# An Empirical Analysis on Rural Credit Cooperatives' Efficiency -Viewing from the Improvement of Peasant Households' Welfare*

Liu Yong [1, a], Tian Jie[2,b], Wu Dingyuan[3,c*]

[1]Political Economy Institute of Wuhan University of Science and Technology, China
[2] School of Finance of Chongqing Technology and Business University, China
[3] School of Civil Works of Wuhan University of Technology, China
[a]michael_ly@wust.edu.cn, [b]tianjie2121@qq.com, [c]woodian@163.com

**Keywords:** Rural Credit Union; Efficiency; Household's Welfare

**Abstract.** Rural Credit Union (RCC) is a key financial organization of rural financial system; its efficiency is always focused. Existed studies concentrated on RCC operating efficiency, while from the perspective of household's welfare, this paper considers that RCC should aim to relieve farmer's credit rationing and improve farmer's welfares So firstly, improved Keynesian consumption function is proposed, consumption is suitable index for farmer's welfare from Mathematical derivation; secondly, VAR model is adopted to experience analyze farmer's welfare; finally, the result shows that RCC loan improves farmer's welfare and it is a efficient organization.

## 1. Introduction

Rural Credit Cooperative (hereinafter referred to as "RCC") plays a dominant role in the rural financial system and its efficiency is always the focus of attention. Many scholars have made in-deep research on its efficiency. Li Guanqing (2013) makes a comparison analysis of the performance of RCCs in Shandong before and after the reform by using DEA method[1]. Shi Rongrong and Xu Zhangyong (2011, 2012)[2,3] conduct an empirical analysis of some factors that affect RCCs' cost efficiency and profit efficiency based on 2000~2009 data of 81 district-and-county-level RCCs of Shaanxi Province. Deng Yan (2012) [4]discusses the influence imposed by the government's behaviors on RCCs' operating efficiency during the system changes of RCCs, including fund support, interest rate privilege, difference reserve ratio, tax deduction and exemption, etc. Huang Huichun and Yang Jun (2011)[5] analyze the relationship between county rural financial structure and RCCs' business performance by using GMM dynamic panel model, and point out that market structure is irrelevant to performance; Wang Junqin, Zong Yixiang and Zhao Banghong (2010)[6] make an evaluation of reform performance and influence factors of RCCs in Hebei Province by applying DEA method and probit model, believing that during 2004 ~ 2006 overall reform efficiency is in vain, technical efficiency is in force, and scale efficiency is in vain. Qin Daoai and Li Xingfa (2009)[7], overcoming the defect of lacking consideration of by-products in traditional DEA performance evaluation, make a multi-angle evaluation of the reform performance of the provincial RCCs in China from 2004 to 2007 through bringing in by-products of non-performing loans and excluding external environment factors and applying multi-stage SBM-Undesirable model, which shows that technical efficiency is improved but scale efficiency, allocative efficiency and cost efficiency have little improvement, etc.; Zhang Lan and Chu Baojin (2007)[8] make an analysis of the efficiency improvement channels from the perspective of property right and under the background of RCCs property right reform. Chu Baojin, Zhang Lan and Wang Juan (2007) [9]analyze the reform efficiency during 1998~2003 of 14 RCCs in the northern Jiangsu area by using DEA models, showing that the efficiency is gradually increased but the political burden of supporting rural area causes an adverse impact on the efficiency. Zhang Bing, Cao Yang and Xu Guoyu (2008) [10]make an evaluation for the reform efficiency of RCCs in Jiangsu Province by applying DID and general DID models, pointing out that the overall efficiency, management efficiency and scale efficiency respectively have increases and suffer reduction. Xie Zhizhong, Liu Haiming, Zhao Ying and Huang Chusheng (2011) [11] determine the operating efficiency of RCC Unions in nine regions and cities of Fujian Province by

*This paper is supported by China Postdoctoral Science Foundation(No.2012M521417), Humanity and Social Science foundation of Education Bureau of Hubei Province(No.2012Q181)

making use of their input and output data between 2005 and 2009 and applying the DEA method, and point out that efficiency varies with regions.

