression coefficient based on VAR model and also a good way for multi-variable co-integration test. The significance of co-integration is to test whether the causality described by the regression equation is a spurious regression, that is, whether there is a stationary relationship between variables. Therefore, the causality test of non-stationary series is a co-integration test [7].

3.3. Granger Causality Test

The winner of the Nobel Economics Prize, Clive W. J. Granger, in 2003 created a method that can be used to analyze causality of variables, *i.e.* Granger causality test. He defined causality as "variance of optimal and least square forecast relying on all information at some time points in the past." Granger causality is used to test the influence of all lagged items of a variable on the current value of another or more variables. If the test result shows significant impact effect, it means that this variable has causality with another or more variables. If the test result can't show significant impact effect, it means that this variable has not causality with another or more variables.

3.4. Impulse-Response Analysis

Impulse response function is used to measure a standard deviation of random disturbance term on impacts of current and future values of endogenous variables and the influence of variation track. It can intuitively show interaction and effect dynamics of variables.

$$Y_{1t} = b_{11}Y_{1t-1} + b_{12}Y_{2t-1} + \delta_{1t}$$

$$Y_{2t} = b_{21}Y_{1t-1} + b_{22}Y_{2t-1} + \delta_{2t} \tag{2}$$

If δ_{1t} alters, the value of variable Y_{1t} will also change immediately. The value of Y_{2t} in the next phase will also change. Due to lag effect, the change in Y_{2t} will trigger the change in future value of Y_{1t}. The influence of the disturbance will gradually trigger changes in the endogenous variable.

4. Empirical Analysis

4.1. Data Collection and Data Processing

This study selects panel data from Fujian Statistical Yearbook over years since the reform and opening up between 1981 and 2013, and carries out data preprocessing. Variables of empirical research are gross national products, consumption, investment, import and export denoted by Y, C1, I, E, M respectively. To get a stationary series more easily, take natural logarithm of each variable which will not change economic significance of each variable. The processed gross national products, consumption, investment, import and export data series are named LY, LC1, LI, LE and LM respectively. Gross national products, consumption, investment, import and export data series after first-order difference are named DLY, DLC1, DLI, DLE, DLM respectively.

4.2. Stationarity Test

Generally, time series variables of macro economy are non-stationary. By establishing a regression model directly with non-stationary variables, spurious regression would probably occur, *i.e.*. the regression equation is significant in statistical test with a very

small DW value as it hasn't any interpretability. Thus, a stationarity test of time series variables shall be conducted to obtain a time series diagram of original variables and logarithmic variables. The Time Series Diagram of Y, C1, I, E and M are shown in Figure1 and Figure2.
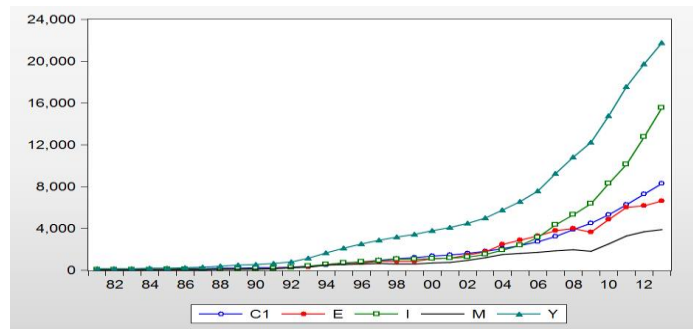

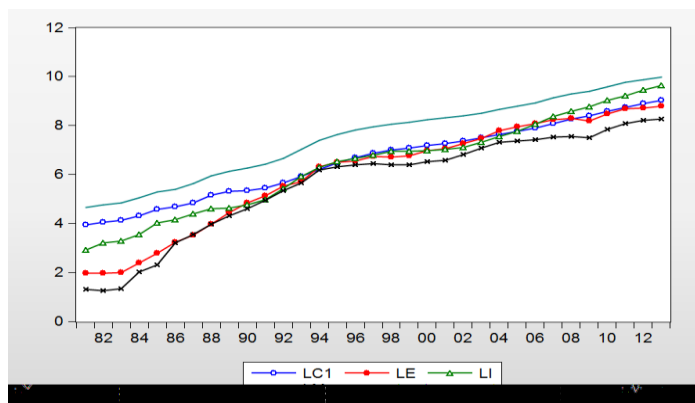**Figure 1. The Time Series Diagram of Y, C1, I, E and M**

