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## Article

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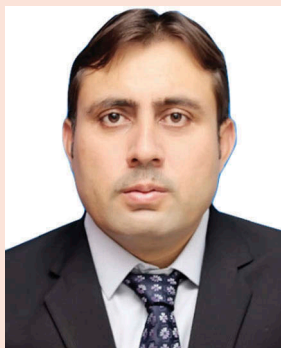
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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# Determinants of export supply in Pakistan: A sector wise disaggregated analysis

Sayed Irshad Hussain<sup>1\*</sup>, Akhtar Hussain<sup>2</sup> and Muhammad Mehboob Alam<sup>3</sup>

**Abstract:** This study aims to investigate the impact of supply-side factors on the export performance of Pakistan at a disaggregated level. It has identified major export categories of Pakistan and constructed a novel time-series data set of each of these categories from 1971 to 2014. Using autoregressive distributed lag (ARDL) model (bound testing), the sectoral focus confirms that major export categories respond differently to changes in various factors of export supply in the long-run. For instance, the relative prices have a larger impact on the export performance of raw materials and value-added manufactured products. Similarly, the cost of production has higher effects on the growth of value-added manufactured and cotton waste exports. On the contrary, production capacity and domestic demand pressure have significantly influenced the export supply almost all manufactured and primary export categories in the long-run. In the short-run, the relative price, cost of production, and production capacity showed mixed effects for the export supply of many primary and manufactured export categories while domestic demand



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### PUBLIC INTEREST STATEMENT

This study explores the impact of supply-side factors on the export performance of Pakistan at a disaggregated level. More precisely, this study provides the reliable elasticities of export supply at a disaggregated level, which are essential for the evaluation of trade policy interventions. Using appropriate econometric techniques, the study confirms that the factors determining the export supply are changing across the export categories. The relative prices and the cost of production strongly affect the export supply of the value-added manufactured goods only, whereas the export supply of almost all types of manufactured and primary goods, particularly food items including rice, fruits, and fish, is chiefly determined by the production capacity and domestic demand. Furthermore, the study verified that along with traditional factors, domestic demand pressure is also relevant for modeling the export supply for Pakistan at a disaggregated level.

pressure hypothesis is valid in most cases. The study concludes that the factors determining the export supply are changing across the export categories. Hence, it is suggested that the government must revisit the export policy and make the new policy in line with new sectorial realities in order to expand the export sector of the country.

**Subjects:** Economics; Macroeconomics; International Economics

**Keywords:** exports; supply function; ARDL approach; disaggregated analysis

**JEL Classification:** F10; F14; C22

## 1. Introduction

The important questions in the contemporary world: Do domestic economic conditions lead to an expansion in export performance? What are the major drivers of export supply function? The potential answers to these questions have crucial policy implications. A considerable empirical literature, Kohli (1978), Zilberfarb (1980), Goldstein and Khan (1978, 1985), Riedel, Hall, and Grawe (1984), Khan and Knight (1988), Arize (1987, 1990), Balassa, Voloudakis, Fylaktos, and Suh (1989), Faini (1994), Atique and Ahmad (2003), Edwards and Alves (2006), Zada, Muhammad, and Bahadar (2011), Moniruzzaman, Toy, and Hassan (2011), Esteves and Rua (2015), Bobeica, Esteves, Rua, and Staehr (2016) and many others have estimated export supply function and identified the key factors that affect export supply growth. However, many of these studies have estimated the export supply function at the aggregate level. The major weakness of the estimation of aggregate export supply function is that it does not allow us to know whether the key determinants affecting the export supply are constant or changing across the export categories. Whether the magnitude of export supply elasticity for major factors of export growth is divergent across various export categories. The answers to these policies-focused questions are desirable for several important reasons. First, it would be useful for evaluating the strategies and identifying priority technologies for the sustainable development of different export sectors. That can lead the country's transition toward high-technology industrialization. Second, accurate elasticities of export supply of various export categories with respect to different factors are essential for suitable trade policy formulation, especially for policy decision in relation to export promotion strategies. Third, there are common views that export incentive and subsidies work in those categories of exports, which have price elasticity greater than unity. Therefore, the answers to these questions can help policymakers' in allocating the export incentive to different export categories and sectors.

Keeping in view the above discussion, relatively a small numbers of empirical studies investigated the determinants of export performance in Pakistan's case. The available empirical studies like Khan and Aftab (1995), Atique and Ahmad (2003), Afzal (2005), Hussain (2010), Zada et al. (2011), Gul and Rehman (2014), etc. are not comprehensive and have some common points and weakness. Firstly, the most important point in extant literature with respect to Pakistan is that the majority of empirical studies have estimated the export supply function at the aggregate level and hardly any single study investigated the export supply determinants at a disaggregated level in a comprehensive manner. However, the existing literature explicitly shows that different types of exports are responded differently to changes in the various factors of export performance across the globe (see Jongwanich, 2010; Riedel et al., 1984; Sheridan, 2012). More importantly, a better knowledge of the influence of supply-side factors at a particular industry level is useful for suitable policy formulation, as most often aggregate export performance mask sector-specific variations.

Secondly, most of the empirical studies in Pakistan's case have utilized the neoclassical approach to model the export supply function in which the export supply is basically determined by the domestic production capacity and relative profitability of producing export goods. All available studies in the case of Pakistan are implicitly based on the assumption of market-

clearing prices and ignore the role of the domestic demand pressure. Here the important question can be posed as in Zilberfarb (1980) that omitting the domestic demand pressure from the export model may produce the upward-bias in the price elasticity. In this context, the present study is intended to investigate the impact of supply-side factors on the export performance of Pakistan at a disaggregated level in order to fill the gaps in the extant literature. More precisely, the study empirically estimates the export supply model for various export categories by including production capacity, relative prices, cost of production, and domestic demand pressure as explanatory variables in the export supply model. The selection of the export categories is based on the availability of relevant data and the importance of the share of each export category in overall exports of Pakistan.

## 2. Literature review

Economic theory has defined exportable goods or exports as a surplus between domestic supplies minus domestic demand at world price where domestic supply is greater than domestic consumption. Hence, so many factors are involved on both the demand and supply side to influence the export performance of an economy. Several economists have emphasized the estimation of the demand side model as they have assumed the supply function is infinitely elastic. On the other hand, the advocates of the supply inelasticity hypothesis ascertained that slower growth of exports of less developed countries (LDC) is mainly due to constraints on the supply side of exports. The major constraints on the supply side are those operating in production capacity, relative profitability, and the factors affecting the cost of productions. Traditional supply function ascertained that export supply is largely determined by production capacity and profitability (See Arize, 1990; Goldstein & Khan, 1978; Khan & Knight, 1988; Kohli, 1978). However, Goldstein and Khan (1985) have derived the export supply function in imperfect substitution model framework. The underlying assumption of the model is that 'neither imports nor exports are the perfect substitutes for domestic goods. They postulate that the producers in the domestic economy are assumed to maximize their profits, subject to the cost constraint. They have included the variable cost of production in addition to relative prices and supply capability in the export supply equation and reported a statistically significant impact of variable cost on export growth. On the other hand, other studies, like Artus (1973), Zilberfarb (1980), Dunlevy (1980), Haynes and Stone (1983), Riedel et al. (1984), Arize (1987), Goldar (1989), Lawrence (1989), Faini (1994) have included the domestic demand pressure or capacity utilization along with prices and production capacity variables in the export supply model in order to test its economic rationale and empirical importance for modeling export behavior; but, all the studies yielded mixed and conflicting conclusions on the role of the domestic demand pressure on export performance. For instance, Artus (1973) for United States, United Kingdom and Germany, Zilberfarb (1980) for Israel, Riedel et al. (1984) for India and Faini (1994) for Turkey, and Morocco has documented a significant adverse impact on domestic demand pressure on export performance, while Dunlevy (1980) and Haynes and Stone (1983) for the United States and the United Kingdom have reported a significant positive effect of domestic demand on export growth. These results imply that domestic demand also appears to be a significant variable for modeling export supply for respective countries.

In recent decade, Ahmed (2000) and Moniruzzaman et al. (2011) for Bangladesh; Redding and Venables (2003) for South-East Asia countries; Algieri (2004) for Russia; Majeed and Ahmed (2006) for developing countries; Sharma (2003) for India; Rahmaddi and Ichihashi (2012) for Indonesia; Esteves and Rua (2015) for Portugal and Bobeica et al. (2016) for European countries have also estimated export supply model and reported divergent conclusion on the impact of various factors on export performance across the countries. However, most of the researchers have argued that domestic economic conditions of the exporting countries have performed decisive roles in the evolution of export performance.

