

CHAPTER 5

ECONOMETRIC RESULTS

The purpose of our empirical investigation is to estimate the effects of FDI on economic growth. The effects of the interaction variables between FDI and human capital are also examined. Then, we test whether FDI has an effect on domestic investment.

Firstly, the stationary or the order of integration of each concerned variables will be examined, followed by estimating cointegration of the variables that are integrated of the same order so as to capture the long-run relationship. Finally, the Error Correction Model (ECM) will be formulated to measure the speed of adjustment to the equilibrium in the long run.

5.1 Unit root test

To avoid the problem of spurious regression, we need to check the properties of stationary for each series. In this study, unit root test would be employed to test for the stationary of each variable. Since the original unit root test or Dickey-Fuller (DF) test has weakness of presence of autocorrelation in the disturbance term, we use the modified DF test or the Augmented Dickey-Fuller (ADF) test to estimate the order of integration of each variable.

Using Eviews program to run ADF unit root test for each of time series variable, we get the findings of unit root test of each variable in levels, first differences as shown in Table 5.1. We check all variables used for Growth equation ($g, FDI, H, FDI*H, H_1, FDI*H_1$) and for Investment equation ($I.FDI, R, GC, G$).

Table 5.1
Summary of ADF Unit Root Test Results

Series	ADF Test Computed t- stat of γ	Number of lags	Conclusion
g_t	-1.568	3	I(1)
FDI_t	-1.289	0	I(1)
H_t	-1.999	2	I(1)
$(FDI*H)_t$	-1.131	0	I(1)
H_{1t}	0.661	0	I(1)
$(FDI*H_{1t})_t$	-1.162	0	I(1)
I_t	-2.842	1	I(1)
R_t	-2.465	1	I(1)
G_t	-2.358	1	I(1)
GC_t	-2.209	1	I(1)
Δg_t	-3.88*	1	I(0)
ΔFDI_t	-4.039*	0	I(0)
ΔH_t	-3.091**	3	I(0)
$\Delta(FDI*H)_t$	-3.965*	0	I(0)
ΔH_{1t}	-4.667*	0	I(0)
$\Delta(FDI*H_{1t})_t$	-4.488*	0	I(0)
ΔI_t	-3.008**	0	I(0)
ΔR_t	-4.749*	3	I(0)
ΔG_t	-3.947*	0	I(0)
ΔGC_t	-3.442**	0	I(0)

Note: 1. The Augmented Dickey-Fuller (ADF) test is under the null of a unit root. The optimal lag length for ADF regression is selected based on the AIC criterion.

2. * and ** means the rejection of a unit root at 1% and 5% level of significance respectively.

Our results show that all level variables exhibit integrated order one $I(1)$. This means that the series are non-stationary in level but stationary in first-differences. The implication is that there is a possibility of having a cointegrating vector whose coefficient can directly be interpreted as long-term equilibrium.

5.2 Cointegration Test

From the ADF test, we know that all variables of interests are nonstationary in level form then the usual regression results might be misleading and incorrect (spurious problem). Since the series are integrated of order one, which means that we have to take first difference of each series to obtain the stationary series, we do not regress on the stationary first difference series instead of those non stationary level data because in running regression in the form of first difference, we will lose a valuable information concerning the long-run relationship among the variables. In addition, most economic theories postulate a long-run relationship between variables in level form, not in difference form. Thus, using the concept of cointegration assists us to find the long run relationship among the non-stationary variables.

The cointegrating relationship among the variables is tested using Johansen Maximum Likelihood method. The test is needed to find the long-run relationship among a group of variables, particularly in the case that series are non-stationary at level. The prerequisite condition of the cointegration test is that each series have to be integrated of the same order. From the findings of stationary test as shown in Table 5.1, we know that all our variables exhibit integrated order one. That means there is a possibility of having a cointegrating vector whose coefficient can directly be interpreted as long-term equilibrium. Thus, we will investigate the long run relationship by a cointegration test.

In this study, Johansen trace test and maximal eigenvalue test are applied to check whether we have a cointegration relationship. Results of the trace test and maximal eigenvalue test are reported in Table 5.2 and Table 5.3 for growth equation (4.13) and Table 5.4 for investment equation (4.14) which give the number of cointegrating vectors.

Table 5.2

Cointegration Tests for Growth Equation (model with H variable)

Null hypothesis	Alternative hypothesis	Statistic	5% Critical value
Trace Test			
$r=0$	$r \geq 1$	128.9299*	69.81889
$r \leq 1$	$r \geq 2$	61.03880*	47.85613
$r \leq 2$	$r \geq 3$	29.19924	29.79707
Maximal Eigenvalue Test			
$r=0$	$r=1$	67.89111*	33.87687
$r \leq 1$	$r=2$	31.83956*	27.58434
$r \leq 2$	$r=3$	17.13009	21.13162

Notes: (i) The test was performed using Eviews;
(ii) r stands for the number of cointegrating vectors.

