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The Impact of Human Capital and Innovation Output on Economic Growth: Comparative Analysis of Malaysia and Turkey*

Beşeri Sermaye ve İnovasyon Çıktısı'nın Ekonomik Büyüme Etkisi: Malezya ile Türkiye'nin Karşılaştırmalı Analizi

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ABSTRACT

The objective of this paper is to examine the impact of human capital and innovation output on economic growth in Malaysia and Turkey, over the period 1988-2013. The conventional Unit Root Tests reveal that all the variables are stationary after taking the first difference, and the Johansen Tests of Co-Integration demonstrate that the variables are co-integrated. Specifically, we find that in both countries, human capital, innovation output and physical capital have a significant positive effect on economic growth. The Causality tests indicate two unidirectional causalities that run from human capital and innovation to economic growth and a bidirectional causality between physical capital and innovation in Malaysia.

ÖZ

Bu makalenin amacı, 1988-2013 dönemi, Malezya ve Türkiye’de beşeri sermaye ve inovasyon çıktısının ekonomik büyüme etkisini incelemektir. Geleneksel Birim Kök Testleri, değişkenlerinin birinci farkı alındıktan sonra durağan olduğunu göstermektedir, Johansen Eş-Bütünleşme Testleri tüm değişkenlerin uzun dönemde eş-bütünleşik olduğunu göstermektedir. Özellikle, her iki ülkede, uzun dönemde beşeri sermaye, inovasyon çıktısı ve fiziki sermaye ekonomik büyüme anlamlı ve pozitif etkisi olduğunu bulduk. Nedensellik Testi, Malezya değişkenlerinde beşeri sermaye ve inovasyon çıktısından ekonomik büyüme iki tek yönlü nedensellik ilişki ve fiziki sermaye ile inovasyon çıktısı arasında çift yönlü nedensellik ilişkisi bulunduğunu göstermektedir.

1. Introduction

In this part, some theoretical discussion related to the paper’s topic is given. After that, the reasons for why the Malaysia and Turkey is chosen are explained in following paragraphs.

Modern human capital theories and disciplines are developed by economists such as Irving Fisher, Theodore W. Schultz, Gary S. Becker, Edward Fulton Denison and Jacob Mincer and so on. And, the role of human capital is widely studied

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in economic development, economic growth, innovation and public policies etc.

Human capital plays a significant role in the development of most countries especially for nations where the government gives priority for human capital development. Ultimately, physical capital is vital for a country growth and development, but precedence should be put to human capital development. The channels involve the positive spillover of human capital on physical investment and growth especially in situation where the ratios of human to physical capital are high. Barro (1992) stated that a country with abundance human capital tends to focus its investment on human capital, which later increases the physical capital development. Most countries have experienced high growth stemming from rapid development in their human capital especially in research and development. For instance, the success of Malaysia today is largely due to the priorities that the Malaysian government placed on human capital development see Afizan, N., Rusli, M., & Hamid, Z. (2014).

As innovation output is one of the focused points in the paper, a simple introduction of innovation is given in the following part also. Innovation mainly includes contents as theoretical innovation, institutional innovation, science and technology innovation, cultural innovation etc. The productivity and market value led by innovation, promotes the continuous progress of industry and society, and it's also important for effectively avoiding economic recession. Basis of innovation theories can be traced back to J. A. Schumpeter's study. Theories and models such as Creative Destruction by Schumpeter, Diffusion of Innovation put forwarded by Everett Roger, Incremental and Radical Innovation, Henderson-Clark Model, Open Innovation Model, Disruptive Innovation and so on have important positions in the literature of innovation.

Coming to the main objective of this paper, it is to examine the impact of Human Capital and Innovation on economic growth in Malaysia and Turkey comparatively, as two countries shares several similarities among developing economies.

For instance, these two countries are considered as upper income developing economies and are both members of OIC (Organization of Islamic Cooperation). When we compare Malaysia and Turkey in term of GNI per capita (current US\$) data, it is obvious that both countries shares similar per capita income see World Bank (2018). In 1988, Malaysia and Turkey's GNI per capita were 2140 US\$, 1860 US\$ respectively. In 2013, Malaysia and Turkey's GNI per capita increased to 10760 US\$, 12530 US\$ respectively (GNI per capita, Atlas method (current US\$), n.d.). Their GNI per capita level had been presenting a rapidly rising trend for years (especially during the 2002-2013 period), until 2013. In terms of economic growth rates, it is similar for both countries with a slight disparity. During the 1988-1996 period, Malaysia's GDP had a relatively stable growth with a rate between 8.8%~10.0%, while Turkey's GDP growth rate was fluctuating between -4.7%~9.3% (GDP growth (annual %), n.d.). In general, both economies sometimes experienced a fluctuation in their growth rate growth with negatives and positives, over the years.

