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Transportation infrastructure of Pakistan's agricultural export

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Pakistan has the highest potential for agri-business development and global marketing. This study responded to standing views about the importance of infrastructure for agricultural trade in Pakistan. It raises the concern to investigate the basic trade facilitation for the transportation of agricultural commodities. This research focuses on transport infrastructure being basic distribution drives. A gravity model is used for panel analysis of twenty countries for the period 2005 to 2015, to find the push and pull factors that contribute to agriculture exports of Pakistan. Fixed effects or random effects technique is employed based on the Hausman's test to investigate the effect of transport infrastructure (ports, air and road) on agricultural exports of Pakistan. Guided by results, it infers that improved ports facilitation can promote the agriculture sector of Pakistan as majority of trade activities are performed through ports because of their cost-effectiveness. Likewise, air network affects agricultural exports positively owing to the reduced time it takes for the air cargo to reach the destination country. Improved connectivity through roads is required to speed up the process across the regions effectively.

Key words: Infrastructure, Pakistan, agriculture exports, gravity model, panel analysis.

INTRODUCTION

The access to international markets is limited in developing countries owing to the poor infrastructure. The physical infrastructure and logistics such as roads, railways, air and sea cargo are considered essential to distribute goods worldwide. It boosts agricultural trade by reducing the transaction and distribution costs. In the global context, agricultural production in Pakistan is fairly decent despite the weaknesses in infrastructure (FAOSTAT, 2016). However, it does not hold strong position in world's agricultural trade. This study therefore, responded to standing views to explore the impact of infrastructure on agricultural exports of Pakistan which has highest potential for agri-business development and global marketing. The agricultural exports constitute 17% of total exports which consists of rice, citrus, mangoes, furniture, cotton fiber, clothing, textiles, sports goods, leather goods, rugs, carpets, chicken, livestock meat, wheat, powdered milk, seafood and fisheries at large (GoP, 2014). Figure 1 shows that the agricultural exports in Pakistan increased after 2006 as a result of the Free

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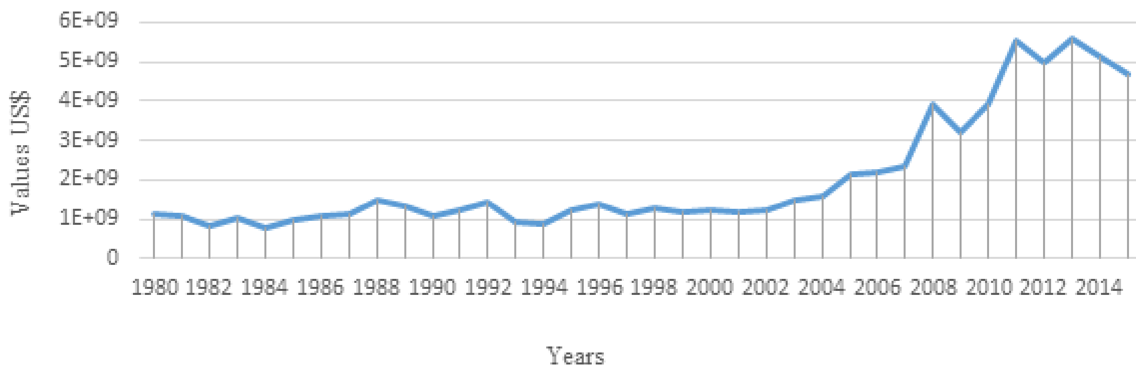

Figure 1. Pakistan agricultural exports.
Source: World Development Indicators (WDI, (2016).

Trade Agreement signed between China and Pakistan that led to an increased share of China's in total exports from 4 to 10% in upcoming years (NTC, 2015). However, it is hovering around at the same level since 2011 and is relatively declining after 2013 to 2014. Pakistan is facing major problems of energy shortage, weak infrastructure and higher cost of establishing businesses whereby its ranking deteriorated to 128th on the ease of doing business index of the World Bank, which was 96th as at 2011.

