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Long term effect of trade openness on economic growth in case of Pakistan

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Abstract The present empirical work aims to investigate the long term effect of trade openness on economic growth in the case of Pakistan from 1971 to 2009. A composite trade openness index is developed by using principal component analysis (PCA) and is employed in the JJ cointegration, autoregressive distributed lag (ARDL) approach to cointegration, dynamic OLS and variance decomposition. The results suggest the existence of a negative and significant association between trade openness and economic growth. But new evidence provided by this study is that there is a strong complementary between human capital and trade openness index in terms of enhancing the real GDP.

Keywords Trade openness index · Economic growth · Human capital · Pakistan

1 Introduction

The trade openness and economic growth nexus are extensively investigated in the literature from the last 30 years. The endogenous growth theories have stated that trade openness stimulates the economic growth through the technological spillover channel (Romer 1990). The available theoretical literature indicates that trade openness cause to economic growth through the followings three channels.[1] First, the trade openness causes economic growth through efficient allocation of resources. Second, trade openness shifts the technology from developed to developing countries.[2] The last learning by doing effect: developed countries innovate and developing countries imitates.

The empirical literature indicates that due to not have an extensive time series data, previous empirical studies investigate the trade openness and growth nexus on cross country

[1] See Grossman and Helpman (1991), Young (1991) and Rivera-Batiz (1995).
[2] It is negatively linked with economic growth if the local resources of the country are unable to effectively use the technology generated by the trade openness (see Romer 1990).

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level. Romer (1990) examined the trade openness and economic growth nexus by using the data of 90 developing countries. He suggested trade openness is helping to get a wide array of innovations and enhancing the economic growth rate. Further the trade openness and human capital accumulation positively cause to economic growth has suggested by Edwards (1989) and Villanueva (1994). Edward (1992) employed two types of trade openness indicators i.e., trade intervention and distortions in the case 30 developing countries. He constructed two indicators of trade openness by using the methodology Leamer (1988) and found openness indicator positively associated to economic growth. On the other hand trade intervention indicator has negatively associated with economic growth. He recommended those countries have followed trade open policies have growing faster as compared to close trade regime. Wacziarg (2001) has examined trade policy and GDP growth relationships in the case of 57 countries. He used three trade policy indicators, Tariff barrier, Non-tariff barriers and a dummy variable included in the model for trade liberalization status. He concluded positive link among trade openness and GDP growth. Yanikkaya (2003) used the data of 120 countries and investigated the impact of trade openness on per capita income growth. He has employed the two trade openness measures: first trade volumes (exports, imports, exports plus imports) as a percentage of GDP and second trade restrictiveness on foreign exchange on bilateral payments and current transactions. His empirical results have indicated trade volume and trade restriction both positively associated with economic growth.

To overcome the deficiencies associated with cross-sectional studies, for any country that enough time-series observations are available, researchers employed time series data. The positive relationship between trade openness and economic growth is documented by Little et al. (1970); Balassa (1971); Bhagwati (1978); World Bank (1987); Roubini and Sala-i-Martin (1991); Dollar (1992); Xu (1996); Shan and Sun (1998); Hwang (1998); Jin (2000) and Hye et al. (2011). These studies test the validity of trade openness hypothesis by estimating the causal relationship between exports and economic growth. But with the development of endogenous growth theories, recently researchers have used Lucas (1988) endogenous growth model to test trade-growth nexus. Ghatak and Milner (1995) examined the effect of trade openness on economic development in the case of Turkey by using the cointegration method. They found a stable long run relationship between trade openness, human capital, physical capital and real GDP as suggested by the endogenous growth theories. Sukar and Ramakrishna (2002) stated that those countries liberalize their international trade can grow faster relatively to close economies. Ahmad (2003) used endogenous growth model to investigate the relationship between trade openness and industrial sector growth in the case of Bangladesh. He employed the exports divided by GDP as an indicator of trade openness and found a long run relationship between industrial production, investment, trade openness, and human capital.

Dutta et al. (2004) used cointegration and error correction approach to examine the association between trade openness and industrial sector growth in Pakistan. He found a long run relationship between the trade policies and industrial sector growth. Khan and Qayyum (2007) used ARDL model to investigate the association between trade openness, financial development and economic growth in the case of Pakistan. They found that trade openness and financial development both positively related to economic growth and suggested further liberalization. Chaudhary et al. (2010) estimated the relationship between trade liberalization, human capital and economic growth. They concluded that trade policies and human capital both positively determines economic growth. Klasra (2011) concluded trade openness derives economic growth in the case of Pakistan and on the other hand economic growth derives the exports in case of Turkey.

