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The Supply and Demand for Exports of Pakistan: The Polynomial Distributed Lag Model (PDL) Approach

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1. INTRODUCTION

In the global economy, the performance of any country will greatly depend on the performance of its exports. The trade performance determines the prospects of change. It helps countries win friends, and break the traditional mould of isolation and indifference. The performance of exports of countries depends on various price and non-price factors.

In international trade transactions it is important to recognise that these transactions require some amount of time that occurs between the decision to buy and actual delivery of the product from foreign country. In the Econometric modelling lag occupies a central role. It is recognised that due to psychological, technical and institutional reasons, a dependent variable may respond to explanatory variables with lapse of time, in particular when dealing with time-series trade models.

A number of studies have been conducted to examine the export performance of Pakistan. In the best of our knowledge, no study has been undertaken incorporating lags to examine the individual and cumulative impact of determinants of export performance of Pakistan.

Thus, the ultimate purpose of this paper is to estimate consistent individual (short run) and cumulative (long run) elasticities of both export demand and supply determinants using annual data over the period 1972–2000 by applying Almon approach.[1]

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[1]Almon technique has a distinct advantage over the Koyck method because the latter has some serious estimation problems. Moreover, Koyck will not work when assumption of β coefficient decline, geometrically, is violated.

The plan of the paper is as follows: Section 2 presents literature review; while the data set and model are discussed in Section 3; the result and interpretations of these analyses are in Section 4 and conclusion and policy implications are summarised in the last.

2. LITERATURE REVIEW

Various studies have been conducted incorporating different determinants of export growth to evaluate the performance of the variables affecting exports and imports in different countries. Houthakker and Magee (1969) conducted pioneering study to determine export performance using time series data. Khan and Goldstein (1978) later examined elasticity of determinants of export demand and supply for the sample of eight countries by using simultaneous approach (2SLS). They found large export price elasticities of demand with medium term effect of independent variables on the adjustment of exports and also explained world income as a significant component of export demand. Goldar (1989) estimated the effect of productivity increase on India's export performance in engineering products and found out positive relationship between world demand and export performance of India's engineering sector. Roy (1991) also supported the finding of Goldar and found out world demand along with exchange rate as important factors in determination of export performance of Bangladesh. He found out that the devaluation has some positive impacts on export performance of Bangladesh. Ahmad (2000) by applying Cointegration Technique and Error Correction Model for the export supply of Bangladesh found the significant relationship between the export price, exchange rate, domestic capacity, and export supply of Bangladesh.

In the case of Pakistan the studies conducted during the last two decades used different techniques and incorporated different determinants for export performance. Initially studies were conducted assuming export demand as exogenous [Naqvi (1982) and (1983)]. Anwer (1985) used the simultaneous approach (2SLS) to examine export performance of Pakistan. He found the price elasticities are not significant while world income and domestic production significantly explain the demand and supply side of export respectively. For Pakistan Hasan and Khan (1994) carried out study and specified demand-side factors and supply-side factors for export performance of Pakistan. They also examined impact of exchange rate policy on Pakistan's trade balance by applying 3SLS technique. Their results showed that export demand is positively related with world demand and negatively related with relative export price in case of both primary and manufactured exports. The nominal exchange rate, on other hand, posited a positive and significant relationship between export demand in both cases. Another study for the determination of export demand and export supply factors conducted by Sajjad and Fauzia (2000) for Pakistan's economy, they examined the impact of exchange rate policy of Pakistan. They also determined the

price and income impact on trade balance with respect to four major trade partners. They estimated Cobb-Douglas form equation using 3SLS technique.

In summary the world income is one of the most important determinants of export demand, whereas, the exchange rate[2] shows statistically mixed results on export performance. Empirical studies showed domestic capacity utilisation as a significant determinant on supply side, while; relative prices do not reach the traditional level of significance in all studies.