The transportation of agricultural output and exports in the global market is a key issue in Pakistan. A significant hindrance to Pakistan's economy is that 4 to 6% of gross domestic product (GDP) is lost per year due to inefficient transport infrastructure. Around 96% of freight vehicles are overloaded with goods and travel at an average speed of 20 to 25 km/h, while in Europe, the average is closer to 80 to 90 km/h. From northern to the southern Pakistan ports, it takes four days by road, which is double the time the same distance takes in European countries. The railway sector carries only 4% of freight and due to poor maintenance, the railways cannot meet the demand for freight cargo. Despite high demand, fruit exports are limited by the lack of direct flights, a shortage of air cargo space, and poor cargo handling. In the shipping sector, container handling is inefficient and costly compared to other South Asian countries in the region (GoP, 2016). The incompetence of other modes of transport has resulted in 95% of the trade in Pakistan being carried out by sea (Hussain et al., 2014). Thus, in Pakistan the high transportation costs and poor physical infrastructure have restrained exports of the agricultural products. The country where 62% of the population is living in rural areas, enough resources are not being devoted to agricultural infrastructural development. The lack of resources leads to an increase in the cost of production and surge in prices of food grains and commercial crops, reducing product surpluses and encouraging food imports. The imports become only respite to the issue of food security. Thus, it is necessary to improve delivery services and its internal and international competitiveness. The investment in infrastructure in low income countries increases the nation's agricultural production and exports. To mitigate the issues under consideration, there is a need to explore the role of infrastructure, for enhancing export volume. A better quality of infrastructure will help improve delivery services for agricultural sector and thus, surpluses to increase agricultural exports.

The study is conducted with the aim to explore and examine the impact of transport infrastructure on agricultural exports in Pakistan. Few studies exist in the empirical literature, which examine the competitiveness of Pakistani agricultural exports (Akhtar et al., 2009) or the agricultural trade potential between Pakistan and India (International Trade Center (ITC), 2013). Amjad et al. (2012) examined the impact of physical infrastructure and energy crisis on the overall exports of Pakistan, rather than the agricultural exports. Ahmed and Mustafa (2016) studied the prospect of future growth in agricultural sector including agricultural exports, as a result of better physical infrastructure after implementation of China Pakistan Economic Corridor (CPEC) project for infrastructure.

Theoretically, inefficient infrastructure affects trade by raising the incurred costs of fuel usage, public tolls, tariffs and time costs. This speaks for the "Iceberg melting" model presented by Samuelson (1954). Further, the role of expenses for trading is modeled by Fujita et al. (1999), with distinct localities in finite number. The underlying assumption is that various types of goods are produced in one location and all variants under the same location adopt the same price and technology. However, in each case, authors believe that aggregate trade of goods specific to a certain area are affected by the transport charges to all ends.

Pakistan's trade has been heavily dependent on agricultural based exports, with textile manufactures accounting for 51% of the exports, other manufactures accounting for 24% and food exports for 17%. The export patterns have provided support to Pakistan's economy in a condition, when the country lacks proper supporting infrastructure and the focus is not on agricultural development. The relevance of infrastructure in the development policy of a country is unquestionable. The amount of rigorous research conducted in this area is very low and not much emphasis has been placed on the impact of large-scale infrastructure on trade. Moreover, infrastructure of such a scale is often built in areas that guarantee fast growth in future; for instance, roads are often built in areas that connect only high economic potentials zones

For any agricultural based economy, such as Pakistan, the quantity and quality of the products is related to global access for competitive price, ready disposal and financial gains for the growers. In Pakistan, all these factors need a massive improvement. The miserable condition of transportation infrastructure in Pakistan is barrier to positive outcomes. Therefore, the study focused to find empirically the significance of transportation infrastructure for agricultural exports of Pakistan. The study contributes to the existing research by employing a gravity model which has not previously been done. Moreover, transportation infrastructure for Pakistan and the trading partners is considered to examine its impact on agricultural exports of Pakistan. This is significant because agricultural sector development is reliant on timely and widespread delivery to the deficient regions nationally as well as globally. This concerns the availability and security of food for larger populations and incentive to agriculturists for quality output. The improvements in infrastructure based on these findings will benefit the economy through higher agriculture trade and, the population at large by providing access to food.