In contrast few theoretical studies have stated that trade openness impedes economic growth see Batra (1992), Batra and Slottje (1993) and Leamer (1995). Vamvakidis (2002) empirically examined the relationship between trade openness and economic growth in the case of developed and developing countries. He concluded negative relationship between trade openness and economic growth in the period of 1920–1940.

The aim of this study is to investigate the relationship between the trade openness and economic growth in the case of Pakistan by using the JJ cointegration, autoregressive distributed lag model, dynamic OLS and variance decomposition analysis. This study constructs the trade openness index in Sect. 1.1, the estimation method explains in Sect. 1.3, results presents in Sect. 2 and Sect. 3 represents conclusion.

1.1 Construction of trade openness index

In 1950s the Pakistan's policy maker was following the highly protected trade policy. The trade policies were formulated in that way the domestic producer purchase agricultural raw material at low price comparison to the international prices (DRI-McGraw Hill 1997). The export bonus scheme, over value exchange rate and import substitution policies were followed in 1960s. The most liberalization measures (like devaluation, the elimination of the exports bonus scheme and end the restrictive licensing) were taken in 1970s.[3] In the late 1980s the import quotas on non capital goods were removed and restricted imports were slowly liberalized. The comprehensive tariff reforms were taken in June 1987: The number of tariff rate was reduced from 17 to 10%, an equal 12.5% sales tax was replaced by previous rate that varies across goods and maximum tariff rate reduces from 225 to 125%. The maximum tariff rate on imports was determined 25% in 2005 (Husain Ishrat 2003; Kemal et al. 2002).

Also the policy of import substitution is replaced by export promotion because the policy of import substitution was generated the anti-export bias in allocation of resources and enhances the inefficiency. In 1994 Pakistan Rupee was made convertible and a dual exchange rate system was adopted in 1998. This was also replaced by a market based exchange rate system given a narrow band in 1999. The unofficial cap on the exchange rate was finally removed on 21 July 2000 to make it purely market based. In order to enhance the level of foreign direct investment, the most of the sectors of the economy were opened and allowing the 100% ownership except a few. The main aims of these trade openness reforms to achieve self reliance and strengthen the industrial base, remove the inefficiency in the economy and control the trade deficit to enhance the exports. The available empirical literature indicates the number of researchers is using different proxies to catch the impact of trade openness on economic growth. [4] These proxies are imports divided by GDP, Exports divided by GDP and exports plus imports divided by GDP. By definition all three proxy indicators of trade openness are positively correlated to each other. Thus we cannot use all three trade openness indicators in a single model. If we select any one indicator it is a loss of information. So this study is used these proxies to develop a composite trade openness index. The weight of each indicator is calculated by using the principal component analysis (PCA). The Table 1 shows the result of PCA. The first principal component explains 79.3%, second another 20.7% and last zero percent. This study uses first eigenvector values as a weight to construct a summary

[3] Little et al. (1970) and Balassa (1971).

[4] Ahmad (2003), Dutta (2004), Khan and Qayyum (2007), Chaudhary (2010), Klasra (2011).

Table 1 Principal components analysis

Eigen values: (Sum = 3, Average = 1)					
Number	Value	Difference	Proportion	Cumulative value	Cumulative proportion
1.000	2.379	1.758	0.793	2.379	0.793
2.000	0.621	0.621	0.207	3.000	1.000
3.000	0.000	–	0.000	3.000	1.000

Eigenvectors (loadings): Variable	PC 1	PC 2	PC 3
$(X+M)/GDP$	0.648	−0.050	−0.760
M/GDP	0.557	−0.650	0.518
X/GDP	0.520	0.759	0.393

$(X+M)/GDP$ = exports plus imports divided by GDP; M/GDP = imports divided by GDP; and X/GDP = exports divided by GDP

measure of trade openness because it explain higher level of variation as compare to the other combination of the variables and it is denoted as TOI.[5]