Malaysia's government expenditure on education (percentage of GDP) is higher than Turkey over the years,

which was up to 7.7% of GDP while Turkey's was 2.7% in 2002 (Government expenditure on education, total (% of GDP), n.d.). Turning to Turkey in recent years, Turkey is also improving its education field and progressing with rates of over 4%. Furthermore, resident patent applications (as a simple measure of innovation output) of Malaysia and Turkey were at a similar level, during 1988-2004. For example, in 1995 Malaysia and Turkey's patents were 141, 170 respectively. However, Turkey is achieving rapid growth in resident patent applications with much higher quantities than Malaysia, since 2004. Focusing on a recent year, Malaysia and Turkey's patent applications were 1109, 6230 respectively, in 2016 (Patent applications, residents, n.d.).

In regards to the above, as it's the objective of the paper, we will therefore examine the impact of Human Capital and Innovation on economic growth in Malaysia and Turkey respectively. The rest of the paper is structured as follows: Section 2 covers the empirical review, section 3 provides the data and methodology, section 4 presents the results and discussions while the last section sets the conclusions and recommendations.

2. Review of Empirical Literature

2.1. Human Capital and Economic Growth

Human capital, refers to stock of knowledge, skills and physical strength (health status) etcetera attributes which embodied in human body. Human capital also plays vital role in producing economic value, as same as factors such as physical capital, labor force etc. Economists such as Irving Fisher, Theodore W. Schultz, Gary S. Becker, Edward Fulton Denison and Jacob Mincer etc. pioneered in forming and developing the modern theories of human capital.

Middendorf (2006) examines the impact of human capital and economic growth in OECD countries, using panel data analysis. He found that human capital stock has a positive impact on economic growth. Aslam et al. (2013) stated that human capital positively and significantly affects the economic growth of Malaysia, during the 1980-2010 periods. In line with the above, Islam et al. (2016) also came with the same result, stating a positive relations between education and economic growth and human capital and growth.

Duasa & Jais (2018) investigated the relationship between economic growth, human capital, and information technology. It was suggested that in the long-run capital, labor, Information Communication Technology, and human capital positively determine economic growth, while human capital negatively affects growth in the short-run. Canpolat (2000) constructed a human capital stock series and made a growth accounting with the series. The result shows that in spite of an increase in enrollment of secondary and higher education, human capital per worker stayed almost constant, over the 1950-1990 periods. But during the 1965-1990 period, the contribution of human capital is found to be closely 40%, indicating that returns to human capital are high.

Çoban (2004) investigates the effect of human capital on economic growth of Turkey, over the period 1980-1997. The variables consist of GNP per capita, schooling rates of primary, middle school, high school, high school and college

respectively, education expenditure. He conducted Co-integration Test, VEC model; Granger Causality Test concluded that the above-mentioned variables positively affect economic growth.

Serel & Masatçı (2005) investigated the relationship between human capital and economic growth of Turkey for the period of 1950-2000, using Johansen Co-integration Test and Granger Causality Test. Their result indicates that there is long-run relation between human capital and growth, with a one-way causality running from economic growth to human capital. Varsak & Bakırtaş (2009) investigate the long-term relationship between human capital and economic growth in Turkey during the period of 1970-2008. They conducted the Johansen & Juselius Co-integration Test, VEC model and Variance Decomposition and found that the changes from educational indicators affect real GNP per capita, but conversely real GNP does not affect educational indicators.

Bekmez, Köneş & Günel (2009) analyzed the importance of human capital in regional economic development of Turkey, over the period of 1990-2001. They conducted a regression analysis with expanding the definition of capital in Solow Model, and Chow Test to compare the average of Turkey (which is obtained by sum of regions) and its regional estimation. They considered investments of education and health are components of growth. They advised that investment for education and health should be increased to minimize the regional development differences.

Yaylalı & Lebe (2011), investigated the relation between education and economic growth of Turkey, conducting Johansen & Juselius Co-integration Test, Granger Causality Test and, Impulse Response Test and Variance Decomposition by VEC (Vector Error Correction) Model. They take real GNP and student numbers of primary, secondary, vocational and technical education and Higher Education as variables, for the period of 1938-2007. They got result of there exists long-run relations between human capital and economic growth. In the short run vocational and technical education affects economic growth more, but in long run primary education affects more.