METHODOLOGY

This study employs three types of transport infrastructure namely road, ports and air transport to estimate its impact on agricultural exports. Following Ismail and Mahyideen (2018), this study uses gravity model to examine the pull and push factors triggering agriculture trade between Pakistan and the rest of the world. Gravity models are used consistently to identify the key factors affecting the volume of trade (Helpman, 1998). The present study has selected agricultural exports as a proxy for agricultural trade.

$$lnEXP_{j,t}\ \Theta_0 + \Theta_1 lnGDPCT_{j,t} + \Theta_2 ln\ ENDW_{j,t} + \Theta_3 lnDIST_j + \Theta_4 LNG_j + \Theta_5 ER_{j,t} + \Theta_6 InTINF_t + \Theta_7 InTINF_{j,t} + + \mu_j + \mu_{jt} \quad (1)$$

where t denotes time series from 2005 to 2015; j = 1 to 19 representing nineteen trading partners (Appendix 1B) of Pakistan; $EXP_{j,t}$ = exports to country j at time t; $GDPCT_{j,t}$ = product of GDP per capita of Pakistan and the foreign economy in period t (Proxy for economic size); $ENDW_{j,t}$=endowment, comparative measure taking difference of GDP per capita between partner j in period t. $DIST_j$=distance between capital cities of exporter and economies j; LNG_j=dummy if partners have common language, 1 otherwise 0; $ER_{j,t}$ =Exchange rate of exporting country in US$.

Transport infrastructure (TINF) variables used in Equation 1 are defined as: $ROAD_{t,}$=Road density for exporting country in time t; $ROADF_{t,j}$ =Road density for importing country in time t; AIR_t =Air transport registered carrier in numbers for exporting country in time t; $AIRF_{t,j}$ =Air transport registered carrier in numbers for importing country in time t; $PORT_t$, =Containers port traffic (TEU: 20 foot equivalent units) for exporting country in time t; $PORTF_{t,j}$= Containers port traffic (TEU: 20 foot equivalent units) for importing country in time t; *Θ*'s are the coefficients, µjt is the random error term and µj is the country-specific error term.

As this study applies to one exporting country, so the subscript "i" is left out. Hence, export varies around recipient countries "j" (Bergstrand, 1985).

Transportation infrastructures namely road, air transport and port facilities are important determinants in successful completion of the trade flows for agricultural goods trade. In this regard, literature suggests few other factors, which are important for trade costs and have diverse significance by time (Olper and Raimondi, 2009). The factors responsible for divergence in trade cost are lingual, geographical, historical and cultural elements.

The economic size is presented in terms of the product of GDP per capita (proxy) for both host and source country. The chances to build more trading links increase respective to the size of the economy. Difference of GDP per capita in absolute terms is taken as relative endowment for exporting and importing economy which indicates the relative development levels of two economies, and similar income level economies like to trade more, so the effect of relative endowment is expected to be negative on agricultural exports. Measure of distance between the economies are supposed to have negative effects when the economies are, more likely to have higher transportation cost and will result in a depletion in trade. Language barriers are also likely to have negative influence on trade, as it costs more to information. The hike in exchange rates impacts positive effect on trade reduces the commodity prices for importers hence increasing the trade flow. However, it may have negative effects as well by reducing commodity prices in turn. This study is drawn heavily from Narayan and Nguyen (2016). So following that, the primary independent variables are GDP per capita, endowment, distance, exchange rate and language as aforementioned. Following Nguyen (2010) and Narayan and Nguyen (2016), this study uses these variables to control the biases as the sample of countries to use for this research are mixed economies.

The trade related infrastructure such as transportation (road, air and ship freight) (Solakivi et al., 2009; Márquez-Ramos et al., 2011), are included in the model to capture the effect on agricultural exports by infrastructure types in this study. The improved roads, rails, air and port infrastructure influences the agricultural trade positively. Dependent variable is derived as the value of agricultural exports in United State of America dollars (US$) from the exporting country, that is, Pakistan in this context. Data for the variables is taken from 2005 to 2015. Sources of data are United Nations COMTRADE database, World Bank and CEPII. The independent variables for gravity model include distance, endowment, language, exchange rate and economic size as used by Narayan and Nguyen (2016). Summary of the variables is presented in the Appendix 1A.

