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Study on Relationship between Interest Rate and Economic Growth by Eviews (2004-2010, Iran)

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ABSTRACT

Interest rate is one of the most important variables of policymaking in macroeconomics and zero interest rate is one of the most important specifications of economy in Islamic countries. Changes of interest rate have considerable effects on decision of the economic agents and have been considered by the economic policymakers. Many traditional economists believe that there is a long term positive relationship between capital accumulation and growth and there is a negative relationship between capital accumulation and capital cost. Some evidences obtained from the industrial countries in recent decades show that decrease of economic growth results from execution of limiting monetary policies. In this research, panel data of 22 countries has been used in 2004-2010 in order to test cause relationship between interest rate and economic growth. The obtained results show that there is negative relationship between interest rate And economic growth and this relationship is a unilateral causal relationship between the economic growth and interest rate in statistical view. Therefore, increase or decrease of interest rate has no effect on economic growth.
KEYWORDS: interest rate, economic growth, panel database, causal relationship.

INTRODUCTION

Zero interest rate is one of the most important economic specifications in Islamic countries and one of the most complex puzzles among quantities and economic indices. Interest gives us opportunity to perform some calculations through which some results are obtained which are quantitatively perfect and logically undeniable and theoretically interesting. Interest is one of main elements of this claim that economy is queen of social sciences and is the only knowledge of this field which can be converted to mathematical expressions and analyses. Recently, effect of productivity on investment has been denied on the basis of tests of the investors. Main motivation of this research is to decrease growth in recent centuries. Different explanations of this decrease are given. Some of these factors related to technological and political factors and essential conditions however execution of limiting monetary policies plays important role in this story. In early 80s, inflation control was considered in order to prevent from inflation resulting from weak managerial expansion. This image in recent years in most industrial countries especially European Union caused them to focus on decrease of budget deficit and monetary policies. Theoretically, relationship between interest rate and economic growth is negative. Its direct mechanism is that investment removes limitations of growth resulting from system oldness and its inability to achieve potential ability and new capital accumulation and technical progress allow reaching desirable capital volume. In this regard, actual interest rate has two roles. (Moazzami, 1991) One the one hand, it directs resources to accumulation and on the other hand, it decreases capital cost as cost factor. In theoretical models especially life cycle model, both roles are emphasized. In important experimental fields, actual interest rate is regarded as investment factor. It seems that demand for investment is not satisfactory in low interest rate. As said before, negative relationship between economic growth and actual interest rate is expected. According to the traditional attitude, we accept that short term interest rates and its structure are affected by monetary policies. It is evident that these conditions may be affected by time intervals, short term shocks of technology and internal nature. We show some experimental evidences about relationship between economic growth and actual interest rate which is not evident. They are based on two essential hypotheses: 1- identification of the conditions applied with technological and financial shocks and internal nature, we believe that long term fluctuations of inters rate are controlled by monetary authorities and they are not exogenous, 2- a negative relationship between economic growth and actual interest rate is expected. This relationship is possible because economic growth rate may be regarded as saving to production ratio of each capital unit. In experimental fields, we expect that sensitivity of capital to interest rate is higher than that of saving to interest rate.

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2- Growth analysis evidences:

Study of experimental evidences has been done on factors effective on economic growth with cross-sectional data and behaviors of different countries have been assessed in recent decades with time series data.
Levine and Renelt (1993) studied relationship between growth and instability. Their results showed that investment is one of the variables which have quantitative effect on growth.

De Long and summers (1993) showed that the most important crisis of investment is accumulation in machinery and equipments.

D'Adda and Scorcu (2001) studied relationship between economic growth and actual interest rate in 1994-1960 with use of panel database. Research results indicate that there is negative correlation between growth and actual interest rate and decrease of economic growth in recent decade's results from execution of limiting monetary policies.