Figure 2. The Time Series Diagram of LC1, LI, LE, LM and LY

According to the property that mean value and variance of stationary series are constant: the time series diagram of the stationary series shall show that this series always fluctuates randomly around a parameter value with boundaries and not big range. As can be seen in the time series diagram of Figure1 and Figure2, time series diagram of original data shows a rising trend, which is obviously non-stationary; five variables are stationary after logarithmic processing, have basically consistent changing trends, but may have a co-integration relationship, and thus ADF unit root test shall be continued on these variables.

Terms with intercept and time trend should be first selected. If intercept term and time trend are non-significant($p>0.05$), terms with intercept should be then selected; If intercept term is non-significant, terms without intercept and time trend should be selected finally. If a stable time sequence cannot form, first difference shall be conducted and steps above should be repeated till the formation of stable time sequence [8].

Table 1. Unit Root Test

Variable	Test Statistic	(C, T, K)	5% Critical Value	Result
LY	-1.438	(C,T,2)	-3.569	Unstable
LC1	-1.622	(C,T,2)	-3.568	Unstable
LI	-2.939	(C,T,2)	-3.568	Unstable
LE	-1.862	(C,T,2)	-3.568	Unstable

LM	-3.798	(C,T,2)	-3.568	Stable
DLY	-3.208	(C,N,1)	-2.964	Stable
DLC1	-4.018	(C,N,1)	-2.964	Stable
DLI	-3.133	(C,N,0)	-2.964	Stable
DLE	-3.682	(C,N,0)	-2.960	Stable
DLM	-3.865	(C,N,0)	-2.960	Stable

C is constant term; T is time trend term; K is the number of lag phase.

It can be seen from Table1 that variables Y(GDP), C1(consumption), I(investment), E(export) and M(import) are unsteady sequences. According to the basic principle of ADF test, as ADF test value of first order differential variable of original variable is less than the critical value of 5% confidence level, the null hypothesis with unit root is rejected, *i.e.*. the sequence of first order difference is stationary sequence and it can be verified that Y(GDP), C1(consumption), I(investment), E(export) and M(import) are first order integrated series. Further test on the co-integration relationship of these variables corresponds to the result of possible existence of co-integration relationship in time chart analysis.

4.3. The Optimum Lag Order

Before Granger Causality Test, the optimum lag order shall be determined. Through testing lag orders by establishing VAR model of LC1、LI、LE、LM and LY(Table 2).

Table 2. The Optimum Lag Order of LLC1, LI, LE, LM and LY

Lag	LR	FPE	AIC	SC	HQ
0	NA	1.44E-11	-10.77487	-10.53913	-10.70104
1	72.30245	3.59E-12	-12.19432	-10.77988*	-11.75133
2	33.80724	3.64E-12	-12.34836	-9.755214	-11.53622
3	45.00909*	1.05e-12*	-14.08646*	-10.31461	-12.90517*

This paper determines the optimum lag order in combination with SC information criterion, AIC information criterion, likelihood ratio test statistics, HQ information criterion and final prediction error method. SC information criterion and AIC information are to determine lag order according to the optimum degree of fitting of model; LR criterion uses the ratio of maximum values of likelihood function with and without constraints; HQ criterion, AIC and SIC have similar principles only with different degrees of punishment for damage of prediction precision by new parameters; FPE criterion is put forward in consideration of a series of changes brought by the decline of residual variance and the rise of model order, and thus further determines the optimum lag order. It can be seen from Table2 that in the test result of lag interval, only SC criterion selects p=1 and final error prediction method(FPE) and other three criteria choose p=3. Through overall consideration, lag interval p=3 should be selected. Therefore, optimal lag interval should be 3.

