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Modeling the impact of exports on the economic growth of Pakistan

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Abstract. This study is an empirical investigation to Export led Growth hypothesis (1971-2016) in case of Pakistan by applying cointegration analysis and dynamic error correction mechanism. The study proves that the exports are important and significant determinant of economic growth in Pakistan. The analysis also reveals that the exports along with labor force, investment and Domestic credit to private sector ratio are important for the long-run as well as short run economic growth of Pakistan.
Keywords. Exports led growth, Cointegration, Dynamic error correction, Pakistan.
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1. Introduction

The thought that export activity leads to economic growth has been liable to impressive level headed discussion in the advancement and development writing for a long time, (Keesing, 1967 and Krueger, 1978). Export growth is considered the "engine" of economic development and growth, and contemporaneous relationship exists between them, (Nurkse, 1961; Tahir *et al.*, 2015). This literature relates that export activity/outward orientation and development was known back since nineteenth century. Outward orientation is measured by some function of the trade flow of exports for the export-led growth (ELG) studies.

The ELG hypothesis suggests that the growth generation in the economy cannot be the result of enhanced labor and investments only but also by expanding the export sector. We restrain our consideration regarding this assortment of work. The Promotion of exports and achieving the potential level are constructive for both industrialized and developing economies for many reasons as according to the neo-classical export led growth (ELG) hypothesis premise that export promotes economies of scale, labor productivity, progress through technological improvements, production of quality enhanced goods and services, reduce current account pressures, lessen the unemployment and other production factors and reduce economic inefficiencies and hence promote economic growth (Helpman & Krugman, 1985; Kruger, 1985 and Akbar *et al.*, 2005).

In both long run and short run, the ELG hypothesis is supported in the Pakistan economy where sometimes accompanied by fluctuations too. (Siddique *et al.*, 2008). Pakistan exports averaged around 38619.28 (Pak Million Rs) from 1950's until 2016, attaining the highest of 275483 million in 2013 and lowest of 51 million in 1958, Accordingly GDP growth fluctuations were also observed showing their relevance and impact.

Previously in Pakistan many studies have been conducted on the ELG model, the Short run and Long run relationships between Exports and economic Growth were estimated by the use of different estimation techniques like Cointegration,

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Granger causality, 3SLS etc and were applied on cross sectional, time series and Panel data sets across the World. Among all, for developing Economies (like Pakistan) the ELGH (Export led Growth Hypothesis) mostly proved valid. (Shirazi & Manap, 2005; Quddus *et al.*, 2005, Siddique *et al.,* 2008 and Shahbaz *et al.,* 2011 etc).

Subsequently, the purpose of this paper is examination and testing the ELGH, considering the data of Pakistan. Following are the three distinct features of this study, in comparison to the bundles of empirical studies published on growth. First, the data gap uptil 2016 will be covered by using new econometric techniques. The exports as a factor of production provides a substitute procedure for capturing TFP growth. Next, focus of this study is on developing country Pakistan for estimatingthe empirical link between the export extension and economic growth i-e to determine long run relationship among the variables using cointegration techniques by Johnson (1988). Finally, this paper employs modern time series methods to estimate the dynamic Error Correction Mechanism on Export-led Growth model. Finally, the objective of study is quantifying the significance of exports in the Pakistan's economic enactment. The rest of the paper contains literature review, methodology for estimation, results and discussion.

2. Literature review

In past Export led Growth Hypothesis was tested through different econometric methods. Among many others, the causal relationship between exports and output growth was found by Kravis (1970), Michaely (1977) Heller & Porter (1978), Bhagwati (1978) and Marin (1992). Balassa (1978) and Krueger (1980) pinpointed that due to exports the enhancement in TFP shows the great effect on economies of scale and other related externalities. Kwan & Kwok (1995) ponder exports a major FOP in case of China and applied the Exogeneity techniques. Bahmani-Oskooee & Alse (1993) re-investigated the relationship ELGH for nine DC's and found strong support for the export-led growth hypothesis for all the countries. Dutt & Ghosh (1996) and Xu (1996) found supportive results among 17 out of 32 economies under study. The analysis were checked for different data sets like time series, cross sectional and panel. Although in many models the trade and growth nexus has been emphasized, they highlighted that one of the major variables enter the growth function is trade. But, the supporters of the ELGH have stressed that the main engine of South East Asian growth is exports.