1.2 Theoretical and estimation model

This study develops the estimation model by using the theoretical framework of Lucas (1988) ‘Human Capital Model of Endogenous Growth’. In this model Lucas considered the human capital accumulation through schooling as an engine of economic growth because human capital accumulation has dual role: first it increase the own productivity of workers. Second it increases the productivity of all factors of production. Lucas (1988) model written as follows:

$$Y_t = A_t K_t^{\beta} (\mu q_t L_t)^{1-\beta} q_{\alpha}^{\delta} \tag{1}$$

where Y_t is the total output; A_t is the level of technology (assumed to be constant); K_t and L_t, respectively physical capital and total numbers of workers. The q_t is average quality of human capital and q_{α}^{δ} shows the externalities of average human capital. Lucas supposed that all labor force is same skill level ($q_t = q_{\alpha}$). The Lucas model rewrite as follows:

$$Y_t = A_t K_t^{\beta} (\mu L_t)^{1-\beta} q_t^{1+\delta-\beta} \tag{2}$$

The Lucas stated stable positive economic growth due to the increasing returns to scale ($2+\delta-\beta > 2-\beta > 1$). The stable growth depends on the value of δ. For simplicity Lucas has supposed that the workers are used a fraction (μ) of their non-leisure time to current production, dedicating the remaining ($1-\mu$) to human capital accumulation thus

$$\Delta q_i / q_i = \gamma_i \mu_i$$

where γ_i denotes the positive coefficient representing workers skill formation in sector i. The internal and external skill of workers is enhanced under the trade openness. This empirical work examines the relationship between trade openness and economic growth by using the Lucas production model. In which the trade openness index is used as a separate factor input with the other inputs factor like physical capital and human capital.

[5] $(X+M)/GDP$, M/GDP X/GDP and are individually contribution to standardize variance of the first principal component, i.e., 64.8, 55.7 and 52%, respectively.

$$Y = F(L_{\text{skill}}, K, \text{TOI}) \tag{3}$$

In equation we rewrite function-3 as follows:

$$\text{Ln}(Y) = \theta_0 + \theta_1 \text{Ln}(L_{\text{skill}}) + \theta_2 \text{Ln}(K) + \theta_3 \text{Ln}(\text{TOI}) + \varepsilon_{\text{i}} \tag{4}$$

The interaction effect of human capital and trade openness index is estimated as follows.

$$\text{Ln}(Y) = \emptyset_0 + \emptyset_1 \text{Ln}(L_{\text{skill}} \times \text{TOI}) + \emptyset_2 \text{Ln}(K) + \varepsilon_{\text{i}} \tag{5}$$

where Y, L_{skill}, K and TOI respectively confers the real GDP, skill labor force/human capital, physical capital and trade openness index. The Ln shows the sign of natural logarithm, and θ_s and $\emptyset_s$ are represents the slope coefficients of respectively variables. The ε_i is the error correction terms. The real GDP is used as a proxy of economic growth. The physical capital is represented the real gross fixed capital formation and primary school enrollment is used as a skill labor force/human capital. The trade openness index is constructed by using different proxies of trade openness. The data of all variables has been taken from State Bank of Pakistan, annual publications and World Bank, world development indicators.

1.3 Estimation techniques

This study employs the different cointegration method like JJ cointegration, autoregressive distributed lag approach (ARDL), dynamic OLS and variance decomposition method in order to check the long run association among variables. Before applying cointegration method it is important to find the level of integration. Thus this study uses the augment dickey fuller and dickey fuller GLS unit tests to determine the level of integration. After that the Johansen (1995) and Pesaran et al. (2001) cointegration tests are employed. The Johansen cointegration test is based on two statistics (λ_{trace} and $\lambda_{\max}$). First 'Trace test' cointegration rank r is that

$$\lambda_{\text{trace}} = -T \sum_{j=r+1}^{n} \text{In}(1 - \hat{\lambda}_j)$$

Second, $\lambda_{\max}$ maximum number of cointegrating vectors against $r + 1$ is presented in the following way

$$\lambda_{\max}(r, r+1) = -T\ \text{In}(1 - \hat{\lambda}_j)$$

Johansen (1995) also recognized λ_{trace} and $\lambda_{\max}$ critical values. The Pesaran et al. method of cointegration is employed with the help of unrestricted error correction model.

