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IMPACT OF EXPORT AND FOREIGN ECONOMIC PERFORMANCE ON DOMESTIC PRODUCTIVITY AND OUTPUT: An Application of VAR Model

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Developments in the theory of international trade and economic growth have identified a number of channels through which productivity (TFP) and output levels (GDP), representing economic growth, are related to export growth. Although, this kind of relationship has been studied by a number of researchers, few have included foreign economic performance in their empirical models. The primary innovation of the current study, is to make estimates of causal relations between exports and domestic output (or domestic TFP) more reliable. *This inclusion also allows us to observe the impact of changes in foreign economic performance on Pakistan's exports, output, and productivity*. The latter information can be very important for the policymaker's in Pakistan, who may wish to set policies depending on their expectations of foreign economic performance. The conceptual framework of the study is extended to include output growth, export and foreign economic performance in one model and productivity, export and foreign economic performance in the other model. This study investigates the long run and short run relationships; first, among exports, foreign economic performance and output, and second among exports, foreign economic performance and productivity using multivariate co-integration and Vector Error Correction Model (VECM). Using exports and foreign economic performance as determinants of total factor productivity and output growth, we find significant impact of outward orientation (export) on productivity in the short run, but exports *do not promote* economic growth. In the long run we do find support for our hypothesis that the variables in both the models have a stable long run relation. For long run the study finds a significant and positive elasticity (1.084) of foreign economic performance in model-1 and 0.045 in model-2, which further confirms the proposition that in the long run spillover of knowledge promotes economic growth and total factor productivity growth in Pakistan. On investigating the effect of foreign economic performance on total factor productivity and domestic output in the short run, the study finds its affect significant only in the case of total factor productivity. The study does not reveal any causal affect of foreign economic performance on domestic output in the short run. Productivity is affected by increase in exports due to the export led growth hypothesis, and is positively affected by increase in foreign economic performance, due to the occurrence of knowledge spillovers between countries that can occur without the help of trade.

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I. Introduction

Developments in the theory of international trade and economic growth have identified a number of channels through which productivity (TFP) and output levels (GDP), representing economic growth, are related to export growth [Afxention and Sertelis (1991), Jung and Marshall (1985), Darrat (1986), Hsiao (1987), Bodman and Jensen (1997), and Hatemi and Irandoust (2001)]. Export growth enables a country to enhance demand for the country's output and thus serves to increase productivity. It loses a binding foreign exchange constraint and allows increase in productive intermediate imports which results in the growth of output. Export promotion establishes contacts with foreign competitors, which leads to more rapid technical change, the development of indigenous entrepreneurship and the exploitation of scale economies. In addition to this, competitive pressure may reduce X-inefficiency and lead to better product quality. As a result, export growth results in higher productivity and output growth. This study primarily investigate the long run and short run relationship, first between exports and productivity, and second between exports and output, using multivariate cointegration and vector error correction model.

Although this kind of relationship has been studied by a number of researchers, few have included foreign economic performance in their empirical models. Some exceptions are Kunst and Marin (1989), Marin (1992), Jin and Yu (1996), Shan and Sun (1999) and Wernerheim (2000). The reason for inclusion of foreign economic performance proxied by foreign real GDP is to test the hypothesis that increases in foreign real GDP will increase the demand for domestic exports. This primary innovation of the current study and inclusion of a foreign real GDP measure in the estimations makes estimates of causal relations between exports and the domestic GDP (or domestic TFP) more reliable. The inclusion also allows us to observe the impact of changes in foreign GDP on Pakistan's exports, output, and productivity. The latter information can be very important for the policymakers in Pakistan who may wish to set policies depending on their expectations of foreign economic performance.