On the contrary Researches that do not support ELGH contain, Kormendi & Meguire (1985), Gonçlaves & Richtering (1987), Helleiner (1986), De Gregorio (1992), Yaghmaian & Ghorashi (1995), and Burney (1996). As it is problematic to isolate why these studies did not supported ELG hypothesis while other studies do but the only reasons we found are different country data sets, time periods variability, socio-political behviours and variable definitions.

Considering Pakistan, Sherazi & Manap (2005), Saeed *et al.,* (2005), Quddus & Saeed (2005), Siddique *et al.,* (2008), Khan & Saqib (1993), Khan, *et al.,* (1995) and Rana (1985) investigated ELGH and used Cointegration, multivariate Granger Causality and different estimation techniques to investigate the long-run /short- run and causal relationships between the growth of exports and output. Apart from finding positive relationship while employing ELGH, there are researches which concluded rejection which includes Mutairi (1993), Ahmed *et al.,* (2000), Kemal *et al.,* (2002), Afzal & Hussain (2010).

3. Methodology

Export-led growth hypothesis in Pakistan is the growth model based on aggregate production function and it started with neo-classicals like Solow (1956) and Swan (1956). Exports and other variables may be added to capture their contribution to economic Growth as independent variables.

Following Frueger (1977), Feder (1982), Fosu (1982), Smith (2001), Balassa (1985) and Lucas (1988) the model appears as,

$$LRY_t = f(LK_t, LL_t, LX_t, \pi_t, LDCRPS_t, u_t) \quad (1)$$

We model the relationship between real GDP and real exports not in a bivariate framework but in a multivariate one by including the other variables. The long-run equation appears as following,

$$LRY_t = \beta_o + \beta_1 LK_t + \beta_2 LL_t + \beta_3 LX_t + \beta_4 \pi_t + \beta_5 LDCRPS_t + \varepsilon_t \quad (2)$$

Where

LRY_t = Log of real Gross Domestic Product

LK_t = Log of Capital, measured by real gross domestic capital formation.

LL_t = Log of Labour, as Total labour force (age 15-60) in Pakistan

LX_t = Log of Total or aggregate exports (real).

π_t= Inflation (annual % change in CPI)

$LDCRPS_t$= Log of Domestic credit to private sector (% to GDP)

$\varepsilon_t \sim$ IID $(0,\sigma^2)$.

Following Granger representation theorem (Granger, 1986) asserts that if two variables are non-stationary that is I(1) and these variables have cointegrating relationship among them then the dynamic function can be represented as an Error Correction Mechanism (Engle & Granger, 1987). In the literature the ECM has different formulations. One of the processes of formulation of the error correction model is following Johansen Maximum Likelihood method (1988) which is as follow;

$$X_t = \sum_{i=1}^{k} \prod_i X_{t-i} + u_t + \varepsilon_t \quad (3)$$

Where $X_t$is a vector of variables included in the model,u_t is constant term and ε_t is

IN(0, Ω) disturbance term.

Having established that a cointegrating relationship exists among the variables, a Vector Error-Correction Model (VECM) is estimated to determine the dynamic behaviour of the growth equation (e.g Johnson & Juselius, 1989), which is presented below;

$$\Delta X_t = \prod X_{t-i} + \sum_{i=1}^{k-1} \tau_i \Delta X_{t-i} + u_t + \varepsilon_t \quad (4)$$

The error correction model captures the short run dynamics of the system. The general modeling based on the ith adjustment to equilibrium period in the expanded equation is

$$\Delta LRY_t = \beta_o + \sum_{i=1}^{n} \beta_{1i} \Delta LRY_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta LK_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta LL_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta LX_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta \pi_{t-i} + \sum_{i=0}^{n} \beta_{6i} \Delta LDCRPS_{t-i} + \lambda ECM_{t-1} + \varepsilon_{t-1} \quad (5)$$

Where ECM is the error correction term. The coefficient (λ) is expected to be negative and significant and shows the speed of adjustment in the model and remaining coefficients in the model are short run dynamic coefficients which shows the adjustment of the long run equilibrium.