3. THE MODEL AND DATA SOURCE

In order to realise aim of the study, world demand for Pakistan goods is specified in log-linear form. The demand function can be expressed in the following form:

$$Ln\ Xd = \alpha_0 + \alpha_1 LnREER + \alpha_2 LnEA + u_1 \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

It is expected that α_1 will be negative and α_2 positive

Xd = Quantity of Export Demanded
EA = World Economic Activities
$REER$ = Real Effected Exchange Rate

In this study world economic activity is represented by industrial production index of industrial countries (IPI).[3]

Since the above equation is specified in log-linear α_1 and α_2 are the elasicities of demand of export with respect explanatory variables.

The Supply of export is specified as follows

$$Ln\ Xs = \beta_0 + \beta_1 Ln\ (RP) + \beta_2 LnY + \beta_3\ LnWr + u_2 \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where it is expected β_1, $\beta_2 > 0$ and $\beta_3 < 0$, similarly as mention above β_1, β_2 and β_3 are the elasicities of supply of export with respect explanatory variables

Xs = quantity of supply of export
RP = (UVE_{pak}/CPI_{pak}) relative prices, the unit value of export (UVE_{pak}) of Pakistan to domestic prices of Pakistan (CPI_{pak})
Y = Domestic Production Capacity
Wr = Wage Rate per Worker[4]

Predicted values of real GDP (1980=100) used as a proxy variable for domestic production capacity of economy.

[2]Different studies used different types of exchange rates (nominal, real, and effective).

[3]Industrial production index of industrial countries is taken as a proxy of world economic activity because more than 60 percent of export of Pakistan goes to industrial countries.

[4]Wage rate as proxy of cost of production is first time used in export supply equation of Pakistan.

In order to estimate the distributed lag model, Equations (1) and (2) remodeled as follows.[5]

The export equation becomes

$$LnXd = \gamma_0 + \sum_{i=0}^{k} Ln\varphi REER_{t-i} + \sum\prod_{i=0}^{k}{}_{i} LnIPI_{t-i} + V_{1t} \quad \ldots \quad \ldots \quad (3)$$

The supply equation becomes

$$LnXs = \beta_0 + \beta_1 LnRP + \beta_2 LnY + \sum_{i=0}^{k}\zeta_i LnWr_{t-i} + V_{2t} \quad \ldots \quad \ldots \quad (4)$$

Equations (3) and (4) were estimated using the Almon lag procedure with K=3[6] and the degree of polynomial were 2 with no end constraint.

Before going on data few words are in order about the data. The estimation was performed using annual data for years 1972-2000, all the data are annual and taken from the following sources:

1. International Financial Statistic (IFS).
2. Economic Survey (ES), various issues.
3. Statistical Year Book (SYB).

Data for unit value of export (UVX), volume of export (VEX), consumer price index (CPI) of Pakistan and world consumer price index (WCPI), Industrial production index (IPI) exchange rate (ER) of selected export partner countries of Pakistan[7] are taken from (IFS). Data for wage rate is taken from (SYB) and data for export of selected countries, real GDP of Pakistan are taken from (ES). This data is further used for estimation of variables.[8]

4. EMPIRICAL RESULTS

The estimated export demand equation is satisfactory with respect to sign, high adjusted R^2, no autocorrelation and particularly significance of long run coefficients of both explanatory variables. The current and lagged one, two and three of REER is insignificant at 5 percent level, but cumulative effect is significant at 5 percent level.

[5]We check the simultaneity problem between export demand and supply equation by employing Huasman Specification Test. We found that there is no simultaneous problem exists between export demand and supply equations.

[6]The number of lags included was determined using Akaike Information Criteria (AIC), indicating that optimal lag is 3.

[7]Share of export of trade partner more than 1 percent in total export in 1990.

[8]Estimation procedure of real effective exchange rate and production capacity of economy is given in Appendix.