Studies relating exports to output and exports to productivity, including foreign economic performance, provide different views on the effectiveness of export growth-led hypothesis. Empirical efforts to link productivity and export promotion also provide mixed results. For example, Kunst and Marin (1989) considered at the macro level, the causal relationship between manufacturing exports and labor productivity in the manufacturing sector using Australian data in a four variable VAR model. The other two variables included in their analysis are terms of trade and OECD output. They found that exports do not Granger cause productivity; but productivity does Granger cause exports. They also found that OECD output does not Granger cause exports, but OECD output does Granger cause productivity. Marin (1992) looked at the effect of manufacturing exports on labor productivity (manufacturing output per employee) at the macro level, and found that exports uni-directionally Granger-cause labor productivity for Germany, Japan, UK, and the US (except that there may be evidence of labor productivity causing exports for Japan at the 10 per cent level). Marin uses four-variables VAR model considering the same type of variables as in Kunst and Marin (1989) discussed above. Similarly, for all four countries Marin found that OECD output does not Granger cause exports, but that OECD output Granger causes productivity. One exception of Marin's finding is that OECD output does not Granger cause US productivity. Based on the bivariate analysis, Bodman and Jensen (1997) report that exports cause labor productivity growth in Australia and Canada without any feedback, except in the Canadian manufacturing sector, for which there is a small significant causal effect of exports. In another bivariate study, Hatemi-J and Irandoust (2001) conducted tests for cointegration and causality between productivity and real exports for several industrial countries, using symmetric error correction models. The authors use two measures for productivity, labor productivity and total factor productivity. They concluded that real exports Granger cause labor productivity without feedback, in France, Italy, Germany and Sweden. For the UK causality is bi-directional. When total factor productivity is used, their estimated results show that causality is running in both directions in Germany, Italy and the UK. In France total factor productivity causes exports and in Sweden causality is in the opposite direction. In this study we investigate the two relations: i.e., the effect of exports on output growth and on productivity – through two VAR models for Pakistan's economy. In one VAR model we include real exports, domestic real GDP and foreign real GDP (proxied by summing the GDP of USA, UK, Germany and Japan). The second VAR model is identical to the first one, except that instead of using domestic GDP we have included total factor productivity. Our methodology is different from all the previous studies conducted in Pakistan based on export led hypothesis, as it includes foreign economic performance and involves the application of the VAR model to estimate the long run relationship by using multivariate cointegration approach and vector error correction model to check for Granger causality among the variables.

The results indicate a stable long run relationship among the variables included in the two models. In the short run our result do not support any causal link between exports and output growth, but we find uni-directional causality between exports and foreign economic performance and total factor productivity growth. The remaining part of the paper is organized as follows: Section-II presents the theoretical frame work, Section-III provides details about the methodology, Section-IV presents the empirical results and Section-V presents the conclusions.

II. Theoretical Framework

The theoretical framework for our empirical study is as follows. Suppose that *X* represents real exports, *Y* is domestic real output, and *Y** is foreign real output. We can reasonably expect the following relationships:

$$Y = f(X_t, Y_t^*) \qquad (1)$$

and

$$X = g(Y_t, Y_t^*) \qquad (2)$$

Expressing the variables in natural logarithms, the base regressions are:

$$lnY_t = \alpha_0 + \alpha_1 lnX_t + \alpha_2 lnY_t^* + \varepsilon_1 \qquad (3)$$

$$lnX_t = \beta_0 + \beta_1 lnY_t + \beta_2 lnY_t^* + \varepsilon_2 \qquad (4)$$

where $\alpha_1,\ \alpha_2\ \beta_1$ and β_2 are the elasticities and ε_1 and ε_2 are the stochastic terms with standard properties. We expect $\partial Y_t / \partial X_t$ to be positive due to the export-led growth hypothesis. As a result of knowledge spillovers between countries that can occur *without* the help of trade, we expect that $\partial Y_t / \partial Y_t^* > 0$. The partial derivative $\partial X_t / \partial Y_t^*$ is expected to be positive since an increase in foreign real income, proxied by foreign real output, will increase the demand for domestic exports. Finally, $\partial X_t / \partial Y_t$ is also expected to be positive. This may be true if increased domestic demand is not sufficient to cover for the increase in output (due to low domestic absorption or high domestic savings), then exports should increase as greater efforts are put into finding additional markets abroad for the excess output, as explained by Kindleberger (1996). This can be exceptionally important for smaller economies.