Karataş & Çankaya (2011) researched the effect of human capital investment on economic growth of Turkey over the period 1981-2006. Variables are growth rate of GDP per capita, growth rate of total fixed capital, share of total education expenditure in GDP, share of total health expenditure in GDP and schooling rate of tertiary education. Romer's (1990) Endogenous Technological Change Model and Engel-Granger Co-integration Test is used. Result shows that the physical capital is more effective than other factor on economic growth of Turkey.

Özşahin & Karaçor (2013) mainly analyzed the importance of higher education for Turkish Economy using 1980-2010 data, with Cobb-Douglas Function adjusted. Regression analysis indicates that higher education expenditure has a positive effect on economic growth. They found that higher education enrollment and economic growth positively affect each other. Çakmak & Gümüş (2014) built a weighted human capital index consists of primary, secondary and tertiary education graduates. Then analyzed the relation between human capital and economic growth of Turkey using co-integration test, for 1960-2002. Their results indicate that human capital and physical capital have a

positive impact on GNP, while labor has a negative impact. Also, the contribution of human capital on growth is less than physical capital in Turkey.

Araç & Ceylan (2016) researched the role of human capital in the process of economic growth over the period 1960-2011 of Turkey, by Johansen Juselius Co-integration Test, nonlinear co-integration test and Threshold Autoregressive (TAR) Model. Variables include GDP, capital, energy consumption and human capital, in per capita term respectively. The results of the TAR model estimations are twofold: Firstly, showing a trending behavior over the period, human capital exceeds its estimated threshold value after 2001. Secondly, human capital affects the relationships between capital stock and energy use and economic growth.

Topallı (2017) researched the relation between human capital and economic growth of Turkey for period of 1960-2012, using VEC model and Toda Yamamoto Causality Test. In the research, real GDP per capita, the number of graduates in Higher Education, vocational and technical education are used. According to result of the study, there is unidirectional causality from the number of graduates in vocational and technical schools to real GDP per capita, and unidirectional causality from real GDP per capita to the number of graduates in higher educational.

Altiner, A., & Toktas, Y. (2017) researched the relationship between human capital and economic growth of 32 developing countries, using panel data of 2000-2014 period. According their findings, human capital affects economic growth positively. Besides, its effect on economic growth reduces as the education level increases.

2.2. Physical Capital and Economic Growth

The relationships between Physical Capital and economic growth can be seen where investing in physical capital, turn to improve productivity which therefore resulted in economic growth.

Numerous empirical findings have indicated that physical capital positively affects growth. Adhikary (2011) examined the linkage between FDI, trade openness, capital formation, and economic growth rates of Bangladesh over the period 1986-2006. The volume of FDI and level of capital formation are found to have a significant positive effect on real GDP. Likewise, Pathania (2013) found unidirectional Granger causality from gross capital formation to the economic growth of India, over 1992-93 to 2009-10 periods. Çakmak & Gümüş (2014) concluded that physical capital has a positive impact on the GNP of Turkey.

On the contrary, Arisoy (2011) tested relationship between physical capital and economic growth of Turkey with AK type growth model perspective, using the data of 1968-2006 period. And, there are no long run relation between physical capital investment and economic growth. Şahbaz, A. (2014). Relationship Gross Fixed Investment And Economic growth: Panel Causality Analysis. *Niğde Üniversitesi İİBF Dergisi*, 7(1), 1-12. Retrieved from <http://iibfdergi.nigde.edu.tr/article/view/5000066641/5000062065>

Besides, Ewubare & Ogbuagu (2015) used an endogenous approach to evaluate the short and long-run impact of Gross

Fixed Capital Formation, human capital formation and population growth rate on economic growth in Nigeria. They found no short or long run impact of these variables on economic growth, according to their ARDL model. Moreover, Wabiga & Nakijoba (2018) examined the relationship between high technology exports, gross capital formation and economic growth in Uganda, with VAR approach. They found that gross capital formation has a significant negative effect on economic growth in the short run.

2.3. Labor Force and Economic Growth

Labor force is one of the topics of economics studies. Usually, labor force in an economy, refers to the total amount of people employed and unemployed who are looking for work.

Cai & Zhou (2003) estimated a two-sector economic growth model. Their results manifested that labor force transfer delays growth of industrial sector and accelerates the agricultural sector growth.

(Zhu, Wu, & Wang, 2011) used GM (1, 1) grey metabolic prediction model to analyze the impact of labor force on economic growth of China. The research indicates labor's contribution to economic growth of China will decrease year by year.