$$\begin{aligned}\Delta\text{Ln}(Y)_t = \lambda_0 &+ \sum_{i=0}^{n} \lambda_i \Delta\text{Ln}(Y)_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta\text{Ln}(L_{\text{skill}})_{t-i} \\ &+ \sum_{i=0}^{n} \lambda_i \Delta\text{Ln}(K)_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta\text{Ln}(\text{TOI})_{t-i} \\ &+ \alpha_1 \text{Ln}(Y)_{t-1} + \alpha_2 \text{Ln}(L_{\text{skill}})_{t-1} + \alpha_3 \text{Ln}(K)_{t-1} + \alpha_4 \text{Ln}(\text{TOI})_{t-1} + \psi_t\end{aligned} \tag{6}$$

For long run investigation the interaction of human capital and trade openness index model is estimated as follows:

$$\Delta \mathrm{Ln}(Y)_t = \lambda_0 + \sum_{i=0}^{n} \lambda_i \Delta \mathrm{Ln}(Y)_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta \mathrm{Ln}(L_{skill} \times \mathrm{TOI})_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta \mathrm{Ln}(K)_{t-i} + \varpi_1 \mathrm{Ln}(Y)_{t-1} + \varpi_2 \mathrm{Ln}(L_{\mathrm{skill}})_{t-1} + \varpi_3 \mathrm{Ln}(K)_{t-1} + \psi_t \tag{7}$$

The existence of long-run relationship among the variables is test through overall F-test statistic and W-test statistic. The no-cointegration null hypothesis for Eq. 6 is that $\langle H_0 = \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0\rangle$ and for Eq. 7 is that $\langle H_0 = \varpi_1 = \varpi_2 = \varpi_3 = \varpi_4 = 0\rangle$. The decision of long run relationship is take in this way: if the computed F-test statistic and W-test statistic are exceeds the upper critical bound value, then the H_0 (null hypothesis) is rejected and if the F-test statistic and W-test statistic falls into the bounds, then the test becomes inconclusive. Lastly, if the F-test statistic and W-test statistic is below the lower critical bounds value, it implies no co-integration. When long-run relationship exists then in next step we estimate the long run coefficients.

1.4 Dynamic OLS

Stock and Watson (1993) have developed a technique for the exploration of long run relations among dependent and independent variables. This method involves estimating the dependent variable on all explanatory variables in levels, leads and lags of the first difference of all I(1) explanatory variables. The insertion of leads and lags of the first difference explanatory variables approves for simultaneity bias and small sample bias between the regressors. The measurement of DOLS model is given below:

$$Y_t = \varphi_0 + \varphi_1 X_t + \sum_{j=-\rho}^{\rho} \sum_{i=1}^{k} \theta_{ji} \Delta X_{i,t-j} + \varepsilon_t$$

Where Y_t is the dependent variable; X_t is the vector of explanatory variables and Δ is the lag operator.

1.5 Generalized forecast error variance decomposition analysis

The generalized forecast error variance decomposition method is estimated through VAR system it shows the proportion contribution in one variable caused by the shocks in order variables (Pesaran and Shin 1998). Thus this study employs the variance decomposition method in order to explore the strength of causal relationship among variables. The main advantage of using generalized method over the orthogonalized forecast error variance decomposition i.e., it is invariant to the ordering of the variables entering to VAR system, thus it is uniquely determined. In addition it permits to estimate the contemporaneous shocks effects. A VAR(p) model is written as follows $\omega_t = \forall' x_t + \mu_t$ where $t = 1, 2, 3, \ldots, n,\ x_t = (1, x_{t-1}, x_{t-2}, \ldots, x_{t-p})$ and ω_t is a $m \times 1$ vector. The residuals μ_t are supposed to be normally distributed and white noise process with the covariance matrix $\sum$ and finally there is no multicollinearity between the independent variables. Hence the VAR model can be rewritten in the form of infinite moving average as follows:

$$\omega_t = \sum_{i}^{\infty} \forall_i \mu_{t-i}$$

where $\forall_i = \emptyset_1 \forall_{i-1} + \emptyset_1 \forall_{i-2} + \cdots + \emptyset_p \forall_{i-p},\ i = 1, 2, 3 \ldots$, with $\forall_0 = I_m$ and $\forall_i = 0$ for $i < 0$. The forecast error of predicating ω_{t+n} conditional on information given at $t-1$ is given by $\partial_t(n) = \sum_{k=0}^{n} \forall_k \mu_{t+n-k}$, where $\partial_t(n)$ is $m \times 1$ vector, and the total forecast error covariance matrix is given by $\text{COV}[\partial_t(n)] = \sum_{k=0}^{n} \forall_k \sum \forall_k'$. Next we consider the forecast error covariance matrix of predicting ω_{t+n} conditional on information at time $t-1$ is $\partial_t^{(j)}(n) = \sum_{k=0}^{n} \left\langle \mu_{t+n-k} - E(\mu_{t+n-k} \middle| \mu_{j,t+n-k} \right\rangle$ assuming that the given values of the shocks to the jth equation are $(\mu_{j,t}, \mu_{j,t+1}, \ldots, \mu_{j,t+n})$. Suppose $\mu_t n(0, \sum)$ and $E\left(\mu_{i,t} = \gamma_i\right) = (\delta_{1,i}, \delta_{2,i}, \ldots, \delta_{n,i})' \delta_{ii}^{-1} \gamma_i$ where $\gamma_i = (\delta_{ii})^{-1/2}$ denotes as a unit standard deviation shock. The results in $\left\langle E(\mu_{t+n-k} \middle| \mu_{j,t+n-k} \right\rangle = (\delta_{ii}^{-1} \sum \epsilon_i) \mu_{i'tn-k}$ for $i = 1, 2, 3, \ldots, m$ and $k = 1, 2, 3, \ldots, n$, with ϵ_i be $m \times 1$ vector with all elements equal to zero, but the jth element will be equal to one. Substitution and taking conditional expectations yields the following expression.

$$\text{COV}[\partial_t(n)] = \sum_{k=0}^{n} \forall_k \sum \forall_k' - \delta_{jj}^{-1} \left\langle \sum_{k=0}^{n} \forall_k \sum \epsilon_t\, \epsilon_t' \sum \forall_k' \right\rangle$$

Next the conditioning on the future shocks to the jth equation will show the decline in the n-step forecast error variance of ω_t is given by:

$$\Delta_{in} = \text{COV}[\partial_t(n)] - \text{COV}\left[\partial_t^{(i)}(n)\right] = \delta_{jj}^{-1} \left\langle \sum_{k=0}^{n} \forall_k \sum \epsilon_t\, \epsilon_t' \sum \forall_k' \right\rangle$$

After that we re-scaling the jth element by the n-step ahead forecast error variance of the jth variables in ω_t would give the generalized forecast error variance decomposition as below:

$$\varphi_{ji,n} = \left[\delta_{jj}^{-1} \sum_{k=0}^{n} \left(\epsilon_i' \forall_k \sum \epsilon_i\right)^2\right] \Big/ \left[\sum_{k=0}^{n} \epsilon_i' \forall_k \sum \forall_k' \epsilon_i\right]$$

The results of generalized decompositions are invariant to the organizing of variables in the VAR method and also compute the effect of variables on forecast variance at zero time horizons.

2 Empirical results

The two unit root tests are employed to examine the level of integration of the variables. The both results of augment dickey fuller (ADF) and dickey fuller GLS unit root test show that all variables [i.e, $\text{Ln}(Y)$, $\text{Ln}(K)$, $\text{Ln}(L_{\text{skill}})$, $\text{Ln}(\text{TOI})$ and $\text{Ln}(L_{\text{skill}} \times \text{TOI})$] are integrated order one (Table 2).

Next to perform the JJ-cointegration and autoregressive distributed lag (ARDL) approach to long run relationship, it is vital first determines the optimum lag length of the variables. The optimal lag length is decided by using the Schwaz's Bayesian Information Criterion (SBC). Table 3 shows the results of JJ cointegration and the ARDL method of long run relationship. The JJ cointegration results of trace statistic and max-Eigen statistic indicate that in model-1 there are two cointegrated vectors and in model-2 the only one cointegrated vector. Thus the long run relationship exists in both model-1 & model-2. In the same table 3 we also show the results of autoregressive distributed lag model (ARDL). The ARDL results of the F-statistic and W-statistic for long run relationship demonstrate that the long run relationship exist in the both cases models 1 & 2, because the F-statistic and W-statistic values are exceeding the critical values at the one percent level of significance.