Thus, results indicate that a 1 percent decrease in REER would increase the quantity of export demanded by 0.49 percent in current year, 0.36 percent in second year, 0.53 percent and 0.003 percent in third and fourth years respectively. Similarly, 1 percent devaluation or depreciation of Rupees will increase the export demand by 0.39 percent in long run.

The result shows that the elasticity of demand for export with respect to real effective exchange rate is inelastic short run (individually) as well as in long run (cumulatively).

The Export Demand Equation

Lagged Explanatory Variables	Estimated Coefficient	T-Ratio
Constant	–6.86	–4.26*
REER (0)	–0.49	–1.57
REER (–1)	–0.36	–1.49
REER (–2)	–0.53	–1.07
REER (–3)	–0.03	–0.01
IPI (0)	0.38	2.47**
IPI (–1)	0.69	2.24**
IPI (–2)	0.68	2.27**
IPI (–3)	1.58	1.77
$\sum_{i=0}^{3} REER(i)$	–0.39	–2.12**
$\sum_{i=0}^{3} IPI(i)$	2.93	12.3*
Adjusted R^2	0.92	
D.W	2.06	

* and ** indicate significant at 1 percent and 5 percent respectively.

The elasticity of demand for export with respect to IPI index is inelastic for individual years except forth year. Their cumulative effect in long run is elastic, the sum of elasticity is greater than one that is, 2.9 and significant at 1 percent level.

The current industrial production index is significant at 5 percent up to 2 lags. This suggests that IPI would take 3 years to have full impact on quanity of export demanded.

In particular, 1 percent increase in industrial index would increase the export of Pakistan by 0.33 percent in current year, 0.69 percent in second year, 0.68 percent in third year and 1.5 percent in forth year.

The results of export supply equation are significant with respect to sign and high-adjusted R^2 and no autocorrelation.

The Export Supply Equation

Explanatory Variables	Estimated Coefficient	T-Ratio
Constant	–37.51	–5.16*
LRP	0.42	0.99
LY	3.67	4.97*
Wr (0)	–0.25	–1.29
Wr (–1)	–0.05	–1.43
Wr (–2)	–0.08	–0.52
Wr (–3)	–0.31	–1.58
$\sum_{i=0}^{3} Wr(i)$	–0.70	–2.56*
Adjusted R^2	0.92	
D.W	2.13	

*and ** indicate significant at 1 percent and 5 percent respectively.

The coefficient of relative price has correct sign but insignificant, predicted values of real GDP and cumulative effect of wage rate have emerged as significant determinant of export supply function.

The performance of (LY) is according with theory; with coefficient being significant the (LY) elasticity is elastic with respect to export supply and also significant. The result suggests that 1 percent increase in domestic capacity of the economy will increase the export supply by 3.7 percent.

The coefficient of wage rate is insignificant individually at 5 percent but significant at 5 percent at cumulative level, elasticity of export supply with respect to wage rate is inelastic. Results suggest that 1 percent increase in wage rate the export supply will decrease by .7 percent. Our result is in the line of structuralist economists that reduction in real wage without increasing productivity does not increase output and employment [Taylor (1990) and Trap (1993)]

5. CONCLUSION AND POLICY IMPLICATIONS

The empirical results suggest that the world economic activity and real effective exchange rate are the important determinants of export demand of Pakistan. However significant and inelastic coefficient of REER on demand side in the long run points out towards an interesting policy implication that devaluation or depreciation may not be an effective source of export growth in Pakistan.

The significant and elastic coefficient of world economic activity shows colossal dependence of Pakistan's export on trading pattern in the world economies. The results indicate that the government should monitor the business cycles of its trade partners in order to target expanding exports during their periods of cyclical

booms. Government should make it a priority in its policy agenda to expand exports to major trade partners by diversification of exports with better quality products and high value added components.