In the case of disaggregated export supply function, Lawrence (1989), Kohli (1998), Jongwanich (2010), Anas, Csis, and Anu (2011) and Sheridan (2012) have dissected the aggregate exports into several export categories. They yielded mixed conclusions on the impact of various factors on

export growth across the categories. Several studies reported that various export categories respond differently to changes in various factors of export performance. For example, Kohli (1998) documented that the export supply of industrial supplies of durable and nondurable goods, consumer durable goods, and other goods are highly elastic to changes in export price while the export supply of food, consumer nondurable goods and capital good are price-inelastic in the case of United States. Jongwanich (2010) for eight East and Southeast Asian economies argued that the real effective exchange rate has a significant effect on merchandise and manufacturing exports only. While for machinery and transport equipment exports, the coefficient of the real effective exchange rate is statistically insignificant. Other studies, like Anas et al. (2011) reported that supply-side factors, including production capacity and domestic price have significant effects on manufactured and agricultural export performance; whereas, all these factors have not made any significant difference in the export performance of oil and gas in the case of Indonesia. Apart from this, a numerous studies, including Artus (1973), Yang (1978), Riedel et al. (1984), Riedel (1988), Goldar (1989), Balassa et al. (1989), Faini (1994), Muscatelli, Stevenson, and Montagna (1995), Athukorala and Suphachalasai (2004), Edwards and Alves (2006), Havrila and Gunawardana (2006), Roy (2007), Jordaan and Eita (2012) and Basarac-Sertic, Vuckovic, and Skrabic Peric (2015) have estimated the manufactured and sub-categories of manufactured export supply functions and yielded the conflicting conclusions on the influence of various factors on the export performance of manufactured products. Their findings indicate that various supply-side factors affected the growth of manufactured export differently across the sub-categories of manufactured exports. For example, Riedel et al. (1984) for India documented that relative prices have significant effects in those sectors in which India's comparative advantage assumed to be strongest, whereas in other sectors the relative prices have insignificant effects on growth of manufactured exports. Jordaan and Eita (2012) for South Africa argued that domestic production capacity (represented by South Africa's GDP) has a negative effect on leather export performance and Roy (2007) for India reported an insignificant effect of domestic production capability on the export performance of manufactured products while several studies like Chan and Au (2007) for the China textile sector and Basarac-Sertic et al. (2015) for total manufacturing and high-tech manufacturing industry for 27 European Union member countries reported that production capacity has a significant effect on the growth of the manufactured exports. In addition, in the case of formulation of export supply function for agricultural commodities, the empirical studies like Haniotis, Baffes, and Glenn (1988), Abolagba, Onyekwere, Agbonkpolor, and Umar (2010) and David (2013) have also documented the mixed results for several determinants of export growth of agricultural products across the crops or commodities. For example, Haniotis et al. (1988) argued that the export supply of wheat and soybeans is less elastic with respect to changes in export price while export supply of corn is unit elastic to changes in export price in the case of United States. Abolagba et al. (2010) reported for Nigeria that various prices do not have a considerable influence on the export of performance of cocoa while the coefficients of the relative price variables are statistically significant in the case of rubber exports. From the above discussion it can be concluded that there is a substantial difference in the effect of various supply-side determinants on the export performance across the export categories.

With respect to the literature available for Pakistan, Akhtar and Malik (2000), Atique and Ahmad (2003), Afzal (2005), Zada et al. (2011) and Gul and Rehman (2014) have yielded the conflicting conclusions on the effect of various factors on export growth. For example, all the mentioned studies have documented the significant positive impact of production capacity on export growth. In the case of relative prices, Atique and Ahmad (2003) reported the insignificant positive effect of relative prices on export growth; whereas, Gul and Rehman (2014) documented a significant negative influence of relative prices on export performance. Moreover, other studies, like Zada et al. (2011) argued that export price has a considerable influence whereas domestic prices have an insignificant impact on export supply. Other studies, like Anwar (1985), Khan and Saqib (1993), Hasan and Khan (1994) and Afzal (2005) have also reported that domestic production capacity has significant influence on the export performance of aggregate as well as manufactured and primary exports while for relative prices, all these studies documented an insignificant effect on the growth

of both primary and manufactured exports in Pakistan's case. In contrast, Malik (2000) for Pakistan's textile and clothing exports, Haleem, Mushtaq, Abbas, and Sheikh (2005) for citrus fruit exports, and Hussain and Mazhar (2018) for leather, cotton cloth, and raw cotton exports reported that the export supply of mentioned categories is significantly elastic to changes in relative price in Pakistan's case. Recently, Cameron and Khair-uz-Zaman (2006) argued that real GDP of Pakistan has an insignificant impact on the export growth of carpet and rugs in the short-run while the relative price has significantly affected the export supply of carpet and rugs in both periods. Other studies, like Haleem et al. (2005) documented that Pakistan's GDP has a significant effect on the export supply of citrus fruits while domestic production of citrus fruits has a negative influence on the export performance of citrus fruits. On the contrary, Ghafoor, Mushtaq, and Abdullah (2013) for mangoes export supply reported that domestic production of mangoes has a significant positive influence on the export supply of mangoes. In the end, we conclude that a look at empirical studies in the case of Pakistan shows the wide disagreement on the role of the various factors in the determination of export supply across export categories from Pakistan.

### 3. Research methods, measurement of variables and data

#### 3.1. Specification of export supply model

Specification of the export supply function is a complex issue. The factors that influence the export supply of an economy vary across the sectors and country due to domestic economic conditions and various governmental and industrial policies. However, there are two main conceptual approaches to model the determinants of export supply; namely, the neoclassical approach and the Keynesian approach.

The advocates of the neoclassical approach postulate that export supply is basically determined by the relative prices and production capacity. On the hand, the Keynesian economists claim that export supply largely depends on domestic demand pressure. Several studies integrate these two approaches to model the factors of export supply across the globe (see Zilberfarb, 1980; Haynes & Stone, 1983; Sharma, 2003; Rahmaddi & Ichihashi, 2012; Basarac-Sertic et al., 2015; Bobeica et al., 2016). The same formulation has also been taken in this study to estimate the export supply function for Pakistan.

The basic assumption in specification of an export supply function for this study is that Pakistan is a small open economy and exporters are regarded as price takers in export markets; therefore, this assumption allows an estimation of a single equation export supply function.<sup>1</sup> The general equation of the export supply function is specified as follows:

$$X_s = f(RP, CoP, PC \text{ and } DDP) \quad (1)$$

Where,  $X_s$  is the quantity of exported, RP is the relative price (the ratio of export price to domestic prices), CoP is the cost of production (represented by the producer price index), PC is the production capacity to reflect the domestic economic activities and DDP is the domestic demand pressure. This equation is also used to estimate the export supply function for all disaggregated export categories covered in this study.

In modeling the export supply function, this study follows the imperfect substitute's model set out in Goldstein and Khan (1985). The basic assumption of the model is that 'neither imports nor exports are the perfect substitutes for domestic goods. The model predicts that imperfect substitutability between domestic and foreign goods allows domestic and export prices to differ from one another. Keeping this in view, the export supply function is derived in this study from the assumption of profit maximization on the part of the producer. First, the producers in the exporting country have the choice to either exporting or selling domestically. However, the export's decision of firms mainly depends upon the price differentials between domestic and foreign goods. For example, if the export price for given goods is different from domestic price, it would change the

relative profitability of either exporting or selling domestically. Therefore, the relative price (the ratio of export price to domestic prices) included in the export supply function as an explanatory variable in order to capture the effect of price differential on the growth of various export categories. The model embodies the hypothesis that if the export price for domestically produced goods in the international market is higher than the domestic price; will increase the relative profitability of producing exportable goods, and firms have an incentive to shift the resources from non-traded sector to exportable production, which in turn would enhance the amount of exports of the country, hence, a positive estimate for the coefficient of relative price is expected. A large number of empirical studies, including Goldstein and Khan (1978, 1985), Balassa et al. (1989), Muscatelli et al. (1995), Ahmed (2000), Havrila and Gunawardana (2006), Jongwanich (2010), Basarac-Sertic et al. (2015) and many others have documented a significant positive impact of relative price on export performance for various countries. The additional assumption is made that a small open economy hypothesis holds for Pakistan implying that producers are a price taker in the export markets; therefore, the value of the relative price variable is determined outside the system.