Table 5.3

Cointegration Tests for Growth Equation (model with H_I variable)

Null hypothesis	Alternative hypothesis	Statistic	5% Critical value
Trace Test			
$r=0$	$r \geq 1$	84.674*	47.856
$r \leq 1$	$r \geq 2$	43.921*	29.797
$r \leq 2$	$r \geq 3$	11.220	15.494
Maximal Eigenvalue Test			
$r=0$	$r=1$	40.752*	27.584
$r \leq 1$	$r=2$	32.700*	21.131
$r \leq 2$	$r=3$	9.960	14.264

Notes: (i) The test was performed using Eviews;
(ii) r stands for the number of cointegrating vectors.

Table 5.4
Cointegration Tests for Investment equation

Null hypothesis	Alternative hypothesis	Statistic	5% Critical value
Trace Test			
$r=0$	$r \geq 1$	108.1694*	69.81889
$r \leq 1$	$r \geq 2$	53.78902*	47.85613
$r \leq 2$	$r \geq 3$	26.09001	29.79707
Maximal Eigenvalue Test			
$r=0$	$r=1$	54.38040*	33.87687
$r \leq 1$	$r=2$	27.69901*	27.58434
$r \leq 2$	$r=3$	18.39913	21.13162

Notes: (i) The test was performed using Eviews;
(ii) r stands for the number of cointegrating vectors.

The findings of cointegration test indicate that there exist stable long run relationships among growth, investment and their determinants.

The test results are presented in Table 5.2 which indicates that for growth equation (the equation in which H is used), the trace test and maximal eigenvalue test imply the existence of 2 co-integrating vector at 5% level of significant.

The test results are presented in Table 5.3 which indicates that for growth equation (the equation in which H_1 is used), the trace test and maximal eigenvalue test imply the existence of 2 co-integrating vector at 5% level of significant.

The test results are presented in Table 5.4 which indicates that for investment equation, the trace test and maximal eigenvalue test imply the existence of 2 co-integrating vector at 5% level of significant.

The implication is that there exist two cointegrating equations for Growth model (model with H and H_1) and two cointegrating equations for Investment model in which their coefficients can be interpreted as long term equilibrium coefficients.

We get the results of the cointegrating equation in Eviews program (Johansen Cointegration Test)¹. Table 5.5 reports the co-integration coefficients of variables estimated by normalizing the coefficient of g and I to one.

¹ For the output from Johansen Cointegration Test, Eviews Program shows the hypothesis of number of at most cointegrating equations with the following outputs of cointegrating equations down below the Trace and Maximum Eigenvalue Test tables. The Trace and Maximum Eigenvalue Test indicate that for our equations, there exist at most 2 cointegrating equations at 5% level of significant. So, we will accept the case of one cointegrating and two cointegrating equations (tables of one cointegrating equation and two cointegrating equations). The first table of one cointegrating equation reports fully and completely the coefficients of our variables which we can utilize to interpret our long term equilibrium. The second table of two cointegrating equations which we accept as indicated in the two tests but it normalizes the coefficients of the two first variables to one, thus we will not apply it to interpret our long term equilibrium.

Table 5.5
Econometric results of co-integration estimates by normalizing
the coefficients of dependent variables (g , I) to one

	Dependent variable: Economic growth (g)		Dependent variable: Investment (I)
	(1)	(2)	(3)
FDI_t	4.478* (9.621)	3.189* (11.144)	2.392* (6.327)
H_t	0.356* (9.671)		
$(FDI*H)_t$	- 0.083* (-9.118)		
H_{1t}		23.201* (9.740)	
$(FDI*H_1)_t$		-7.195* (-10.483)	
GC_t			-11.907* (-8.511)
R_t			-0.279* (-6.292)
G_t			0.196 (0.571)
Adjusted-R ²	0.688	0.226	0.526

Notes: (i)* implies that the estimated coefficients are statistically significant at 1% level

(ii) numbers in the brackets are t-statistics

Based on the signs and the magnitude of coefficients on growth equation in regression (1) and (2), the results show that the coefficients of FDI and coefficients of H , H_1 are positive and significant. The coefficients of interaction terms $(FDI*H)$, $(FDI*H_1)$ are negative and significant.