On the supply side the wage rate is although insignificant in the short run but its cumulative effect is significant and less elastic. Our result is in the line of structuralist economists that institutions (economic and political) do matter. The coefficient of domestic production capacity is significant and elastic that shows greater role of domestic production in determination of export of Pakistan. These results suggest need of policies for greater utilisation of productive capacity of the economy. While insignificant relative price coefficient suggests that it is not statistically important determinant of export supply in case of Pakistan.

Despite the importance of above mentioned factors non price factors such as product differentiation, trade promotion, facilities at ports, infrastructural facilities, etc. may also produce greater influence on export performance and government should also consider non price factors in future policy formulation to promote export.

APPENDIX

Real Effective Exchange Rate

In this section, we shall briefly explain the calculation of Pakistan's rupees real effective exchange rate based on export weighted exchange rate. For export weighted exchange rate, the trade partners were chosen on the basis of exports are more than 1 percent in total exports in 1990.

Let X_0^p be the value of exports to the *p*th trading partner in the base period (0), expressed in that partner's currency. Let e_1^p and e_0^p be the dollar values ($/currency) of one unit of the *p*th partner's currency in period 1 and in the base period (0), respectively, and e_1^r and e_0^r be the dollar values ($/currency) of one unit of the reporting country's currency in period 1 and in the base period (0), respectively. Then, to compare the change in the values of the base period's export earnings (from all partners) owing to exchange rate movements, the following ratio is formed

$$E = \frac{\sum_p X_o{}^p (e_1^p / e_1^r)}{\sum_p X_o{}^p (e_o^p / e_o^r)} * 100 \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Where, subscripts refer to the time period and superscripts to the country. The price and quantity components X_0^p of the value of export receipts are held constant only the relative exchange rates are changed. Through simple manipulation,

Equation (1) can written in a form readily recognisable from the effective exchange rate literature

$$E = \sum_p \frac{W_0^p}{\sum W_0^p} \left(\frac{e_1^p}{e_0^p} \Big/ \frac{e_1^r}{e_0^r} \right) * 100 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where,

$$W_0^p = X_0^p \frac{e_0^p}{e_0^r}$$

In formulation (2), the index is shown to be simply the bilateral export weighted index of the nominal effective exchange rate described by the Rhomberg [(1976), p. 95]. The result $\frac{e_1^p}{e_0^p}$ and $\frac{e_1^r}{e_0^r}$ are the indices changes from the base period in p's and r's numeraire exchange rates, respectively.

Nominal Effective Exchange Rate—Adjustment for Inflation Differentials

Consider the nominal index rate derived in formulations (1) and (2). Deflating equation (1) by the ratio of price changes from the base period in the partner countries to that in the reporting country gives, after a number of mathematical manipulations,

$$R = \sum_p Z_p \left(\frac{e_1^{pr}}{e_0^{pr}} \right) \Big/ \left(\frac{p_1^{pr}}{p_0^{pr}} \right) * 100 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where, $Z_p = W_0^p \Big/ \sum_p W_0^p$ is the bilateral export share; $e_0^{pr} = e_0^{pr} \big/ e_0^r$ and $e_1^{pr} = e_1^p \big/ e_1^r$ are bilateral exchange rates of the partner countries to those of the reporting country at time 0 and time 1, respectively;and $p_0^{pr} = p_0^p / p_0^r$ and $p_1^{pt} = p_1^p / p_1^r$ are the ratios of export process of the partner countries to those of reporting country at time 0 and time 1.

Equation (3) can, in turn, be easily expressed in a more reduced, mathematically equivalent form, that is,

$$R = \sum_p Z_p \left(r_1^p \big/ r_0^p \right) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

Where $r_1^p = e_1^{pr} \big/ p_1^{pr}$ and $r_1^p = e_0^{pr} \big/ p_0^{pr}$ so that R is a weighted sum of real exchange rates.

Production Capacity of Economy

For production capacity of economy, the Predicted value of real GDP (1990=100) used as proxy of real GDP [See Khan and Goldstein (1978) and Ahmad (2000)].

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