Ayoyinka & Isaiah (2011) examined the employment and economic growth relationships in the Nigerian economy. They estimated a model of employment and found that there is a positive relation between employment level and economic growth. Yufen & Jingwen (2017) researched the impact of labor supply on economic growth of China for 1978-2015 periods. They decomposed the labor supply factor into population size, working-age population, and labor participation rate. They found that labor supply factor has a significant and positive impact on economic growth, and the impact is greater than human capital and smaller than physical capital.

Raleva (2014) studied the impact of labor on economic growth of Bulgaria, over the 1991-2013. Contribution of labor to economic growth rates showed negative and positive signs in different period.

Çakmak & Gümüş (2014) also came out with a different result, stating that labor has a negative impact on GNP in Turkey, for 1960-2002. Ongo & Vukenkeng (2014) used GLS estimation and found that labor force negatively affects the economy of CEMAC sub-region.

Chen, Hsu & Lai (2016) found that changes in labor market institutions lead to a non-monotone relation between long-run economic growth and unemployment, depending the effects on labor force and employment.

Peterson (2017) analyzed the relationship between population growth and economic growth. The research concluded that lower growth rate of population and limits on migration may lead to national and global economic inequality.

2.4. Innovation Output and Economic Growth

The productivity and market value led by innovation, promotes the continuous progress of industry and society,

and it's also important for effectively avoiding economic recession. Therefore, innovation output and its effects on economic growth are topics worth studying. In the following paragraphs, empiric researches of recent several years are reviewed.

Sinha (2007) selected data of 1963-2005 periods, and found that real GDP and the number of patents of Japan are co-integrated. Results also shows that the growth of real GDP Granger causes the growth of the number of patents, but not vice versa. Ortiz (2009) got result of positive correlation between patent and Gross Fixed Capital Formation in his quantitative research.

Josheski & Koteski (2011) investigated the dynamic link between patent growth and gdp growth in quarterly term for G7 countries. Their ADRL model shows that there exist positive relationship in long run between growth of patents and GDP growth. In the short run, the relationship between patents and GDP is negative. However, the Johansen Co-integration Test shows long run positive relationship between patent growth and GDP growth. Additionally, they found that patent Granger cause GDP.

Petrariu, Bumbac & Ciobanu (2013) investigated the link between innovation and economic growth in the Central and Eastern European countries (CEE). They considered R&D spending, patenting or the number of researchers, as well as firms characteristics and mergers and acquisitions as proxy of innovation. And, innovation makes significant contribution to national competitiveness and economic growth, in their research result.

Pece, Simona & Salisteanu (2015) researched the relationship between innovation and economic growth. CEE countries used patents, number of trademarks, R&D expenditures as proxy data for innovation. They found a positive relationship between innovation and economic growth of CEE countries.

Türedi (2016) used GMM estimation approach, and found one-way positive causality from patent applications to economic growth of OECD countries from panel causality test. Khalili, Lau & Cheong (2016) found a unidirectional causality from patent application to economic growth of Japan in the long-run, with ADRL approach.

Similarly, Özkul & Örün (2016) analyzed the effect of entrepreneurship and innovation on economic growth of 9 OECD countries, during the 2002-2013 period. According to their research, technological innovation intensity has positive impact on economic growth.

Dmitriev, et al. (2016) discussed different types of growth, and analyzed the relationship with innovation and the territorial distribution of higher education. As their conclusion, innovation and strong economic growth didn't reduce inequality in the growth of national income in different countries, at the same time this inequality is increasing.

Maradana, et al. (2017) examined the long-run relationship between innovation and economic growth of 19 European countries, using data of 1989-2014. They used six different indicators of innovation including patents-residents, patents-nonresidents, research and development expenditure, researchers in research and development activities, high-technology exports, and scientific and technical journal

articles. They found long-run relationship between innovation and per capita economic growth.

Shukla (2017) researched the relationship of innovation and economic growth of India. The research result shows that patents and R&D expenditures have negative correlations with economic growth of India.

3. Data and Methodology

3.1. Data Sets

The data set of the research consists of real Gross Domestic Product (GDP), real Gross Capital Formation (GCF), Labor Force (L), Secondary Enrollment, see Table 1. Considering the availability of data, we use real GCF as a proxy of

physical capital, labor force (15-65) as proxy of labor force, Secondary Enrollment as a proxy of human capital, and Resident Patent Applications as a simple proxy of innovation output.