Some effects are negligible in some periods but they dominate on other factors and variables in some other periods. In any way, we can't be satisfied with cross-sectional analyses because dynamic change of variables is neglected. But, Baltaji mentions use of panel data as follows:

1- Since panel data relates to persons, agencies, states, countries and such units, difference of variance is limited in these units.
2- Panel data gives estimates with more information; more changeability, less co-linearity between variables, more degree of freedom and more efficiency by combining time series and cross sectional observations.
3- Studies of cross sectional and iterative observations with panel data are more suitable and better fort dynamical study of changes. For this reason, unemployment periods, job rotation and mobility of the unemployed force are studied better with panel data.
4- Panel data determines effects which can't be observed simply in cross-sectional data and time series data. For example, effects of laws for the minimum wage on employment and earning income can be studied better.
5- Panel data enables us to study complex behavioral models. For example, phenomena such as saving for technological changes and scale can be studied better with panel data in comparison to time series and cross-sectional data.
6- Panel data can minimize bias which may be obtained due to communication of persons with agencies (collectively and generally) by presenting data for thousands of units.

3- Data and research methodology

This research considers cross-sectional analysis on the basis of 6-year data for countries group (Hong Kong, Indonesia, Iran, India, Japan, Korea, Malaysia, Brazil, Mexico, South Africa, Thailand, The Philippines, Singapore, Argentina, Chile, Colombia , Peru , Venezuela, Egypt, Israeli , Czech Republic, and Russia) which have homogenous agencies. Local capital market has been regarded efficient which provides the expected information of investors .On the other hand, decrease of actual interest rate increases economic growth by increasing capital accumulation. In this research, capital bias from desirable capital has been assumed to be insignificant. In this study, some factors such as gradual evolution of financial institutes and financial institutes are not considered. All data of economic growth and actual interest rate come from WDI statistics. Even if the countries show different growth and interest rate, they kept their special homogeneity in spite of different degrees of openness and their regulations. The highest value of investment in these countries relates to private section which is affected by actual interest rate. It is very difficult to measure actual interest rate. Here, there are two evident beliefs: 1- use of actual expected interest rates is interest rate. Another is use of average interest rates of long term periods. The first solution makes experimental results dependent on theoretical hypotheses of price expectations which are not very true. It is assumed in this solution that monetary authorities predict current inflation correctly. As a result, we prefer to use solution 2 even if it takes long to identify prediction error. This process has been used in assessment of international capital transfer degree through Feldstein- Horioka regression. In Iran, actual interest rate is determined from long-term five year bank interest rate minus inflation. We should note that relationship between bank interest rate as substitute of interest rate and investment demand in economy of Iran is more ambiguous than that of developed economies. (Mishkin, 1995, 2003) This ambiguity has been created due to lack of actual and balanced formal interest rates and difference between them and informal interest rates and credits rationing. Although higher interest rate means higher rental of capital, there is no index of actual capital cost especially when actual interest rate has been negative in most years. Other hypotheses which have been considered relate to type of governments. Use of panel data with fixed effects is a suitable solution for failure to recognize regression especially when their effects of each country dominate on its time effects. (Miyagawa, 2003)
We consider the following panel regression model:

$$Y_{it} = \beta_{1,t} + \beta_2 X_{i,t} + \varepsilon_{i,t} \qquad (1)$$

In relation (1), I show i cross sectional unit and t shows t time period. It is assumed that there is the maximum cross sectional n and the maximum t time period.
Estimation of model (1) depends on our hypotheses of intercept, slope coefficients and $\varepsilon_{i,t}$ error sentence. Generally, relation (1) estimation includes:
A-we assume that of intercept and slope coefficients at time and in space are fixed and error sentence is different at time and for different persons.
B- Slope coefficients are fixed but intercept is different for different persons. The simplest ways are omission of space dimensions from combined data in state A and estimation of common least squares regression. In this state, model (1) will be expressed as follows:

$$Y_{i,t} = \beta_1 + \beta_2 X_{it} + \varepsilon_{i,t} \qquad (2)$$

As you observe, intercept and slope coefficients will be common between all cross sections in estimation of relation (2) . Estimation of relation (2) which is done with least squares is called pooled least squares method.
Another method for individual observation of each cross sectional unit and intercept is different for each one of them. Given fixed slope coefficients between cross sections, we can express regression equation as follows:

$$Y_{i,t} = \beta_{1,i} + \beta_2 X_{it} + \varepsilon_{i,t} \qquad (3)$$

In relation (3), index I in intercept sentence shows that different intercepts may result from special characteristics of each one of the cross sections. In economic literature, model (3) is known as regression model of fixed effects or least squares dummy variable. Term of fixed effects results from the fact that intercepts of each cross section don't change over time in spite of difference of intercept between the cross sections. In order for each cross section intercepts to be unchanged, dummy variables are used in this method.
In order to select pooled least squares model and fixed effects model, bound f test is used. This test is expressed as follows:

$$f = \frac{(R^2_{fe} - R^2_{pls})/(N-1)}{1 - R^2_{fe}/(NT - K - N)} \qquad (4)$$

In relation (4), R^2_{fe} is determination coefficient in pooled least squares method, N is the number of cross sections, k is the number of explained variables and T is time period. If calculation f is larger than critical f, fixed effects method will be selected.

Although direct application of fixed effect model or the least squares dummy variable is possible, this model suffers from some problems such as shortage of freedom degree and combined co-linearity. Basic argument of the fixed effects model is that one can't enter the suitable variables which don't change over time in the model for expression of regression model. Followers of random effects model (RE) or error components model believe that if dummy variables show lack of our knowledge and information about real model, why don't we express it through error sentence of $\varepsilon_{i,t}$? Essential idea starts with relation (3). Supporters of random effects method believe that the random variable with average β_1 and intercept value is expressed for each cross section as follows:

$$\beta_{1i} = \beta_1 + \varepsilon_i \qquad (5)$$

In relation (5), ε_i is random error sentence with zero average and variance of σ^2_ε.

Essential hypothesis in random effects model is that the studied cross sections belong to larger community and have common average for intercept. Difference in values of intercept in each cross section is reflected in error sentence of ε_i. On the basis of random effects model, relation (3) include:

$$Y_{i,t} = \beta_{1,i} + \beta_2 X_{it} + \varepsilon_i + u_{i,t}$$

$$Y_{i,t} = \beta_{1,i} + \beta_2 X_{it} + w_{i,t}$$

$$w_{i,t} = \varepsilon_i + u_{i,t}$$

Combined error sentence of $w_{i,t}$ is composed of two components ε_i (cross sectional error) and $u_{i,t}$(combined error).

Error components model shows that combined error sentence $w_{i,t}$ has been composed of two or more error components . Structure of error sentence shows that this method should be estimated with help of the generalized least squares.

We should mention some points about fixed and random effects methods: in random effects method, there should be no relationship between cross sectional error and explanatory variables of the model while intercept can change over time in random effects method.

In fixed effects method, we can't use dummy variable because there will be co-linearity with the dummy variables which are applied for intercept in this model while random effects method can use this variable.

In order to select fixed and random methods, we can use Hasman Test:

$$H = [(\beta f_e - \beta_{re})\ [\mathrm{cov}\, f_e - \mathrm{cov}_{re})^{-1}(\beta f_e - \beta_{re})] \sim \chi^2 \quad (6)$$

K is the number of explanatory variables, βf_e and β_{re} are coefficient vector in fixed and random effects method, cov f_e and cov $_{re}$ are coefficients variance matrix in fixed and random effects method.
Null hypothesis: random effects method is more efficient.
Null hypothesis: random effects method is more efficient.
Alternative hypothesis: fixed effects method is more efficient.
As observed in relation (6), Hasman Test results have asymptotic distribution of X^2 and its degree of freedom equals to the number of the model explanatory variables.