In regression (1), for each percentage point increase in the FDI-to-GDP ratio, the rate of growth of economy increases by 4.478 percentage point. That consists with our hypothesis about contribution of FDI on economic growth in Vietnam and our analysis about the trends and benefit from FDI in Chapter 3. Human capital also has positive impact on economic growth (g), for each percent point increase in the secondary school enrollment rate, the economic growth rate (g) increase by 0.356 percentage point. Since the rate of secondary school enrollment is a proxy for human capital at lower level skill, thus its contribution on growth is not much. The coefficient of interaction term ($FDI*H$) is negative and significant at 1%. The presence of this variable is regarded as the measurement of the economy's absorptive ability of FDI, which depends on the skilled labors of an economy. Thus, low level of human capital is the reason that hinders the contribution of FDI on economic growth.

According to the regression (2), FDI also has positive impact on economic growth (g). For each percentage point of increase in the FDI-to-GDP ratio, the rate of growth of the economy increases by 3.189 percentage point. For one percentage increase in the ratio of enrollment of tertiary education, the rate of growth increase by 23.201 percentage point. Ratio of enrollment of tertiary education is another proxy for human capital at higher level skills. Thus, their contribution is found very high to economic growth. However the estimation results show a negative sign of the coefficient of the interaction term. This implies that Vietnam cannot absorb well the benefit brought by FDI inflows. This can be explained by its low level of enrollment in tertiary education. Besides, the adjusted R^2 in estimation (2) is just 0.226, thus the determinants in this model can't explain well the economic growth (g) as in regression (1).

Each of variable H and H_1 is used to represent the labor skills at difference level in which H stands for secondary enrollment rate and H_1 is the ratio of enrollment in tertiary and population. Since the two proxies are measured differently, this leads to results which are explained differently between the two regressions. However, in estimation results (1) and (2), both human capitals have positive effect on growth (g), though their interaction is unfavorable to growth (g).

The negative signs of interaction terms confirm that, limited labor skills hinder the growth effect of FDI. Such results seem to coincide with Borensztein et al (1995) when he stated that the benefits of FDI on host country depend on its absorptive capability of foreign technology through FDI, which is measured by the interaction between FDI and H. In order that a developing country captures such benefit, human capital must reach a certain threshold. Too low labor skills may restrict the effect of FDI on growth.

FDI and Domestic Investment

As mentioned above, the effect of FDI on economic growth in Vietnam is positive. However, the findings of estimations need to be read with caution. In fact, the finding will be more significant if we expect that FDI crowds in domestic investment through vertical linkages, or improves their productivity through knowledge spillovers. De Mello (1999) argued that if FDI is expected to affect economic growth (g) positively, it requires a complementary relationship between FDI and domestic investment. In this section, we examine the nature of the relationship between FDI and domestic investment in Vietnam in the framework of a simple equation in which domestic investment is determined by a function of FDI, government consumption GC , GDP growth, and the interest rate.

The test result in regression (3) indicates that there exists a long run relationship between domestic investment and FDI. For each percentage point of increase in the FDI-to-GDP ratio, the rate of I-to-GDP increases by 2.392 percentage points. Since FDI is already included in investment, if the coefficient estimated of FDI is positive and equal to unity implies that FDI has no effect on domestic investment. If the coefficient is positive and different from unity, then there is evidence of complementary effect on domestic investment. According to our results found in regression (3) that is positive and different from unity and statistically significant, this implies that FDI has complementary effect on domestic investment. Although the high output growth (G) is expected to be associated with high investment, in this study, we found that output growth (G) coefficient is insignificant.

Our results also suggest that interest rate has a negative impact on domestic investment since it raises the cost of capital, which reduces the investment rate.

The result of negative impact of government consumption suggests that in Vietnam government consumption spending may crowd out domestic investment by raising interest rates, by reducing the pool of funds in the markets, and by increasing distortion taxation on investment activities.

5.3 Error Correction Model

The results of cointegration test show that there is a long-run relationship between FDI and economic growth. Now, the short-run dynamics toward long-run equilibrium is investigated. The error correction model (ECM) is formed to find this short-run dynamics; that is, the speed of adjustment toward equilibrium. The ECM shows how the system converges to the long-run equilibrium implied by the cointegrating regression as estimated above. As a result, according to the Granger Representation Theorem, we can formulate an error correction model in order to capture the short run movement of all variables included in this cointegrating regression.