To examine the interactions of productivity with exports and output, we find it useful to estimate a closely related model to the one presented in Equations (1) and (2). The new model has real GDP, *Y*, replaced by total factor productivity, Φ, and likewise Y_t replaced by Φ_t, leading to Equations (5) and (6):

$$\Phi = f(X_t, Y_t^*) \qquad (5)$$

and

$$X = g(\Phi_t, Y_t^*) \qquad (6)$$

Expressing the variables in natural logarithms, the base regression are:

$$ln\ \Phi_t = \gamma_0 + \gamma_1 lnX_t + \gamma_2 lnY_t^* + \mu_1 \qquad (7)$$

$$lnX_t = \delta_0 + \delta_1 ln\ \Phi_t + \delta_2 lnY_t^* + \mu_2 \tag{8}$$

where $\gamma_1, \gamma_2, \delta_1$ and δ_2 are the elasticities and μ_1 and μ_2 are the stochastic terms with standard properties; and the first-order partial derivatives of each of the two above equations are expected to be positive. Since the signs of partial derivatives involving Y or Y_t for Equations (3) and (4), i.e., $\partial Y_t/\partial X_t, \partial Y_t/\partial Y_t^*, and\ \partial X_t/\partial Y_t$, were based at least in part upon changes-in-productivity arguments, these same arguments can be used for the signs of the corresponding partial derivatives in Equations (7) and (8). Due to the export led growth hypothesis, Φ is positively affected by increase in X_t, and is positively effected by the increase in Y_t^* due to the occurrence of knowledge spillovers between countries that can occur without the help of trade. Since increased productivity reduces the cost of production X is positively affected by increase in Φ_t, thus making exports more competitive, and is positively affected by increase in Y_t^*, since an increase in foreign income (again, proxied by foreign output) will increase the demand for these exports.

III. Econometric Methodology

The distinction between whether the levels or differences of a series is stationary leads to substantially different conclusions and the test for non-stationarity i.e., unit roots is the usual practice today. Engle and Granger (1987), define a non-stationary time series to be integrated of order d if it achieves stationarity after being differentiated 'd' times. This notion is usually denoted by $X_t \sim I(d)$. Hence, all series are tested for the probable order of difference stationarity by using the augmented Dickey-Fuller (ADF) tests. ADF is a standard unit root test, it analyzes order of integration of the data series. These statistics are calculated with a constant and a constant plus time trend respectively, and has a null hypothesis of non-stationarity against an alternative of stationarity. ADF test to check the stationarity of the series is based on the equation of the form:

$$\Delta Y_t = \beta_1 + \beta_{2t} + \delta\ Y_{t-1} + \alpha_i \sum_{i=1}^{\cdots} \Delta Y_{t-i} + \varepsilon_t$$

where ε_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$ etc.

These tests determine whether the estimates of δ are equal to zero. Fuller (1976) provided the cumulative distribution of the ADF statistics, if the calculated t-ratio of the coefficient d is less than the critical value from the Fuller table, then Y_t is said to be stationary.[1] Now, consider for example two series X_t and Y both

[1] Note that the 't' ratio of coefficient δ always has a negative sign.

integrated of order (d). Engle and Granger have shown that in general their linear combination will also be I(d). It is an empirical fact that many important macroeconomic variables appear to be integrated of order (d) [or I(d) in the terminology of Engle and Granger (1987)], so that their changes are stationary. Hence, if the variables in the two VAR model are each I(d) than it may be true that any linear combination of these variables will also be I(d). Having established that all the series are integrated of order (d), that is I(d), the study then proceeds to determine the long run behavioral relationships among these variables. For examining the long run relationship among the variables, they must be co-integrated.

1. Testing Co-Integration Using Vector Autoregressive (VAR) Approach

The VAR model used is denoted as follows:

$$X_t = \rho_1 X_{t-1} + \rho_2 X_{t-2} + \ldots.. + \rho_k X_{t-k+t} + \eta + \mu_t \qquad 1 \le t \le T$$

where X_t is a vector containing Y, X and Y^* in one model and Φ, X and Y^* in the other model.

