Effects of Human Capital and Openness on Economic Growth of Developed and Developing Countries: A Panel Data Analysis

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Abstract—Technology transfer by international trade and foreign direct investment is the most important positive outcome of open economy. It is widely accepted that new technology and knowledge have an important role in enhancing economic growth. Human capital is the other important factor assisting economic growth. In this study, the role of human capital in the growth process is examined in a view of new endogenous growth theory emphasizing on the technology transfer resulting from international trade. Using the panel data of 10 developed and 10 developing countries, impact of human capital and openness on the rate of economic growth of different countries is analysed. Evidence suggests the view that human capital and openness contribute to the economic growth in both developing and developed countries, but with different rates.

Keywords—economic growth, human capital, openness, technology

I. LITERATURE REVIEW

FROM the classical economists to the endogenous growth economists, researchers have been tried to understand the process of economic growth. The question "What determines the rate of growth?" has always been central to the economists. It is apparent that some countries have faster growth rates than others. Generally, studies show that the role of technological change has been always crucial to explain these differences in growth rates. Classical economists, such as Adam Smith, David Ricardo and Karl Marx provided many of the basic concepts that are used in modern theories of economic growth like competitive behavior, diminishing returns and its relation to the accumulation of capital, per capita income and the growth rate of population. They have discussed differences in growth rates across the countries extensively but their main focus was not on the technology. In the classical growth theories, the effects of technological change are in the forms of discoveries of new goods, innovation in production methods and increase in specialization of labor.

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In the supply side driven model of Smith, output growth was a function of population growth, investment growth, land growth and overall productivity. According to him, improvement in machinery as a main source of specialization increased economic growth. Ricardo modified this model by using diminishing returns to land which could be eliminated by technological improvements and specialization. The other famous classical economist, Marx, argued that technological progresses in the form of machinery or division of labor were not beneficial ways of improving growth. It created the technological unemployment and caused to a decline in wages. Also technological improvement was a way of alienation of the working class. After the classical models, Harrod and Domar attempted to analyze the elements of economic growth by using Keynesian model and they argued that the capitalist system was inherently unstable.

In contrast to Keynesian growth theory, the neoclassical growth model developed by reference [1] and reference [2] generated a simple general equilibrium model of the economy in which all the long-run equilibrium variables such as gross domestic product, the capital stock and the labor grew at the same exogenously determined rate. The technological progress allowing the long-run growth in GDP per capita was an exogenous variable. Neoclassical growth theory has been criticized both on theoretical and empirical grounds. The main theoretical weakness of neoclassical model is attributing long-run growth to exogenous technological progress. In the empirical studies using a neoclassical growth model, the importance of technical progress which was measured as a residual has been emphasized. As reference [3] argued, growth accounting exercises did not explain why growth rates differed across countries. In the growth accounting exercises studying the neoclassical model, there is no attempt to measure directly the contribution of increase in knowledge to economic growth. Increase in the two factors of production, capital and labor, can not explain the residual. Also from an empirical perspective there is a little evidence of convergence, it has been found that convergence is a phenomenon that holds only for particular countries over particular periods.

The recent empirical studies indicate that technological change is endogenous and there are some country specific factors which affect the technological progress. Changing the assumptions of Solow exogenous growth model, reference [4] and some other authors developed vintage models to provide endogenous technological progress. Reference [5] introduced a model with research sector which produced technology and

pointed out that technical advance came from a sector which produced new ideas and innovation.

In response to criticisms of the neoclassical growth model, endogenous growth theory was developed in the mid 1980s. The main feature of the endogenous growth models is the existence of a sector producing new ideas. Mainly human capital which is the most crucial determinant of growth process has been become focal point in these models. Unlike the neoclassical growth model, long-run growth rate are determined within the model. These new growth models beginning with the work of reference [6] and reference [7] built on the work of reference [4] and reference [5]. Endogenous growth theory helps to explain the existence of technological progress which is taken as given by neoclassical growth model.

In fact, one of the theoretical contributions of endogenous growth model is allowing analysis of open economies. Technology transfer by trade and foreign investment is the most important positive outcome of open economy. It is widely accepted that new technology and knowledge have an important role in enhancing economic growth. However, there is uncertainty about the diffusion of new technology across the countries. International trade may promote a higher level technological progress among some member countries, but it is important to say that not all the open economies may benefit from this progress. Reference [8] argued that productivity differences among the countries were explained by the technological mismatches. Using the same technology in different countries lead to a technological mismatch which in turn caused to productivity differences since less developed countries did not have human capital skilled enough to employ in tasks performed by skilled workers in developed countries. If technology is free good which is accessible for every country through international trade, government should implement most effective policies to make domestic capacity available for technology spillover.

New endogenous innovation models include international movements of capital, goods and knowledge. The effects of international trade on the rate of economic growth are extensively analyzed and in fact, trade affects the economic growth through market integration and resources allocation [9], [10], [11] and [12]. General claim is that more open developing country with more skilled labor force benefits more from foreign R&D spillovers [13]. However, in the literature many writers have accepted that each country has distinct national characteristics which affect the process of technological change [14], [15] and [16].

