THE IMPACT OF FOREIGN DIRECT INVESTMENT ON ECONOMIC GROWTH

Haykanush AYVAZYAN
Ph.D. student at YSU
International Economics Chair

Key words: FDI, economic growth, economic and econometric model, data observation, empirical analysis, ramsey RESET test, correlation, homoscedasticity

Economic model

To build our model we started with basic production function. Suppose the factors of production and the production technology determine the level of output in an economy according to:

Y = f (K, L), where Y denotes the output level (i.e., GDP), K denotes the amount of capital (which is measured by Gross Capital Formation (GCF) as percentage of GDP), and L denotes the amount of labor (measured by labor force of the country).

Therefore, we have added FDI also in the production function to analysis its impact on economic growth, also population growth (annual %), trade in services (% of GDP), price level ratio of PPP conversion factor (GDP) to market exchange rate. Moreover these indicators have also been included in the famous Coub-douglas Production Function for further observations. Trade in services is the sum of service exports and imports divided by the value of GDP, all in current U.S. dollars. The ratio of PPP conversion factor to market exchange rate is the result obtained by dividing the PPP conversion factor by the market exchange rate. The ratio, also referred to as the national price level, makes it possible to compare the cost of the bundle of goods that make up gross domestic product (GDP) across countries. It tells how many dollars are needed to buy a dollar's worth of goods in the country as compared to the United States.

Therefore, production function can be expanded by adding population growth (annual %) (P), trade in services (% of GDP) (TS), price level ratio of PPP conversion factor (GDP) to market exchange rate (PL) as an extra variables. The augmented production function can be written as follows:

Y = f (K, L, FDI, P, TS, PL)

Econometric model

Considering the above production function in context of multiple regressions, the evaluation of the above function can be done on the basis of following equation:

$Y= \beta_0 + \beta_1 (K) + \beta_2 (L) + \beta_3 (FDI) + \beta_4 (P) + \beta_5 (TS) + \beta_6 (PL) + \varepsilon$, where Y = Economic Growth (GDP growth (annual %))

K = Gross Capital Formation (% GDP)

L= Labor force participation rate, total (% of total population ages 15+)

FDI = Foreign direct investment, net inflows (% of GDP)

P= Population growth (annual %),

TS= Trade in services (% of GDP)

PL= Price level ratio of PPP conversion factor (GDP) to market exchange rate

Further β_0 is the total factor productivity that explains output growth i.e. not accounted by all the six factors and ε is the error term.

Data observation

The data set has been collected from the databank of World Bank because this is the most reliable source of data and is used by almost every researcher. First of all we get the summery statistics to show the main characteristics of our model.

Table 1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
economicgr~h	97	3.029897	3.026107	-7	10.2
laborforce	97	63.84536	9.49818	41	89
grosscapit~n	97	23.81443	8.208646	6	64
population~l	96	1.223958	1.21098	-1.7	7.1
tradeinser~p	97	18.0268	13.60629	4.3	91.3
foreigndir~t	97	3.049485	2.483576	-6.4	8.6
pricelevel~o	97	.6659794	.3325678	.3	1.8

As we see, we have 97 observations. The mean for FDI is 0.665 and standard deviation is 0.332. After that we check whether there is a correlation between our variables and the multicollinearity.

Table 2. Correlation between variables

	econom~h	laborf~e	grossc~n	popula~l	tradei~p	foreig~t	pricel~o
economicgr~h	1.0000						
laborforce	0.4423	1.0000					
grosscapit~n	0.4064	0.2083	1.0000				
population~l	0.4198	0.5022	0.0805	1.0000			
tradeinser~p	-0.1981	-0.2784	0.0978	-0.2091	1.0000		
foreigndir~t	0.2724	0.1524	0.1335	-0.0201	0.2351	1.0000	
pricelevel~o	-0.4000	-0.0870	-0.2647	-0.2593	0.0509	-0.1872	1.0000

As we see from the table 2 the most correlation there exists between population growth and labor force, but that is just 0,5 and this result is not as much that we can exclude one of the variables between the model. The mentioned correlation between these two variables exists because in long run term we can say that population growth will lead to the increase of labor force. But as our data is observed for just 2012 the correlation between them is only 0,5.