Apparently, the above researches are mainly based on the perspective of RCC organizations and evaluate their internal operating efficiency, and some valuable conclusions have also been drawn. However, this paper argues that the evaluation mode to analyze their efficiency by confining to the RCC organizations still has its limitations: the goal of RCC organizations is to provide as much funds to the peasant households as possible to relieve their credit rationing and then improve their welfare, that is, whether the goal is achieved or not. Therefore, only evaluate RCCs' efficiency from the view of improving peasant households' welfare, can we radically get an objective conclusion of their efficiency evaluation. And the research made in this paper is the supplement and improvement for existing researches.

Subsequent structure arrangement of this paper is as follows: in Part II, put forward an improved Keynes consumption function on the basis of theoretical analysis, and make a mathematical deduction that consumption is an appropriate index to measure peasant households' welfare; in Part III, by VAR model, make an empirical analysis of the influence of the RCCs' agricultural loans on peasant households' welfare (consumption), and the results show that agricultural loans have a positive impact on peasant households' welfare, and therefore from the view of peasant households' welfare, RCC is an effective system arrangement; Part IV draws a conclusion over the whole paper.

## 2. Theoretical analysis and mathematical deduction

### 2.1Theoretical analysis of welfare indexes

For the measurement of peasant households' welfare, most researches have been made from the view of their incomes (Li Rui, 2004; Li Rui and Zhu Xi, 2007), because it is our intuition that "the higher income people get, the better welfare they enjoy" "economic income level determines the welfare level", and led by this consciousness, people form a thought that "income is welfare". Therefore, while researching welfare, people usually focus its attention on the income level.

The feeling that "the higher income people get, the better welfare they enjoy"may be an illusion for the phenomenon that "the higher income people get, the more they consume", and they may also think that the more people consume, the better welfare they enjoy. But two conditions need our consideration: 1) According to Keynes's consumption function theory, $C = C_0 + c \cdot Y$, only a pat of incomes is used for consumption, so even if the logic of "income – consumption -- welfare" is correct, income exceeds consumption in most of time, and consumption is only one part of income, that is to say, income level is higher than consumption level; 2) when people spend their money, they are usually influenced or restrained by their incomes.

However, for poor peasant households, they are often restrained to buy what they need due to low income level, and if an external organization can offer them some funds at this time, such as loans, t-cycle loan for consumption, t+1 cycle income repayment, if this cross-cycle consumption can be realized, peasant households' welfare level will be increased, and this increase can't be reflected in income level. More specifically, as for RCC system, as the only formal financial institution in rural areas, RCC offers loans to peasant households, which can iron the consumption constraint fluctuation due to limited incomes, and peasant households' welfare is improved at this time.

### 2.2 A mathematical deduction of peasant households' welfare index

Because loans have substitutability, that is, they can be used for productive investments, they can be regarded as emergency consumption. The part used for productive investments can be reflected in income growth, while the nonproductive expenditure can't be reflected in incomes. Assume that peasant households' consumption function complies with Keynes consumption function, namely:

$$C=C_0+\alpha Y \qquad (1)$$

Where: C – Total consumption of the peasant households; $C_0$ -- Autonomous consumption; $\alpha Y$ -- Induced consumption; $\alpha$ -- Marginal propensity to consume; Y – Income level.