Second, the model assumed that the variation in production costs or factor cost also influence the profitability of producing export goods. Economic theory assumes that the factor cost have inversely associated with the export volume of an economy. That is, an increase in factor cost in export industries, for a given level of export price, would reduce the profitability of producing exportable goods, thereby inducing resources to shift from export production to the non-traded sector, which in turn will shrink the export volume of the country. On the other side, the lower factor cost could be an incentive for producers to produce tradable goods cheaply; it would tend to improve the competitiveness of domestic firms in export markets, which in turn boost the export volume of the economy (see Goldstein & Khan, 1985; Riedel, 1988). Much of empirical studies, including Riedel (1988), Atique and Ahmad (2003), Basarac-Sertic et al. (2015) and many others have also produced a significant negative impact of factor cost on export performance.

Moreover, the model posited that if the prices and cost remain constants, then the volume of exports may alter due to excess supply, which in turn depends on the country's production capacity. The basic argument of inclusion of the country's production capacity in the export supply function is that the producer's ability and willingness to supply exports will not be fully captured by the prices and cost but it will also rely on the production capacity of the country as a whole. In other words, secular trend in the level of aggregate real output caused by the improvement in the factor supplies, infrastructure and total factor productivities would also tend to boost the export supply at any given level of prices and cost (Goldstein & Khan, 1985). Therefore, a variable that represents the production capacity is included in the export supply model. A positive relationship between exports and production capacity is expected. That is, an increase in the level of the country's production capacity generates a surplus; hence, such surplus can be exported abroad and would increase the export volume of the country. A considerable body of empirical literature, including Goldstein and Khan (1978), Yang (1978), Arize (1987, 1990), Ahmed (2000), Atique and Ahmad (2003), Chan and Au (2007), Jongwanich (2010), Anas et al. (2011) and many others reported that production capacity (represented the country's real GDP/trend value of domestic production) has a strong positive influence on export growth across the globe.

Several economists argued that variation in the domestic demand may have direct effects on export growth by affecting the availability of goods for exports, and these effects are not fully captured by changes in the relative prices (see Artus, 1973; Rahmaddi & Ichihashi, 2012; Zilberfarb, 1980). Therefore, a variable that represents the domestic demand pressure included in export supply function to capture the effects of domestic demand pressure on export supply. The model hypothesized that the higher domestic demand pressure is associated with decreases in export volume. There are so many macroeconomic explanations for a negative relationship between domestic demand pressure and export quantities. One possible explanation is from the demand side when domestic demand is booming; it would increase the price level in the local



markets. The consequent higher domestic prices would increase the profit margin in the domestic market relative to export markets. Hence, the productive resources are then transferred into the production of non-traded goods from exportable production.

There is also an explanation from the supply side. When there is high domestic demand pressure, the firms will work at full capacity and will not be able to allocate resources to the export sector. On the contrary, when there is fall in domestic demand pressure, the firms will be able to devote more resources to the export sector. A considerable number of empirical studies focusing on the effects of domestic demand pressure on export performance, including Zilberfarb (1980), Riedel et al. (1984), Faini (1994), Sharma (2003), Rahmaddi and Ichihashi (2012), Esteves and Rua (2015), Bobeica et al. (2016) and many others have also documented a significant negative effect of domestic demand pressure on export growth for various countries.

In the extant literature, there are still controversial views on the selection of an appropriate functional form of export supply model. Generally, a log-log model is preferred due to interpretation and its superior fit. Therefore, all variables in equation (1) are logarithmically transformed and re-written the equation (1) econometrically for estimation purpose as follows:

$$\ln X_{sit} = \alpha_0 + \alpha_1 \ln RP_{it} + \alpha_2 \ln CoP_{it} + \alpha_3 \ln PC_{it} + \alpha_4 \ln DDP_{it} + \mu_{it} \quad (2)$$

Where,  $i$  represents the export supply of  $i^{th}$  industry,  $t$  is the time period,  $\ln$  is the natural log,  $\mu$  is the error term which is independently and identically distributed with mean zero and constant variance, and  $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4$  are unknown parameters to be estimated. In equation (2) each variable is expressed in logarithmic terms; therefore, the estimated coefficients are the relevant elasticities of export supply with respect to corresponding variables. The hypothesized signs of the elasticities are  $\alpha_1 > 0, \alpha_2 < 0, \alpha_3 > 0$  and  $\alpha_4 < 0$ .

Finally, the disequilibrium model is estimated by including the lagged dependent variable in the model. The rationale for including the lagged dependent variable as an explanatory variable is that time lag involved in adjustment of export supply to changes in independent variables.

### 3.2. Analytical framework

The literature identifies so many techniques including ordinary least squares method, two-stage least squares methods, generalized method of moments and cointegration technique that are utilized for the estimation of export demand and supply functions in various research studies. Recently, most of the researchers like Ahmed (2000), Hossain (2009), Jongwanich (2010), Anas et al. (2011), and Esteves and Rua (2015) emphasized the use of cointegration technique for estimation of export demand and supply functions in order to avoid the endogeneity and spurious regression problems. Keeping in view these problems, the current study uses the autoregressive distributed lag (ARDL) model (Pesaran, Shin, & Smith, 2001) to estimate export supply function for Pakistan. The rationale of using ARDL model instead of Engel and Granger (1987) and Johansen (1991) tests for cointegration is that ARDL has advantages over the other two techniques. First, ARDL is the most reliable and suitable model in the case of small sample size. Secondly, the ARDL can be employed, whether the underlying series are  $I(1), I(0)$  or mixed order. The specification of an unrestricted ECM-ARDL model for the export supply function is obtained by transforming the equation (2) as follows:

$$\Delta \ln X_{sit} = \alpha_0 + \sum_{i=0}^a \alpha_{1i} \Delta \ln RP_{t-i} + \sum_{i=0}^b \alpha_{2i} \Delta \ln CoP_{t-i} + \sum_{i=0}^c \alpha_{3i} \Delta \ln PC_{t-i} + \sum_{i=0}^d \alpha_{4i} \Delta \ln DDP_{t-i} + \sum_{i=1}^e \alpha_{5i} \Delta \ln X_{sit-i} + \varphi_1 \ln RP_{t-1} + \varphi_2 \ln CoP_{t-1} + \varphi_3 \ln PC_{t-1} + \varphi_4 \ln DDP_{t-1} + \varphi_5 \ln X_{sit-1} + \varepsilon_t \quad (3)$$

Where  $\Delta$  represents the first difference for all variables,  $i$  the number of lag and  $t-1$  is the level lag of variables. The study utilizes the bound test to know the cointegration. Hence,  $\alpha_1, \alpha_2, \alpha_3, \alpha_4,$  and  $\alpha_5$  are coefficients of short-run estimation and  $\varphi_1, \varphi_2, \varphi_3, \varphi_4,$  and  $\varphi_5$  are coefficients of long-run estimation. The  $(a, b, c, d$  and  $e)$  are the number of lags used for each variable. In order to determine the appropriate lag length for each variable, Akaike's Information Criterion (AIC) and

other diagnostic tests have been employed. After identifying the appropriate lag length, the specification is tested for the presence of cointegrating relationship by utilizing bound testing approach. Under the Wald test, the null and alternative hypotheses are:

$$H_0 : \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5 = 0 \text{ (No Co-integration)}$$

$$H_a : \varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4 \neq \varphi_5 \neq 0 \text{ (Co-integration)}$$

In case of evidence in favor of cointegration, the next step is to estimate the long-run effects which can be extracted from the reduce form solution of the unrestricted ECM-ARDL model (3), when  $\Delta X_{Si,t} = \Delta RP_t = \Delta CoP_t = \Delta PC_t = \Delta DD_t = 0$ . The long-run coefficients “normalized by the lagged exports” from model (3) for relative price, cost of production, production capacity and domestic demand pressure can be obtained as  $-\left(\frac{\varphi_1}{\varphi_5}\right)$ ,  $-\left(\frac{\varphi_2}{\varphi_5}\right)$ ,  $-\left(\frac{\varphi_3}{\varphi_5}\right)$  and  $-\left(\frac{\varphi_4}{\varphi_5}\right)$  respectively.

Lastly, the short-run effects are captured by estimating the restricted ECM-ARDL model derived from the conditional ARDL-ECM through a simple linear transformation. The restricted ARDL-ECM model consist of the difference of variables and error correction term. The error correction term (ECT) is obtained by estimating the long-run level model using OLS for each export category. The restricted ECM-ARDL model is written as follows:

$$\Delta \ln X_{Si,t} = \alpha_0 + \sum_{i=0}^a \alpha_{1i} \Delta \ln RP_{t-i} + \sum_{i=0}^b \alpha_{2i} \Delta \ln CoP_{t-i} + \sum_{i=0}^c \alpha_{3i} \Delta \ln PC_{t-i} + \sum_{i=0}^d \alpha_{4i} \Delta \ln DD_{t-i} + \sum_{i=1}^e \alpha_{5i} \Delta \ln X_{Si,t-i} + \gamma ECT_{t-1} + \varepsilon_t \quad (4)$$

Where  $ECT_{t-1}$  is the lagged residual series from the long-run “level model” and  $\Delta$  is the first difference operator.  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ , and  $\alpha_4$  are the short-term elasticities, and  $\gamma$  is an adjustment coefficient. The  $\gamma$  indicates the speed and direction of change toward equilibrium in the long-run. The expected value of the adjustment coefficient should be negative and statistically significant. Finally, verifying the validity of classical assumption of residual, the study has been applied the normality test, Serial correlation LM test, ARCH test for heteroscedasticity and Ramsay’s Reset test.

