Aviation Demand and Economic Growth in the Czech Republic: Cointegration Estimation and Causality Analysis

Bilal Mehmood[1] | *Government College University, Lahore, Pakistan*
Amna Shahid[2] | *Government College University, Lahore, Pakistan*

Abstract

The main purpose of the paper is to empirically examine the aviation-led growth hypothesis for the Czech Republic by testing causality between aviation and economic growth. We resort to econometric tests such as unit root tests and test of cointegration purposed by Johansen (1988). Fully Modified OLS, Dynamic OLS and Conical Cointegration Regression are used to estimate the cointegration equation for time span of 42 years from 1970 to 2012. Empirical results reveal the existence of cointegration between aviation demand and economic growth. Graphic methods such as Cholesky impulse response function (both accumulated and non-accumulated) and variance decomposition have also been applied to render the analysis rigorous. The positive contribution of aviation demand to economic growth is similar in all three estimation techniques of cointegration equation. Finally, Granger causality test is also applied to find the direction of causal relationship. Findings help in lime-lighting the importance of aviation industry in economic growth for a developing country like the Czech Republic.

Keywords

Aviation, economic growth, Unit Root Tests, Fully Modified Ordinary Least Square (FMOLS), Dynamic Ordinary Least Square (DOLS), Conical Cointegration Regression (CCR), Aviation Multiplier

JEL code

L93, O40, C22

INTRODUCTION

Role of transportation has been pivotal in transporting of human beings (services) and goods since historic times. Economic activities, both from production (supply) and consumption (demand) side depend on transportation. This paper analyses 'aviation/air transportation' as covariate in association with economic growth. Recent work dealing with this issue has shown positive effects of aviation on economic growth of a country. Nearly no heed has been paid to the empirical analysis of the relationship between economic growth and aviation of the Czech Republic. This is a justification of this research. The aim

[1] Department of Economics, Government College University, Lahore, Pakistan. E-mail: digital.economist@gmail.com.
[2] Department of Economics, Government College University, Lahore, Pakistan. E-mail: samna10@hotmail.com.

of this research is to explore the causal relationship between aviation and economic growth in the Czech Republic. To measure aviation, we used 'passengers carried by air transport' (PAX). While for incorporating economic growth, GDP in constant local currency unit is used. For statistical analysis, this paper resorts to econometric tests such as unit root tests (ADF and Phillips Perron) and test of cointegration purposed by Johansen (1988). The time span covered by the study is the period from 1970 to 2012. This paper scrutinizes the relationship between aviation and economic growth by applying the Johansen cointegration approach for the long-run and the standard error correction method (ECM) for the short-run. This paper contributes to the existing methodology in Marazzo et al. (2010) by using FMOLS, DOLS and CCR to estimate cointegrating equations. Estimation of cointegration equations is becoming a popular practice. For recent application of FMOLS, see Mehmood, et al. (2012).

1 LITERATURE REVIEW

Empirical work on aviation-led economic growth is still in its infancy. A few existing examples of it are reviewed as follows. Beneš, et al. (2008) discuss the development of the transport sector of the Czech Republic. Before 1989, there was a planned economy while after the advent of market economy, main focus was placed on the market of developed European countries and especially on the transport sector covering individual transport systems, transport preferences and transported commodities. They faced many difficulties because although most changes were favorable for meeting transport demands in domestic and global magnitudes but there were many additional problems, too. Thus, authors have recommended to focus on the efficiency of transport systems, with a special emphasis on quality, infrastructure development, lower energy demands, environmental protection and, most importantly, on investment in this sector as this contributes to the GDP of the country very well.

Pioneering research on aviation-growth nexus is conducted by Marazzo et al. (2010). They empirically tested the relationship between aviation demand and GDP for Brazil. They used passenger-kilometer as a proxy of aviation demand and found a long-run equilibrium between the two variables using bi-variate Vector Autoregressive Model. Their findings reveal strong positive causality between GDP and aviation demand, and relatively weaker causality the other way round. Robustness tests were applied through Hodrick and Prescott filter to capture the cyclical components of the series and the results withstood these robustness tests. Their interpretation of positive causality indicates the existence of multiplier effect. Oxford Economic Forecasting (2009) performed some quantifications affirming that Czech aviation sector generates economic benefits for its customers and international economy. Analysis of economic indicators shows that 0.7% of the Czech GDP and 31 400 jobs or 0.6% of the Czech labor force is attributed to the Czech aviation sector. Including the contribution of tourism sector, GDP upsurges to 0.9% and job creation increases to 42 900 jobs (or 0.9% of the labor force). Czech-based carriers were responsible for 67% of passengers carried and 39% of freight. All the income and revenues by these air companies have generated aviation multiplier effects on the Czech economy. Macroeconomic significance of Czech aviation are highlighted in this work.