From formula (1) we can see that there are several connotative assumptions in Keynes consumption function:

① Autonomous consumption is stable, which means $C_0$ is relatively stable;

② Marginal propensity to consume is stable, which means $\alpha$ is relatively stable;

③ Income can be estimated, which means Y can be estimated;

Considering that Keynes consumption function leaves consumption fund shortage out of account, the author improves the function as follows:

Assume that the loan got by a peasant household from an external organization is $L$, loan yield rate is $\beta$, then the peasant household's consumption function shall be:

$$C_1=C_0+\alpha Y^1+\gamma L=C_0+\alpha(Y+\Delta Y)+\gamma L$$

$$\Delta Y=\beta\delta L$$

$$\gamma+\delta=1$$

Where: $\gamma$-- The rate of loans used for consumption after being got, reflecting that the loan relieves peasant household's consumption constraint, $\Delta Y$ -- increased income due to investment after getting the loan, $\beta$ -- Peasant household's rate of return on loan investment, $\delta$ -- Productive consumption after the loan, namely investment, and then the peasant household's consumption function after the loan shall be:

$$C_1=C_0+\alpha Y^1+\gamma L=C_0+\alpha(Y+\beta\delta L)+\gamma L=C_0+\alpha Y+\alpha\beta\delta L+\gamma L \quad (2)$$

Where: $C_0$-- Autonomous consumption, $\alpha Y$ -- Induced consumption by income, $\alpha\beta\delta L$ -- Induced consumption by income growth due to the loan, $\gamma L$ -- Consumption directly induced by the loan.

In this paper, $\alpha\beta\delta L$ is called loan-related income growth consumption effect, and $\gamma L$ is called loan-related consumption effect. Formula (2) is the above said improved Keynes Consumption Function[†]. Through the analysis of this formula, we can get the following conclusions:

① It is not appropriate to use income index to measure peasant households' economic welfare effect produced by RCC loans, for example, the loan-related consumption effect $\Delta C_2=\gamma L$ in formula (2) can't be reflected in income effect; ② Use consumption expenditure index, including both induced consumption effect $\Delta C_1=\alpha\beta\delta L$ by income growth effect $\Delta Y=\beta\delta L$ due to the loan and the direct consumption effect $\Delta C_2=\gamma L$ after the loan, therefore, for the measurement of welfare effect of RCC loans, this index is more comprehensive than the income index.

## 3 Empirical analysis based on VAR model

In consideration of bidirectional interaction among peasant households' per capita net income, RCC agricultural loan and peasant households' per capita expenditure (consumption), single equation can't fully describe this relationship. Besides, it is impossible that the relationships among economic variables are such simple in reality, there will be dynamic lag effect, and the influence of one variable on another gradually changes. Therefore, this paper plans to use vector autoregression model (VAR) to research the dynamic relationships among each variable. This method is effective for analysis of variables having no strict precedence, and avoids the defect of subjective judgment and setting model, and thus it is beneficial to proving the interdependent, bidirectional and dynamic relationships among RCC loan, peasant households' net income and per capita expenditure.

### 3.1 Brief introduction of VAR model

VAR model was proposed by Sims in 1980. This model adopts the form of simultaneous equations, and conducts regression for several lagged values by using all current endogenous variables in the model, and then estimates the dynamic relationships of all endogenous variables. This model has the advantage of analyzing the interaction effect among multiple economic variables by using simultaneous equations, besides, there is no problem about simultaneous equations model in VAR model because its explanatory variables do not include any current variables.

VAR model including N variables lagged for k periods is expressed as follows:

$Yt = m + P1\ Yt\text{-}1 + P2\ Yt\text{-}2 + \ldots + Pk\ Yt\text{-}k + ut, ut$ . IID $(0, W)$

Where $Yt = (y1, t\ y2, t \ldots yN, t)'$

[†] This improved consumption function is first proposed by the author of this paper.

Yt –N×1-Rank time series column vector; m -- N×1-Rank constant term column vector; P1, … , Pk -- N×N-Rank parameter matrix; ut . IID (0, ) -- N×1-Rank random error column vector. Endogenous variable series in empirical model of this paper is defined as follows:

Yt = (RJZC， RJSR， NYDK )', the connotation of each variable is explained in attached table 1.