4. Results and dicussion

The Annual Time series data of Pakistan is used from the period 1971 to 2016 and gathered from national data sources. National data source followed is Government of Pakistan i-e Economic survey of Pakistan. (Various issues) and State Bank of Pakistan

It is essential to know the order of integration for the analysis of cointegration, in which all series must have same order of integration I (d). Therefore we applied the Augmented Dickey Fuller test of unit root on our data series. For this purpose all data series is transformed into logarithm except inflation.

The ADF test result shows that we cannot reject the null hypothesis of Unit root at 5% significance level because the t-statistics of each series (LRY, LX, LDCPS, L π , LL and LK) are greater than the ADF critical values recommended by Mackinnon. So, its concluded that $\{x_t, e_t\}$, (where x_t represents all variables that are used in the study) are weakly dependent processes or these processes are independent of stochastic and deterministic trends like unit roots means all the series are non-stationary at level. Now take first difference of variables to test the unit root at first difference and it can be seen that t-statistics of each series is less than the critical vales of ADF, so we can reject the null hypothesis of non-stationary and concluded that all serried has same order of integration that is I(1) (See Table 1).

Table 1. *Augmented Dickey Fuller (ADF) Test of Unit Root*

Variables	C & T	Lags	t- statistics	Variables	Lags	t- statistics	C & T
LRY_t	C,T	0	-2.45	ΔLRY_t	0	-7.11	C
LX_t	C,T	1	-3.06	ΔLX_t	1	-9.25	C
LL_t	C,T	0	-0.84	ΔLL_t	1	-2.81	No C,T
LK_t	C,T	1	-3.34	ΔLK_t	0	-5.14	C
$LDCPS_t$	C,T	0	-1.41	$\Delta LDCPS_t$	2	-3.97	No C,T
π_t	No C,T	0	-1.61	$\Delta\pi_t$	1	-8.47	No C,T

Note: L is for log and Δ shows first difference. ADF τ<–3.52 for C and t both, ADF τ<–2.93 for C only , and ADF τ<–1.95 for no C,t ,at the 5 percent level of significance.

Before turning to the empirical estimations of co integration, its been suggested to find the lag (k) order of vector autoregressive (VAR) models, when they are at levels, which represents a critical stage of MLE i-e Johansen maximum likelihood procedure. In literature its recommended to use Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) for selecting the lag length of the VAR system which can only be achieved through minimization of concerned criterias. In many cases, both of the criteria's suggest the use of VAR with the same order of lags while the others with different choice criterias recommend the one with the smaller lag order. The reason is as for example, if we use VAR of greater order i.e. 3, 4, 5, or 6 it would become the greater cause of over parameterization, that is a condition which becomes more acute in those cases where the sample size is countable or finite.

Additionally, as the data is taken annually (1971-2016), the lag length for the VAR system is determined by considering AIC and SBC. Both criteria suggest different lags in the VAR, i-e according to AIC and SBC, 5 and 1 lag is determined respectively see Table 2. so we will consider k as 1, following above description. Moreover, in Table 3 we checked autocorrelation, where the results show that there is no serial correlation when the VAR lags taken are 5. The problem of autocorrelation doesn't appear even at lag order 1.

Table 2. *VAR Lag Order Selection*

Endogenous variables: LGDP LX LK LL LDCPS INF; Sample: 1971 2016						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	27.10750	NA	1.44e-08	-1.029634	-0.778868	-0.938319
1	269.2836	401.6579*	6.29e-13*	-11.08700	-9.331638*	-10.44780
2	299.9082	41.82874	9.18e-13	-10.82479	-7.564824	-9.637690
3	346.1097	49.58213	7.71e-13	-11.32243	-6.557860	-9.587434
4	388.3731	32.98603	1.17e-12	-11.62796	-5.358789	-9.345070
5	468.8159	39.24039	6.57e-13	-13.79590*	-6.022131	-10.96512*

Note: * indicates lag order selected by the criterion

Table 3. *VAR Residual serial correlation LM Test*

Lags	LM-Stat	Prob
1	58.32082	0.0107
2	57.39985	0.0132
3	27.11071	0.8573
4	29.95906	0.7506
5	45.75576	0.1278