Malaysia’s labor force data (age 15-65) for the 1991 and 1994 are having missing data while Turkey’s human capital data (secondary enrollment) for 1996 and 1998 are also missing. Before running the tests, we fixed the missing data by linear interpolation (LINT Function), which is supported by IBM SPSS Statistics 25 software. The LINT replaces missing values using linear interpolation and the last valid value before the missing value and the first valid value after the missing value are used for the interpolation

Table 1 Annual Data Set (1988-2013)

Variables	Codes	Natural Log.	Proxy Data	Data Source	
				Turkey	Malaysia
Output	Y	LnY	Real GDP (2010=100)	World Bank Data	World Bank Data
Physical Capital	K	LnK	Real Gross Capital Formation f(2010=100)	World Bank Data	World Bank Data
Labor Force	L	LnL	Labor Force (15-65)	Turkish Statistical Institute	Department of Statistics Malaysia
Human Capital	H	LnH	Secondary Enrollment	UN	UN
Innovation Output	T	LnT	Resident Patent Applications	World Bank Data	World Bank Data

3.2. Methodology

In our research, we use the following form of growth model with human capital included to conduct our analysis. We follow the method of Wang & Abbas (2000) to expand the model. And, the research data is analyzed by E-Views 9.0 software.

$$Y_t = A * f(K_t, L_t, H_t, T) = A_t K_t^\alpha L_t^\beta H_t^\theta T^\gamma e_t \quad (1)$$

The equation (1) can be rewritten as below with natural logarithmic form:

$$\ln Y = \ln A_t + \alpha \ln K_t + \beta \ln L_t + \theta \ln H_t + \gamma \ln T_t + \ln e_t \quad (2)$$

(Where Y-Output, A_t -Total Factor Productivity (constant), K_t -Physical Capital, L_t -Labor Force, H_t -Human Capital, T-Innovation Output, e_t -random error term, $\alpha, \beta, \theta, \gamma$ -elasticity of $K_t, L_t, H_t,$ and T_t respectively, t-time)

In order to conduct the analysis, we employ the following processes: Unit Root Tests (using ADF Test and Phillips-Perron Test), Johansen Co-integration Test, VAR or VECM (we will consider VECM if the variables are co-integrated) to estimate the long-run model. The processes are conducted using the E-Views software. In detail, if all the variables of both countries are stationary at level (with no unit root) or get stationary with first difference, it enable us to conduct the co-integration test to test in other to examine the long run relationship between the variables. Then we will conduct VECM analysis if there exist co-integrating relationships between variables, otherwise we have to apply the VAR model.

4. Results and Descriptions

4.1. Unit Root Test

A unit root process is a stochastic trend in a time series, which also be called “random walk with drift” sometimes. It shows a systematic pattern unpredictable, and causes “Spurious Regression” problem, if a time series has a unit root. (Unit Root: Simple Definition, Unit Root Tests, 2016) Thus, before the further process of the research, we conducted unit root tests including ADF test and PP test to check the stationarity of our time series and avoid from “Spurious Regression” problem. Lag length in ADF test.

The variables of Malaysia and Turkey are tested in Level and in First Difference, and results given by Table 2, Table 3 below. Results show that all variables of two country accept H_0 (null hypothesis of the presence of unit root process) at 5% significant level (see in Table 2).

First differenced variables of Malaysia significantly reject H_0 , for intercept included test equation at 1% significant level, and intercept and trend included test equation at 5% significant level, respectively (see in Table 3). First differenced variables of Turkey reject H_0 for intercept included test equation at 5% significant level, and intercept and trend included test equation at 5% significant level, respectively (see in Table 3). The results signify that the selected variables of Malaysia and Turkey are not stationary in their level, but become stationary with first difference at 5% significant level. It indicates that variables selected are integrated of order one I (1). Thus, it provides stage for conducting co-integration tests.

Table 2 Unit Root Tests

Tests In level (H0:variables present unit root process)					
Country	Var	ADF		PP	
		Intercept	Intercept & Trend	Intercept	Intercept & Trend
Malaysia	LNY	-2.381502	-2.305149	-2.81319	-2.37639
	LNK	-2.393214	-2.715201	-2.39623	-2.7152
	LNL	0.62453	-3.112764	-0.9754	-1.58413
	LNH	-0.975398	-0.920027	-0.9754	-1.09341
	LNT	-0.794216	-2.569605	-0.75023	-2.56489
Turkey	LNY	0.462571	-2.261349	0.547308	-2.34358
	LNK	-0.628231	-3.388591	-0.73628	-3.3757
	LNL	-0.242601	-4.723769	-0.2426	-1.46034
	LNH	0.127825	-2.413419	0.127825	-2.47307
	LNT	1.578192	-2.020597	1.578192	-2.06283