Panel data analysis

Generally, the random effect model uses a weighted average between and within variations, which does not take in all the information but is more appropriate if the panel data comprises of *N*-individuals drawn randomly from a large population, such that the

μ_i is randomly distributed across countries or cross-sectional units. The fixed effect model uses within variation only in the data, and allows the endogeneity of the regressors. This model is more appropriate when focusing on a specific set of *N* firms or countries that are not randomly selected from a large population. A major drawback of the fixed effect model is that separate intercept terms are used for each cross-sectional unit, which can use up degrees of freedom very quickly.

To make the right decision for choosing a model, two basic tests are implemented. First to decide whether data should be simply pooled instead of using random effects or fixed effects, the Breusch-Pagan, Lagrangian Multiplier (LM) test is employed.

$H_0: \sigma_\mu^2 = 0$ (Pooled OLS)
$H_1: \sigma_\mu^2 > 0$ (Random Effect)

LM requires the OLS residuals $\widehat{\varepsilon_{it}}$. it is given as:

$$LM = \frac{NT}{2(T-1)}\left[\frac{\sum_{i=1}^{N}(\sum_{t=1}^{T}\widehat{\varepsilon_{it}})^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{\varepsilon}_{it}^2} - 1\right]^2$$

where LM is distributed as chi-squared, with one degree of freedom under the null hypothesis; rejecting null hypothesis would indicate that variation among the data is strong enough that it should not be pooled together.

To choose between random and fixed effect models, Hausman test is incorporated. The hypotheses are as follows:

$H_0: Cov\ (\mu_i, x_{it}) = 0$ (Random Effect)
$H_1: Cov\ (\mu_i, x_{it}) \neq 0$ (Fixed Effect)

Hausman test statistics has an asymptotic chi-squared distribution with k degrees of freedom under the null hypothesis of regressor-effect independence (RE is appropriate). If the test statistic is large enough, fixed effect model should be used. This implies that rejection of null hypothesis indicates that the co-variance between independent variable and cross sectional unit's specific effect is absent. Further, Hausman's test statistics suggest that in case of an individual country, specific effect is largely independent, making fixed effect model a more appropriate choice for the estimator. However, if the co-variance is present, then the country specific effect is not independent of the explanatory variable. Therefore, random effect estimator would provide a consistent estimation (Gujarati and Porter, 2009).

RESULTS

Descriptive statistics

Table 1 shows the summary statistics of all the variables used in the study. Minimum and maximum values with mean and standard deviation are given in raw form for all the variables used to see the impact of infrastructure on agricultural exports of Pakistan. The correlation matrix of independent variables in Equation 1 is shown in Table 2.

In the correlation matrix for Equation 1 shown in Table 2, it can be seen that product of GDP per capita (GDPCT) is highly correlated with difference of GDP per capita (US$) between exporting and importing countries (ENDW) and exchange rate (ER). Amongst the primary variables of interest, ROAD is highly correlated with air transport registered carrier in numbers (AIR) and ship containers (PORT) whereas AIR is highly correlated with PORT. Such correlations require the use of multicollinearity diagnostics whereby in the case of high VIF and low tolerances, equation 1 would have to be readjusted.

Table 3 shows the outcome of multicollinearity diagnostics. It can be observed that road and port have low tolerance values which indicate that it is preferable that all three forms of transport infrastructure are incorporated in separate models respectively. The corresponding values of GDPCT and ENDW are also low. However, since these are control variables, omitting them from the gravity model may lead to inefficient outcome. Therefore, they are included in all the equations. For clarity models A, B and C are reported as follows:

Model A:

$$EXP_{j,t} = \Theta_0 + \Theta_1 GDPCT_{j,t} + \Theta_2 ENDW_{j,t} + \Theta_3 ER_{j,t} + \Theta_4 ROAD_t + \Theta_5 ROADF_{j,t} + \mu_j + \mu_{jt}$$

Model B:

$$EXP_{j,t} = \Theta_0 + \Theta_1 GDPCT_{j,t} + \Theta_2 ENDW_{j,t} + \Theta_3 ER_{j,t} + \Theta_4 AIR_t + \Theta_5 AIRF_{j,t} + \mu_j + \mu_{jt}$$

Model C:

$$EXP_{j,t} = \Theta_0 + \Theta_1 GDPCT_{j,t} + \Theta_2 ENDW_{j,t} + \Theta_3 DIST_j + \Theta_4 LNG_j + \Theta_5 ER_{j,t} + \Theta_6 PORT_t + \Theta_7 PORTF_{j,t} + \mu_j + \mu_{jt}$$

Diagnostic analysis

Results of diagnostic analysis are shown in Table 4. To choose between random effects estimator and POLS, the Breusch-Pagan LM test is considered. Rejection of the test indicates that there is enough variation in the country specific error term, thus, data cannot be pooled due to heterogeneity and random effects estimator should be preferred over POLS. To choose between random effects estimator and fixed effects estimator, Hausman test is

Table 1. Summary statistics.