Table 3. The Multicollinearity of the variables

. vif

Variable	VIF	1/VIF
laborforce~l	1.55	0.643789
population~l	1.36	0.736063
tradeinser~p	1.21	0.824504
foreigndir~t	1.13	0.882455
grosscapit~n	1.08	0.926848
Mean VIF	1.27	

The vif test suggests that if the mean VIF is less than 10, then there is no multicollinearity between our variables. In our data the mean VIF is 1.27, so this means that we also do not have multicollinearity. Getting the main characteristics for our data, we can do regression in order to see how the following factors affect Economic Growth.

Empirical Analysis

Table 4. Estimated Regression Model Indicating the Factors that Affect Economic Growth

Source	SS	df	MS	Number of obs = 96
				F(6, 89) = 12.67
Model	399.99839	6	66.6663983	Prob > F = 0.0000
Residual	468.299933	89	5.261797	R-squared = 0.4607
				Adj R-squared = 0.4243
Total	868.298323	95	9.13998234	Root MSE = 2.2939

economicgr~h	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
grosscapit~n	.1056304	.0308406	3.43	0.001	.0443508	.1669101
laborforce~l	.0540726	.0312937	1.73	0.087	-.0081072	.1162525
foreigndir~t	.261338	.102983	2.54	0.013	.0567129	.4659631
population~l	.5681901	.2363351	2.40	0.018	.0985972	1.037783
tradeinser~p	-.0379782	.0190821	-1.99	0.050	-.0758939	-.0000625
pricelevel~a	-1.82966	.7824451	-2.34	0.022	-3.384361	-.2749577
_cons	-2.554743	1.969236	-1.30	0.198	-6.467572	1.358087

According to the table 3 we can get

Y= -2.554 +0.106 (K) + 0.054 (L) + 0.261 (FDI) + 0.056 (P) - 0.038 (TS) - 1.829(PL) +ε

The coefficients describe the dependence of economic growth on the other variables. The intercept estimate b_1=-2.554 is the value of the dependent variable when each of the independent, explanatory variables takes the value zero, but this is economically impossible, because it is not realistic if the variables such as labor force or gross capital formation and other indicators be zero. The other parameters in the model measure the change in the value of the economic growth given a unit change in the explanatory variable and all other variables held constant. In our example the parameter

β_1=0.106 shows that 1 unit increase of gross capital formation will lead to the increase of economic growth by 0.106, when other variables held constant.

β_2=0.054 - shows that 1 unit increase of labor force will lead to the increase of economic growth by 0.054. This is because additional labor force make additional product or services which is surely increase GDP.

β_3=0.261- shows that the increase of FDI by 1unit will increase the economic growth by 0.261 and the other variables held constant. That means we have positive relation between the change of FDI and economic growth. So, the increase in FDI leads to an increase in economic growth. Or, expressed differently, a reduction in FDI of 1unit will lead to the decrease in Economic growth by 0.261. The sample mean of FDI is 3.049 and its standard deviation is 2.48. This means a 1% increase in FDI is a relatively large change. So the 10% increase of FDI leads to the 2.61% increase of the economic growth.

β_4= 0.056-if the population will increase by 1% the economic growth will increase by 0.056. This is because of the population growth the probability of the labor force increases, which brings to the economic growth.

In our example we have trade in services and Price level ratio of PPP conversion factor (GDP) to market exchange rate have negative effect in our economic growth. Purchasing power parity conversion factor is the number of units of a country's currency required to buy the same amount of goods and services in the domestic market as a U.S. dollar would buy in the United States. The ratio of PPP conversion factor to market exchange rate is the result obtained by dividing the PPP conversion factor by the market exchange rate. So the negative impact of this variable means, that in average within our 96 countries there is a real large range between currency exchange rate of the host and other countries that influences bad to the economic growth.

Trade in services has negative effect, because trade in services means not only export of services but also import of services. In 2012 within our 96 countries in average the import exceed the export that is why we have a negative effect.