4 -estimation of model and hypothesis test

Application of Granjer causal method with combined data (time series-cross sectional) will not be possible in practice. In order to solve this problem, GGDP and r variables have been used in 1999-2003 among the countries non -continuously. In order to determine optimal lag length of interest rate and economic growth variables, Akaike criteria have been used. On this basis, lag length 5 is optimal for variables. For this reason, apparently unrelated regression system with 5 lags has been used for each variable.

*GGDP=C(1)+C(2)*R-1+C(3)*R-2+C(4)*R-3+C(5)*R-4+C(6)*R-5+C(7)*R+C(8)*GGDP-1+C(9)*GGDP-2+C(10)*GGDP-3+ C(11)*GGDP-4+C(12)*GGDP-5*

*R=C(13)+C(14)*GGDP-1+C(15)*GGDP-2+C(16)*GGDP-3+ C(17)*GGDP-4+C(18)*GGDP-5+ C(19)* GGDP+C(20)*R-1+C(21)*R-2+C(23)*R-3+C(24)*R-4+C(25)*R-5*

In this model, wald test has been used as follows:
If null hypothesis of *C(2)+C(3)+C(4)+C(5)+C(6)+C(7)= 0* is rejected, there is causal relationship between interest rate and economic rate.
If null hypothesis of *C(2)+C(3)+C(4)+C(5)+C(6)+C(7)= 0* is not rejected, there is no causal relationship between interest rate and economic rate.

If null hypothesis of *C(14)+C(15)+C(16)+C(17)+C(18)+C(19)= 0* is rejected, there is causal relationship between interest rate and economic rate.
If null hypothesis of *C(14)+C(15)+C(16)+C(17)+C(18)+C(19)= 0* is not rejected, there is no causal relationship between interest rate and economic rate.

Results obtained from final estimate can be found in table 1.

Table 1-results of model estimation in SUR method

System: SYS01
Estimation Method: Seemingly Unrelated Regression
Date: 03/09/11 Time: 10:15
Sample: 6 132

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	4.013017	0.821868	4.882797	0.0000
C(2)	0.052117	0.043800	1.189890	0.2353
C(3)	0.002077	0.043724	0.047492	0.9622
C(4)	0.073982	0.043062	1.718042	0.0871
C(5)	-0.037748	0.042975	-0.878359	0.3807
C(6)	-0.041117	0.037814	-1.087362	0.2780
C(7)	-0.157223	0.036439	-4.314714	0.0000
C(8)	0.178411	0.090177	1.978457	0.0491
C(9)	-0.064962	0.090960	-0.714181	0.4758
C(10)	0.092287	0.090364	1.021279	0.3082
C(11)	0.024381	0.088720	0.274808	0.7837
C(12)	-0.095800	0.088960	-1.076888	0.2827
C(13)	4.205059	2.079658	2.021996	0.0443
C(14)	0.611326	0.207697	2.943347	0.0036
C(15)	-0.163070	0.213475	-0.763882	0.4457
C(16)	0.276512	0.211552	1.307060	0.1925
C(17)	-0.199779	0.207537	-0.962622	0.3367
C(18)	0.104375	0.209651	0.497851	0.6191
C(19)	-0.866526	0.200830	-4.314714	0.0000
C(20)	0.588374	0.088132	6.676061	0.0000
C(21)	0.072856	0.102431	0.711268	0.4776
C(23)	0.064357	0.102179	0.629851	0.5294
C(24)	0.032681	0.101175	0.323011	0.7470

C(25)	-0.150113	0.088140	-1.703118	0.0899
Determinant residual covariance		645.7720		
Equation: GGDP=C(1)+C(2)*R-1+C(3)*R-2+C(4)*R-3+C(5)*R-4 +C(6)*R-5+C(7)*R+C(8)*GGDP-1+C(9)*GGDP-2+C(10) *GGDP-3+ C(11)*GGDP-4+C(12)*GGDP-5				
Observations: 127				