Table 2 Results of unit root

Regressors	ADF		DF-GLS	
	Level	First difference	Level	First difference
Ln(Y)	−0.677	−5.523[a]	−1.224	−4.539[a]
Ln(K)	−1.609	−4.502[a]	−1.672	−4.245[a]
Ln(L_{skill})	−1.664	−5.353[a]	−1.734	−5.505[a]
Ln(TOI)	−2.376	−4.223[b]	−1.889	−5.146[a]
Ln($L_{\text{skill}} \times$ TOI)	−2.378	−4.243[a]	−2.748	−4.843[a]

[a] and [b] indicates the 1% and 5% level of significance

Table 3 Long run relationship

H_0	H_1	JJ Cointegration			Max–Eigen statistic	ARDL Cointegration	
		Trace statistic	H_0	H_1		F-statistic	W-statistic
Model-1: $\text{Ln}(Y) = \theta_0 + \theta_1 \text{Ln}(L_{\text{skill}}) + \theta_2 \text{Ln}(K) + \theta_3 \text{Ln}(\text{TOI}) + \varepsilon_i$							
$r = 0$	$r \geq 1$	83.813[a]	$r = 0$	$r \geq 1$	44.936[a]	35.892[a]	143.571[a]
$r \leq 1$	$r \geq 2$	38.876[b]	$r \leq 1$	$r \geq 2$	24.741[b]		
$r \leq 2$	$r \geq 3$	14.136	$r \leq 2$	$r \geq 3$	8.878		
$r \leq 3$	$r \geq 4$	5.257	$r \leq 3$	$r \geq 4$	5.257		
Model-2: $\text{Ln}(Y) = \emptyset_0 + \emptyset_1 \text{Ln}(L_{\text{skill}} \times \text{TOI}) + \emptyset_2 \text{Ln}(K) + \varepsilon_i$							
$r = 0$	$r \geq 1$	47.091[a]	$r = 0$	$r \geq 1$	31.818[a]	7.586[a]	22.759[a]
$r \leq 1$	$r \geq 2$	15.272	$r \leq 1$	$r \geq 2$	9.651		
$r \leq 2$	$r \geq 3$	5.621	$r \leq 2$	$r \geq 3$	5.621		

[a] and [b] respectively represents rejected H_0: no cointegration at 1% and 5% level of significance

Table 4 Long run coefficients

Regressors	ARDL		DOLS	
	Model-1	Model-2	Model-1	Model-2
Ln(K)	0.766[0.000]	0.779[0.000]	0.936[0.000]	0.792[0.003]
Ln(L_{skill})	0.393[0.000]	–	0.305[0.001]	–
Ln(TOI)	0.014[0.886]	–	−0.368[0.066]	–
Ln(TOI(-1))	−0.145[0.096]	–	–	–
Ln($L_{\text{skill}} \times$ TOI)	–	0.307[0.000]	–	0.313[0.085]
Constant	1.286[0.098]	0.348[0.693]	−0.091[0.936]	−0.076[0.971]
R-squared	0.991	0.983	0.996	0.987954
Adjusted R-squared	0.990	0.982	0.994	0.984385
Akaike info criterion	−2.863	−2.243		
Schwarz criterion	−2.647	−2.115		

In prickets [] the probability value of the coefficients

The long run coefficients of ARDL and DOLS are showed in Table 4. The human capital [Ln(L_{Skill})] and physical capital both positively determine the economic growth. The one percent increase in skill labor force cause to enhance the economic growth 0.305–0.393%. The trade openness index negative associated with economic growth. The one percent increases in trade openness the real GDP decline by 0.145–0.368%. This result against the theoretical statement of Lucas (1988) and Romer (1990), and earlier empirical findings in case of Pakistan, Khan and Qayyum (2007) who found 1% increase in trade openness (exports plus