From this regression we also get that there is 95% confidence interval for β_3 being in the range of 0.567129 and 0.4659631. We can get this interval also doing

calculations. Having N=96 and degrees of freedom are N-K=89, for 95% confidence interval α=0.05. The critical value $t_c=t_{(1-\alpha/2,\ N-2)}=t_{(0.975,89)}$ = 1.960 is the 97.5 percentile from the $t_{(N-K)}$-distribution with 89 degrees of freedom and $t_c=t_{(0.025,89)}$=-1.960 is the 2.5 percentile of the $t_{(N-K)}$ distribution. For β_3 the probability statement becomes

$P(b_3 - 1.987*se(b_3) \le \beta_3 \le b_3+1.987*se(b_3)) = 0.95$

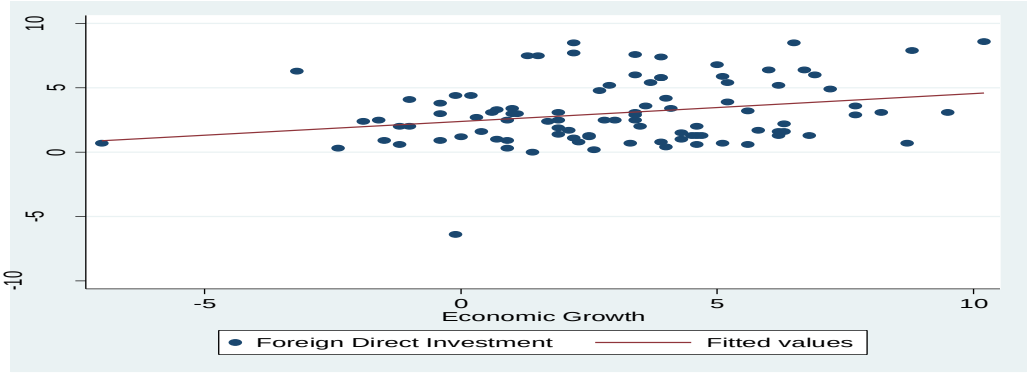
$b_3 \pm t_c * se(b_3) = 0.261 \pm 1.987*0.102 = (0.056; 0.46)$

There is just one remaining parameter to estimate- the error term. In our example we have

$\delta^2 = \sum_{i=1}^{96} e_i^2 / N-K = 468.29/96-7=468.29/89=5.26$

$SSE=\sum_{i=1}^{96} e_i^2 = 468.29$

From here the root MSE=2.29, which is absolutely we also get with the help of regression. Also, viewing the relationship between FDI and economic growth with the help of graph we see that foreign direct investments show increasing nature.



Graph 1. The relationship between FDI and economic growth

From the graph we see that FDI effects economic growth directly.When FDI increases we get more economic growth. First of all let's check whether our model homoscedastic or not. For that reason we do Breusch-Pagan Test and white's test. Now let's do Breusch-Pagan Test for checking heteroscedastisity of our model.

Table 5 The Breusch-Pagan test for heteroscedasticity

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: laborforceparticipationratetotal grosscapitalformation populationgrowthannual tradeinservicesofgdp
                foreigndirectinvestment pricelevelratioofpppconversionfa