Variable	Mean	Standard deviation	Minimum	Maximum
EXP	52.1	55.6	0.3428677	340
GDPCT	122	102	7.395631	411
ENDW	25984.86	23293.99	0.9	94023.5
DIST	5174.414	2737.093	683.345	11392.38
LNG	0.421	0.494	0	1
ER	700.984	2276.292	0.268	13389.42
ROAD	32.954	0.374	32.401	33.612
AIR	59064.75	8488.268	48903.29	72692.98
PORT	2152843	291613.6	1686389	2597344
ROADF	108.622	146.612	7.3	572.836
AIRF	871487.7	2169799	0	10100000
PORTF	18900000	32100000	238613.4	182000000

Table 2. Correlation matrix

Explanatory variable	GDPCT	ENDOW	ER	DIST	LNG	ROAD	AIR	PORT	ROADF	AIRF	PORTF
GDPCT	1	-	-	-	-	-	-	-	-	-	-
ENDW	0.945	1	-	-	-	-	-	-	-	-	-
ER	-0.719	-0.683	1	-	-	-	-	-	-	-	-
DIST	-0.025	-0.112	0.141	1	-	-	-	-	-	-	-
LNG	-0.103	-0.121	0.012	0.376	1	-	-	-	-	-	-
ROAD	0.081	-0.002	0.0170	0.014	0.000	1	-	-	-	-	-
AIR	0.055	0.015	0.007	0.012	0.000	0.649	1	-	-	-	-
PORT	0.083	0.008	0.013	0.016	0.000	0.935	0.701	1	-	-	-
ROADF	0.528	0.550	-0.375	0.348	0.081	0.068	0.052	0.069	1	-	-
AIRF	0.319	0.339	-0.370	0.107	0.140	0.047	0.045	0.054	0.375	1	-
PORTF	0.324	0.398	-0.046	0.063	-0.002	0.062	0.050	0.060	0.216	0.321	1

Correlation analysis of the variables shown represents their natural logarithmic value.

Table 3. Multicollinearity diagnostics.

Variable	VIF	Sort VIF	Tolerance
GDPCT	13.7900	3.7100	0.0725
ENDW	12.6300	3.5500	0.0792
ER	2.8600	1.6900	0.3497
DIST	1.9400	1.3900	0.5161
LNG	1.4300	1.2000	0.7000
ROAD	8.2400	2.8700	0.1213
AIR	1.9700	1.4000	0.5066
PORT	9.1900	3.0300	0.1088
ROADF	2.2300	1.4900	0.4478
AIRF	1.5600	1.2500	0.6406
PORTF	1.5100	1.2300	0.6609

undertaken. Rejection of Breusch-Pagan LM test indicates that country-specific effect is significant and each country should be included in the form of a dummy variable in the empirical model or, in other words, LSDV model would be preferred over random effects estimator. Once the most appropriate estimator is selected, other

Table 4. Diagnostic analysis.

Diagnostic test	Model A	Model B	Model C
	(Dependent Variable: EXP)		
Breusch-Pagan LM test	309.81***	300.68***	302.84***
Hausman	12.41*	20.10***	6.72
CSD	9.652***	8.244***	3.332***
First order autocorrelation	6.373**	7.048**	4.244**
Groupwise heteroskedasticity	1427.27***	1680.64***	109.2580***

***, ** and *, Indicates significance <1, <5 at <10%.

diagnostics are performed to ensure the reliability of the estimates in the empirical models. The diagnostics include testing the presence of autocorrelation, heteroscedasticity across panels and cross-sectional dependence (CSD).