### 3.3. Data and measurement of variables

The study uses annual time series data over the time period of 1971 to 2014. All variables are in Pak Rupee (PKR) with year 2000 = 100. Data for all variables are taken from the International Financial Statistics yearbooks [various years], Federal Bureau of Statistic of Pakistan [various issues] and the Economic Survey of Pakistan. This data is further used for the estimation of different variables.

Many studies have used the real value of exports as a quantity of export supply; hence, following the extant literature, the present study also uses the current value of aggregate and disaggregated exports in PKR deflated by the export unit value index of Pakistan, to measure the quantity of export supply of various categories. However, the disaggregated exports, including primary, manufactured, etc., were deflated by the same category of export unit value index of Pakistan. Relative price is obtained by dividing the export unit value index of Pakistan to the wholesale price index of Pakistan; whereas, the relative price for primary and manufactured export categories is calculated by dividing the export unit value index of a specific category to the same category of the wholesale price index. There are so many proxies like real wages, labor unit cost, producer price, etc., are used to measure the cost of production in the extant literature. Following the previous studies, including Abolagba et al. (2010) and David (2013), this study used producer price index as a proxy for the cost of production. Pakistan is among the countries which can not report the production capacity data directly. Therefore, trend real GDP of Pakistan is used to represent the production capacity and changes in productivities. However, for disaggregated exports, production capacity is proxy by trend value of sector-wise GDP or trend value of domestic production of a specific category. A vast literature, including Zilberfarb (1980), Dunlevy (1980), Haynes and Stone

(1983), Arize (1987), Goldar (1989), Edwards and Alves (2006), Rahmaddi and Ichihashi (2012) and at a more practical level Bobeica et al. (2016) have used deviation from the trend income/GDP as a proxy to measure the domestic demand pressure. Following the extant literature, the present study measures domestic demand pressure by taking the ratio<sup>2</sup> of real GDP to trend real GDP,<sup>3</sup> where later captures the long-term performance of the economy and former reflects the influence of the short-term factors. For disaggregated export categories, the domestic demand pressure is measured by the ratio of sector-wise GDP or the domestic production of a specific category to its trend value.

#### 4. Results and discussion

In the time-series framework, it is crucial to test the order of integration of concerned variables. For this purpose, this study utilizes the Augmented Dickey-Fuller and DF-GSL tests for the presence of a unit root in the individual time series. The results of each variable, whether it is integrated of order zero or one, are reported in Table A1 in the Appendix. According to Table A1, the test statistic values of both tests indicate that all variables are non-stationary in level, except the relative price of various groups and readymade garment exports. However, after taking the first difference of the variables, the null hypothesis of unit root is rejected for both ADF and DF-GSL tests at 1% level of significance. These results signify that almost all relative price variables and readymade garments exports are stationary in level and integrated of order zero  $I(0)$  while all other variables are stationary in the first difference and integrated of order one  $I(1)$ . This gives a good justification to apply the bound testing approach or unrestricted ARDL-ECM. Under such methodology, there is no restriction on the order of integration of regressors, as it should be  $I(1)$  or  $I(0)$  or mixed order.

##### 4.1. Cointegration results

Akaike information criteria (AIC) and other diagnostic tests have been utilized to determine an appropriate lag length and accurate specification of the ARDL model. Different lags length for each variable and the ARDL in the different specification was selected across the various export categories in accordance with general-to-specific methodology (Hendry, 1995). After selection of the best-fit model, Wald test has been employed for the identification of cointegrating relationship among the examined variables. The results of bound testing for each estimated equation are reported in Tables 1 and 2. In all cases, except gaur and products exports, the computed F-statistic value of Wald test is greater than the upper bound critical value  $I(1)$  of Pesaran et al. (2001) at a reasonable level of significance. These results confirm the existence of a cointegrating relationship among various factors of export supply across aggregate, as well as disaggregated export categories. The F-statistic value of guar and guar products exports lying between upper and lower bound critical values; hence, the decision about the cointegration relationship between guar and products export supply and examined variables is inconclusive. Moreover, the results of several diagnostic tests reported with the corresponding equation in Tables 2 and 3 are also up to the mark, and residual of each equation satisfies the classical assumptions. Based on this finding, the next step is to proceed to determine the long- and short-run dynamics.

##### 4.2. Long- and short-run dynamics for primary export categories

The results of long- and short-run effects of various export supply-side factors on aggregate and primary export categories are reported in Tables 3 and 4 together with the lag structure of ARDL. This lag specification of ARDL is the same as used for bound testing/Wald test by confirming the cointegration relationship, which is selected after ensuring that residual of each equation satisfies the classical assumptions. The long-run estimates show that aggregate export supply is highly elastic to changes in relative price and production capacity; while, inelastic to changes in the cost of production and domestic demand as the long-run elasticities of the cost of production (-0.42) and domestic demand (-0.86) are significantly less than unity. When aggregate exports are disaggregated into several primary and manufactured export categories, however, the long-run elasticities of various supply-side factors vary considerably in terms of magnitude and signs across the sub-categories of primary and manufactured exports. It implies that the effects of supply-side factor are not the same across the sub-categories of primary and manufactured exports.

**Table 1. Results of cointegration for primary export categories**

Export Category	Wald test		Model Diagnostic Tests		
	F-Statistic	Normality J-B ( $\chi^2$ )	Heteroscedasticity ARCH (F)	RESET (F)	Autocorrelation LM (F)
Aggregate Exports	13.43*	1.56 [0.46]	1.44 [0.20]	0.14 [0.71]	0.58 [0.45]
Total Primary	8.90*	1.97 [0.37]	1.13 [0.37]	0.30 [0.58]	0.13 [0.85]
Fish	6.24*	0.45 [0.79]	1.49 [0.21]	2.30 [0.12]	1.51 [0.23]
Rice	3.42***	0.03 [0.98]	1.37 [0.24]	0.32 [0.58]	0.81 [0.45]
Fruits	6.55*	4.38 [0.11]	1.19 [0.33]	0.05 [0.83]	1.61 [0.21]
Raw Wool	4.22**	1.79 [0.40]	0.73 [0.71]	0.30 [0.58]	0.05 [0.94]
Raw Cotton	5.52*	5.68 [0.05]	0.81 [0.63]	0.18 [0.67]	0.57 [0.57]
Cotton Waste	4.06**	1.00 [0.60]	1.00 [0.47]	2.43 [0.13]	0.05 [0.94]
Guar & Guar- Products	2.89	0.97 [0.60]	1.14 [0.36]	3.10 [0.09]	0.61 [0.44]
Raw Tobacco & Products	3.96**	9.22 [0.01]	1.03 [0.44]	2.84 [0.10]	0.28 [0.78]

Notes: Asymptotic critical values of Pesaran et al. (2001), upper bound and lower bound for the Wald test at 1%, 5%, and 10% significance level are (4.68, 3.41), (3.79, 2.62) and (3.35, 2.26), respectively. The superscript \*, \*\*, and \*\*\* represents the F-statistic value of the Wald test for the specific equation is greater than the upper critical value I(1) of Pesaran et al. (2001) at 1%, 5% and 10% level of significance.