R-squared	0.089625	Mean dependent var		3.550680
Adjusted R-squared	0.002546	S.D. dependent var		3.750381
S.E. of regression	3.745604	Sum squared resid		1613.398
Durbin-Watson stat	1.990396			
Equation: R=C(13)+C(14)*GGDP-1+C(15)*GGDP-2+C(16)*GGDP-3 + C(17)*GGDP-4+C(18)*GGDP-5+ C(19)* GGDP+C(20)*R-1 +C(21)*R-2+C(23)*R-3+C(24)*R-4+C(25)*R-5				
Observations: 127				

R-squared	0.463183	Mean dependent var		8.589926
Adjusted R-squared	0.411835	S.D. dependent var		11.46583
S.E. of regression	8.793359	Sum squared resid		8892.163
Durbin-Watson stat	2.054399			

Wald test has been performed on causal relationship between interest rate and economic growth and results are included in table 2.

Table 2- results of Wald test

Wald Test:			
Null Hypothesis:	**C(2)+C(3)+C(4)+C(5)+C(6)+C(7)=0**		
Chi-square	7.300802	Probability	0.006892

On the basis of equation of domestic gross product growth, there is no causal relationship between interest rate and economic growth. The results obtained from Wald test based on interest rate equation show that economic growth is the cause of interest rate. (Table 3)

Table 3- results obtained from Wald test

Wald Test:			
Null Hypothesis:	C(14)+C(15)+C(16)+C(17)+C(18)+C(19)=0		
Chi-square	0.258557	Probability	0.611113

After recognition of direction of causality from economic growth to interest rate, basic model of interest rate has been estimated only as a function of economic growth with combined method (panel):

$$r_{it} = a_i + bgy_{it} + u_{it} \qquad i = 1,.....,22 \text{ و } \quad t = 1,....,6$$

At first, Limer test has been used in order to recognize estimation. F statistic has been larger than critical point. As a result, hypothesis H0 i.e. hypothesis of intercepts equality has been rejected. As a result, fixed effect method has been used for estimation of the model: results of estimation are given in table 4. As observed in this table, R square value equals to 0.31 and Durbin-Watson statistic has been obtained to be 2.2.

Table 4- results obtained from estimation of model with use of panel database

Dependent Variable: R?
Method: Pooled Least Squares
Date: 024/09/11 Time: 12:55
Sample: 2004 2010
Included observations: 6
Total panel (balanced) observations 132
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GGDP?	-0.453145	0.130374	-3.475724	0.0007
Fixed Effects				
HONGKONG--C	13.38538			
INDONESYA--C	8.845257			
INDIA--C	10.34234			
IRAN--C	19.74040			
JAPAN--C	3.935521			
KOREA--C	8.043050			
MALYSIA--C	6.889451			
BRAZIL--C	50.79363			
MEXICO--C	4.463195			
SOUTHAFRICA--C	8.321213			
THAILAND--C	8.491559			
PHLIPPINES--C	6.599694			

SINGAPORE--C	7.516821			
ARGENTINA--C	12.20547			
CHILE--C	6.484633			
COLOMBIA--C	9.862730			
PERU--C	18.36030			
VENEZUELA--C	0.278737			
EGYPTE--C	10.31276			
ISRAEL--C	9.757909			
CZECH--C	5.223746			
RUSSIAN--C	-2.547693			
R-squared	0.842214	Mean dependent var		8.718335
Adjusted R-squared	0.810367	S.D. dependent var		11.28588
S.E. of regression	4.914645	Sum squared resid		2632.758
Durbin-Watson stat	1.651392			

Fixed effects of each country include different factors such as structure of physical and human capital in each country, population growth rate, technical progress level and other structural factors are studied in this period as fixed factor. In order to study special effects of each country and mention relationship between them, panel database for each country has been used separately. Results obtained from estimation are given in table 5.