        chi2(6)      =  4.94
        Prob > chi2  =  0.5509
```

We get chi sq. distribution that has a certain numbers of freedom. In or example it is six, because we have six parameters in our model except the constant one. So the Breusch-Pagan Test produced a chi sq statistics with six degrees of freedom. Breusch-Pagan / Cook-Weisberg tests the null hypothesis that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables. We get prob chi2 smaller than chi 2, so we do not reject the null and except that our model is homoskedastic. We can do the same test this time with the help of white test. The results are

Table 6. The White's test for homoscedasticity

White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity

chi2(27) = 26.34
Prob > chi2 = 0.4999

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	26.34	27	0.4999
Skewness	8.79	6	0.1860
Kurtosis	0.41	1	0.5237
Total	35.53	34	0.3961

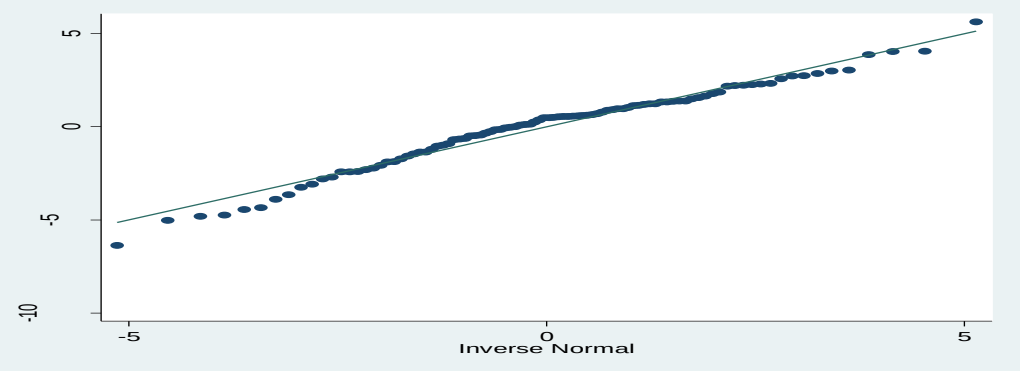
As we see from the results we get p value is greater than 0.05, so we do not reject the null and except that our model is homoskedastic. The results confirm the fact that our model is homoscedastic and now by doing sktest we show that the residuals have normal distribution. For that first of all we generate a new variable r and get the following result.

Table 7. Skewness /Kurtosis tests for residuals normality

Skewness/Kurtosis tests for Normality

				joint	
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
r	96	0.0630	0.4227	4.22	0.1211

Results from the table 7 indicate the fact that the residuals are normally distributed as the prob. is greater than 0.05. We also show that with the help of graph.



Graph 2. Qnorm test for the normality of residuals

Histograms and boxplots are useful for assessing distributional shapes, but the qnorm command is the best for assessing whether a variable approximately follows a normal distribution. We want to know if the plotted data fall approximately on a straight line. Real data never fall exactly on a straight line, but if the residual are very close to the straight line then we can conclude that there is a normally distribution.

The significance of the model.

1. We are testing $\beta_1 = 0$, $\beta_2 = 0$, $\beta_3 = 0$, $\beta_4 = 0$, $\beta_5 = 0$, $\beta_6 = 0$.

Against the alternative H_1: At least one of them is not zero. If Ho is true F = (SST- SSE) / (7-1) / SSE/ (96-7) ~ $F_{(6,89)}$

2. Using a 5% significance level, we find the critical value for F-statistics with (6,89) degrees of freedom is $F_C = 2.2$. Thus, we reject Ho if $F \geq 2.2$

3. SST = 879.103, SSE =468.29, which gives an F- value of F = (879.10-468.29)/6/ 468.29/ (96-7) = 68.46/ 5.261 = 13.01. Also p- value = P ($F \geq 13.01$) = 0.000

4. Since 13.01 > 2.2, **we reject the null and conclude that the estimated relationship is a significant one.**

Testing the Significance of the FDI coefficient

If we want to confirm the belief, that explanatory variable FDI influence the dependent variable economic growth we need to show that $\beta_3 \neq 0$. Thus let's test the null hypothesis

Ho: $\beta_3 = 0$ against the alternative hypothesis H1: $\beta_3 \neq 0$

To carry out the test, we use the test statistics, which, if the null hypothesis is true, is

t=b3/se (b3) ~ $t_{(N-K)}$

So, our standard testing format will be

1. The null hypothesis is H_0: $\beta_3=0$. The alternative hypothesis is H1: $\beta_3 \neq 0$

2. The test statistics $t=(b_3/se(b_3) \sim t_{(N-7)}$ if the null hypothesis is true

3. $\alpha=0.05$. The critical values for this two-tail test are the 2.5-percentile $t_{(0.025,89)=}$ -1.9870 and the 97.5-percentile $t_{(0.975,89)}$ = 1.9870. Thus we will reject the null hypothesis if the calculated value of $t \geq 1.9870$ or if $t \leq -1.9870$. If $-1.9870 < t < 1.9870$ we will not reject the null hypothesis.