Starting from the highest possible lag order, and sequentially testing down to the lowest, the optimal lag order is chosen based on AIC and SC. This optimal lag order is to be used in the co-integration and Granger-causality tests based on vector-error correction model. The lag order is determined to be 2 for the model containing Y_t, X_t and Y^*_t while for the model containing Φ_t, X_t and Y^*_t the lag is determined to be 5. This is justifiable when using annual data spanning from 1950 to 2000. After running the VAR model and obtaining the most efficient lag order by observing the AIC and SC values, the long run relationship among the variables have been tested using the Johansen co-integration technique. Two or more variables are said to be co-integrated if their linear combination is integrated to any order less than 'd'. Co-integration test provides the basis for tracing the long-term relationship. The theory of co-integration put forward by Johansen and Juselius (1990) indicates that the maximum likelihood method is more appropriate in a multivariate system. Therefore, this study used this method to identify the number of co-integrated vectors in the model. The selection of "r" co-integrating vector is based on the two statistics defined by Johansen as the maximal eigen-value and the trace statistic. There are "r" or more co-integrating vectors. The Johansen model is given by:

$$\Delta x_t = a_0 + \Pi x_{t-1} + \sum_{i=1}^{k} \theta_i \Delta x_{t-k} + \omega_t \qquad 1 \le t \le T$$

where X_t is a column vector of m endogenous variables, Π and θ are $m \times m$ matrices of unknown parameters and ω_t is a Gaussian error term. Π can be dichotomised into two $m \times r$ matrices Ω and σ. The reduced rank $r < m$ of Π is hypothesized as H(r):

$\Pi = -\Omega\, \sigma^T$. The vectors of σ representing the r linear combinations of $\sigma^T X_t$ are stationary. The matrix Ω represents the error-correction parameters. To investigate the relationship two main likelihood ratio test (also known as the trace test to evaluate the null hypothesis of atmost *r* co-integrating vectors) and the Maximum Eigenvalue Test (used to evaluate the null hypothesis of r co-integrating vectors against the alternative of $(r+1)$ co-integrating vectors) are used.

2. *Vector Error Correction Model (VECM)*

If X_t have *r* co-integrating vectors, then each X_t will have an error correction model representing the form:

$$\Delta x_t = \sum_{t=i}^{k} \Gamma_i \Delta x_{t-i} + \Pi x_{t-k} + \mu + \eta_t$$

where, X_t is the vector of the growth rates of variables and Γs are estimable parameters.

After expansion, the following systems of equations are obtained for model-1, in the final estimation we have used log values of the variables:

$$\Delta Y_t = a_0 + \sum_{i=1}^{s} a_{1i} \Delta Y_{t-i} + \sum_{j=1}^{u} a_{2j} \Delta X_{t-j} + \sum_{k=1}^{v} a_{3k} \Delta Y^*_{t-k} + a_4 V_{t-1} + \mu_{1t} \qquad (9)$$

$$\Delta X_t = \beta_0 + \sum_{i=1}^{s} \beta_{1i} \Delta Y_{t-i} + \sum_{j=1}^{u} \beta_{2j} \Delta X_{t-j} + \sum_{k=1}^{v} \beta_{3k} \Delta Y^*_{t-k} + \beta_4 v_{t-1} + \mu_{2t} \qquad (10)$$

$$\Delta Y^*_t = \eta_0 + \sum_{i=1}^{s} \eta_{1i} \Delta Y_{t-i} + \sum_{j=1}^{u} \eta_{2j} \Delta X_{t-j} + \sum_{k=1}^{v} \eta_{3k} \Delta Y^*_{t-k} + \eta_4 v_{t-1} + \mu_{3t} \qquad (11)$$