Table 5- results of model estimation with use of panel database

Dependent Variable: R?
Method: Pooled Least Squares
Date: 26/09/11 Time: 11:300
Sample: 2004 2010
Included observations: 6
Total panel (balanced) observations 132
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HONGKONG--GGDPHONGKONG	0.512786	0.389215	1.317488	0.1900
INDONESYA--GGDPINDONESYA	-1.267220	0.769663	-1.646461	0.1020
INDIA--GGDPINDIA	-0.090052	0.190252	-0.473330	0.6368
IRAN--GGDPIRAN	-0.165163	0.076993	-2.145161	0.0338
JAPAN--GGDPJAPAN	0.170746	0.058746	2.906522	0.0043
KOREA--GGDPKOREA	0.890877	0.178074	5.002858	0.0000
MALYSIA--GGDPMALYSIA	-0.917818	0.273430	-3.356686	0.0010
BRAZIL--GGDPBRAZIL	-2.719244	1.935351	-1.405039	0.1624
MEXICO--GGDPMEXICO	0.188189	0.497494	0.378274	0.7058
SOUTHAFRICA--GGDPSOUTHAFRICA	-2.794477	0.902123	-3.097667	0.0024
THAILAND--GGDPTHAILAND	-0.697218	0.811760	-0.858896	0.3920
PHLIPPINES--GGDPPHLIPPINES	-0.145027	0.202792	-0.715152	0.4758
SINGAPORE--GGDPSINGAPORE	-0.366994	0.235997	-1.555082	0.1223
ARGENTINA--GGDPARGENTINA	-0.930573	0.377908	-2.462434	0.0151
CHILE--GGDPCHILE	-1.186278	0.511188	-2.320631	0.0218
COLOMBIA--GGDPCOLOMBIA	-0.630865	0.180863	-3.488089	0.0007
PERU--GGDPPERU	-2.532734	1.002159	-2.527277	0.0127
VENEZUELA--GGDPVENEZUELA	-0.264618	0.270269	-0.979092	0.3293
EGYPTE--GGDPEGYPTE	-0.124913	1.356026	-0.092117	0.9267
ISRAEL--GGDPISRAEL	0.454598	0.163321	2.783456	0.0062
CZECH--GGDPCZECH	-0.302042	0.433180	-0.697265	0.4869
RUSSIAN--GGDPRUSSIAN	-1.592290	0.691567	-2.302440	0.0229
Fixed Effects				
HONGKONG--C	8.991378			
INDONESYA--C	12.09083			
INDIA--C	8.174519			
IRAN--C	18.31141			
JAPAN--C	3.295463			
KOREA--C	-0.137540			
MALYSIA--C	9.385154			
BRAZIL--C	56.02263			
MEXICO--C	2.655115			
SOUTHAFRICA--C	15.86343			
THAILAND--C	9.707311			
PHLIPPINES--C	5.310334			
SINGAPORE--C	7.120493			
ARGENTINA--C	12.07354			
CHILE--C	8.816100			
COLOMBIA--C	10.16918			
PERU--C	24.49736			
VENEZUELA--C	0.203543			

EGYPTE--C	8.917779			
ISRAEL--C	7.531360			
CZECH--C	4.798749			
RUSSIAN--C	5.184714			
R-squared	0.874158	Mean dependent var		8.718335
Adjusted R-squared	0.812667	S.D. dependent var		11.28588
S.E. of regression	4.884750	Sum squared resid		2099.749
F-statistic	29.10907	Durbin-Watson stat		1.907427
Prob(F-statistic)	0.000000			

Effect of economic growth on actual interest rate is negative and significant in most countries but it is positive and significant in Israeli, Japan and Korea. This relation is positive but insignificant in Mexico and Hong Kong.

5- SUMMARY AND CONCLUSION

Evidences in economy of countries such as Germany and Japan showed that low interest rate accompanies high economic growth: but the question is: has high economic growth decreased interest rate or vice versa? In order to answer this question, interstate observations have been used in 2004-2010. The obtained results with use of panel database indicate that there is one-sided causal relationship between economic growth and interest rate and negative effect of economic growth on interest rate has been estimated. On the other hand, increase of economic growth causes to decrease interest rate in economy.

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