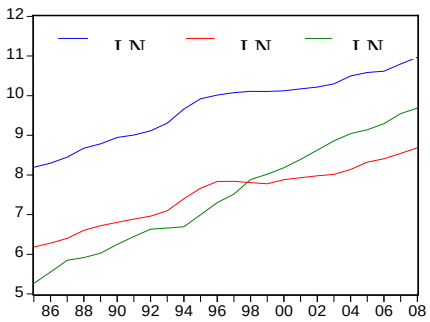
VAR analysis is mainly composed of three parts: first is Generalized Method of Moments (GMM), explaining the regression relationship among variables; second is impact response diagram, through dynamic impact response diagram, we can observe the response of each variable for the impact; third is method analysis of error item, which can explain the influence factors of error items. The basic requirement for VAR analysis is that the variables must be steady, and unsteady variables needs to take co-integration tests, and after passing the co-integration tests, the variables can use vector error correct model (VEC) to further check the relations among them.

**3.2 Data selection and initialization**

This paper collects relevant data from 1985 to 2008 for empirical analysis, such as RCC agricultural loans, peasant households' per capita net income, peasant households' per capita expenditure, etc. Selection principles are: RCC loan for supporting agriculture consists of two parts, of which the agricultural loan is for peasant households; peasant households' per capita net income includes wages income, net income from household business, transfer income and property income, which are all possibly used for consumption expenditure in improved Keynes Consumption Function; peasant households' per capita expenditure includes living expenditure and productive consumption expenditure. It has been demonstrated in the above improved Keynes Consumption Model analysis that it is more reasonable to use peasant households' total consumption expenditures.

In order to avoid linearization among several variables and the heteroscedastic phenomena, logarithmic method can be used for original data in the model analysis to eliminate heteroscedastic phenomena, which can also avoid fierce fluctuation among variables and will not change the relations among these variables. The economic meaning after the logarithmetics is growth rate, as shown (1) NYDK means RCC agricultural loan; RJSR means per capita net income; RJZC means per capita expenditure; LN means the results after eliminating each variable's natural logarithm; economic meaning means growth rate. (2) Data source: China's Finance Statistics Yearbook 1986~2009, and year 1993's agricultural loan data are unavailable in China's Statistics Yearbook, Chinese Ruralareas Yearbook and China's Agricultural Yearbook 1994, so it adopts the average value of year 1992 and 1994.

Figure 1 Data trend chart




We can see that since 1985, there has been a strong common trend among China's peasant households' per capita net income, agricultural loan and per capita expenditure, and there may be great interaction among them. This trend is more obviously shown in figure 1.

**3.3 Empirical analysis results**

Agricultural loan, peasant households' per capita income and per capita expenditure may be causally interrelated with each other, or have unidirectional causal relationship, or there is no causal relationship among them at all, any of these conditions may happen. The above relations may exist among agricultural loan, peasant households' per capita income and per capita expenditure. This paper hereby conducts Unit Root Test and Granger Causality Test to judge the causal relationships among them.

**Unit Root Test:**Stationary test results of the three variables – LNNYDK (agricultural loan), LNRJSR (per capita net income) and LNRJZC (per capita expenditure) are summarized that, LNNYDK, LNRJSR and LNRJZC in time series, it can be seen that they are unsteady at 10% level, and thus VAR analysis can not be conducted directly. Then after using the first difference method for LNNYDK, LNRJSR and LNRJZC, we conclude that the first differences of the three variables -- LNNYDK, RJSR and RJZC are all steady at 5% level, and thus co-integration analysis can be conducted. The variables are all steady after the first difference (at 5% critical level).

**Granger Causality Test:**Because China's rural finance has obvious exogenous characteristics, and the exogeneity of Rural Credit Cooperative (RCC) – the main force of rural finance is more obvious, during the quantitative analysis of the relationships of the three variables, this paper takes RCC loan as the exogenous variable, and per capita expenditure and per capita income as the endogenous variables, and thus we only need to analyze the causal relationships of the endogenous variables, namely the causal relationships between per capita expenditure and per capita income. Before the test of causal relationship, the optimum lag periods of the causality test shall be determined first. And in consideration of too long duration of lag resulting in reduction of degree of freedom, which will directly influence the effectiveness of the model parameter estimation, and therefore lag period 2 is the best choice by referring to LR parameter and SC parameter. After testing we conclude that LNRJZC does not Granger Cause of LNRJSR, but LNRJSR is Granger Cause of LNRJZC.