For the second model:

$$\Delta \phi_t = \gamma_0 + \sum_{i=1}^{s} \gamma_{1i} \Delta \phi_{t-i} + \sum_{j=1}^{u} \gamma_{2j} \Delta X_{t-j} + \sum_{k=1}^{v} \gamma_{3k} \Delta Y^*_{t-k} + \gamma_4 v_{t-1} + \mu_{4t} \qquad (12)$$

$$\Delta X_t = \lambda_0 + \sum_{i=1}^{s} \lambda_{1i} \Delta \phi_{t-i} + \sum_{j=1}^{u} \lambda_{2j} \Delta X_{t-j} + \sum_{k=1}^{v} \lambda_{3k} \Delta Y^*_{t-k} + \lambda_4 v_{t-1} + \mu_{5t} \qquad (13)$$

$$\Delta Y^*_t = \Psi_0 + \sum_{i=1}^{s} \Psi_{1i} \Delta \phi_{t-i} + \sum_{j=1}^{u} \Psi_{2j} \Delta X_{t-j} + \sum_{k=1}^{v} \Psi_{3k} \Delta Y^*_{t-k} + \Psi_4 v_{t-1} + \mu_{6t} \qquad (14)$$

where, v_{t-1} is the residual from the co-integrating equations (Error Correction Term). The error correction term (ECT) is thus given by a stationary linear combination of the residuals at single lag. The ECT reflects the temporal status of the long-run relationship in the system. The sign and size of the estimated coefficient on the ECT in each equation reflects the direction and speed of adjustment of the dependent variable to temporary deviations from the long-run equilibrium summarized by the co-integrating vector. For example, a negative and significant coefficient on the ECT in Equation ΔY_t would imply a positive response of growth to fluctuations that depress the value of the stationary combination. If, however, ECT is insignificant, that would indicate the absence of any long-run adjustment of the growth measure to movements amongst the system's variables.

3. Data and related information

For empirical estimation this study used the data on real exports taken from the International Financial Statistics (IFS), and economic growth (real GDP), taken from the Penn World Table, while TFP (representing productivity level of the country) is derived by taking the relevant variables from the Penn World Table.[2] Data on real foreign GDP is calculated by summing the real GDP of USA, UK, Germany and Japan taken from the Penn World Table. Analysis is performed by using the annual data spanning the period from 1950 to 2000.[3] All these variables are expressed in natural logarithm and hence their first differences approximate their growth rates.

IV. Empirical Analysis

The preliminary step in our analysis is concerned with establishing the degree of integration of each variable. For this purpose we tested for the existence of a unit root in the level and first difference of variables by using the well-known Augmented Dickey-Fuller procedure (ADF test). ADF test statistic checks the stationarity of the series. The result presented in Table 1 reveals that all the variables are non-stationary in their level form. However, the stationarity property is found in the first/second differencing of the variables.

[2] TFP measure is derived conceptually within the context of the neoclassical growth model. TFP growth is calculated as a residual by subtracting the contribution of growth in the capital labour ratio from labour productivity growth. This method is also adopted by Kim and Lau (1994), Sargent and Rodriguez (2001), Eichengreen (2002) and Fatima, et al., (2003).

[3] The study has used the annual observations because the impact and adjustment lags of various macroeconomic relations are too long for monthly or even quarterly observations to reflect the actual correlation between these macroeconomic variables. Though annual observations yield smaller degrees of freedom, the noisy effects associated with monthly or even quarterly observations tend to average out with annual data which better approximates the relationship [See, Masih and Masih (1975) and Spencer (1989)]. Moreover, Hakkio and Rush (1991), Van Den Berg and Taynetti (1993) have contended that co-integration is a long run concept and hence requires long span of data to give co-integration power.