4.4. Johansen Co-Integration Test

In terms of co-integration object, co-integration test can be divided into two types–co-integration test based on regression diversity(E-G Test and CRDW Test) and co-integration test based on regression coefficient(Johansen co-integration test). This paper uses Johansen co-integration test method. The E-views test results are shown as follows.

Table 3. Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.727894	113.1305	76.97277	0
At most 1	0.665345	72.78199	54.07904	0.0005
At most 2	0.415174	38.84767	35.19275	0.0193
At most 3	0.3793	22.218	20.26184	0.0266
At most 4	0.213216	7.433859	9.164546	0.1053

In the Table 3, Hypothesized No. of CE(s) is the number of co-integration relationships under the original hypothesis; Eigenvalue is the characteristic value; Trace Statistic denotes trace test statistics; 0.05Critical Value denotes 5% of critical value; and Prob.** denotes the probability value of test statistics. The Table3 shows test results of trace statistics, and "None" in the first column denotes test of original hypothesis "0 co-integration relationship exists", under which trace statistics is 146.2203 and 5% of critical value is 69.81889, thus the trace statistics is larger than the critical value. So, the original hypothesis is rejected, indicating that there is at least one co-integration relationship. For "At most 1", "At most 2" and "At most 3", it can be seen that their trace statistics are all greater than 5% of critical value and the original hypothesis shall be rejected. According to the investigation on "At most 4", it is found that trace statistics 2. 363987 is less than critical value 3. 841466 and the null hypothesis is accepted, indicating that at most four co-integration equations exist, *i.e.*. LC1, LI, LE, LM and LY have long-term equilibrium relationship.

Through co-integration test results, Parameters of Co-integration Regression Model Equation can be determined. and is shown as follows.

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4 Cointegrating Equation(s):      Log likelihood      356.1819

Normalized cointegrating coefficients (standard error in parentheses)
   LC1            LI             LE             LM             LY
1.000000       0.000000       0.000000       0.000000      -0.968647
                                                            (0.01991)
0.000000       1.000000       0.000000       0.000000      -1.116904
                                                            (0.03569)
0.000000       0.000000       1.000000       0.000000      -1.369529
                                                            (0.03343)
0.000000       0.000000       0.000000       1.000000      -1.237515
                                                            (0.04595)
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Figure 3. Parameters of Co-integration Regression Model Equation

The co-integration regression model equation is shown as follows.

$$LNY = -0.9686471LC1 - 1.116904LI - 1.369529LE - 1.237515LM \tag{3}$$

Co-integration regression model reflects long-term influence of explanatory variables on explained variables. According to co-integration regression model equation, if the logarithm of social consumption increases by 1%, the logarithm of GDP will increase by about 0.97% accordingly. If the logarithm of investment in the fixed assets increases by 1%, the logarithm of GDP will increase by about 1.12 % accordingly. If the logarithm of total export increases by 1%, the logarithm of GDP will increase by about 1.37% accordingly. If the logarithm of total import increases by 1%, the logarithm of GDP will increase by about 1.24% accordingly.

It can be inferred from this model that the increase of consumption, investment, import and export in Fujian Province can result in a percentage of increase of regional gross

production from the perspective of long-term effects, indicating that consumption, investment, import and export have positive effects on its economic growth.

4.5. Granger Causality Test

Among economic variables, some variables have significant correlation without significance. To better explain whether the change of a variable is the reason of another variable, Clive Granger (1969) and C. A. Sims (1972) respectively put forward a test method with identical meaning, *i.e.*. Granger causality test. The causality among LC1, LI, LE, LM and LY is tested respectively. The test results are shown in Table4.