4. $b_3=0.261$ with std error se $(b_3) = 0.102$. The value of the test statistics is

T=b3/se (b3)=0.261/0.102=2.54

Since t=2.558 > 1.9870 **we reject the null hypothesis** that $\beta_3=0$ **and conclude that there is a statistically significant relationship between FDI and economic growth.** Also in our table we have t-statistics value for FDI=2.54 and p value 0.013, that means we can reject null hypothesis and except the alternative one. In our example we can also calculate the p value in such a method

$P= P (t_{(89)} \geq 2.54 + P(t_{(89)} \leq -2.54 = 0.013$

In this case we reject Ho because 0.013 < 0.05

Now let's do joint hypothesis trying to see whether economic growth is influenced by FDI, gross capital formation and labor force and use F-test.

Thus, for this test our null and alternative hypotheses are

Ho: $\beta_1 =0, \beta_2 = 0, \beta_3 = 0$

H_1: $\beta_1 \neq 0, \beta_2 \neq 0, \beta_3 \neq 0$ or they all are nonzero

So $Y= -2.554 +0.106 (K) + 0.054 (L) + 0.261 (FDI) + 0.056 (P) - 0.038 (TS) - 1.829(PL) +\varepsilon$ is unrestricted model

And $Y= -2.554 + 0.056 (P) - 0.038 (TS) -1.829(PL) +\varepsilon$ – will be the restricted model, which is obtained by assuming the parameter restrictions in Ho are true. Doing regression for our restricted and non restricted models we see that $SSE_R-SSE_U \geq 0$

625.09-468.29=156.8 ≥ 0

1. The joint null hypothesis is Ho: $\beta_1 =0, \beta_2 = 0, \beta_3 = 0$. The alternative hypothesis is H_1: $\beta_1 \neq 0, \beta_2 \neq 0, \beta_3 \neq 0$ or they all are nonzero.

2. Having three restrictions in Ho means J = 3. Also N = 96, K = 7, so the distribution of the F-test statistics when Ho is true is

$F= (SSE_R – SSE_U)/3 / SSE_U/(86-7) \sim F_{(3, 89)}$

3. Using $\alpha = 0.05$, the critical value from the $F_{(3, 89)}$ distribution is $F_c = F_{(0.95, 3,89),}$ giving a rejection region of $F \geq 2.71$. Alternatively, Ho is rejected if p-value ≤ 0.05

4. The value of F-test statistics is $F= (SSE_R – SSE_U)/3 / SSE_U/(86-7)$ = (625.09-468.29) /3 / 468.29/ (96-7) = 52.26/5.261 = 9.933

5. The corresponding P-value is p = P(F(3,89) > 9.933) = 0.00001

Since $F = 9.933 > F_C = 2.71$, we reject the null hypothesis that $\beta1 = 0$, $\beta2 = 0$, $\beta3 = 0$, and conclude that at least one of them is not zero. The same conclusion is reached by noting that p-value = 0.00001< 0.05.

Now let's show that adding irrelevant variable, that is correlated to FDI and trade in services is not expected to influence economic growth. For that we generate a new variable with the name new variable = FDI * trade in services.

Table 8. Estimated Regression Model with the irrelevant variable

Source	SS	df	MS	Number of obs =	96
				F(7, 88) =	10.78
Model	400.882583	7	57.2689404	Prob > F =	0.0000
Residual	467.41574	88	5.3115425	R-squared =	0.4617
				Adj R-squared =	0.4189
Total	868.298323	95	9.13998234	Root MSE =	2.3047

economicgr~h	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
laborforce~l	.0561382	.0318462	1.76	0.081	-.0071495	.1194259
grosscapit~n	.1050759	.0310159	3.39	0.001	.0434384	.1667134
population~l	.5590414	.2385061	2.34	0.021	.0850606	1.033022
tradeinser~p	-.0472619	.0297544	-1.59	0.116	-.1063925	.0118686
foreigndir~t	.1995077	.1834975	1.09	0.280	-.165155	.5641703
pricelevel~a	-1.818893	.7865778	-2.31	0.023	-3.382051	-.2557351
A	.0024096	.0059058	0.41	0.684	-.0093269	.0141461
_cons	-2.464944	1.990727	-1.24	0.219	-6.421094	1.491207

As expected, the p-values of the variables get higher of 0.05, because here we already have correlated variables. Also the standard errors of the coefficients for all variables have increased. Besides **ovtest** also shows that we need not to add any variable.

Table 9. Ramsey RESET test