Table 3 Unit Root Tests

Tests In First Difference (H0:variables present unit root process)					
Country	Var	ADF		PP	
		Intercept	Intercept & Trend	Intercept	Intercept & Trend
Malaysia	Δ LNY	-4.193283*	-4.648980*	-4.16530*	-4.64389*
	Δ LNK	-4.727399*	-4.689115*	-4.72647*	-4.68777*
	Δ LNL	-4.857001*	-4.845926*	-4.86206*	-4.84600*
	Δ LNH	-3.842831*	-3.88678**	-3.84283*	-3.87225**
	Δ LNT	-5.986423*	-5.863456*	-5.99144*	-5.86826*
Turkey	Δ LNY	-5.234953*	-5.196590*	-5.23495*	-5.19269*
	Δ LNK	-6.998753*	-6.834925*	-7.05644*	-6.89045*
	Δ LNL	-4.827128*	-4.786113*	-4.82713*	-4.78591*
	Δ LNH	-4.661853*	-4.453384*	-4.64734*	-4.42498*
	Δ LNT	-3.66181**	-4.333106**	-3.62627**	-4.34036**

Notes: *:denotes 1% significant level **:5% significant level

4.2. Co-integration Test

Considering the facts that all the variables are non-stationary in their level (and become stationary with first difference), we conduct co-integration tests for Malaysia and Turkey respectively, to confirm the existence of long-run relationships between the selected variables for each country. Regarding our small sample biased, we adjusted Trace and Max-Eigen Statistics of Johansen Co-integrating Test, suggested by (Godbout & Norden, 1997).

Malaysia:

The lag Interval of Malaysia's Johansen Co-integration Test is [1,2]. The Trace Statistics reject the null hypothesis of existing at most 3 co-integrating equations and Max-Eigen Statistics reject the null hypothesis of existing at most 1 co-integrating equation (see Table 4). Thus, Trace Test indicates 4 and Max-Eigenvalue Test indicates 2 co-integrating equations at the 5% level.

After adjustment, both Trace and Max-Eigen Statistics we reject the null hypothesis of the existence of at most 1 co-integrating equation, which means there are 2 co-integrating equations. It means there is long-run relationship for the Malaysia variables.

Turkey:

According to the Johansen Co-integration Test for Turkey, the Trace Statistics reject null hypothesis of existing at most 3 co-integrating equations and Max-Eigen Statistics reject null hypothesis of existing at most 3 co-integrating equation (see Table 5). Thus, Trace Test indicates 4 and Max-Eigenvalue Test indicates 4 co-integrating equations at the 5% level.

After adjustment, both of Trace and Max-Eigen Statistics rejected null hypothesis of existing at most 1 co-integrating equation, which means there are 2 co-integrating equations (Table 5). It means there long run relationship between variables of Turkey.

Table 4 Johansen Co-integration Test for Malaysia

Test Statistics (lag interval:1,2)						
H ₀	Eigenvalue	Trace		Max-Eigen		
		Statistic	5% CV	Statistic	5% CV	
Malaysia	r=0	0.966365	188.2033* (101.3402)a*	79.34145	78.02041* (42.01099)a*	37.16359
	r≤1	0.958489	110.1829* (59.32925)a*	55.24578	73.18105* (39.40518)a*	30.81507
	r≤2	0.552217	37.00181* (19.92405)a	35.0109	18.47928 (9.950382)a	24.25202
	r≤3	0.507444	18.52253* (9.97367)a	18.39771	16.28738 (8.770128)a	17.14769
	r≤4	0.092608	2.235158 (1.203547)a	3.841466	2.235158 (1.203547)a	3.841466

Notes: H₀: Null Hypothesis r: at most exist corresponding number of co-integrating equations CV: critical value *: denotes rejection of null hypothesis at 5% significant level (a): values in parenthesis tagged with "a" are adjusted Trace and Max-Eigen statistics, regarding degree of freedom, (Godbout & Norden, 1997).

Table 5 Johansen Co-integration Test for Turkey

Test Statistics (lag interval:1,2)						
H ₀	Eigenvalue	Trace		Max-Eigen		
		Statistic	5% CV	Statistic	5% CV	
Turkey	r=0	0.959445	191.3093* (103.0127)a*	79.34145	73.71719* (39.69387)a*	37.16359
	r≤1	0.917827	117.5921* (63.31882)a*	55.24578	57.47537* (30.94828)a*	30.81507
	r≤2	0.795923	60.11672* (32.37054)a	35.0109	36.55296* (19.68236)a	24.25202
	r≤3	0.582986	23.56376* (12.68818)a	18.39771	20.11662* (10.83203)a	17.14769
	r≤4	0.139185	3.44714 (1.856152)a	3.841466	3.44714 (1.856152)a	3.841466

Notes: H₀: Null Hypothesis r: at most exist corresponding number of co-integrating equations CV: critical value *: denotes rejection of null hypothesis at 5% significant level (a): values in parenthesis tagged with "a" are adjusted Trace and Max-Eigen statistics, regarding degree of freedom, (Godbout & Norden, 1997).