Table 5 Results of variance decomposition

Part-A Variance decomposition of Ln(Y)					Part-B Variance decomposition of Ln(TOI)			
Period	Ln(Y)	Ln(TOI)	Ln(L_{skill})	Ln(K)	Ln(Y)	Ln(TOI)	Ln(L_{skill})	Ln(K)
1	100.000	0.000	0.000	0.000	3.028	96.971	0.000	0.000
2	98.624	1.206	0.000	0.169	37.137	59.193	1.616	2.052
3	89.359	10.121	0.393	0.126	38.823	55.184	2.480	3.512
4	75.091	21.612	3.209	0.086	38.988	52.637	2.394	5.979
5	61.038	32.802	6.099	0.059	36.784	51.601	3.585	8.029
6	51.639	40.210	8.104	0.045	35.653	51.722	4.737	7.886
7	45.205	45.379	9.341	0.073	35.379	51.694	5.305	7.621
8	40.566	49.015	10.265	0.152	34.827	51.679	5.693	7.801
9	36.998	51.738	11.014	0.249	34.074	51.998	6.105	7.821
10	34.199	53.882	11.606	0.311	33.318	52.508	6.523	7.649

Part-C Variance decomposition of Ln(L_{skill})					Part-D Variance decomposition of Ln(K)			
Period	Ln(Y)	Ln(TOI)	Ln(L_{skill})	Ln(K)	Ln(Y)	Ln(TOI)	Ln(L_{skill})	Ln(K)
1	14.987	2.611	82.401	0.000	7.061	9.214	0.058	83.666
2	15.669	10.277	63.515	10.537	30.514	8.458	0.031	60.995
3	18.400	15.443	44.764	21.391	52.507	5.951	0.334	41.205
4	16.448	19.398	41.863	22.289	59.425	5.017	0.294	35.262
5	15.709	21.235	41.779	21.274	59.673	7.097	1.352	31.877
6	15.699	20.771	41.524	22.004	54.886	13.395	3.938	27.780
7	16.575	20.304	40.852	22.267	47.908	21.976	6.317	23.797
8	18.955	19.758	39.667	21.618	42.436	28.744	7.871	20.947
9	21.846	19.142	37.905	21.105	39.242	33.051	8.824	18.883
10	24.033	19.361	36.168	20.436	37.399	35.453	9.424	17.722

imports divided by GDP) enhances economic growth by 0.371%, and Chaudhary et al. (2010) who found one percent increase in trade openness (exports plus imports divided by GDP) increases economic growth by 3.06%. The new evidence provided by this study is that the interaction term of $L_{Skill} \times$ TOI positive determines the real GDP. Thus there is a strong complementary relationship between human capital and trade openness index in terms of enhancing the real GDP. This shows that a 1% increase in interaction term the real GDP increases by 0.307–0.313%.

The strength of causal relationship between the real GDP, real capital, trade openness index and human capital is examined by using the generalized forecast error variance decomposition method within the VAR method. The number of empirical studies suggested that variance decomposition method within the VAR framework is superior (see Engle and Granger 1987; Ibrahim 2005)(Table 5).

The results demonstrate that when the shock in Ln(Y) or real GDP. In the first round the complete shock explain by the real GDP innovation them in the second period 1.206% explain by the trade openness innovation and 0.169% by the real capital innovation remaining 98.624% demonstrate by the own real GDP innovation. In period five the 32.802, 6.099, and 0.059 respectively confers the trade openness index, human capital and physical capital. In tenth round 53.882% explain by the trade openness index innovation. In part-B the variance decomposition of trade openness index. In the first round the 3.028% explain the real GDP the shock of Ln(TOI) and remaining innovation is 96.971% explain by its self Ln(TOI). In round five 36.784% demonstrate by real GDP, 8.029% explains real capital, 3.585% shows human capital and 51.601% explains by its own innovation. One interesting finding in part-A

& B is that the shock in Ln(Y) highly explain by the Ln(TOI) and shock in Ln(TOI) highly explain by the Ln(Y) innovation as compare to the other variables in the system. This finding suggests the bidirectional causal relationship between the real GDP and trade openness index in the case of Pakistan. Part-C shows the variance decomposition of human capital shock. The results give direction when the shock occur in the first round the 14.987% explain by the real GDP, 2.611% is showed trade openness and remaining shock explain by the own innovation of human capital which is 82.401%. As the time period increases the explanation of human capital to own shock reduce, it means that the effect shift on the other variables. In period tenth period 24.033, 19.361, and 20.436% respectively explain the Ln(Y), Ln(TOI), and Ln(K). The part-D explains the variance decomposition of Ln(K). The shock in Ln(K) is initially explained by the Ln(Y) and Ln(TOI). In round five 59.673, 7.097 and 1.352% are explained respectively Ln(Y), Ln(TOI), and Ln(L_{Skill}) innovations the shock of Ln(K). In total one to ten periods (part-D) the shock of Ln(K) is highly explain by the real GDP innovation that confirm the causality from real capital to real GDP.