A substantial amount of study which examines the relationship between integration and growth is based on the model of reference [17], in which technological change comes from a research sector as a result of deliberate costly activity. Innovator produces new design and retains a perpetual monopoly power over the production of the new type of input. In his model, technological progress takes the form of expanding variety of product. Technological improvement leads to expansion in the number of available intermediate good. In the knowledge driven specification of R&D,

knowledge accumulation is provided by the human capital and existing stock of knowledge.

In the endogenous framework, it is claimed that the total factor productivity can be increased by either increase in inputs or higher input quality [18]. Open trade increases productivity by allowing higher quality inputs. It induces the economic growth by encouraging the efficient allocation of resources and by introducing innovation and learning from abroad. New inputs, new technologies, new management techniques become available to domestic producer. Following the large number of studies which examine international trade and growth [13], in this study, international trade is introduced as an input into the production function in addition to labor and capital.

In this study we are trying to investigate the effects of human capital and openness on the growth rate of ten developed and ten developing economies during the period 1996-2005 within the new endogenous growth theory framework. Evidence suggests the view that opens trade and human capital contributes to the economic growth in both developing countries and developed countries, but output elasticity of developed countries' human capital, domestic investment, and openness are higher than that of developing countries.

The paper follows in three sections. Section 2 includes a theoretical framework to motive our empirical investigation, an account of data used in the analysis and the regression results and section 3 provides some concluding remarks.

II. EMPIRICAL ANALYSIS

A. Theoretical Model

Starting with an early form of the production function $Y = AK^{\alpha}L^{1-\alpha}$, we can rewritten it by inserting other variables;

$$Y = f(K, L, XM) \qquad (1)$$

where Y, K, L and XM refer to output, capital, labor and openness. Labor can be decomposed into unskilled labor which produces final good and skilled labor which produces technology. Also capital consists of domestic and foreign parts of investment.

Taking logarithms of the variables in the both sides of the equation (1), we can get total output as the following equation,

$$g = \alpha + \beta hki + \gamma i + \lambda fdi + \phi xm \qquad (2)$$

where g, hki, i, fdi and xm denotes the gross domestic product, human capital, domestic investment, foreign direct investment and openness and, β, γ, λ and ϕ refer to output elasticity of human capital, domestic investment, foreign direct investment and openness respectively.

B. Data Analysis

As it is mentioned above, the aim of this study is to examine the impact of human capital and openness on the economic growth of countries for a period of 1996 and 2005. To analyze this effect, growth equation (2) is taken into consideration. In this equation, g refers to log values of real GDP per capita, i

refers to log values of gross fixed capital formation per capita, fdi refers to log values of foreign direct investment per capita, xm refers to the share of exports and imports of goods and services in GDP and hki refers to human capital index. This index is based on the human capital index used in reference [19], ''Time series Econometrics of Growth Models: A guide for Applied Economists.'' The index is formed according to the weighted average of four variables; labor force with primary education, labor force with secondary education, labor force with tertiary education and life expectancy at birth total, (years). All these data are taken from World Development Indicators database of The World Bank.

The countries examined are divided in two groups; developing and developed countries. As developing countries, Argentina, Brazil, Bulgaria, Czech Republic, Hungary, Mexico, Poland, South Africa, South Korea and Turkey are chosen and as developed countries Austria, France, Germany, Italy, Japan, Netherlands, Norway, Switzerland, Spain and U.K are analyzed.

In this study, a panel data set is used. This data set has some advantages over cross section and time series data sets since it has both time and cross section dimensions, it provides a large number of observations to the researchers and improves the efficiency of econometric estimates "by increasing the degrees of freedom and reducing the collinearity among explanatory variables" [20]. Additionally, panel data models can solve unobserved heterogeneity problem resulting from the different country specific factors and omitted variables problems [21]. In the analysis of panel dataset, the software program ''Stata'' is used.

C. Empirical Results

A static panel data analysis is made. In order to decide whether random or fixed effects models are more appropriate, a Hausman test is run. The Hausman test tries to find the more efficient model which gives consistent results by testing the null hypothesis ''that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are insignificant (P-value, Prob>chi2 larger than 0.05) than it is safe to use random effects. If you get a significant P value, you should use fixed effects'' [22].

Since Prob>chi2 = 0.7741 is larger than 0.05, it is better to use random effects model for developed countries and when we observe the output of random effects regression from table 2, we realize that all coefficients are statistically significant.

After determining the appropriateness of random effects for developed countries, the same Hausman test is applied for developing countries and the following output is obtained. Table 3 shows that random effects model is more efficient for developing countries since Prob>chi2 = 0.9986 is larger than 0.05 and table 4 support this view by demonstrating the statistical significance of all coefficients.