Mehmood & Kiani (2013) examine the aviation-led growth hypothesis for Pakistan by testing Granger causality between aviation and economic growth using unit root tests and cointegration tests. Using the data from 1973 to 2012, they innovated the work of Marazzo et al. (2010) by applying Fully Modified OLS and Dynamic OLS for the estimation of cointegration equation. Estimations reveal that positive contribution of aviation demand to economy is more prominent as compared to that of economic growth to aviation demand. They found out that positive contribution of aviation demand to economic growth is similar in both FMOLS and DOLS. To our knowledge no further instances of research on the Czech aviation exist. To significantly add to empirical literature, this paper aims at analyzing the aviation-growth nexus for the Czech Republic. Specific testable proposition is as follows:

P$_A$: *There exists a (Granger) causal relationship between Aviation Demand and Economic Growth in the Czech Republic.*

For scrutinizing the above set proposition, data dimensions and sources are explained below. Moreover, detailed explanation of the analysis methodology is provided:

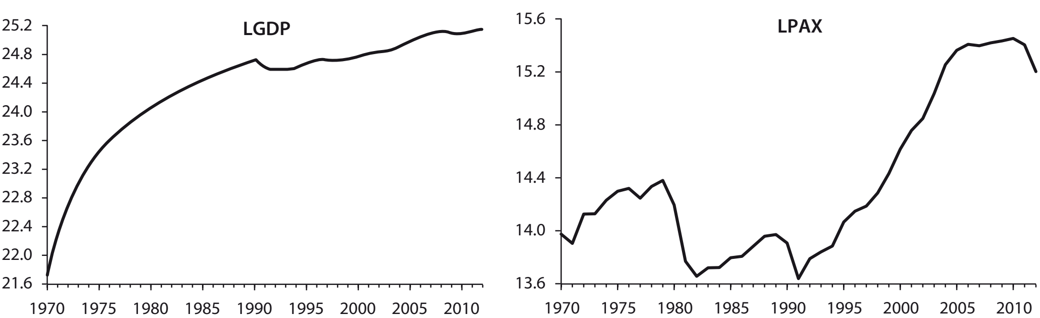
2 DATA AND METHODOLOGY

Borrowing from Marazzo et al. (2010), the demand for aviation is represented by 'air transport, passengers carried' and economic growth by GDP is used in local currency (at constant terms). Data for these variables is taken from World Development Indicators (WDI). For the Czech Republic data on passengers carried and GDP is available from 1970 to 2012. The time span allows us to use 43 observations for our time series analysis. EViews 8 is used for all estimations. Before conducting the inferential analysis, line chart and descriptive analysis is furnished.

3 DESCRIPTIVE STATISTICS

Economic growth is proxied by GDP (current LCU), while demand for aviation is proxied by 'passengers carried by air transport' (PAX). The line charts of GDP (current LCU) and passengers carried by air transport are plotted against time in years. Both of these shows trend and intercepts. This information will be helpful in conducting the stationarity tests.

Figure 1 Chart of GDP and PAX (Natural logged forms for GDP and PAX)



Note: Line charts of GDP and PAX are plotted that show intercept (constant) and trend (slope) in both the variables.
Source: World Development Indicators, own construction

4 INFERENTIAL ANALYSIS

4.1 Stationarity Tests

Both stationarity tests, Augmented Dickey Fuller (ADF) and Phillip Peron (PP), are applied with the assumptions that GDP and PAX in their logarithmic form reveal intercept and trend. Both variables are stationary at first level using ADF and PP tests. So GDP and PAX are stationary at first difference i.e. I(1). Such is tabulated in Table 1.

4.2 Augmented Dickey Fuller Test

For scrutinizing non-stationarity in a time series Augmented Dickey–Fuller test (ADF) test was purposed by Dickey and Fuller (1979). In order to check if the series carry one unit root, the ADF test presents the following specification:

$$\Delta Y_t = \alpha + \beta T + \varphi Y_{t-1} + \sum_{i=1}^{p} \Delta Y_{t-i} + \varepsilon_t, \tag{1}$$

where Y_t and ΔY_t are respectively the level and the first difference of the series, T is the time trend variable, and α, β, φ, ψ are parameters to be estimated. The p *lagged* difference terms are added in order to remove serial correlation in the residuals.