**Table 2. Results of cointegration for manufactured export categories**

Export Category	Wald Test			Model Diagnostic Tests		
	F-Statistic	Normality J-B ( $\chi^2$ )	Heteroscedasticity ARCH (F)	RESET (F)	Autocorrelation LM (F)	
Total Manufactured	6.48*	0.71 [0.70]	1.74 [0.11]	0.22 [0.64]	0.77 [0.48]	
Leather	6.50*	0.23 [0.89]	1.45 [0.20]	1.63 [0.21]	0.43 [0.65]	
Cotton Yarn	3.42***	0.01 [0.99]	1.39 [0.22]	0.03 [0.95]	0.20 [0.82]	
Synthetic Textiles	4.37**	0.13 [0.94]	0.68 [0.76]	1.60 [0.22]	0.53 [0.59]	
Cotton Cloth	5.49*	2.14 [0.34]	0.97 [0.50]	0.15 [0.70]	1.19 [0.32]	
Readymade Garments	4.43**	3.02 [0.22]	0.79 [0.46]	2.76 [0.11]	1.57 [0.23]	
Carpets & Rugs	4.51**	2.70 [0.26]	0.74 [0.71]	1.16 [0.29]	1.92 [0.17]	
Footwear	6.92*	1.01 [0.62]	0.85 [0.62]	2.40 [0.13]	0.50 [0.61]	
Petroleum & Products	5.25*	82.23[0.00]	0.78 [0.68]	0.92 [0.35]	0.79 [0.47]	
Sports Goods	5.34*	0.13 [0.94]	1.64 [0.14]	1.49 [0.15]	1.56 [0.23]	
Surgical Instruments	3.54***	0.62 [0.73]	0.68 [0.74]	0.00 [0.96]	1.65 [0.21]	
Drugs & Chemicals	7.57*	0.55 [0.76]	1.24 [0.31]	0.94 [0.36]	0.80 [0.46]	
Paints & Varnishes	4.04**	0.06 [0.97]	0.59 [0.86]	1.83 [0.19]	0.04 [0.84]	

Notes: Asymptotic critical values of Pesaran et al. (2001), upper bound and lower bound for the Wald test at 1%, 5%, and 10% significance level are (4.68, 3.41), (3.79, 2.62) and (3.35, 2.26), respectively. The superscript \*, \*\* and \*\*\* represents the F-statistic value of the Wald test for the specific equation is greater than the upper critical value I(1) of Pesaran et al. (2001) at 1%, 5% and 10% level of significance.

**Table 3. Long-run elasticities for primary export categories**

Export Category/ARDL Lag Specification	Intercept	RP	CoP	PC	DDP	R-Square	F-Statistic
Aggregate Exports (1,1,1,1)	-14.89* (-4.11)	1.22* (4.06)	-0.42** (-2.31)	2.18* (4.59)	-0.86* (-3.52)	0.87	15.73 [0.00]
Primary Exports (2,1,1,1)	-9.17** (-2.47)	1.11* (5.25)	0.14* (2.05)	1.32* (4.58)	-1.49*** (-1.83)	0.66	5.04 [0.00]
Fish & Fish Preparation (2,2,1,2,2)	-29.05* (-3.767)	-0.32 (-1.51)	-0.671** (-2.62)	2.62* (3.74)	-0.99* (-3.42)	0.71	5.15 [0.00]
Rice (2,2,2,1,1)	-9.61** (-2.37)	0.38 (0.50)	0.064 (0.36)	2.01* (2.97)	4.10** (2.69)	0.52	2.53 [0.02]
Fruits (2,1,2,2,1)	-15.34** (-2.33)	1.15* (4.11)	1.56* (3.95)	1.11** (2.07)	-1.41*** (-1.95)	0.76	6.45 (0.00)
Raw Wool (2,3,2,2,3)	10.50** (2.35)	-2.42 (-1.26)	1.53** (2.29)	-2.95** (-2.57)	-5.76*** (1.69)	0.56	2.50 [0.02]
Raw Cotton (2,2,2,2,3)	-21.65** (-2.05)	6.32** (2.29)	0.82*** (1.92)	2.15** (2.48)	-5.90*** (-1.75)	0.62	3.21 [0.01]
Cotton Waste (2,1,1,2,2)	-44.70* (-2.79)	6.07** (2.38)	-4.59*** (-1.93)	11.69** (2.67)	-10.50** (-2.58)	0.56	3.01 [0.01]
Guar & Guar Products (2,1,1,1,2)	7.68*** (1.72)	0.978 (1.32)	0.43** (2.05)	-0.492 (-1.48)	-2.58*** (-2.01)	0.43	2.36 [0.03]
Raw Tobacco & Products (1,0,2,2,2)	-10.54** (-2.21)	0.91** (2.15)	-0.34*** (-1.86)	1.18* (3.19)	5.63* (3.05)	0.64	4.71 [0.00]

Notes: The values in parentheses () and [] for all equations are t-statistics values and F-statistics probability values respectively. Whereas \*, \*\* and \*\*\* represents 1%, 5% and 10% level of significance respectively. In the first column, the numeric values in parentheses () are the number of lags of each variable.

**Table 4. Short-run elasticities for primary export categories**

Export Category ARDL lag Specification	Intercept	RP	CoP	PC	DDP	ECT(-1)	R <sup>2</sup>	F-Statistic
Aggregate Exports (1,1,1,1,1)	-0.05 (-1.41)	0.571* (4.48)	0.250 (1.00)	1.40*** (1.89)	-1.71* (-4.48)	-0.89* (-6.27)	0.83	19.73 [0.00]
Primary Exports (2,1,1,1,1)	-0.10 (-1.34)	0.41*** (1.93)	-0.05 (-1.47)	2.49*** (1.70)	-2.23** (-2.89)	-0.80* (-5.65)	0.60	8.73 [0.00]
Fish (2,2,1,2,2)	0.04 (0.52)	-0.17 (-1.00)	-0.43 (-0.97)	1.06 (0.79)	-1.05*** (-1.72)	0.570* (-3.400)	0.57	4.52 [0.00]
Rice (2,2,1,1)	0.070 (0.67)	0.54*** (1.82)	0.050 (0.90)	0.94 (1.47)	-1.18* (-3.13)	-0.34* (-3.13)	0.54	6.77 [0.00]
Fruits (2,1,2,2,1)	0.458* (3.04)	0.091 (0.32)	-1.20 (-1.59)	3.829 (0.72)	-3.595 (-0.71)	-0.88* (-5.52)	0.62	6.52 [0.00]
Raw Wool (2,3,2,2,3)	-0.51** (-2.05)	-0.51 (-1.02)	-0.06 (0.57)	11.13** (2.25)	-8.31** (-2.44)	-0.38* (-3.01)	0.42	2.17 [0.06]
Raw Cotton (2,2,2,2,1)	-0.35 (-0.77)	1.631 (1.54)	0.584** (2.26)	9.907 (1.12)	-12.5*** (-1.69)	-0.62* (-4.06)	0.55	4.86 [0.00]
Cotton Waste (2,1,1,2,2)	0.66** (2.63)	0.503 (1.284)	-3.19** (-2.46)	-6.82 (-1.57)	-3.71*** (-1.76)	-0.33* (-3.18)	0.40	3.17 [0.01]
Guar & Guar Products (2,1,1,1,2)	0.169 (0.93)	-0.478 (-1.41)	0.11 (1.46)	-4.37 (-1.23)	-2.09 (-1.20)	-0.58* (-3.75)	0.39	3.66 [0.00]
Raw Tobacco & Products (1,0,2,2,2)	0.040 (0.13)	1.62* (3.43)	-0.058 (-0.47)	2.631 (0.57)	-2.08*** (-1.84)	-0.47* (-2.88)	0.52	5.14 [0.00]

Notes: The values in parentheses () and [] for all equations are t-statistics values and F-statistics probability values respectively. Whereas \*, \*\* and \*\*\* represents 1%, 5% and 10% level of significance respectively. In the first column, the numeric values in parentheses () are the number of lags of each variable.

For total primary exports, using a reasonable level of significance, the coefficients of all variables are statistically significant and have expected signs, except the cost of production. However, export supply of primary goods is highly responsive to changes in relative price, production capacity, and the domestic demand pressure; while, it is inelastic with respect to changes in the cost of production. These results are generally in contradiction to the findings of previous studies, like Afzal (2005) for Pakistan, who obtained the relative price elasticity of primary export supply, less than unity and insignificant. Results further indicate that among all factors, the production capacity and domestic demand pressure have a greater effect on the export supply of total primary exports as the estimated coefficients of production capacity (1.32) and domestic demand pressure (-1.49) are much higher as compared to relative price and cost variables. This signifies that the export supply of total primary export is chiefly determined by the domestic demand and production capacity in the case of Pakistan. Moreover, the results show that the export supply of all food items, except fruits, is less responsive to changes in relative price in the long-run as the relative price elasticity for these export categories is less than unity and statistically insignificant. These results are generally consistent with the economic theory, which claimed that basic necessity goods like food items, etc., are normally inelastic with respect to changes in prices. On the contrary, the long-run relative price elasticities of raw material exports, including raw cotton and cotton waste, and tobacco raw and products have expected signs and statistically significant with a magnitude greater than and close to unity. It indicates that the export supply of raw materials is relative price elastic in the long-run in Pakistan's case.

