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MOSAYEB PAHLAVANI

University of Sistan and Baluchestan, Iran

VOLATILITIES OF INVESTMENT IN HUMAN CAPITAL ON IRAN'S ECONOMIC GROWTH: A BOUND TESTING APPROACH AND GARCH MOD

Abstract:

In this study, we investigated the effect of "volatility" of investment in human capital on Iran's economic growth, such that the government expenditure on educational and R & D budget have been replaced as proxies of human capital variable. Volatility of government expenditure on education and volatility in research and development budget have been estimated using the Generalize Autoregressive Conditional Heteroskedasticity (GARCH) Models. Coefficients of the short term and long term are estimated using Auto-Regressive Distributed Lag (ARDL) pattern. The results indicate that the costs of educational and R & D budget have a positive effect on economic growth, but the effect of volatility in these variables on economic growth is negative and significant. More addition, the effect of long term coefficients is more than the short term. Therefore, to achieve a high growth rate, development of human capital and its continuation is essential.

Keywords:

Human capital, Volatility, R&D, expenditure on education, Economic growth

JEL Classification: C32, E24, H52

1- Introduction

Human capital is defined as a saved knowledge which is conveyed to the human being intrinsically and educationally. Most of the economists believe that the human capital and physical capital are the basic determinants of the economic growth in any country. The role of human capital on the economic growth in the new economic theories is remarkable and educated and skillful labor forces are recognized as the engine of the economy; such that it can make more productive the physical capitals.

This paper aims to evaluate the impact of the investment volatilities in human capital on the Iranian economic growth during the period 1975-2011 based on the central bank databases as well as statistical center of Iran. The paper employed two proxies of the human capital investment entitled "research and development budget plus educational expenditures of government" in order to extract its volatilities under the conditional Heteroskedasticity models.

There are several studies in Iran and abroad in the framework of this paper that some of them include: Sultan Qadri & Waheed (2011), Naya & Ndeffo (2012), Mehmet Mercan (2013), Wakeel A. Isola, R. A Alani (2013), Barghandan *et al* (2010).

2- Research Methodology

In this study, we employ the Raymo (1995) model. According to the *Cobb-Douglas* function, this model divides the human capital into two parts including the research and development budget as well as the educational expenditures of government. Accordingly, we consider the human capital proxy in addition to the physical capital and labor force indices in the *Cobb-Douglas* function as:

$$Y = f(k, L, HK) \quad (1)$$

Where Y is gross domestic products; term K is the physical capital; L is labor force; RES is the research and development expenditures and finally term HK indicates the educational expending that divides into two sub- variables as:

$$Y = f(k, L, RES, HCA) \quad (2)$$

Where RES is Research and Development spending, and term HCA indicates the educational expenditures of government.

It is noted that there are several other effective variables that affect the economic growth of a country. Accordingly, the Iran economy is relative and we should consider some variables such as economic openness, inflation rate, and oil revenues in the basic model. Considering this changes, we have the following function:

$$Y = A.f(K, L, HK, Z, D57, DU) \quad (3)$$

Where terms D57 and DU are the dummy variables which are used due to the Iran- Iraq war. Moreover, we use term Z for corresponding effective variables including inflation rate (CPI), economic openness (OPEN). In this study, we use the gross domestic formation of capital (INV) as a proxy of physical capital. Therefore, the function will be as:

$$Y = A f(INV, L, RES, HCA, CPI, OPEN, D57, DU) \quad (4)$$

Since we are going to examine the effect of volatilities of educational expenditures as well as volatilities of R & D Budget on the economic growth therefore we use Autoregressive Conditional Heteroskedasticity patterns to extract the volatilities. After taking logarithm form the *Cobb-Douglas* functional form we can reach the two following regressions:

(First model):

$$Y = LA + \alpha LINV_t + \beta LL_t + \gamma_1 LRES_t + \gamma_2 LGARCHHCA_t + \delta LZ_t + u_t \quad (5)$$

(Second Model)

$$Y = LA + \alpha LINV_t + \beta LL_t + \gamma_1 LHCA_t + \gamma_2 LGARCHRES_t + \delta LZ_t + u_t \quad (6)$$

3- Empirical Results

3-1- Testing Stationarity of Variables

In this section, we employ the ADF test in order to evaluate the stationary of variables. The following table uses the level and first difference of variables recognizing the stationarity of the variables under investigation:

Table 1: Testing for Stationarity of variables by ADF test

Variable	Test Statistic		variable	Test Statistic	
	Intercept	Intercept and Trend		Intercept	Intercept and Trend
LGDP	-1/76(-2/93)	-2/92(-3/51)	DLGP	-3/74(-2/93)	-3/79(-3/51)
LL	-0/88(-2/93)	-3/626(-3/53)	DLINV	-6/49(-2/93)	-6/42(-3/52)
LINV	-1/38(-2/93)	-3/45(-3/51)	DLHCA	-8/16(-2/93)	-8/20(-3/52)
LHCA	-2/27(-2/93)	-3/04(-3/52)	DLRES	-5/02(-2/93)	-4/95(-3/52)
LRES	-0/18(-2/93)	-3/06(-3/52)	DOPN	-5/09(-2/93)	-5/04(-3/53)
LCPI	-3/20(-2/93)	-3/11(-3/52)	The Value cited in bracket are estimated at 95 percent Confidence Level		
LOPEN	-1/45(-2/93)	-1/54(-3/52)			

Source: Current Research, 2015.