The null hypothesis is H0: $\varphi \neq 0$ and the alternative hypothesis is H_1: $\varphi \neq 0$. ε_t is the error term presenting zero mean and constant variance. First order integrated series can present stationary linear combinations (I(0)). In these cases, we say variables are cointegrated. It means there is a long-run equilibrium linking the series, generating a kind of coordinated movement over time. In order to assess the existence of cointegration between I(1) series, Engle and Granger (1987) proposed a regression between two non-stationary variables (Y_t, X_t) to check the error term integration order. If the error term is stationary one can assume the existence of cointegration.[3] Thus:

$$Y_t = \alpha + \beta X_t + \mu_t \tag{2}$$

is an equation of cointegration if μt is stationary. This condition can be evaluated through the ADF test. A more recent approach is provided by Johansen and Juselius (1990). They suggested an alternative method which has been applied under the following specification:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + \beta X_t + \varepsilon_t, \tag{3}$$

where Y_t is a vector of 'k' non-stationary variables, X_t is a vector of d deterministic variables and ε_t is a vector of random terms (zero mean and finite variance). The number of cointegration relations is represented by the rank of Π coefficient matrix. The Johansen method relies on estimating the P matrix in an unrestricted form and testing whether it is possible to reject the imposed restrictions when reducing the rank of Π. The maximum likelihood test, which checks the hypothesis of a maximum number of r cointegration vectors, is called the trace test. It should be highlighted that variables under cointegration analysis should present the same integration order. If one concludes that cointegration exists in (3), then there is at least one stationary variable that may be included in the model. This representation is known as Error Correction Model (ECM), specified as follows:

$$\Delta Y_t = \lambda + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \Delta X_{t-j} + \phi Z_{t-1} + \varepsilon_t, \tag{4}$$

where λ is the constant term, α, β, φ are coefficients, m and n are the required number of lags to make the error term ε_t a white noise and Z_{t-1} is the cointegration vector ($Z_{t-1} = Y_{t-1} - \delta X_{t-1}$), where δ is a parameter to be estimated). In this case, Z_{t-1} works as an error correction term (ECT). The ECT provides valuable information about the short run dynamics between Y and X. In Eq. (4), all the terms are I(0).

4.3 Phillip Perron Test

Phillips and Perron (1988) propose an alternative (nonparametric) method of controlling for serial correlation when testing for a unit root. The PP method estimates the non-augmented DF test equation [$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \epsilon_t$] and modifies the t-ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. The PP test is based on the statistic:

[3] For more see Bouzid (2012).

$$\bar{t}_{\alpha} = t_{\alpha}\left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2f_0^{1/2}s}, \tag{5}$$

where $\hat{\alpha}$ is the estimate, and t_{α} the t-ratio of α, $se(\hat{\alpha})$ is coefficient standard error, and s is the standard error of the test regression. It is a consistent estimate of the error variance in equation (1) (calculated as $(T - k)s^2/T$, where k is the number of regressors). The remaining term, f_0, is an estimator of the residual spectrum at frequency zero.

Table 1 ADF and PP Tests

Using constant and trend	Stationarity	Variables	t-Statistic	Prob. value
I	II	III	IV	V
Augmented Dickey Fuller (ADF)	At level	GDP	–2.3707	0.3886
		PAX	–1.5658	0.7892
	At first difference	ΔGDP	–10.9086	0.0000
		ΔPAX	–3.7524	0.0298
Phillips & Perron (PP)	At level	GDP	–3.3445	0.0731
		PAX	–1.4104	0.8434
	At first difference	ΔGDP	–13.1762	0.0000
		ΔPAX	–3.7524	0.0298

Note: (i) t-statistics estimates listed in column IV. (ii) ADF and PP tests of GDP show stationarity at 1st difference with significance at all levels (1%, 5% & 10%) while of PAX show stationarity at 1st difference with significance at 5% & 10%.
Source: World Development Indicators, own construction