The error-correction term (ECT) is derived by normalizing the cointegrating vector on g . It captures the changes in g required to eliminate past departures of actual values of the variables from the equilibrium levels. According to the results, the coefficient of the error-correction term (ECT) which is commonly recognized as the adjustment coefficient has emerged with the negative sign and statistical significance. The negative and significant sign of the adjustment coefficient shows how much of the disequilibrium is being corrected, i.e. the extent to which any disequilibrium in the previous period effects any adjustment in g_t . This implies that there is an adjustment process which prevents the errors in the long-run relationship to become larger.

$$\begin{aligned} \Delta g_t = & 0.922 - 0.0205\Delta g_{t-1} - 1.238\Delta FDI_{t-1} - 0.489\Delta H_{t-1} \\ & (3.924) \quad (-0.138) \quad (-1.685) \quad (-3.914) \\ & + 0.0213\Delta(FDI * H)_{t-1} - 0.769ECT_{t-1} \\ & (1.377) \quad \quad \quad (-5.718) \end{aligned} \tag{5.1a}$$

$$\begin{aligned} \Delta g_t = & 0.337 - 0.212\Delta g_{t-1} - 0.263\Delta FDI_{t-1} - 0.636\Delta H_{1,t-1} \\ & (0.934) \quad (-0.900) \quad (-0.545) \quad (-0.156) \\ & + 0.402\Delta(FDI * H_1)_{t-1} - 0.235ECT_{t-1} \\ & (0.487) \quad \quad \quad (-2.49) \end{aligned} \tag{5.1b}$$

Note: numbers in the brackets are t-statistics

In above equations, the speed of adjustment toward equilibrium in the long run are shown by coefficient of lagged error correction term (ECT_{t-1}) is -0.769 and -0.235 and statistically significant. The negative signs suggest that when the actual growth rate is higher than their long-run equilibrium value, there will be a mechanism to reduce the actual growth rate by 0.769 and 0.235 in the next period so that the error will be slowed down and growth rate will be forced back toward equilibrium. Alternatively, within one year, about 76.9% and 23.5% of the disequilibrium between actual and long run economic growth can be decreased.

The result shows that most of coefficients in both equation (5.1a) and (5.1b), exhibit statistical insignificance which means that the lagged values of change in those explanatory variables do not affect change in g. The coefficient of human capital variable (H) in (5.1a) is negative and significant. This can be explained that short run change in H last period has negative impact on change in g at current period. However, the problem with our ECM is that the chosen lag is 1 due to the limited number of observations and the too short lag length may not capture the full dynamics of our variables.

The estimated ECTs are different between the two above equations due to the change of H and H₁ which are 0.769 and 0.235. Since H and H₁ are two different proxies of human capital variable in which H₁ stands for high skill labor which is critical for measurement of absorbing ability of FDI and foreign technology of a country. This high skill labor is important and stable for the labor market that leads to the small change each year. Thus, this may leads to the small change in error correction term.

In the equation (5.2), the speed of adjustment toward equilibrium in the long run is shown by coefficient of lagged error correction term (ECT_{t-1}) is -0.169 and statistically significant. Its negative sign suggests that the actual investment rate is higher than its long-run equilibrium value and there will be a mechanism to reduce the actual investment rate by 0.169 in the next period so that the error will be slowed down and investment rate will be forced back toward equilibrium.

The coefficient of short run impact of FDI on investment is positive but insignificant. The result also shows that G has short run positive impact on investment while GC has short run negative impact on investment. The reason may be explained that the change in investment is quickly adjusted by the change in G and GC. While in equation (5.1a) and (5.1b), it takes more than one period of the change in FDI and H to affect the change in g

$$\begin{aligned} \Delta I_t = & 0.706 + 0.298\Delta I_{t-1} + 0.139\Delta FDI_{t-1} - 0.051\Delta R_{t-1} \\ & (2.096) \quad (1.158) \quad (1.000) \quad (-1.354) \\ & + 0.550\Delta G_{t-1} - 2.778\Delta GC_{t-1} - 0.169ECT_{t-1} \\ & (2.683) \quad (-2.892) \quad (-2.710) \end{aligned} \tag{5.2}$$

Diagnostic Tests for equations (5.1a), (5.1b) and (5.2) show that there is no problem of autocorrelation because the probability value are 0.0855, 0.889 and 0.85 indicating that the null hypothesis of no autocorrelation cannot be reject at 5% level of significant. The problem of heteroscedasticity also does not exist since the probability values are 0.201, 0.649 and 0.327 for each equation (Appendix B).

Overall, the result indicates that there exists a long-run relationship between FDI and economic growth. FDI and human capital have positive effects on economic growth. Domestic investment is stimulated by FDI. Nevertheless, the negative effects of interaction terms between FDI and human capital on economic growth show that the low labor skills in Vietnam restrict the contribution of FDI to economic growth. It also means that absorptive capability of FDI in Vietnam is still low and thus Vietnam need to improve the labor skills to utilize the best effect of FDI on economic growth. Applying the ECM, we evaluate the speed of adjustment of the model toward the long run equilibrium. However, too short lag length may not capture the full dynamics of variable and may give some imprecise or insignificant conclusion about the short run impact.