Table 4. Granger Cause and Effect Test Results of Variables

Cause and effect relation assumption	LP	F value	P value	Decision
GDP is not the cause of change of consumption.	4	6.56957	0.0015	reject
Consumption is not the cause of change of GDP	4	5.57443	0.0035	reject
GDP is not the cause of change of investment.	1	0.99031	0.3279	accept
Investment is not the cause of change of GDP.	1	4.30302	0.047	reject
GDP is not the cause of change of export.	1	1.38763	0.2484	accept
Export is not the cause of change of GDP.	1	6.75828	0.0145	reject
GDP is not the cause of change of import.	1	0.42931	0.5175	accept
Import is not the cause of change of GDP.	1	9.06976	0.0053	reject

It can be seen from conclusion that:

(1) Resident consumption level and economy growth have bi-directional causal relationship. In other words, Resident consumption level is the cause for growth of economy growth. Meanwhile, economy growth will stimulate changes in resident consumption level. This might be related to relevant government policies for resident consumption in Fujian after the reform and opening up. Since the reform and opening up, subsistence problem of residents has always been a severe problem. Though the economy develops rapidly now, residents start to pay more attention to substantial consumption except subsistence problem. Consumption of residents exists everywhere in life. Meanwhile, the existence of consumer demand can promote enterprise reform so as to adapt to consumption and promote economic growth.

(2) There is a one-way causality relationship between the investment of fixed assets and economic growth, and the investment of fixed assets is the Granger cause of economic growth. The investment of fixed assets is served as major impetus of economic growth, important way of optimizing industrial structure.

(3) There is a one-way causality relationship between import & export and economic growth, and t import & export is the Granger cause of economic growth. However, as each country had different economic development situation, macro policies and causality, governments of these countries shall consider about their economic development characteristics in order to implement foreign trade policy effectively.

4.6. Vector Auto Regression Model

VAR model is mainly used to predict and analyze dynamic impact of random disturbance, the extent of the impact on system, positive and negative effect and duration. Impulse response function describes the influence of impact of each endogenous variable on a unit standard deviation on the current value and future value of endogenous variable. In this paper, the best lag order is 3 to set up VAR model. Whether VAR model is stationary needs to be judged according to system stationarity, *i.e.* calculation the value of characteristic polynomial. Since lag length of the model is three, and there are five endogenous variables, there are 3×5 unit roots of the model, as shown in Figure 3.
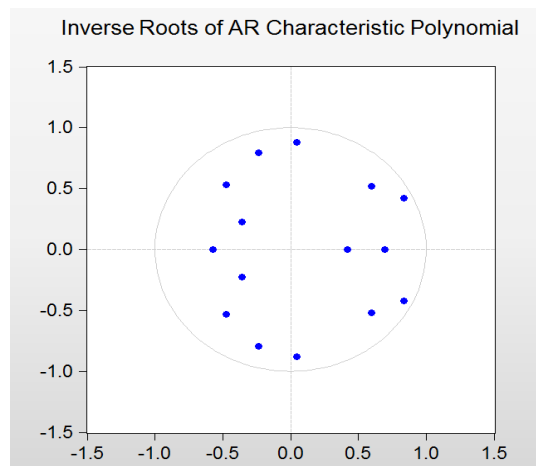
Figure 4. AR Test Result

It can be seen from the Figure4 that the module of 15 unit roots is less than 1, *i.e.* all roots are within the unit circle. This proves estimated VAR model is stationary. It can be seen from the Figure4 that the module of 15 unit roots is less than 1, *i.e.* all roots are within the unit circle. This proves estimated VAR model is stationary.