Johansen cointegration test is applied on the variables of concern and mathematically this is expressed in equation (6) and (7):

$$\Delta PAX_t = \alpha_1 + \sum\nolimits_i \alpha_{11}(i)\Delta PAX_{t-i} + \sum\nolimits_i \alpha_{12}(i)\Delta GDP_{t-i} + \beta_1 Z_{t-1} + e_{1t}, \tag{6}$$

$$\Delta GDP_t = \alpha_1 + \sum\nolimits_i \alpha_{21}(i)\Delta PAX_{t-i} + \sum\nolimits_i \alpha_{22}(i)\Delta GDP_{t-i} + \beta_2 Z_{t-1} + e_{2t}. \tag{7}$$

Here ΔPAX_{t-i} and ΔGDP_{t-i} are the lagged differences which seize the short term disturbances; e_{1t} and e_{2t} are the serially uncorrelated error terms and Z_{t-1} is the error correction (EC) term, which is obtained from the cointegration relation identified and measures the magnitude of past disequilibrium.

Table 2 Johansen-Juselius Likelihood Cointegration Tests

Null	Alternative	Statistic (GDP & PAX)	Critical Value (95%)
I	II	III	IV
Maximal eigenvalue test			
$\gamma = 0$	$\gamma = 1$	15.7949	17.1477
Trace test			
$\gamma = 0$	$\gamma \geq 1$	15.7949	17.1477

Note: (i) Values of Maximal eigenvalue test and Trace tests. (ii) Optimum lag length is '2' in this case which is selected using the SIC and AIC.
Source: World Development Indicators, own construction

Maximal eigenvalue test and Trace tests reveal the existence of one cointegrating vector. Cointegration is evidenced, using which estimation of cointegrating equations is conducted in the next step.

4.4 Vector Error Correction Model

The model is a first order VEC (Vector Error Correction) model as shown in equation (6) & (7). The lag length was found to be '2' which is established on the basis of SI and AI criteria. Based on column 1 of Table 2, the cointegration vector confirms the expected positive relationship between aviation demand and economic growth (1 PAX = 0.9681 GDP).

Succeeding in uncovering of the cointegration between GDP and PAX, an Error Correction Model (ECM) is estimated for scrutinizing short and long-run causality. In the ECM, the first difference of each endogenous variable (GDP or PAX) was regressed on a one period lag of the cointegrating equation and lagged first differences of all the endogenous variables in the system.

Table 3 shows the results of causality test. We have performed several tests for Granger causality: (1) short-run causality — the significance of the sum of lagged terms of each explanatory variable by joint F test; (2) long-run causality — the significance of the error–correction terms by t-test; and (3) short-run adjustment to re-establish long-run equilibrium — the joint significance of the sum of lagged terms of each explanatory variable and the Error Correction Term (ECT) by joint F test. The lag of the system is decided by AIC criterion as 5.

Short-run causality is found only from PAX to GDP, but not the reverse, i.e. there is unidirectional Granger causality. The coefficient of the ECT is found to be significant in GDP equation, which shows that given any deviation in the ECT, both variables in the ECM would interact in a dynamic fashion to restore long-run equilibrium. Results of the significance of interactive terms of change in PAX, along with the ECT in the GDP equation are consistent with the existence of Granger-causality running from PAX to GDP. These indicate that whenever there is the presence of a shock to the system, PAX would make short-run adjustment to re-establish long-run equilibrium.

Table 3 Estimation results of Error Correction Model for logarithmic series of GDP and PAX

Source of causality					
Short-run			Error Correction Term	Joint short/long term test	
Variables	ΔGDP	ΔPAX	ΔGDP	ΔGDP	ΔGDP
F-statistics			t-statistics	F-statistics	
ΔGDP	–	3.3538**	–2.1018**	–	8.1637***
ΔPAX	0.7169	–	–0.0580	0.6502	–

Note: ΔGDP and ΔPAX are the first difference series of GDP and PAX respectively. **is 5% critical level and *** is 1% critical level.
Source: World Development Indicators, own construction

4.5 Cointegration Equation Estimation

Cointegrating equation is estimated using recently developed econometric methodologies, namely: fully modified ordinary least squares (FMOLS) of Phillips and Hansen (1990), dynamic ordinary least squares (DOLS) technique of Stock and Watson (1993) and Conical Cointegration Regression (CCR) of Park (1992). These methodologies provide a check for the robustness of results and have the ability to produce reliable estimates in small sample sizes.

[3] For more see Bouzid (2012).