As can be seen from Table 3, the cost of production (measured by the producer price index) has mixed signs for sub-categories of primary exports in the long-run. It has a significant negative effect on export supply of fish and fish preparation, and cotton waste only, while in the case of all other sub-categories of primary exports, the cost of production has a significant positive effect on export growth, except rice. These results are generally consistent with the findings of previous studies. For instance, David (2013) obtained the significant positive impact of producer price on export performance of cocoa bean products in Ghana. Abolagba et al. (2010) also reported a significant positive effect of producer price on rubber exports for Nigeria. In addition, the results show that the elasticities of producer price index for 6 of the 9 sub-categories of primary exports are less than unity. These results signify that cost of production has a smaller effect on the export supply of various types of primary exports in the case of Pakistan.

Additionally, the results in Table 3 clarify that the coefficients of production capacity have expected signs with magnitude greater than unity for all sub-categories of primary exports, except raw wool and guar and guar-products. These results imply that export supply of almost all sub-categories of primary exports is highly responsive to changes in production capacity in the long-run. These results are generally consistent with the findings of Haleem et al. (2005), they reported a significant positive effect of domestic economic activities (represent by real GDP) on the export performance of citrus fruits for Pakistan. Recently, Ghafoor et al. (2013) obtained the production capacity elasticity of export supply of mango, more than unity for Pakistan. The stronger and significant impact of the production capacity shows the importance of primary products, especially agricultural products like rice, raw cotton, fruits, etc., in the economy of Pakistan. With the rise of the robustness of the economy, there is more importance given on the exports of these categories to earn more foreign exchange through different incentives.

Furthermore, the long-run estimates confirm that export supply of all sub-categories of primary goods is highly elastic with respect to domestic demand pressure as the obtained domestic demand pressure elasticities of export supply are significantly greater than unity for all sub-categories of primary goods. However, the domestic demand pressure hypothesis is invalid in the case of export supply of tobacco raw and products, and rice. It has a positive effect on the growth of these two exports categories. In all other cases, the domestic demand pressure has a significant negative impact on the growth of sub-categories of primary exports. Overall, the results indicate that the production capacity and domestic demand pressure elasticities are



relatively high as compared to prices and cost in most cases, implying that Pakistan's primary exports depend largely on the production capacity and domestic demand conditions.

The short-run dynamics presented in Table 4 show that lagged error correction terms for all sub-categories of primary export equations are negative and highly significant. This implies that disequilibrium arises from external shocks, which is corrected or it returns to equilibrium in the upcoming period. However, the coefficients of adjustment are varied across the sub-categories of primary export. This signifies that the speed of adjustment toward equilibrium is significantly different across the sub-categories of primary exports. The findings further indicate that the coefficients of relative price have unexpected signs for 3 of the 9 sub-categories of primary exports, namely; fish, guar and guar products, and raw wool in the short-run but statistically insignificant. In all other cases, the coefficients of relative price are positive. However, only export supply of raw cotton, and tobacco raw and products is relative price elastic as the magnitude of price elasticities of export supply for these two categories exceeds the unity, while the degree of relative price elasticities for other sub-categories of primary exports is either less than unity or statistically insignificant. Similarly, the coefficients of the cost of production are statistically significant for only cotton waste and raw cotton exports in the short-run. However, it has a negative effect on cotton waste exports, while a positive influence on raw cotton exports. For all other sub-categories of primary exports the coefficients of cost of production are statistically insignificant, with a mix of negative and positive signs. More interestingly, the coefficients of production capacity are found to be statistically significant in the case of total primary and raw wool exports only, while in the case of all other sub-categories of primary exports, it is statistically insignificant. However, the production capacity has a negative impact on the growth of cotton waste, and guar and guar products exports, while in all other cases, the coefficients of production capacity are positive. Furthermore, the short-run estimates in Table 4 explicate that the coefficients of domestic demand pressure are negative and highly significant for almost all sub-categories of primary exports, indicating that domestic demand pressure hypothesis is relevant for modeling export supply of all sub-categories of primary exports in the short-run. Overall, the short-run estimates for sub-categories of primary exports clarify that the coefficients of domestic demand pressure are much greater in magnitude and significant as compared to other factors of export supply almost in all cases, implying that domestic demand pressure has appeared as a major determinant of export performance of all sub-categories of primary exports in the short-run in Pakistan's case.

### **5. Long- and short-run dynamics for manufactured export categories**

The long- and short-run estimates for manufactured and sub-categories of manufactured exports are reported in Tables 5 and 6. The lag structure of ARDL is the same as used for bound testing, which is selected after ensuring that residual of each equation satisfies the classical assumptions. The coefficients of all variable have expected signs for manufactured exports and the same holds true for all sub-categories of manufactured exports, except cost of production for leather, paints and varnishes exports, and synthetic textile, relative price for footwear and synthetic textile exports, and domestic demand pressure for petroleum products, leather and drugs, and chemical exports. However, the degree of the elasticities varies considerably across the sub-categories of manufactured exports. The long-run results in Table 5 show that the estimated elasticities of relative price, cost of production, production capacity and domestic demand pressure for manufactured exports are statistically significant with magnitude greater than unity, indicating that the export supply of manufactured goods is highly elastic to changes in prices, cost, production capacity and domestic demand pressure in the long-run. These results are generally consistent with the findings of previous studies. For example, Faini (1994) obtained the statistically significant effects of relative price, production capacity and capacity utilization on total manufactured exports for Morocco and Turkey. Afzal (2005) obtained domestic production elasticity of export supply of manufactured goods more than unity for Pakistan. Finally, Basarac-Sertic et al. (2015) obtained the production capacity and domestic demand elasticities of export supply of manufactured goods more than unity and statistically significant for 27 European Union member countries.

**Table 5. Long-run elasticities for manufactured export categories**

Export Categories ARDL lag Specification	Intercept	RP	CoP	PC	DDP	R-Square	F-Statistic
Total Manufactured (2,1,2,3,2)	-11.13** (-2.50)	1.84*** (1.75)	-1.08** (-2.30)	3.05* (2.87)	-1.64*** (-1.96)	0.704	4.75 [0.00]
Leather (1,2,2,1,2)	-2.56 (-0.82)	2.30*** (1.97)	0.173 (1.23)	0.98*** (2.04)	2.56** (2.45)	0.717	4.71 [0.00]
Cotton Yarn (1,1,2,2,2)	-23.19** (-2.89)	0.93 (0.94)	-1.46** (-2.22)	4.04* (2.94)	-3.03** (-2.11)	0.541	4.07 [0.00]
Synthetic Textiles (ARDL: 2,2,1,2,2)	-46.25* (-3.55)	-3.26 (-1.12)	0.51 (1.05)	4.14* (3.74)	-8.35** (-2.75)	0.532	2.26 [0.03]
Cotton Cloth (1,2,2,2,1)	-18.04* (-3.22)	1.45* (3.41)	-0.38*** (-1.77)	2.25* (3.47)	-1.90** (-2.07)	0.80	8.08 (0.00)
Readymade Garments (2,2,1,2,2)	-51.84** (-2.59)	5.41** (2.53)	-3.40** (-2.46)	7.64** (2.65)	-4.89* (-2.98)	0.65	3.81 [0.00]
Carpets & Rugs (1,1,1,2,1)	-7.50** (-2.34)	6.17* (3.74)	-2.19* (-2.83)	2.49** (2.13)	-1.22 (-0.62)	0.65	4.38 [0.00]
Footwear (2,2,2,2,2)	-99.56* (-4.92)	-1.36 (-1.56)	-0.83** (-2.44)	7.27* (5.01)	-9.84* (-4.18)	0.74	4.85 [0.00]
Petroleum Products (2,1,2,2,2)	-53.51 (-1.65)	2.88** (2.73)	-2.78*** (-1.69)	5.36*** (1.87)	5.67** (2.14)	0.58	2.61 [0.02]
Sports Goods (2,1,2,1,1)	-24.49* (-3.61)	2.41*** (1.76)	-1.27*** (-1.92)	5.25* (3.60)	-8.01* (3.43)	0.60	3.55 [0.00]
Surgical Instrument (1,0,2,2,1)	-16.94** (-2.73)	0.35 (1.01)	-0.69*** (-1.90)	2.66* (3.00)	-1.05*** (-1.80)	0.52	2.891 [0.011]
Drugs & Chemicals (1,2,1,2,2)	-11.23* (-3.02)	4.31** (2.45)	-2.06* (-3.51)	5.23* (3.51)	5.49 (1.19)	0.67	4.67 [0.00]
Paints & Varnishes (2,2,1,2,1)	-188.72* (-3.30)	2.94* (3.81)	0.27 (0.19)	7.61** (2.16)	-9.43*** (-1.71)	0.59	2.39 [0.03]

Notes: The value in parentheses () and [] for all equations are t-statistics values and F-statistics probability values respectively. Whereas \* and \*\* and \*\*\* represent 1%, 5% and 10% level of significance respectively. In the first column, the numeric value in parentheses () is the number of lags of each variable. The long-run elasticities and value of R-square, etc., are obtained from the results for each equation reported in the appendix.