4.3. VEC Model and Long Run

Considering results from Johansen Co-integration test, it is verified that there are long run relationship between ln(Y), ln(K), ln(L), ln(H), ln(T). Thus, we conduct Vector Error Correction (VEC) analysis for Malaysia and Turkey, and the first co-integrating equation of each presented below respectively.

The estimated VEC model of Malaysia (Table 6) shows that Physical Capital, Human Capital and Patent positively affect

real GDP in long run. However, Labor Force negatively affects real GDP in long run. The coefficients of the model are significant at 1% sig, according to their t-statistics.

For the Malaysian case, a 1% increase in Physical Capital leads to 0.36% increase in real GDP; a 1% increase in Human Capital leads to 0.87% increase in real GDP; a 1% increase in Innovation Output leads to 0.20% increase in real GDP; a 1% increase in Labor Force leads to 0.44% decrease in real GDP in the long-run (Table 6).

Table 6 Long Run Equation from VEC model of Malaysia

Malaysia	LNY = 0.360307LNK - 0.438679LNL + 0.869481LNH + 0.202904LNT + 10.20356			
	(0.01409)	(0.11820)	(0.06165)	(0.01095)
	[-25.57350]	[3.71145]	[-14.10330]	[-18.53770]

Notes: Values in () are standard errors ; Values in [] are t-statistics.

Table 7 Long Run Equation from VEC model of Turkey

Turkey	LNY = 0.330801LNK + 0.463929LNL + 0.332606LNH + 0.004656LNT + 5.67276			
	(0.00380)	(0.01318)	(0.00741)	(0.00147)
	[-87.01480]	[-35.19640]	[-44.89620]	[-3.16165]

Notes: Values in () are standard errors ; Values in [] are t-statistics.

The estimated VEC model of Turkey (Table 7) shows that all variables positively affect real GDP in long run and all the coefficients are significant at 1% significant level.

In Turkish Economy specifically, a 1% increase in Physical Capital leads to 0.33% increase in real GDP; a 1% increase in Labor Force leads to 0.46% decrease in real GDP; a 1% increase in Human Capital leads to 0.33% increase in real GDP; a 1% increase in Innovation Output leads to 0.005% increase in real GDP, in the long- run (Table 7).

Our findings is in line with the study of Çakmak & Gümüş (2014), Adhikary (2011) Wabiga & Nakijoba (2018) whose results equally indicate that physical capital significantly and positively affect economic growth. The results show that Human Capital positively impact growth which is also in line with (Middendorf, (2006) Aslam, Shakar, & Hassan (2013) Islam et al. (2016) Çoban (2004) Yaylalı & Lebe (2011). Likewise, the results indicate that Innovation Output (patents) positively impact growth, which is in line with (Ortiz, 2009; Josheski & Koteski, 2011). In addition, the positive result of Turkey is in line with Ayoyinka & Isaiiah (2011) Yufen & Jingwen (2017).

However, for labor force, it has a negative long run effect on economic growth in Malaysia while in in Turkey, it

positively affect economic growth. The negative relationship between the labor force and economic growth in Malaysia is also in line with the study of Çakmak & Gümüş (2014) Ongo & Vukenkeng (2014).

4.4. VEC Based Granger Causality Test and Short Run

We have conducted the Granger Causality tests based on VEC model and then analyzed the short run and long run dynamics of the variables for the two countries separately.

Malaysia:

According to the test results (Table 8 & Figure 1), we found that Human Capital and Innovation Output Granger cause real GDP in the short run, while Physical Capital and Labor Force doesn't Granger cause real GDP in the short run.

Besides, Real GDP and Human Capital unidirectional Granger cause Physical Capital. Moreover, Physical Capital and Innovation Output Granger cause each other, bilaterally. Human Capital and Labor Force also Granger cause Innovation Output.