Notes: Probs from chi-square with 36 df.; Sample: 1971 2016

In the cointegration test we used the third model as explained by the Johansen (1995), Table 4 is reporting the results of Maximal eigenvalue statistics and trace statistics, both of these are Johnson Maximal Likelihood ratio tests employed for testing the cointegrating (CI) relationships between the variables. The results indicate that there exist two CI relations as explained by trace and one cointegrating relationship exists if we rely on maximum Eigen values, between real GDP, real exports, labour, real investment, DCPS, and inflation. Although both tests report different number of cointegrating vectors yet we chose trace test because it is more powerful than maximum eigenvalue test. Again in case of non-normality as explained by Hubrick *et al.,* (2001) and Chueng & Lai (1993) , trace test is preferred over maximum-eigenvalue test. In this study we consider the results of trace test having two cointegrating relationships. That is because the null hypothesis $H_{o=}$ $r \leq 1$ and $r \leq 2$ is overruled against the alternative $r \geq 2$ and $r \geq 3$ one-to-one at 5 % significance level.

Table 4. *Johansen Maximum Likelihood Test of Cointegration*

	Trace Test		*Maximal*	*Eigen Value*
Null	Alternative	Chi-square	Alternative	Chi-square
r=0	r≥ 1	136.8241	r=1	57.85866
r ≤ 1	r ≥ 2	78.96541	r=2	32.06888
r ≤ 2	r ≥ 3	46.89653	r=3	23.10136
r ≤ 3	r ≥ 4	23.79517	r=4	11.89457
r ≤ 4	r ≥ 5	11.90060	r=5	8.999904
r ≤ 5	r ≥ 6	2.900693	r=6	2.900693

Note: *Indicates significant at the 5 percent level.

Cointegration test in the case of multiple cointegrating (CI) vectors are often challenging to interpret. In such case, the first vector is used for long run export led growth function, normalized by LRY (real GDP*).* From the cointegration analysis we obtain long run coefficients of our variables for the desired GDP growth function that are given below. Chi-Square values are reported in parentheses.

$$LRY_t = \underset{(4.54)}{0.417814}LRX_t + \underset{(7.27)}{0.455273}LK_t + \underset{(7.09)}{1.459530}LL_t - \underset{(21.49)}{0.014175}\pi_t + \underset{(1.20)}{0.108689}LDCPS_t \quad (6)$$

Observing the above equation equation 6, it can be seen that Real Exports(RX) have significantly positive relationship with RGDP (RY) in a way that for 1 % increase in the real exports there will be 0.41% increase in the real GDP of Pakistan, that is a strong support towards ELGH in the longrun. There is significant positive relationship between real investment (K) and RGDP. If there is 1 % increase in the K then there will be 0.45 % increase in the RGDP. There is

significant positive relationship between Labor Force participation rate (L) and RGDP showing that if there is 1 % increase in the L the RGDP will boost up by 1.45 % , similarly in case of Domestic credit to Private sector ratio (% age of GDP) 'DCPS' the situation appears same, as by 1% increase in DCPS, the RGDP enhances by 0.108 %. On the other hand there exists negative relationship between inflation and RGDP as if 1% increase in inflation there will be 0.01 % decrease in the RGDP. As explained in literaturein case of Pakistan, ELGH is supported in the longrun. Some studies conducted recently in past on Pakistan like Khan & Saqib (1993), used simultaneous equation model and proved that there exists a solid relationship between exports and economic growth of Pakistan. Shirazi & Manap (2004) also found the same in case of longrun. Pakistan has a developing economy with unlimited natural resources, by efficient use of labor, a contribution in the capital is observed and quality product production provides an incentive towards export to developed or developing economies, which definitely play a vital role in the GDP growth. Exports are a key component of aggregate demand (AD) in any economy. Rising exports will lead to an increase in AD and are a cause towards higher economic growth. Export growth can also have a knock-on effect to 'service industries' that somehow is related, similarly plays crucial role in employment. The positive coefficient of 0.41% of exports, shows significant contribution in RGDP of Pakistan and stresses the need that by developing the Export sector this contribution can significantly improve.

As per expectations and relying on the theoretical and empirical evidence, it indicates that the relationship between labour force and capital formation towards RGDP is positive (Romer, 1986; Lucas, 1988; Rebelo, 1991; Smith 2001). Adequate amount of capital is one of the initial basic needs for the economic growth. Capital flow is seen because of savings and savings as out of income. The enhancement in the capital means increase in production and raised production is indication towards more output or Growth. This is because with more capital available, a given number of workers will be able to produce more output, ceterus peribus.