Table 1

Unit Root Test

	Level		First Difference		Second Difference	
Variables	Constant	Constant & trend	Constant	Constant & trend	Constant	Constant & trend
LY*	-0.7207	-0.3814	-2.1130	-2.2445	-7.0472*	-7.0375*
LX	-1.6836	-1.8965	-4.9433*	-4.9560*		
LY	0.7417	-2.6943	-3.5280**	-3.4652***		
LΦ	-0.6133	-2.0834	-4.8138*	-4.7625*		

Note: Critical values are: -3.61, -2.94, -2.61 (significant at 1%, 5%, 10% respectively, when the 1st difference is constant), and -4.22, -3.53, -3.21 (significant at 1%, 5%, 10% respectively, when the 1st difference is constant and trend). *, **, ***, Represent significant at 1%, 5% and 10% respectively. 'L' before variables represent log form of the variables.

After establishing that, all individual series under consideration are stationary, two VAR models are used to estimate the co-integrating vectors among the variables. As mentioned earlier, Johansen and Juselius (J-J) maximum likelihood approach is most appropriate for the co-integration test. The result from the J-J test are summarized in Tables 2 and 3, where both the maximal-eigen value and trace values are used to examine the null hypothesis of no co-integration against the alternative of co-integration. Starting with the trace statistics, the variables of model-1 [based on Equations (1) and (2)] shows that, there are two co-integrating vectors among the three variables. Now, turning to the maximal-eigen value test, the null hypothesis of no co-integration is rejected at the 5 per cent level of significance in favour of the general alternatives of two co-integrating relationship. Based on the two tests it is confirmed that there are two co-integrating relationship among the three variables of model-1.

Now, moving to model-2 [based on Equations (5) and (6)] and starting with the null hypothesis of no co-integration among the variables the trace statistics is found above 5 per cent critical value, hence, rejecting the null hypothesis of no cointegration. As is evident from Table 3, there is only one co-integrating relationship among these three variables. The maximal eigen-value test, do not reject the null hypothesis of no co-integration at the 5 per cent level of significance in favour of the general alternative. Hence, we draw the overall conclusion that there is only one co-integrating relationship among the three variables included in model-2.

Table 2

Johansen Maximum Likelihood Co-Integration Test
Results for LY_t, LY^*_t and LX_t (lags 1-2)

	Likeli-hood Ratio	5 % Critical Value	1 % Critical Value	Maximum Eigen-Value	5 % Critical Value	1 % Critical Value
R=0	42.95055*	29.68	35.65	23.02908**	20.97	25.52
R<=1	19.92147**	15.41	20.04	16.487312**	14.07	18.63
R<=2	3.434158	3.76	6.65	3.434158	3.76	6.65

Co-integrating Vector Normalized on Y_t

LY^*_t	LX_t	C
1.08399* (0.02342)	0.056321 (0.11563)	-5.48111

Note: * (**) represent significant at 1% (5%). Johansen co-integration test provides two 'co-integrating equations at 5% significannt level.

Although, both trace and eign-value tests indicate the presence of cointegrating vectors for the two models, there is a further need to explore the issue concerning the impact of foreign economic performance on economic growth (or total factor productivity) in the long run. Tables 2 and 3 also report the cointegrating coefficients normalized on LY_t (or $L\Phi_t$). Variables in each model specification have yielded statistically significant coefficients with the expected signs, except for LX_t in model-1. Hence, we interpret these specifications as indicating stable long run relationships among exports, output and foreign economic performance, and among exports, total factor productivity growth (TFP) and foreign economic performance for Pakistan, for the period covered in the study. The implied long run significant and positive elasticity (1.084) of foreign economic performance in model-1 and 0.045 in model-2 confirms the proposition that spillover of knowledge is promoting economic growth and total factor productivity growth in Pakistan. Moreover, the long run elasticity of export (0.277) is also highly significant indicating that export growth enabling Pakistan to enhance the demand for the country's output and thus services to increase productivity in the long run. Further, to confirm the conclusion drawn on long run equilibrium, the study performed the Granger Causality test (an exclusion test) to explore what is driving the model. Results of pair wise Granger causality tests are

Table 3

Johansen Maximum Likelihood Co-Integration Test
Results for $L\Phi_t$, LY^*_t and LX_t (lags 1-5)

	Likelihood Ratio	5 % Critical Value	1 % Critical Value	Maximum Eigen-Value	5 % Critical Value	1 % Critical Value
R=0	30.98144**	29.68	35.65	19.67633	29.68	35.65
R<=1	11.30511	15.41	20.04	5.910847	15.41	20.04
R<=2	5.394263**	3.76	6.65	5.394263	3.76	6.65

Co-integrating Vector Normalized on Φ_t

LY^*_t	LX_t	C
0.344656*	0.276642*	-8.029412
(0.01883)	(0.10315)	

Note: * (**) represent significance at 1% (5%). Johansen co-integration test provides one 'co-integrating equations' at 5% significance level.