```
. ovtest

Ramsey RESET test using powers of the fitted values of economicgrowth
      Ho:  model has no omitted variables
                  F(3, 86) =      2.82
                  Prob > F =      0.0437
```

As we see from the results of the ovtest we do not reject the null and this test also confirm the fact that model has no omitted variables as the probability of omitted variables is 0.0437.

References

1 Impact of Foreign Direct Investment on Economic Growth, Journal of Management and Social Sciences,Vol. 6, No. 2, (Fall 2010) 84-92
2 Impact of Foreign Direct Investment on Gross Domestic Product, Global Journals Inc. (USA), 2011
3 Does Foreign Direct Investment Promote Economic Growth? Evidence from a Threshold Regression Analysis, Wu Jyun-Yi & Hsu Chih-Chiang Economics Bulletin, Vol. 15, No. 12 July 23, 2008.
4 Economic Impact of Foreign Direct Investment in South Asia, Institute of Development Research, (2000).
5 Foreign direct investment, economic freedom and growth: new evidence from Latin America, Marta Bengoa, Blanca Sanchez-Robles, European Journal of Political Economy Vol. 19 (2003).
6 Impact of foreign direct investment on economic growth, Empirical evidence, International Journal of Academic Research in Accounting, Finance and Management Sciences, 2013
7 Impact of FDI on GDP: A Comparative Study of China and India, ABV-Indian Institute of Information Technology and Management, India, 2011
8 UNCTAD. (1994). World Investment Report. New York:United Nations.
9 UNCTAD. (1999). World Investment Report. New York:United Nations.
10 UNCTAD. (2010). World Investment Report. New York:United Nations.
11 http://www.worldbank.org
12 http://www.nber.org/papers/w12522
13 https://ideas.repec.org/h/izm/prcdng/200802.html
14 http://www.ats.ucla.edu/STAT/stata/library/cpsu.htm
15 http://www.stata.com/statalist/archive/2006-04/msg00091.html

Haykanush AYVAZYAN

The Impact of Foreign Direct Investments on Economic growth

Key words: FDI, economic growth, economic and econometric model, data observation, empirical analysis, ramsey RESET test, correlation, homoscedasticity

FDI has long been recognized as a major source of technology and know-how to developing countries. There are several studies done on FDI and economic growth. Their findings vary from different methods used on their research, some of the researchers found that FDI has a positive effect on economic growth.

Հայկանուշ ԱՅՎԱԶՅԱՆ

ՕՈՒՆ ազդեցությունը տնտեսական աճի վրա

Բանալի բառեր. ՕՈՒՆ, տնտեսական աճ, տնտեսական և տնտեսաչափական մոդել, վերլուծական տվյալներ, էմպիրիկ վերլուծություն, Ռամսեյ թեսթ, կորելացում

Զարգացող երկրներում ՕՈՒՆ-երը համարվում են տեխնոլոգիայի և նոու-հաուների հիմնական աղբյուր: ՕՈՒՆ-երի և տնտեսական աճի վերաբերյալ կան կատարված որոշակի հետազոտություններ, որոնք միմյանցից տարբերվում են ըստ հետազոտության մեթոդների: Որոշ հետազոտություններ ցույց են տալիս որ ՕՈՒՆ-երը ունեն դրական ազդեցություն տնտեսական աճի վրա:

Айкануш АЙВАЗЯН

Воздействие ПИИ на экономический рост

Ключевые слова: ПИИ, экономический рост, экономическая и эконометрическая модель, аналитические данные, эмпирический анализ, Рамсей тест, регрессия, корреляция, гомоскедастичность

В развивающихся странах ПИИ считаются основным источником технологий и ноу-хау. В отношении ПИИ и экономического роста проведены некоторые исследования, различие которых состоит в методах, применимых при исследовании. Некоторые исследования обнаружили, что ПИИ оказывают положительное влияние на экономический рост.