4.7. Impulse-response Analysis

The function among economic growth, consumption, investment, import and export based on VAR model is set up. Short-term dynamic relation of the two is further analyzed. The results of impulse response functions are as follows in Figure5, Figure6, Figure7 and Figure8. In the Figure5 to Figure8 horizontal coordinate represents the number of phases; the vertical coordinate represents the magnitude of impulse-response function; the solid line represents the trend of economic growth after the impact; the imaginary lines at both sides represent twofold standard errors of the trend.
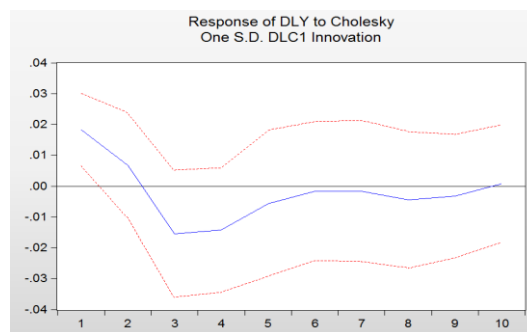

Figure 5. Influence of Impact of Economic Growth on a Standard Deviation of Consumption

It can be seen from Figure5 that the impact effect of consumption on GDP. In the first two years, consumption had positive promoting function for total output value in Fujian, which showed a downtrend, turned to zero at the beginning of the third year, became negative then and started to approach zero till the tenth year.
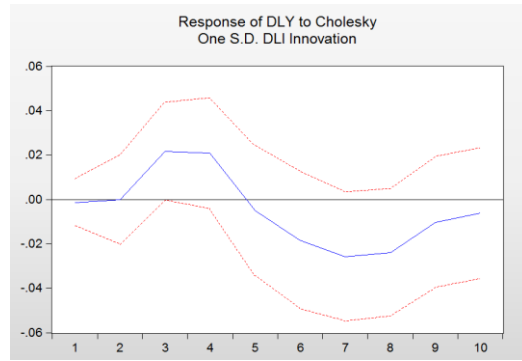
Figure 6. Influence of Impact of Economic Growth on a Standard Deviation of Investment

The impact effect of investment on GDP can be seen according to the Figure6. Investment impact caused both positive and negative changes of gross domestic product. The influence was minor in the first two years, became positive in the third year, started to decline after reaching the peak in the forth year, turned to zero in the fifth year, declined continuously and became negative and approached zero in the tenth year.
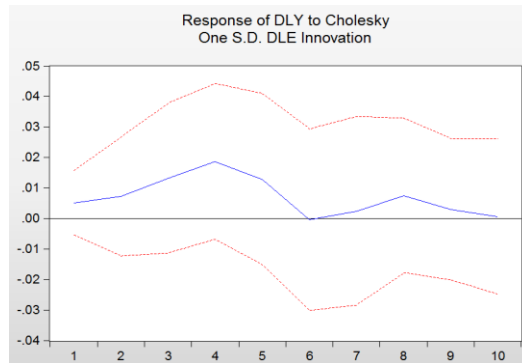

Figure 7. Influence of Impact of Economic Growth on a Standard Deviation of Export

It can be seen from Figure7 that the impact effect of export on GDP. The function of export for gross regional domestic product of Fujian was positive. The impact of export on GDP showed a positive rising trend at the very start, declined after reaching the peak in the forth year, turned to zero in the sixth year and approached zero in the tenth year after a fluctuation.
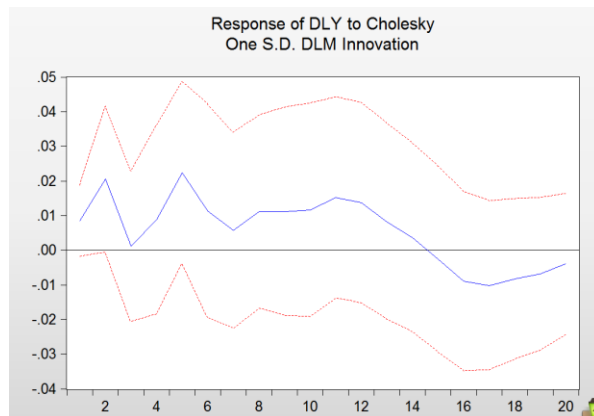

Figure 8. Influence of Impact of Economic Growth on a Standard Deviation of Import

The impact effect of import on GDP can be seen according to the Figure8. As the influence of import on the economy of Fujian did not approach zero in the tenth year, the time span was extended to 20.The impact of import on gross regional domestic product of Fujian was positive in the fluctuation during the first four years, reached the peak in the fifth year, turned to zero in the 15th year, started to become negative and approached zero in the 20th year.