It can be observed that the Breusch-Pagan LM test is consistently emerging significant, which shows that random effects estimator is better than POLS for all models. In the context of random effects and fixed effects estimators, the Hausman test statistics for models A and B show the latter should be preferred over the former, whereas the statistic for model C show that random effects estimator should be preferred over both POLS and fixed effects estimator. All the models show the presence of serial correlation, group wise heteroscedasticity and CSD. To cater for such issues, the Driscoll-Kraay standard errors have been considered. Under these standard errors, the error structure is assumed to be heteroscedastic, auto correlated and possibly correlated between the panels which in this case are countries. This nonparametric technique of estimating standard errors does not place any restrictions on the limiting behavior of the number of countries. Hence, such standard errors can produce more robust results under the stated issues. For models A and B, the Driscoll-Kraay standard errors are estimated with fixed effects regression and for model C, the standard errors are estimated with POLS regression. For robustness, the results of fixed effects estimator for models A and B and the random effects estimator for model C under robust standard errors are also reported. Another issue is that under the fixed effects estimator, the time invariant variables such as language and distance have to be omitted as fixed effects estimator only picks up the effects of those factors that vary over time (Ismail, 2008).

Regression analysis

The regression results are shown in Tables 5 and 6. Among the control variables, GDPCT appears as significantly positive in majority of the models as expected in theory and empirically. Combined GDP per capita between Pakistan and trade partners revealed a positive relationship which implied that the larger market size the higher agriculture trade. Negative coefficient of endowment (ENDOW) in the regression outcome is observed in models 1B, 1C and 2B. So Pakistan's agricultural exports do not increase as the GDP difference between Pakistan and trading partners increase. The coefficient of exchange rate (ER) is emerging as positive in models 1A and 1B with a statistically significant coefficient in the latter. A 1% increase in ER is leading to a 0.85% increase in agricultural exports (EXP) in model 1B and 2B and 0.1421% decrease in model 2C. Distance (DIST) is consistently emerging as negative and significant in all the models as expected. Coefficient of language (LNG) is positive but insignificant. The primary variables of interest representing physical infrastructure namely road and port are appearing significantly positive. Air transport (AIR) significantly impacts the EXP positively while insignificant impact of foreign air transport (AIRF) is observed. A 1% increase in port facilities (PORT) lead to a more than 3% increase in the value of agricultural exports of Pakistan. Detailed discussion of the results is described subsequently.

DISCUSSION

Theoretically, if the difference between economic development stage of Pakistan and the trading partner is low, that is, the endowment (ENDW) has low value; the EXP demand from Pakistan will increase. It can be inferred that a trading partner belonging to a third world may hold the capability to afford more agricultural exports from Pakistan in comparison the one belonging to high income or upper middle income status, which may prefer purchasing EXP from other rapidly developing or developed economies, making use of better quality standards existing in such countries. Negative coefficient of ENDOW indicates that most of Pakistan's EXP are channeled towards relatively more developed economies that have high endowments of strategic assets and other resources.

As the value of exchange rate increases or as it depreciates against US$, the exports become cheaper

Table 5. Regression results; fixed effects and random effects with robust standard errors.

Explanatory variable	Model 1A	Model 1B	Model 1C
	Dependent variable: EXP		
GDPCT	1.1743* (0.6701)	1.7630*** (0.6016)	0.0687 (0.2457)
ENDOW	-0.0598 (0.0389)	-0.1301*** (0.0339)	-0.1000*** (0.0293)
ER	0.5234 (0.3837)	0.8525** (0.3062)	-0. 0591 (0.0710)
ROAD	20.9882*** (5.9376)	-	
ROADF	0.4672 (0.2783)	-	-
AIR	-	1.7447*** (0.4598)	-
AIRF	-	0.0100 (0.0561)	-
PORT	-	-	3.1996*** (0.5524)
PORTF	-	-	0.2527*** (0.0575)
DIST	-	-	-0.4538** (0.1942)
LNG	-	-	0.3301 (0.3604)
Constant	-79.8646*** (21.2316)	-34.6886*** (12.1088)	-29.8074*** (8.4913)
R-Squared	0.3546	0.3743	0.4170

***, ** and *, Indicates significance <1, <5 at <10%.Standard errors reported in the round parenthesis. Model 1A and 1B: Fixed effects regression with robust standard errors. Model 1C: Random effects regression with robust standard errors.