**Table 6. Short-run elasticities for manufactured export categories**

Export Category ARDL Lag Specification	Intercept	RP	CoP	PC	DDP	ECT(-1)	R <sup>2</sup>	F-Statistic
Total Manufactured (2,1,2,3,2)	0.084 (1.338)	0.67* (3.68)	-0.87** (-2.65)	2.55*** (1.71)	-2.02*** (-1.93)	-0.26** (-2.08)	0.72	10.80 [0.00]
Leather (1,2,2,1,2)	0.17*** (1.75)	0.30 (0.98)	0.05 (1.29)	9.21*** (1.71)	-8.61*** (-1.73)	-0.22*** (-1.73)	0.67	7.042 [0.00]
Cotton Yarn (1,1,2,2,2)	0.031 (0.24)	0.169 (0.44)	-0.93 (-1.39)	2.43 (1.06)	-0.86 (-0.52)	-0.26*** (-1.98)	0.43	3.57 [0.01]
Synthetic Textiles (ARDL: 2,2,1,2,2)	0.67 (1.43)	0.47 (0.48)	-0.24 (-1.35)	2.61 (0.35)	-3.67 (-0.92)	-0.60* (-3.73)	0.38	2.46 [0.03]
Cotton Cloth (1,2,2,2,1)	0.18** (2.62)	0.39* (3.12)	-0.67*** (-1.99)	1.64*** (1.88)	-1.26*** (-1.70)	-0.33** (-2.3)	0.57	5.20 [0.00]
Readymade Garments (2,2,1,2,2)	-0.008 (-0.05)	0.75*** (1.80)	-2.56** (-2.56)	6.47** (2.36)	-1.01*** (-1.92)	-0.34** (-2.26)	0.49	5.56 [0.00]
Carpets & Rugs (1,1,1,2,1)	0.02 (0.02)	0.54** (2.40)	-1.14** (-2.13)	1.78 (1.20)	-1.07*** (-1.99)	-0.29** (-2.21)	0.53	6.51 [0.00]
Footwear (2,2,2,2,2)	0.22 (1.67)	0.26 (0.68)	-1.61** (-2.41)	1.32 (0.77)	-1.04*** (-1.91)	-0.31** (-2.38)	0.49	3.72 [0.00]
Petroleum Products (2,1,2,2,2)	0.05 (0.08)	1.72* (3.05)	-4.28*** (-1.761)	8.86** (2.01)	-6.12 (-1.05)	-0.87* (-4.82)	0.53	3.37 [0.01]
Sports Goods (2,1,2,1,1)	0.20 (2.26)	0.90* (4.43)	-0.89*** (-1.82)	-1.63 (-1.19)	-0.22 (-0.86)	-0.16** (-2.16)	0.52	6.39 [0.00]
Surgical Instrument (1,0,2,2,1)	0.13 (2.63)	0.47* (3.14)	-0.78** (-2.07)	0.59 (0.54)	-0.50*** (-1.73)	-0.60* (-4.20)	0.50	4.77 [0.00]
Drugs & Chemicals (1,2,1,2,2)	0.29 (2.33)	0.372 (0.98)	0.109 (1.55)	-2.46 (-1.05)	-1.06* (-2.85)	-0.14** (-2.33)	0.40	4.88 [0.00]
Paints & Varnishes (2,,2,1,2,1)	-0.14 (-0.32)	0.84 (1.03)	-2.89 (-1.30)	4.51 (0.71)	-5.43*** (-1.79)	-0.50* (-3.24)	0.45	2.29 [0.04]

Notes: The values in parentheses () and [] for all equations are t-statistics values and F-statistics probability values respectively. Whereas \*, \*\* and \*\*\* represents 1%, 5% and 10% level of significance respectively. In the first column, the numeric values in parentheses () are the number of lags of each variable.

Additionally, the long-run estimates clarify that coefficients of relative price are correctly signed and statistically significant in all cases of sub-categories of manufactured exports with few exceptions. However, the relative price has a large effect on the growth of high value-added manufactured exports as the price elasticities of export supply of high value-added goods including cotton cloth, readymade garments, sports goods, carpets, and rugs, etc., are noticeably greater than unity. These results are in agreement with Malik (2000)'s findings; who obtained price elasticity of export supply of textile and cloth more than unity and significant for Pakistan. Cameron and Khair-uz-Zaman (2006) also reported a statistically significant effect of relative price on the carpet and rugs exports for Pakistan.

Likewise, the coefficients of the cost of production have expected signs for 9 of the 12 sub-categories of manufactured exports in the long-run. However, elasticities of the cost of production are considerably more than unity and statistically significant for export supply of high value-added manufactured goods only. These results signify that prices and cost have emerged as significant determinants of export supply of high value-added goods only in the case of Pakistan.

Moreover, as can be seen from Table 5, the coefficients of production capacity are correctly signed with magnitude greater than unity and statistically significant for all sub-categories of manufactured exports in the long-run, indicating that the export supply of all types of manufactured goods is highly elastic to changes in production capacity. Similarly, the coefficients of domestic demand pressure are statistically significant with magnitude greater than unity for all sub-categories of manufactured exports, except the carpet and rugs, and drugs and chemical. However, the domestic demand pressure is invalid in the case of leather, drugs and chemical, and petroleum products exports. While in all other cases, the domestic demand pressure hypothesis is statistically relevant in the long-run for modeling export supply of sub-categories of manufactured goods in the case of Pakistan. In conclusion, the findings of the long-run dynamics confirm that almost all types of manufactured exports heavily rely on production capacity and domestic demand in Pakistan's case.

The short-run estimates reported in Table 6 indicate that lagged error correction terms are negative and statistically significant for all sub-categories of manufactured exports. This implies that disequilibrium arises from external shocks, which is corrected or it returns to equilibrium in the upcoming period. However, the speed of adjustment toward equilibrium is varied across the sub-categories of manufactured exports. In addition, the short-run estimates explicate that the coefficients of relative price are correctly signed in the case of all types of manufactured exports. However, the short-run relative price elasticities are less than unity for 12 of the 13 sub-categories of manufactured exports. For only 7 of the 13 categories, the relative price elasticities are statistically significant. These findings suggest that all the sub-categories of manufactured exports are relative-price inelastic in the short-run. Similarly, the coefficient of cost of production are negative and statistically significant for 10 of the 13 sub-categories of manufactured exports. However, the short-run elasticities of cost of production significantly greater than unity for readymade garments, rugs and carpets, footwear and petroleum products exports only. It implies that export supply of only high-value-added manufacturing goods is highly responsive to changes in cost of production in the short-run.

More interestingly, the coefficients of production capacity are correctly signed for all sub-categories of manufactured exports, but statistically significant for only 5 export categories. It implies that production capacity has not emerged as a significant determinant of the various types of manufactured exports in the short-run. Furthermore, the short-run estimates confirm that the coefficients of domestic demand pressure have expected signs in all cases of sub-categories of manufactured exports. However, it is statistically significant in 9 out of 13 cases. This validates that domestic demand development is relevant for modeling the short-run dynamics of various types of manufactured exports in Pakistan. In addition, the results also clarify that the coefficients of domestic demand pressure are much greater in magnitude compared to prices, cost, and

production capacity in the short-run almost in all cases, implying that the export supply of various types of manufactured goods heavily depends on the domestic demand in the short-run in Pakistan's case.

To sum up, the estimated results statistically supported the main argument of the study that various supply-side factors affected the export growth differently across the export categories. However, the relative price have a larger impact on the export supply of raw material and high value-added manufactured goods only. Similarly, the cost of production has higher effects on the growth of value-added manufactured and cotton waste exports only. Production capacity and domestic demand have a substantial influence on the export supply of almost all types of manufactured and primary goods. Lastly, the results also verified that domestic demand pressure hypothesis is relevant for modeling the export performance of Pakistan at a disaggregated level.

## 6. Conclusion

This study is an attempt to investigate the impact of supply-side factors on export performance of Pakistan at a disaggregated level by covering the period from 1971 to 2014. The main purpose of the study is to discover the role of prices, cost, production capacity, and domestic demand pressure in the development of export supply from Pakistan. In order to achieve the objective of the study, autoregressive distributed lag (ARDL) model (bound testing approach) has been employed. The empirical results based on the bound testing approach showed a cointegrating relationship among aggregate exports, disaggregated exports, and other important variables under study. In addition, the results confirm that aggregate exports are highly elastic to changes in prices and production capacity while inelastic to changes in the cost of production and domestic demand pressure. When aggregate exports are disaggregated into several primary and manufactured export categories, however, the long-run elasticities of various supply-side factors are varied noticeably in terms of magnitude and signs across the sub-categories of primary and manufactured exports. This implies that the effects of supply-side factor are not the same across the sub-categories of primary and manufactured exports.