The results cited in the table based on the ADF test indicate that the variables including LCPI and LL are stationary at level while the rest of the variables are stationary after taking a first difference.

3-2-the Empirical Results

This section of our paper evaluates the conditional heteroscedasticity models pertaining to the volatility of the educational as well as research and development expenditures. After that, the short term dynamics in addition to the long-term relations and the conventional classic hypotheses are examined.

3-2-1- Conditional Heteroskedasticity Approach

ARCH and GARCH models are patterns that don't have a constant variance. Constant variance assumption grants that the ordinary least square estimators to be unbiased and efficient. This is while; some economic and financial time series have clustering variations that affect the estimators. The tables 2 and 3 reports the results raised by the conditional heteroscedasticity models.

Table 2: Estimation Results of the GARCH Model On Educational Expenditures

$LHCA = C(1)*LOG(GARCH) + C(2) + C(3)*LHCA(-1)$		
$GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)$		
Variable	Coefficient	Z (P.V)
LOG(GARCH)	-0/19	-3/36(0/0008)
C	3/95	3/34(0/0008)
LHCA(-1)	0/47	3/47(0/0005)
Variance Equation		
C	0/001	1/69(0/091)
RESID(-1)^2	0/007	1/68(0/092)
GARCH(-1)	0/882	12/80(0/000)
DW:1/93	AC:-0/91	SC : -0/67

Source: Current Research, 2015.

According to the empirical results in table 2 we can write:

$$LHCA = 3.95 + -0.19LOG(\sigma_t^2) + 0.47LHCA(-1) \quad (7)$$

$$\sigma_t^2 = 0.001 + 0.007u_{t-1}^2 + 0.88\sigma_{t-1}^2 \quad (8)$$

Where, the equation 7 is the mean equation which is function of logarithmic conditional variance, constant and finally first lagged of the dependent variable. The equation 8 is the variance equation which is a function of constant term, first lag of residual and the conditional variance of the prior year. The findings show that all the coefficients are significant statistically.

Table 3 Estimation results of A GARCH Model For Extracting R & D Volatilities

LRES = C(1)*LOG(GARCH) + C(2) + [AR(1)=C(3)]		
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)		
Variable	Coefficient	Z (P.V)
LOG(GARCH)	-0/02	-24/30(0/000)
C	8/93	207/14(0/000)
AR(-1)	0/91	114/30(0/000)
Variance Equation		
C	0/0001	1/93(0/054)
RESID(-1)^2	1/395	8/95(0/000)
GARCH(-1)	0/326	32/35(0/000)
DW:2.32	AC: -3.84	SC:-3.59

Source: Current Study, 2015.

According to the empirical results in table 3 we can write:

$$LRES = -0.02 \text{ LOG}(\sigma_t^2) + 8.93 + [AR(1) = 0.91] \quad (9)$$

$$\sigma_t^2 = 0.0001 + 1.40u_{t-1}^2 + 0.33\sigma_{t-1}^2 \quad (10)$$

Where, the equation 9 is the mean equation which is function of logarithmic conditional variance, constant and finally first lagged of the dependent variable; The equation 10 is the variance equation which is a function of constant term, first lag of residual and the conditional variance of the prior year. The findings show that all the coefficients are significant statistically.

3-2-2- ARDL Approach

Given the different degree of integration for the variables in the study therefore, we use the ARDL approach estimating the model coefficients. The results form estimation of the basic models for both short term and long term are summarized in the following tables:

Table 4: ARDL Estimation Result for the first Model

ARDL (2,2,0,2,0,0,2)					
Short Term Results			Long Term results		
Variable	Coefficient	t statistic (p-value)	Variable	Coefficient	t statistic (p-value)
LOGRES	-0/3	2/99 (0/006)	LOGRES	-0/92	-11/27 (0/000)
LHCA	0/12	2/74 (0/011)	LHCA	0/24	2/22 (0/036)
OPEN	0/003	2/97 (0/007)	OPEN	0/005	3/28 (0/003)
CPI	-0/002	2/50 (0/020)	CPI	-0/004	-2/43 (0/023)
LINV	0/004	1/12 (0/27)	LINV	0/071	1/05 (0/304)
LL	0/006	0/93 (0/361)	LL	0/13	3/88 (0/001)
INPT	2/94	4/90 (0/000)	INPT	6/02	10/14 (0/000)
DU	-0/014	-1/94 (0/052)	DU	-0/03	-1/99 (0/051)
D57	-0/13	-2/92 (0/007)	D57	-0/27	-3/84 (0/001)
			ECM(-1)	-0/48	-4/02 (0/000)

Source: Current Study, 2015.