Table 6. Regression Results: fixed effects and pols regression methods with driscoll-kraay standard errors.

Variable	Model 2A	Model 2B	Model 2C
	Dependent Variable: EXP		
GDPCT	1.1743*** (0.3575)	1.7630*** (0.3601)	-0.0154 (0.3369)
ENDOW	-0.0598 (0.1032)	-0.1301** (0.1350)	-0.1861 (0.1218)
ER	0.5234 (0.4370)	0.8525* (0.3921)	-0.1421*** (0.0359)
ROAD	20.9882** (7.3130)	-	-
ROADF	0.4672** (0.1649)	-	-
AIR	-	1.7447*** (0.4688)	-
AIRF	-	0.0100 (0.0569)	-
PORT	-	-	3.3077*** (0.2032)
PORTF	-	-	0.2329*** (0.0350)
DIST	-	-	-0.4123** (0.1439)
LNG	-	-	0.2653 (0.2314)
Constant	-79.8646*** (23.0770)	-34.6886*** (5.9910)	-28.8799*** (4.9237)
R-Squared	0.3546	0.3743	0.3821

***, ** and *, Indicates significance <1, <5 at <10%. Standard errors reported in the round parenthesis. Model 2A and 2B: Driscoll-Kraay standard errors with fixed-effects regression method. Model 2C: Driscoll-Kraay standard errors with POLS regression method.

and ultimately, increase. The exchange rate of Pakistani Rupee (PKR) has been continuously depreciating, encouraging exports from the agricultural sector. However, continuous depreciation also increases the price of essential imported products, indicating economic issues such as current account deficit and more expensive overseas investment. The subsequent rise in the cost of production for the business sector and low profits earned from low value added exports, adversely affected the exports from agricultural sector; therefore, the unexpected negative sign of ER in model 1C is witnessed. Hence, the policymakers must address the issues arising from ER depreciation and interpret the positive sign of ER in a cautious manner.

The coefficients of time invariant variables such as distance and language also demonstrate expected outcomes. More DIST between Pakistan and destination country, the transportation costs becoming more expensive with increase in the export, ultimately discouraging the EXP. Similarly, higher resemblance in the official/spoken languages in Pakistan and importing countries attracts more agricultural exports from Pakistan. However, insignificant coefficient of language indicates that it is not a crucial pull factor responsible for higher EXP. Other economic factors such as, economic development stage of Pakistan, GDP per capita and DIST hold more importance in determining the extent of exports in agricultural sectors from Pakistan to other countries worldwide.

An improved infrastructure in the context of more comprehensive road network allows the agricultural output to be transported more efficiently around different parts of the country. As it becomes more cost-effective to supply the products, especially the perishable agricultural products, it becomes easier to transport the output to airports and seaports which increases the amount of EXP. According to Mcquaid (2016), in Pakistan, as the urban areas are developing at a rapid pace, the demands for agricultural products are also increasing. The expansion of urban areas assisted in forming better transport network that permitted the connection of agricultural farms to cities via paved and high-quality roads over time. Moreover, the Silk Road has remained oldest and a cost-effective route for trade that connects Pakistan with China (Ahmed and Mustafa, 2016). However, there are still many areas in rural Punjab and Sindh provinces that are not connected to mainstream cities which restrict the growth in agricultural output and EXP. Therefore, the formation of CPEC, which includes improvement of Silk Road, other transport networks and physical infrastructure, is considered to be a beneficial step towards increasing the agricultural output and raising EXP. In view of the positive relationship between ROAD and EXP, the similar initiatives are needed to further increase agricultural exports, as they at the provincial level or at the national level. The less than proportionate impact of ROADF on EXP shows that presence of better road networks in the foreign economies may act as a push factor responsible for higher EXP from these economies, rather than acting as a push factor behind higher imports from Pakistan, as majority of the EXP are transported via ocean and therefore, seaport facilities and their networks, rather than the road networks, play a more important part in trade of goods worldwide (World Industrial Reporter, 2012).