Table 8 Granger Causality Test based on VECM for Malaysia

Dependent Variables	Chi-sq statistics of lagged 1st differenced term					ECT(t-1) Coefficient	
	D(LNY)	D(LNK)	D(LNL)	D(LNH)	D(LNT)		
Malaysia	D(LNY)	---	4.040753 (0.1326)	3.100115 (0.2122)	8.048771** (0.0179)	19.14133* (0.0001)	-1.014232* [-5.15738]
	D(LNK)	7.616128** (0.0222)	---	0.393385 (0.8214)	7.613087** (0.0222)	7.816832** (0.0201)	-3.386169* [-2.95073]
	D(LNL)	4.093366 (0.1292)	1.062752 (0.5878)	---	1.326527 (0.5152)	4.110833 (0.128)	-0.279418 [-1.36950]
	D(LNH)	0.777074 (0.678)	0.195313 (0.907)	0.79461 (0.6721)	---	1.999817 (0.3679)	0.262345 [0.79799]
	D(LNT)	1.097184 (0.5778)	7.429373** (0.0244)	15.73872* (0.0004)	9.82338* (0.0074)	---	4.461514* [3.05997]

Notes: Chi-sq denotes Chi-square * indicates 1% significance level, and ** indicates 5% significance level. Value in () is probability. Value in [] is t-statistic.

Turkey:

According to Granger Causality Test based on VEC model (Table 9), there are no Granger Causality between variables of Turkey in the short run.

Figure 1 Summary of Granger Causality Test Results of Malaysia

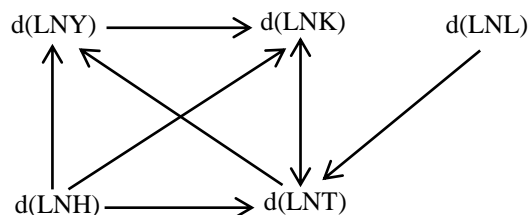


Table 9 Granger Causality Test based on VECM for Turkey

Dependent Variables	Chi-sq statistics of lagged 1st differenced term					ECT(t-1) Coefficient
	D(LNY)	D(LNK)	D(LNL)	D(LNH)	D(LNT)	
D(LNY)	---	0.600899 (0.7405)	0.024872 (0.9876)	2.50271 (0.2861)	3.665051 (0.16)	-1.34545 [-0.55740]
D(LNK)	0.286738 (0.8664)	---	0.347579 (0.8405)	1.62206 (0.4444)	4.134609 (0.1265)	-3.73044 [-0.41883]
Turkey D(LNL)	4.151256 (0.1255)	2.096301 (0.3506)	---	2.983468 (0.225)	1.7608 (0.4146)	3.050585** [2.52379]
D(LNH)	0.762594 (0.683)	0.852724 (0.6529)	1.219518 (0.5435)	---	0.849032 (0.6541)	-0.55935 [-0.31549]
D(LNT)	1.394357 (0.498)	1.790833 (0.4084)	0.824171 (0.6623)	1.14685 (0.5636)	---	-11.8224 [-1.36438]

Notes: * indicates 1% significance level, and ** indicates 5% significance level. Value in () is probability. Values in [] are t-statistics

5. Conclusion and Recommendation

Our work has led us to conclude that Human Capital have a significant and positive impact on economic growth for both Malaysia and Turkey. Other than human capital, Physical Capital and Innovation Output (patents as its simple measure) are also significant in explaining the economic growth of Malaysia and Turkey, while Labor Force is significant but with a negative impact on growth in Malaysia. Particularly for Turkey, all the variables are significant with positive effect on economic growth, but the impact of Innovation Output on growth is less compared with the other variables.

According to the Granger Causality Test based on VEC, there is multiple causality between variables of Malaysia, in the short-run. Only Human Capital and Innovation output Granger cause Real GDP in the short-run. Besides, Real GDP and Human Capital Granger cause Physical Capital one-way. Physical Capital and Innovation Output Granger cause each other, bilaterally. Human Capital and Labor Force also Granger causes Innovation Output.

As it is our main concern, we found that both Human Capital and Innovation Output positively impact growth in Malaysia and Turkey, in the long-run. Being more specifically, Human Capital is more effective on economic growth in Malaysia while it is less effective for Turkey. Innovation Output (patents) is also a significant variable that explained growth but its impact on growth is less than of Human Capital for Malaysia. However, for the case of Turkey, the effect of Innovation Output on economic growth is not that obvious.

According to our findings, human capital is an important variable for explaining growth in Malaysia and Turkey. Therefore, it is recommended that both countries should continue in supporting their education system. Besides, the Malaysian and Turkish government should focus more in improving the support for their innovation system. Particularly for Turkey, more emphasis should be placed on improving the effective utilization of their existing innovation output, as its impact on growth is almost negligible.

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