The long-run estimates clarify that only raw materials and value-added manufactured exports are highly responsive to changes in relative price. Similarly, the cost of production has higher effects on the export supply of value-added manufactured and cotton waste exports only. Additionally, the findings of the long-run dynamics confirm that all sub-categories of primary exports, except raw wool, and gaur and guar products are highly elastic with respect to production capacity. Likewise, almost all sub-categories of primary exports are highly responsive to changes in domestic demand pressure in the long-run. However, the domestic demand pressure hypothesis is invalid in the case of rice, and raw tobacco and related products exports. In the case of sub-categories of manufactured exports, the export supply of all types of manufactured goods is highly elastic to changes in production capacity in the long-run. Similarly, all sub-categories of manufactured exports, except carpet and rugs, and drugs and chemical are highly responsive with respect to domestic demand pressure. However, the domestic demand pressure is invalid in the case of leather, drugs and chemical, and petroleum products exports. In conclusion, the long-run estimates suggest that almost all sub-categories of primary and manufactured exports heavily rely on production capacity and domestic demand in Pakistan's case. Moreover, the value-added manufactured exports are also significantly influenced by relative prices and the cost of production in the long-run.

The results of short-run dynamics clarify that relative price, cost of production, and production capacity have not emerged as significant factors for the growth of export supply of majority primary and manufactured products. As the export supply of all sub-categories of primary exports, except raw cotton, and raw tobacco is inelastic to changes in relative price. Similarly, export supply of all sub-categories of primary exports, except cotton waste and raw wool is inelastic to changes in production capacity and cost of production in the short-run. In addition, the short-run estimates confirm that export supply of all sub-categories of manufactured exports, except petroleum products is inelastic to changes in relative price in the short-run. Likewise, only a few sub-

categories of manufactured exports are highly responsive to changes in the cost of production and production capacity in the short-run. On the contrary, the domestic demand pressure hypothesis is valid almost in all cases of primary and manufactured export categories in the short-run. This implies that the export supply of almost all sub-categories of primary and manufactured exports significantly depends on the domestic demand pressure in the short-run in Pakistan's case.

The conclusion that emerges from this study is that major export categories respond differently to changes in various factors of export supply. Hence, it is suggested that the government must revisit the export policy and make the new policy in line with new sectoral realities in order to expand the export sector of the country, as well as to ensure the economic prosperity of the country on a sustainable basis. Since the prices and cost of production have a larger impact on the export supply of value-added manufactured goods. Thus, it is recommended that the government should provide an incentive to value-added manufactured goods exporters in order to expand the export sector of the country. Apart from this, the government should stabilize price ratio of inputs and industrial material around the level which would balance the production of value-added products. Furthermore, the export supply of almost all types of manufactured and primary goods, particularly food items, including rice, fruits, and fish, is chiefly determined by the production capacity and domestic demand pressure. Therefore, it is strongly suggested that provincial governments should provide special incentives to farmers in the pre-production stage to increase the output of the agricultural products and to generate the surplus for exports.

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#### correction

This article has been republished with minor changes. These changes do not impact the academic content of the article.

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#### Notes

1. A small country assumption holds in this case because According to International Financial Statistics (IFS, 2016), Pakistan's exports constitute a small share that is less than 1% of world exports for the period covered in this study 1971–2014. In econometric terms, this signifies that the estimation of export supply function is relatively free from the simultaneous-equation bias.
2. Dunlevy (1980), and Goldar (1989) have used the ratio of real income to trend real income to avoid the negative values in the case of taking the domestic demand pressure in logarithm.
3. Trend Level of Real GDP is obtained by fitting the linear time trend to the real GDP of Pakistan.

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## Appendices

**Table A1. Results of ADF\* and PP\* tests for Unit Root**

Variables in Natural log	Level of Variable		First difference		Conclusion
	ADF test	DF-GLS test	ADF test	DF-GLS test	
Aggregate Exports	-1.608	0.257	-9.521	-2.930	I(1)
Primary Exports	-0.958	-0.183	-6.648	-2.113	I(1)
Fish & Fish Preparation	-0.252	0.246	-5.333	-5.287	I(1)
Rice	-1.736	0.679	-6.038	-5.173	I(1)
Fruits	0.086	1.895	-9.099	-6.212	I(1)
Raw Wool	-2.175	-2.375	-5.066	-	I(0)
Raw Cotton	-2.348	-1.375	-10.842	-8.834	I(1)
Cotton Waste	-1.109	-0.987	-4.688	-5.313	I(1)
Guar and Guar Products	-2.097	-1.129	-8.394	-4.149	I(1)
Tabacco Raw & Products	-1.296	0.119	-10.351	-9.378	I(1)
Manufactured Exports	-2.164	0.279	-10.315	-5.785	I(1)
Leather	-1.44	0.696	-4.635	-4.743	I(1)
Cotton yarn	-0.785	-0.516	-6.576	-5.328	I(1)
Synthetic Textiles	-1.118	-0.292	-7.104	-6.169	I(1)
Cotton Cloth	-0.917	0.294	-6.836	-7.426	I(1)
Readymade Garments	-2.783	-0.458	-6.769	-6.537	I(1)
Carpets and Rugs	-2.284	-1.157	-3.84	-2.635	I(1)
Footwear	-1.825	-0.333	-4.727	-3.501	I(1)
Petroleum & Products	-2.58	-1.373	-8.197	-4.476	I(1)
Drugs & Chemicals	-0.537	1.570	-4.389	-5.701	I(1)
Surgical Instruments	-2.576	-0.191	-5.099	-4.560	I(1)
Sports Goods	-1.821	2.970	-6.058	-5.215	I(1)
Paints & Varnishes	-1.186	-1.259	-4.575	-4.571	I(1)
Producer Price Index	2.933	-0.065	-3.629	-3.462	I(1)
Relative Price Food	-4.107*	-1.648*	-	-	I(0)
Relative price General	-9.268*	-2.842*	-	-	I(0)
Relative Price of Beverage & Tobacco	-1.894	-1.603	-5.469	-5.422	I(1)
Relative Price Lubricants	-3.439*	-1.983*	-	-	I(0)
Relative Price Chemical	-1.842	-0.950	-5.253	-4.026	I(1)
Relative Price Manufactured	-5.040*	-2.067*	-	-	I(0)
Relative Price Textile	-5.778*	-1.962*	-	-	I(0)
Trend Real GDP	-2.092	0.116	-4.407	-3.805	I(1)
Trend GDP_Agricultural	-0.471	-0.457	-6.13	-6.136	I(1)
Trend GDP_Manufactured	-1.71	-1.699	-7.08	-7.156	I(1)
Ratio of RGDP to Trend RGDP	-2.55	-2.466	-15	-14.04	I(1)
Ratio of AG_GDP to Trend Value	-1.925	-1.567	-6.725	-5.467	I(1)
Ratio of MAN_GDP to Trend Value	-2.224	-2.452	-10.165	-10.518	I(1)

Notes: ADF (Augmented Dicky-Fuller) and DF-GLS (Dicky-Fuller)-GLS tests. Notes: The Null hypothesis is that the variable has a unit root. The Critical values of ADF at 1%, 5% and 10% level of significance are -3.59, -2.93 and 2.60 respectively. While the Critical values of DF-GLS at 1%, 5% and 10% level of significance are -2.62, 1.94 and 1.62 respectively. The superscript \* represent the variable stationary in level. The both tests performed without included trend.

**Table A2. Detail of abbreviation and data source for each variable**

Variables	Abbreviation and measurement of variables	Data source
PC	Production Capacity Trend Real GDP is used as a proxy to measure production capacity	Economics Survey of Pakistan Various Issues
RP	Relative Price Ratio of Unit Value of Export to Wholesale Price Index	Pakistan Bureau of Statistics
CoP	Cost of production, Producer Price Index is used as a proxy to measure cost of production	IMF (International Financial Statistics)
DDP	Domestic demand Pressure: Ratio of real GDP to trend Real GDP is used as a proxy to measure domestic demand pressure	-
X <sup>s</sup>	Export Supply. Current value of aggregate and disaggregated exports in Pak Rupee deflated by the export unit value index of Pakistan to measure the quantity of export supply for various categories	Economic survey of Pakistan Various Issues

Note: All variables are in Pak Rupee (PKR) with year 1999–2000 = 100



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