Looking at inflation, which shows a reduction in the Real GDP of Pakistan is commonly observed among economies because GDP is the total production that occurs in an economy thus as a result of inflation price rise, this will increase the cost of factors of production (like raw material, labor and capital, ect). This means that people will buy less of that commodity due to the increase in its price (basic law of demand and supply). If we aggregate this phenomenon for all goods across all sectors we see a huge drop in aggregate production which leads to a slowdown in the economy and hence reducing the RGDP.

The contribution of domestic credit to private sector as ratio to GDP is positive as expected theoretically. The results suggest that in the long-run, DCPS is essential to growth. This is a confirmation about the theoretical expectation of classical and monetarists views on the role of government in the macro economy. The positive contribution of DCPS on growth of real GDP in the long-run may be due to the fact that the private sectors do more productive investments, efficiently use technology, create employment opportunities, increase output and growth. This is because most of government expenditures are seen on consumption rather than investment in infrastructures (Peter, 2015).

Following is the error correction model of the study in equation 7. The ECM represents two parts that are short run dynamics and long run.

The *t- statistics* of parameters are in parenthesis.

$$\Delta LRY_t = \underset{(-5.07)}{-0.115282} + \underset{(4.59)}{0.098981}\Delta LRX_t + \underset{(5.59)}{0.240627}\Delta LK_t + \underset{(2.70)}{0.621176}\Delta LL_t - \underset{(-4.40)}{0.213826}\Delta LDCPS_t - \underset{(-5.56)}{0.149844}\, \mathrm{E}CM_{t-1} \quad (7)$$

Diagonostic Tests

$R^2 = 0.71$ F = 19.39 Auto$\chi^2_{(1)}$ = 1.29 Norm $\chi^2_{(2)}$ = 0.50 Hetero $\chi^2_{(1)}$= 0.19

In the equation 7 the t-statistics of differenced independent variables shows the short run estimates and t-statistics of lagged error correction term (ECM) indicates long run relationship that is derived from the long run equation of our study. The following equation is estimated with one lag length that is chosen on the basis of diagnostics tests. The results of diagnostic test can be seen below equation 7.

The short run equation 7 is tested through the above mention diagnostic tests for the sake of reliable and accurate results. To be specific, we applied several diagnostic tests to check validity and reliability of model and test the hypotheses of non autocorrelated, homoskedastic and normally distributed residuals. The serial correlation hypothesis is tested by using the Lagrange-Multiplier test (up to the maximum lag), Next, ARCH test is applied to detect the hetroskedasticity and the Jarque-Bera test is applied to check the normality. So first the Breusch Godfrey LM test has been applied on the residuals of the model to test the autocorrelation and from the $(\chi^2_{(1)})$ that is (1.29) we cannot reject the null hypothesis of no autocorrelation. Joint significance is checked through F test which appears as 19 in this model. The $\chi^2_{(1)}$ of Heteroskedasticity test is 0.19 showing that we cannot rejects the null hypothesis of no Heteroskedasticity. To test normality of residual Jarque-Bera test has been applied and chi square value appears as 0.50 so we cannot rejects the null hypothesis and conclude that residuals are normal. This information takes us to believe that the estimated ECM is stable and significant enough for the prior analysis.

The results also indicates that coefficient of error correction term (ECM (-1)) is negative and significant at 5 % level which validates that there exist a long run relationship between variables. Further, the value of estimated coefficient of error correction term is 0.149 % which shows a slow speed of adjustment to the long run equilibrium. Its mean error term is correcting its previous disequilibrium to the long term.

5. Conclusion

This study empirically verified the Export-led Growth Hypothesis (ELGH) in case of Pakistan by the implication of econometric techniques by considering yearly data ranging from 1971 to 2016. Through cointegration analysis, both in the long run and short run the theory is positively proved as a confirmation to literature and economist views. The dynamic error corrections model basically confirmed the short run relationship between Real GDP and Real Exports along with other independent variables (labour, Real Investment and DCPS. Moreover, the existence of Cointegration between Real GDP and Real exports through Johnson Maximum Likelihood test justifies the application of the dynamic ECM approach and hence also proved the short run relationships between the preferred variables.

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