Table 5: ARDL Estimation Result for the Second Model

ARDL (2,2,0,2,0,2,2)					
Short Term Results			Long Term results		
Variable	Coefficient	t statistic (p-value)	Variable	Coefficient	t statistic (p-value)
LOGHCA	-0/13	-3/44 (0/002)	LOGHCA	-0/25	-2/74 (0/012)
LRES	0/31	3/55 (0/002)	LRES	0/78	9/09 (0/000)
OPEN	0/003	2/81 (0/010)	OPEN	0/004	2/53 (0/019)
CPI	-0/002	-2/65 (0/020)	CPI	-0/003	-2/54 (0/019)
LINV	0/073	2/47 (0/022)	LINV	0/22	2/47 (0/018)
LL	0/005	2/28 (0/042)	LL	0/12	4/72 (0/000)
INPT	3/17	5/88 (0/000)	INPT	5/83	11/97 (0/000)
DU	-0/024	-1/17 (0/254)	DU	-0/044	-1/28 (0/214)
D57	-0/15	-3/67 (0/001)	D57	-0/28	-4/65 (0/000)
			ECM(-1)	-0/54	-4/90 (0/000)

Source: Current Study, 2015.

Empirical results in the above tables shows that the short term coefficients are significant statistically and theoretically. More addition, the dummy variables pertaining to the Iran-Iraq war have a negative effect that their effects are larger than the regime shift dummy variable in the short term.

The long term equation of the economic growth for both models can be written as:

$$LGDP = 6.0207 INPT - 0.92074 LOGRES + 0.23951 LHCA + 0.0053388OPEN - 0.0039926 CPI + 0.071008LINV + 0.13121LL - 0.029486 DU - 0.27230 D57 \quad (11)$$

(model 2) $LGDP$

$$= 5.8309 INPT + 0.77503 LRES - 0.24673 LOGHCA + 0.0035709 OPEN - 0.0034663 CPI + 0.21561 LINV + 0.11970 LL - 0.044439 DU - 0.28014 D57 \quad (12)$$

All the long term coefficients are significant statistically. Such that, according to the table 4 we can say that ten percent increase in the logarithm of R&D budget leads to enhance the economic growth near to 2.4 percent on average. Inflation rate has the lowest effect on the dependent variable while the volatilities of educational expenditures variable has the highest effect on the Iranian economic effect with value 9.2 percent.

The results at the table 5 demonstrate that logarithm of the educational expenditures has the highest impact on the economic growth; such that if this variables raise one percent, then the economic growth increases 7.8 percent on average. If the second explanatory variable, logarithm of the R&D volatilities, increases one percent, it is expected that the dependent variable raises 1.1 percent directly. The inflation rate has the lowest impact on the economic growth. Additionally, if the economic openness raises one percent, the dependent variable increase about 0.04 percent directly.

Consequently, the comparison of long term and short term indicate that the effect value of short term is less than the long term effects.

4-2-3- Diagnostic Tests

The following tables verifies the classic hypotheses including non- autocorrelation, proper functional form, normal distribution for disturbances and homoscedasticity. In other words, now the coefficients are valid for inference.

Table 6: Diagnostic Tests

First Model		
Test	χ^2 آماره (P.V)	Result
non- autocorrelation	1/35 (0/246)	Accept
Functional Form	1/202 (0/273)	Accept
Normality	0/850(0/654)	Accept
homoscedasticity	1/055 (0/960)	Accept
Second Model		
Test	χ^2 آماره (P.V)	
non- Autocorrelation	0/268 (0/605)	Accept
Functional Form	0/533 (0/465)	Accept
Normality	0/719(0/698)	Accept
homoscedasticity	2/061 (0/151)	Accept

Source: Current Study, 2015.

5- Conclusion and Policy Implication

This paper intended to evaluate the impact of the investment volatilities in human capital on the Iranian economic growth during the period 1975 - 2011. The paper employed two proxies of the human capital investment entitled “research and development budget plus educational expenditures of government” in order to extract its volatilities under the conditional heteroscedasticity models.

In accordance with the estimation results we can conclude that the logarithm of volatilities of educational expenditures has the greatest effect in the model. Hence, the education is one of the important determinants of the Iranian economic growth. Accordingly, the government should allocate adequate financial resources in this sector. The interesting point pertaining to the volatilities of educational expenditures is that these volatilities have a negative and significant statistically on the economic growth. Consequently, the government should have a permanent program to control the volatilities in order to maintain their negative effects on the economic growth.

Allocation trend of educational and research credits in Iran indicate that the corresponding officials has not used appropriate criteria for measurement, recognition and monitoring of the credit allocation. In fact, since the budget considered for the issue of the human capital has not follow the universal and long term plan, such that the fact and figures of this budget has had a decreasing and increasing trend ,that affect the economic growth negatively. Thus, the officials should set a platform for their short term and long term policies.

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