Table 4

Pair-wise Granger Causality Tests

Null Hypothesis	Observations	F-Statistic	Probability
LY^*_t does not Granger cause LY_t	46	4.93091	0.00161*
LY_t does not Granger cause LY^*_t	46	2.22919	0.07315*
LX_t does not Granger cause LY_t	46	0.23819	0.94291
LY_t does not Granger cause LX_t	46	1.91130	0.11738
LX_t does not Granger cause LY^*_t	46	0.22390	0.94974
LY^*_t does not Granger cause LX_t	46	1.43923	0.23469

Note: *represents significance at the 1% level.

reported in Tables 4 and 5. These tables clearly show uni-direction causality running from LY^*_t to $L\Phi_t$, and LX_t to $L\Phi_t$, while causality is bidirectional in case of foreign economic performance and economic growth in Pakistan. The study once again does not find any causality between LX_t and LY_t.

Once a co-integrating relationship is established, then a VECM can be estimated to determine the short run behavior among the variables in the two models. Tables 6 and 7 report the results of VECM formulation [Equations (9), (10) and (11) of model-1 and Equations (12), (13) and (14) of model-2]. According to Engle and

Table 5

Pair-wise Granger Causality Tests

Null Hypothesis	Observations	F-Statistic	Probability
LY^*_t does not Granger cause $L\Phi_t$	46	3.15728	0.01864*
$L\Phi_t$ does not Granger cause LY^*_t	46	0.18445	0.96660
LX_t does not Granger cause $L\Phi_t$	46	4.35703	0.00346*
$L\Phi_t$ does not Granger cause LX_t	46	0.62403	0.68242
LX_t does not Granger cause LY^*_t	46	0.22390	0.94974
LY^*_t does not Granger cause LX_t	46	1.43923	0.23469

Note: *represents significance at the 1% level.

Table 6

Granger Causality Based on Error Correction Model

Dependent Variable	F-statistics for $\Sigma\Delta LY_{t-i}$	F-statistics for $\Sigma\Delta LY^*_{t-j}$	F-statistics for $\Sigma\Delta LX_{t-k}$	t-statistics for V_{t-1}
ΔLY_t	12.1630*	2.0430	1.3910	-4.319*
ΔLX_t	1.8110	1.6880	3.2890**	-2.494**
ΔLY^*_t	0.0833	1.2615	0.64860	-4.582*

Note: *, **, *** represents significance at 1%, 5% and 10% levels respectively.

Table 7

Granger Causality Based on Error Correction Model

Dependent Variable	F-statistics for $\Sigma\Delta\ L\Phi_{t-i}$	F-statistics for $\Sigma\Delta\ LY^*_{t-j}$	F-statistics for $\Sigma\Delta\ LX_{t-k}$	t-statistics for V_{t-1}
$\Delta\ L\Phi_t$	4.3350*	2.5550**	6.3640*	-3.804*
$\Delta\ LX_t$	0.3120	1.4660	1.5100	-2.354**
$\Delta\ LY^*_t$	1.3665	2.0724	0.7775	-1.767***

Note: *, **, *** represents significance at 1%, 5% and 10% levels respectively.