5. Conclusions

The VAR model of influence relation between consumption, investment and import & export and economic growth is established based on dynamic time sequence data such as GDP, the retail sales of consumer goods, fixed asset formation, import & export and estimated with stationary test, co-integration test and impulse response function methods. The author reveals long-term stable balance among consumption, investment, import, export and economic growth in Fujian Province as well as bidirectional causal relationship between consumption and economic growth. Therefore, we cannot simply consider from the perspective of increasing investment when establishing economic policies and should promote the continuous and long-term development of economy by promoting consumption growth. In addition, import and export have significant function for promoting economic growth and profound influence in Fujian as coastal city. Actual benefits for the economy of Fujian after the approval of Fujian Free Trade Area mainly include its ability to vitalize the trade of Fujian and provide greater space for its trade development. This paper makes policy suggestions on macroeconomic control of Fujian based on dynamic change of promoting function of consumption, investment and import and export for economic growth of Fujian in order to promote the transition of economic growth of Fujian steadily:

(1) In terms of consumer demand stimulation, it is required to pay attention to the change of consumption concept, guide residents to form correct consumption concept in policy and understand consumption at a level with equal importance to saving for economic development, change the traditional low consumption habit of making ends meet and cultivate positive moderate consumption concept; meanwhile implement consumer credit service vigorously, change the backward situation of consumer credit and establish a complete individual credit rating system; positively promote credit forms mainly involving high-end durable consumer goods such as house and automobile, with diversified and flexible methods; greatly support consumers with stable income for consumption in advance.

(2) Reinforce promoting function of project and emphasize pulling function of investment; strengthen the construction of urban and rural infrastructure, effectively expand investment and promote consumption, promote economic and social development and improve well-being of people's livelihood, which is an urgent task of accelerating comprehensive construction of well-off society, and require scientific organization and emphasis of key points; break through funding bottleneck, smoothen main channel of financing, innovate financing mode, make proper use of financial fund and solve the problem of great investment and long period of infrastructural construction; reinforce management and strengthen cooperation.

(3) To optimize the structure of export commodities, it is required to give full play to their comparative advantages, improve the competitiveness of export enterprises and products and finally narrow the international gap of labor productivity. For labor intensive industry, it is required to continue to expand domestic demand, improve the performance of quantity and quality in the domestic market, fully exploit the pulling potential of domestic demand growth for the industry, further improve the core competitiveness of industry and increase the additional value of export products; finally reinforce technological updating and transformation, promote industrial upgrading and improve

product competitiveness; and vigorously develop export industries with high growth rate of international market demand, rapid technical progress, low material consumption and strong correlation effect while continuing to consolidate the export of traditional products. In the future, Fujian should give full play to trade advantages of Free Trade Area and promote its overall economic development through Free Trade Area.

(4) By increasing import appropriately, Fujian can not only promote steady economic growth, but also alleviate the pressure brought by the appreciation of RMB exchange rate and avoid international trade friction incurred by trade surplus. Moreover, the appropriate introduction of foreign consumer goods is good for improving the living standard of people and promoting further development of Chinese consumer goods. Fujian will adopt more effective measures and expand import in the future, *e.g.* guide enterprises to attach equal importance to import and export rather than simply get involved in export business as in the past, turn to integration of domestic and foreign trade from simple foreign trade agency, understand the information of domestic and foreign new equipment, technologies and products and introduce appropriate products; guide enterprises to expand the import of resource commodities, advanced technologies and key equipment with urgent need based on bilateral trade preference such as Bangkok Agreement and further promote the rapid development of economy in Fujian and even China.

Acknowledgements

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