So LNRJSR is the "cause" of LNRJZC, that is to say, LNRJSR can explain LNRJZC, and thus in the co-integration analysis, LNRJSR shall be put on the right side of the equation as the explanatory variable, while LNRJZC shall be put on the left side of the equation as the explained variable. And the exogenous variable, RCC loan, shall also be put on the right side of the equation.

**Determination of co-integration equation:** Co-integration equation is determined by EG method (two-step method), with steps as follows:

Step 1: first figure out the regression equation among these variables according to the above Granger analysis results and the determination of endogenous variables and exogenous variables; the regression equation is as follows:

$$LNRJZC = 0.8221LNRJSR + 0.0454LNNYDK - 0.8115$$

| | | | | |
|---|---|---|---|---|
| S.D | (0.042012) | (0.025511) | (0.229583) | (a) |
| t-value | (9.56941 ) | (1.778889 ) | (-3.534877 ) | |
| p-value | (0.0000 ) | (0.0897) | (0.0020) | |

$R^2 = 0.9967, DW = 1.18$

In equation (a), t-value and p-value are notable, $R^2$ means high degree of fitting, but D-W value means residual series have autocorrelation, which needs to be corrected by error correction model.

Step 2: Extract the regression equation's residuals to confirm the existence of co-integration relationship determined in equation a. We find that the residual series are basically in horizontal distribution, and the further stationary test of the residuals shows that the residuals are steady, which means the three variables have co-integration relations, but the D-W value (1.18) in step 1's regression equation shows that there is an obvious autocorrelation in the residuals. Therefore, they shall be adjusted by error correction items.

Step 3: Error correction model.After error correction, it can be observed from the corrected D-W value (2.02), the corrected residual plot and the LM check results that the corrected residuals have no autocorrelation (related plots are not attached due to space shortage). Co-integration equation is:

$$LNRJZC_t = 0.8324LNRJSR_t + 0.0405LNNYDK_t + 0.5716ecm_{t-1} - 0.5007ecm_{t-2} - 0.8776$$

| | | | | | | |
|---|---|---|---|---|---|---|
| S.D | (0.0359 ) | (0.0219) | (0.2172) | (0.2181) | (0.2004) | (b) |
| t-value | (23.1607) | (1.8486) | (2.6308) | (-2.2952) | (-4.3771) | |
| p-value | (0.0000) | (0.0820) | (0.0175) | (0.0347) | (0.0004) | |

Where error correction items are:

$$ecm_t = LNRJZC_t - 0.8221\ LNRJSR_t - 0.0454\ LNNYDK_t + 0.8115 \quad (c)$$

Plug equation (c) into equation (b), we can get an accurate co-integration model:

$$LNRJZC_t = 0.8324LNRJSR_t + 0.0405LNNYDK_t + 0.5716\ LNRJZC_{t-1} - 0.5007\ LNRJZC_{t-2}$$
$$- 0.4699\ LNRJSR_{t-1} + 0.4116LNRJSR_{t-2} + 0.0213\ LNNYDK_{t-1} - 0.0187LNNYDK_{t-2} - 0.8755 \quad (d)$$

**Analysis of empirical results:**

From co-integration equation (d), we can see that:

● Agricultural loans have a positive influence on peasant households' per capital expenditures (also known as peasant households' welfare in this paper), which proves that agricultural loans facilitate peasant households' expenditures, and thus it shows that RCCs relieve peasant households' credit rationing to a certain extent and promote the improvement of their welfare level.