3 Conclusion

This study has examined the long-term effect of trade openness on economic growth in the case of Pakistan. The present article has presented a contribution to the empirical literature through introducing a composite trade openness index by using PCA to combine three traditional measures of trade openness. The results indicate that the human capital and physical capital both positively impact on economic growth. The available empirical studies in case of Pakistan show positive relationship between economic growth and trade openness (export plus import divided by GDP). But this empirical study shows that trade openness index negative related to economic growth in the long run, and a one percent increase in trade openness reduces real GDP growth by in the range of by 0.145–0.368%. Thus this study rejects the earlier finding in the case of Pakistan, Khan and Qayyum (2007) found a positive link between trade openness and economic growth, and suggested a 1% increase in trade openness expanded economic growth by 0.371%. Chaudhary et al. (2010) suggested 1% increase in trade openness enhances economic growth by 3.06%. The empirical findings of this study are also against the theoretical explanation of Romer (1990), and also earlier empirical findings of cross country case Romer (1990); Edwards (1989); Villanueva (1994); Edward (1992); Wacziarg (2001) and Yanikkaya (2003). The most important finding of this study is that the interaction term of $L_{\text{skill}} \times$ TOI is positively related to economic growth. A one percent increase in $L_{\text{skill}} \times$ TOI enhances real GDP by in the range of 0.307–0.313%. Thus there is a significant evidence that human capital and trade openness index are complementary in terms of expediting the real GDP in Pakistan. The strength of causal relationships is measured through variance decomposition (VCD). The result of VCD has confirmed the strong bidirectional causal relationship between the trade openness index and economic growth because the shock in real GDP highly explains by trade openness index Innovation, and in contrast the shock in trade openness highly explains by the innovation of real GDP. So there is a bidirectional relationship between trade openness and economic growth.

The policy implication that emerges from this study is that overall, our findings support of Batra (1992), Batra and Slottje (1993), Leamer (1995) and Vamvakidis (2002), if trade openness cannot be managed properly it impedes economic growth. The Grossman and Helpman (1991), Young (1991) and Rivera-Batiz (1995) stated that trade openness causes economic growth through a channel of efficient allocation of resources and the spillover effect

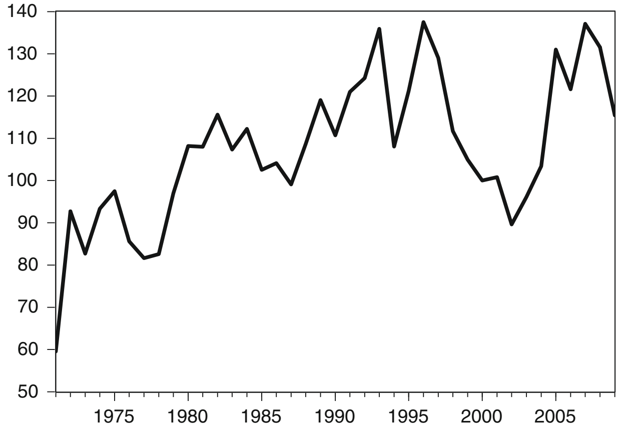

Fig. 1 Indicates the graph of TOI, which indicates the changes in trade policies that took place in Pakistan economy during the sample

of technology. If the trade openness brings the technology in the country, so for efficient utilization of technology we need appropriate human capital. Thus in this study we found a strong complementary relationship between human capital and trade openness index in terms of expediting the real GDP in Pakistan. This indicates that trade openness without human capital has negative impacts on economic growth. There is need for a parallel expansion in human development and trade openness in order to attain stable economic growth. Currently Pakistan is spending 2.1% of GDP on education (GOP 2011), which is less than other regional countries like India, Bangladesh and Nepal. Thus this study guides to increase the expenditure on education sector in order to sustain economic growth by enhances human capital in the economy. Further physical capital also positively impacts on economic growth. This result gives direction to launch an appropriate financial policy that enhances the level of investment in the real sector of the economy like agricultural and industrial sectors. But it is also important to attract foreign direct investment in these sectors by providing a suitable investment environment in the country (Fig. 1).

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