A better quality of air transport network acts as a crucial push factor responsible for higher agricultural exports owing to the reduced time it takes for the air cargo to reach the destination country. Although Pakistan Civil Aviation Authority (CAA) charges higher amounts for agricultural exports, especially for perishable products such as fruits and vegetables, from the local exporters (Hussain, 2010), the disadvantages are overpowered due to the quicker deliveries of the agricultural exports. Hence, more efficient and cost-effective air transport networks are desirable to assist high AIR in further increasing EXP. The current air transport networks for export of fresh fruits and vegetables in Pakistan are insufficient as stated by Maqsood (2018). Owing to the positive relationship between EXP and AIR, this indicates that EXP might be adversely affected if such situation continues. The insignificant impact of AIRF displays that Pakistan's agricultural export (EXP) forms a low proportion of total agricultural exports in majority of the export destinations as previously mentioned. Therefore, even if the AIRF increases, the change in EXP from Pakistan is insignificant or not as positive as the EXP being received from other countries of origin. Besides, when AIRF increases, the impact is insignificant since it is a lesser used mode of transporting EXP due to higher costs.

As majority of the exports in Pakistan are performed through ports because of their cost-effectiveness. Thus, creation of more seaports and improvement of the physical infrastructure on these ports substantially impacts the EXP positively, which would also strengthen the economy of Pakistan. Gul (2017) stated that the initiative taken by the Chinese investment under mega project namely China Pakistan Economic Corridor (CPEC), has a prominent feature of upgrading and establishing Gwadar deep seaport as a regional giant promoting Pakistani exports to the Middle East, Central and South Asian regions. Since Gwadar Deep Seaport is located at the convergence of these regions; it bears an immense strategic importance that can be exploited to serve the existing markets and explore new markets for EXP, leading to an increase in the revenues of agricultural exports and further, strengthening the relationship between PORT and EXP. Moreover, as ports of major export destinations expand, their imports of agricultural products from Pakistan also increase significantly as seaport is widely used mode of transporting agricultural exports.

Conclusion

Precisely, study concludes that physical infrastructure such as road network has significantly positive impact on agricultural exports of Pakistan which suggests more investment in building effective road network. Thus, enhanced connectivity of rural areas to the highways is crucial to reap the benefits from other mega projects such as CPEC.

Moreover, agricultural output can be exported across various regions through enhanced airport network and increasing the number of flights. Owing to positive relationship between air infrastructure and agricultural exports, reduced fares to a certain extent can considerably boost exports of agriculture sector.

Present study also indicates a significant increase in agricultural exports owing to sea port infrastructure in both exporting and importing countries as seaport is widely used mode of transporting agricultural exports. Further improvement and expansion of facilities in existing seaports and establishing new seaports would provide a more cost effective route for transporting output, such as; strategically positioned Gwadar seaport. It would contribute substantially to export revenue of the country.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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APPENDIX

Appendix 1A. Summary of the variables.

Variable	Source	Expected signs
Dependent		
EXP: Value of agricultural exports (million US$) from exporting country (Pakistan) to importing economies	UN Comtrade database	
Independent		
***TINF*:**		
Transportation infrastructure	WDI database, World Bank	+
ROAD: Road density (km of road per 100 km2 of land area		
AIR: Air transport registered carrier in numbers	-	
PORT: Ship containers (TEU: 20 foot equivalent units)	-	
Control variables for gravity equation:		
GDPCT: Gross domestic product per capita in million US$ (Product of GDP per capita)	WDI database, World Bank	+
$ENDW$: Difference of GDP per capita (US$) between exporting and importing countries	UN Comtrade database	-
$DIST$: Distance between capital cities of both economies	CEPII Database	-
LNG: Common language of the trading countries	CEPII Database	+
ER: Exchange rate	WDI database	+/-

Appendix 1B. List of countries included in analysis.

Country	Code	Country	Code
Australia	AUS	Malaysia	MYS
Bahrain	BHR	Mauritius	MUS
China	CHN	Republic of Korea	KOR
Germany	DEU	Senegal	SEN
India	IND	Singapore	SGP
Oman	OMN	Turkey	TUR
Pakistan	PAK	Ukraine	UKR
Indonesia	IDN	United Kingdom	GBR
Kenya	KEN	Tanzania	TNZ
Kuwait	KWT	United States	USA