● Peasant households' per capita expenditure is influenced not only by current agricultural loan, but also by the two lag periods. The lag period 1 has a positive influence, and the possible reasons are the income effect due to the loan and the ratchet effect due to the consumption. The lag period 2 has a negative influence, and it is believed that agricultural loans may have a periodical effect to peasant households' expenditures in the long term.

● For the three variables -- peasant households' per capita expenditure, agriculture loan and per capita income, the short-term fluctuation conforms to the error correction model equation (c), and there are steady relationships among them in the long term, such as the co-integration relationship shown in equation (d).

## 4. Conclusions

Rural Credit Cooperative acts as the core organization in rural financial system and its efficiency has always been concerned by the people. The existing researches mostly concentrate on RCCs' internal operational efficiency, but its external efficiency for supporting agriculture and improving peasant households' welfare is totally neglected. As a regional financial organization in rural areas, it aims at relieving peasant households' credit constraints and achieving welfare improvement. This paper, evaluating RCCs' efficiency from the perspective of peasant households' welfare improvement, is a useful supplement for existing researches. This paper also deduces through mathematic methods that consumption is an effective index to measure peasant households' welfare, and proves through VAR model empirical analysis that RCC facilitates the improvement of peasant households' welfare, and thus it is an efficient system arrangement.

**References:**


[1] Li Guanqing, 2013, *Performance Appraisal and Policy Suggestions for Reform of Rural Credit Cooperatives—Empirical Research Based on Shandong Area*, Dongyue Tribune, Issue 12.

[2] Shi Rongrong and Xu Zhangyong,2011,*Study on Profit Efficiency and Influence Factors of Rural Credit Cooperatives Based on Stochastic Boundary Analysis*, China Soft Science, Issue 9.

[3] Shi Rongrong and Xu Zhangyong,2012,: Research on cost efficiency *and Influence Factors* of *Rural Credit Cooperatives—Statistical data from 81 Districts and Counties in Shaanxi Province,* Journal of Agrotechnical Economics, Issue 3.

[4] Deng Yan,2012,*Government Action and Efficiency Response for Change Process of Rural Credit Cooperatives: Evidence from Shandong Province*, China Reform, Issue 3.

[5] Huang Huichun and Yang Jun,2011,*Inspection on Relationship between Structure of Rural Financial Market and Performance of Rural Credit Cooperatives in County Region—Based on GMM Dynamic Panel Model*, Chinese Rural Economy, Issue 8.

[6] Wang Junqin, Zong Yixiang and Zhao Banghong,2010, *Analysis on Performance Appraisal and Influence Factors for Reform of Rural Credit Cooperatives—Take Hebei Province as Example*, Journal of Agrotechnical Economics, Issue 6.

[7] Qin Daoai and Li Xingfa,2009, *Performance Appraisal for Reform of* Rural Credit Cooperatives in Our Country Based on SBM-Undesirable Model, Journal of Financial Research, Issue 9.

[8] Zhang Lan and Chu Baojin,2007, Empirical Research on Property Reform of Rural Credit Cooperatives—Based on Analysis of Survey Data in Jiangsu Province, Journal of Agrotechnical Economics, Issue 4.

[9] Chu Baojin, Zhang Lan and Wang Juan,2007, Analysis on Operational Efficiency and Influence Factors of Rural Credit Cooperatives in China—Take Northern Jiangsu Province as Example, China Rural Survey, Issue 1.

[10] Zhang Bing, Cao Yang and Xu Guoyu, 2008, policy effect evaluation for reform of rural credit cooperatives in developed regions—take rural commercial bank in Jiangsu Province as example, Journal of Agrotechnical Economics, Issue 5.

[11] Xie Zhizhong, Liu Haiming, Zhao Ying and Huang Chusheng,2011, *Analysis on Measurement and Evaluation for Operational Efficiency Change of Rural Credit Cooperatives in Fujian Province*, Journal of Agrotechnical Economics, Issue 6.