TABLE I
HAUSMAN TEST FOR DEVELOPED COUNTRIES

| | ---- Coefficients ---- | | |
| | (b) | (B) | (b-B) |
	fixed	random	Difference
i	0.4673277	0.4882834	-0.0209556
fdi	-0.0058035	-0.0061011	0.0002976
xm	0.2453908	0.2304477	0.0149431
hki	0.4297073	0.4090463	0.0206611

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$chi2(3) = (b-B)'[(V\_b-V\_B)^{\wedge}(-1)](b-B) = 1.79$

Prob>chi2 = 0.7741

TABLE II
RANDOM EFFECT GLS REGRESSION FOR DEVELOPED COUNTRIES

R-sq: within= 0.8990
   between = 0.4867
   overall = 0.4726

g	Coef.*	Std. Err**.	t	P>|t|	[95Conf.Interval]***	
i	0.4882	0.0297	16.43	0.000	0.4300	0.5465
fdi	-0.0061	0.0040	-1.50	0.132	-0.0140	0.0018
xm	0.2304	0.0433	5.32	0.000	0.1455	0.3153
hki	0.4090	0.0889	4.60	0.000	0.2346	0.5834
_cons	13.8709	0.7214	19.23	0.000	12.4569	15.284

Coef.* refers to coefficients
Std.Err** refers to standard errors
[95Conf.Interval]*** refers to %95 confidence interval

TABLE III
HAUSMAN TEST FOR DEVELOPING COUNTRIES

| | ---- Coefficients ---- | | |
| | (b) | (B) | (b-B) |
	fixed	random	Difference
i	0.3074	0.3095	-0.0020
fdi	-0.014	-0.0141	0.0001
xm	0.2005	0.2016	-0.0011
hki	0.3329	0.3293	0.0036

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho;obtained from xtreg

Test: Ho: difference in coefficients not systematic

$chi2(3) = (b-B)'[(V\_b-V\_B)^{\wedge}(-1)](b-B) = 0.11$

Prob>chi2 = 0.9986

TABLE IV
RANDOM EFFECT GLS REGRESSION FOR DEVELOPING
COUNTRIES

R-sq: within=	0.7734					
between=	0.3369					
overall =	0.3310					

g	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
i	0.3095	0.0333	9.28	0.000	0.2441	0.3748
fdi	-0.0141	0.0088	-1.60	0.110	-0.0316	0.0032
xm	0.2016	0.0315	6.40	0.000	0.1398	0.2634
hki	0.3293	0.0744	4.42	0.000	0.1833	0.4752
_cons	18.682	1.05291	17.74	0.000	16.6185	20.7459

III. CONCLUSION

In this study we try to investigate whether the contributions of human capital and openness for different countries are the same or not. We think that marginal productivity of human capital using foreign technology is not the same as marginal productivity of human capital using domestic technology. In fact, integration makes both foreign and domestic technology available through foreign direct investment and international trade. Assuming developing country's level of technology is lower than developed country's level of technology, integration leads to acceleration of technological advance in the developing economy, if the human capital using foreign knowledge has the minimum threshold to use advanced technology.

Empirical analysis for both developed and developing countries shows a negative estimated coefficient of foreign capital which is significant at 14 percent level. We should note that there is a weak evidence to say that foreign capital affects growth rate of the countries in a negative way. To investigate whether the effect of foreign capital on GDP growth rate is permanent or transitory, we used the lagged versions of foreign capital as variables in the regressions and observed that estimated coefficient of the lagged foreign capital was insignificant. The interesting point is that the coefficient of foreign direct investment is estimated as negative. One may think that this coefficient should be positive like that of openness. Actually the effect of open trade regime is widely discussed and it is not possible to say that foreign capital always affects economic growth positively. Also, readers should take difficulties of measuring foreign capital into consideration. Since the composition of foreign capital is crucial in determining the growth effects, this result shows that foreign capital inflow is the cash inflow which does not contribute to the industrialization.

Thus our analysis does not give completely consistent results with the theoretical model suggesting positive and significant coefficients for every variable. All coefficients of independent variables are significantly different from zero, but foreign capital variable has not a positive sign while the others are signed positively.

Needless to say that both quality and amount of human capital affect economic growth. Thus we use an index representing the number and capacity of labor force. Empirical results support the view that human capital is one of the most important factors enhancing economic growth. Estimated coefficients of human capital for both developed and developing countries are positive and significant at 1 percent level. Output elasticity of developed countries' human capital, domestic investment, and openness are higher than that of developing countries. This means that these variables contribute more to growth for developed countries. This may happen, because in these countries which are analyzed in the context of open economy, integration making foreign capital and knowledge available may have different effects on economic growth. The important point is that integration leads to higher available knowledge stock which brings higher growth rate in both types of countries but technology stock of partner in the integration is very important. Also more open economy with more skilled labor force benefits more from foreign R&D spillovers available through foreign direct investment and international trade.

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