Granger (1987), co-integrated variables must have VECM representation. The VECM strategy provides an answer to the problem of spurious correlation. Technically, the error correction term measures the speed of adjustment back to the co-integration relationship. The VECM posited to be a force causing the integrated variables to return to their long run relation when they deviate from it, and thus the longer the deviations, the greater would be the force tending to correct the deviation [Banerjee, Galbraith and Henry (1994)]. The coefficients on the lagged values of ΔLY_t, ΔLY_t^*, ΔLX_t and $\Delta L\Phi_t$ are short run parameters measuring the immediate impact of the independent variables. In Equation (9), the coefficients of lagged values of ΔLY_t^* and ΔLX_t are statistically insignificant, showing no impact of the independent variables on ΔLY_t, in the short run. While the coefficient of lagged value of ΔX_t and ΔLY_t^* are significant in Equation (12), indicating the immediate impact on $\Delta L\Phi_t$ in the short run. But the coefficients of lagged values of the independent variables are found insignificant for Equations (10) and (13) indicating no immediate impact of independent variables on ΔX_t. In the short run the same is true for Equations (11) and (14), where once again no impact of the independent variables are found on LY_t^*. Whereas, the error correction terms of all the equations (V_{t-1}) are statistically significant suggesting a powerful long run causality running in the two models.

Overall, it can be concluded that for Pakistan no causal relationship exists between export growth and output growth. Our findings indicate that, exports do not cause output growth and that output growth does not Granger cause export growth. Also, by replacing output growth by total factor productivity, our result show strong causality running from export growth to total factor productivity. As far as foreign economic performance is concerned, our result do not lend support to the hypothesis that foreign economic performance impacts on total factor productivity growth, both in the short and the long run with output growth impacting only in the long run. It means that the spill over of knowledge between Pakistan and the major trading countries[4] is strong. According to Helpman et al., (1985), countries to benefit (through spill over of knowledge) in this way must have trading partners that are capable of providing products and information in which the country is in short supply. It depends on the trade partners accumulated knowledge that is embodied in products, technologies and organizations. Thus, by trading with an industrial country that has a larger 'stock of knowledge' a developing country stands to gain more in terms of the products it can import and the direct knowledge it can acquire than it would by trading with another developing country.

V. Conclusions

This study investigates the effects of exports and foreign economic performance on total factor productivity and output growth using time-series data for Pakistan. Our results show that there is a significant impact of outward orientation (export) on productivity in the short run, but exports are not found promoting economic growth; while in the long run, we do find support for our hypothesis that the variables in both the models have a stable long run relationship. For the long run, the study finds significant and positive elasticity (1.084) of foreign economic performance in model-1 and 0.045 in model-2; which further confirms the proposition that in the long run, spillover of knowledge promotes economic growth and total factor productivity growth in Pakistan. On investigating the effect of foreign economic performance on total factor productivity and domestic output in the short run, the study finds that its effect is significant only in the case of total factor productivity. The study does not find any causal affect of foreign economic performance on domestic output in the short run.

Finally, even though a strong positive influence of exports and foreign economic performance on total factor productivity possesses obvious implications for policy, we conclude with a strong word of caution. Productivity is affected by increase in exports due to the export led growth hypothesis, and it is positively affected by increase in foreign economic performance due to the occurrence of knowledge spillovers between countries that can occur without the help of trade. This means that the spillover of knowledge between Pakistan and the trading countries is strong. Hence, to benefit (through spillover of knowledge) in this way it is necessary that Pakistan should have trading partners that are capable of providing it with products and information in which the country is in short supply. This can be achieved by

4 To estimate the impact of foreign economic performance on productivity and economic growth for Pakistan, countries selected in our sample are the major developed trading partners in terms of both, imports and exports providing products and information which is in short supply.

implementing recommendations of the WTO. Pakistan has recognized that trade liberalization is beneficial for global economy; free trade has been benefiting the developing countries by providing them opportunity to trade with developed countries. Despite its economic and political difficulties, Pakistan has taken steps, since its previous review to liberalize its trade and investment regimes, either unilaterally or in the context of commitments made in the WTO, IMF, and the World Bank. Over the past two years, efforts in several crucial areas have seemingly intensified, with the result that Pakistan is becoming a more open and secure market for its trading partners.

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