4.5.1 Fully Modified Ordinary Least Squares (FMOLS)

On the basis of VAR model results, cointegrating regression is estimated. In a situation, where the series are cointegrated at first difference 'I(1)', Fully modified ordinary least square (FMOLS) is suitable for estimation. FMOLS is attributed to Phillips and Hansen (1990) to provide optimal estimates of cointegrating regressions. FMOLS modifies least squares to explicate serial correlation effects and for the endogeneity in the regressors that arise from the existence of a cointegrating relationship.[4]

$$X_t = \hat{\Gamma}_{21} D_{1t} + \hat{\Gamma}_{21} D_{1t} + \hat{\epsilon}_t, \tag{8}$$

or directly from the difference regressions:

$$\Delta X_t = \hat{\Gamma}_{21} \Delta D_{1t} + \hat{\Gamma}_{21} \Delta D_{1t} + \hat{\upsilon}_t. \tag{9}$$

Let $\hat{\Omega}$ and $\hat{\Lambda}$ be the long-run covariance matrices computed using the residuals $\hat{\upsilon}_t = (\hat{\upsilon}_{1t}, \hat{\upsilon}_{2t}')'$. Then we may define the modified data:

$$y_t^* = y_t - \hat{\omega}_{12} \hat{\Omega}_{22}^{-1} \hat{\upsilon}_2. \tag{10}$$

An estimated bias correction term:

$$\lambda_{12}^* = \lambda_{12} - \hat{\omega}_{12} \hat{\Omega}_{22}^{-1} \hat{\Lambda}_{22}. \tag{11}$$

The FMOLS estimator is given by:

$$\hat{\theta} = \begin{bmatrix} \hat{\beta} \\ \hat{\gamma}_1 \end{bmatrix} = (\Sigma_{t=1}^{T} Z_t Z_t{}')^{-1} \left(\Sigma_{t=1}^{T} Z_t y_t^* - T \begin{bmatrix} \hat{\lambda}_{12}^* \\ 0 \end{bmatrix} \right), \tag{12}$$

where $Z_t = (X_t', D_t')'$. The key to FMOLS estimation is the construction of long-run covariance matrix estimators $\hat{\Omega}$ and $\hat{\Lambda}$. Before describing the options available for computing $\hat{\Omega}$ and $\hat{\Lambda}$, it will be useful to define the scalar estimator:

$$\hat{\omega}_{1.2} = \hat{\omega}_{11} - \hat{\omega}_{12} \hat{\Omega}_{22}^{-1} \hat{\omega}_{21}, \tag{13}$$

which may be interpreted as the estimated long-run variance of υ_{1t} conditional on υ_{2t}. We may, if desired, apply a degree-of-freedom correction to $\hat{\omega}_{1.2}$.

4.5.2 Dynamic Ordinary Least Square (DOLS)

Dynamic Ordinary Least Squares (DOLS) is attributed to Saikkonen (1991) and Stock & Watson (1993). DOLS is a simple approach to constructing an asymptotically efficient estimator that eliminates the feedback in the cointegrating system. Technically speaking, DOLS involves augmenting the cointegrating regression with lags and leads of so that the resulting cointegrating equation error term is orthogonal to the entire history of the stochastic regressor innovations:

$$y_t = X_t'\beta + D_{1t}' \gamma_1 + \sum_{j=-q}^{r} \Delta X_{t+j}' \delta + \upsilon_{1t}. \tag{14}$$

---

4 See Phillips and Hansen (1990) and Hansen (1995) for details.

Under the assumption that adding q lags and r leads of the differenced regressors soaks up all of the long-run correlation between υ_{1t} and υ_{2t}, least-squares estimates of $\theta = (\beta', \gamma')'$ have the same asymptotic distribution as those obtained from FMOLS and Conical Cointegration Regression (CCR).

An estimator of the asymptotic variance matrix of $\hat{\theta}$ may be computed by computing the usual OLS coefficient covariance, but replacing the usual estimator for the residual variance of υ_{1t} with an estimator of the long-run variance of the residuals. Alternately, you could compute a robust HAC estimator of the coefficient covariance matrix.

4.5.3 Conical Cointegration Regression (CCR)

The CCR estimator is based on a transformation of the variables in the cointegrating regression that removes the second-order bias of the OLS estimator in the general case. The long-run covariance matrix can be written as:

$$\Omega = \lim_{n\to\infty} \tfrac{1}{n} E\,(\textstyle\sum_{t=1}^{n} u_t)(\sum_{t=1}^{n} u_t)' = \begin{bmatrix}\Omega_{11} & \Omega_{12}\\ \Omega_{21} & \Omega_{22}\end{bmatrix}. \tag{15}$$

The matrix Ω can be represented as the following sum:

$$\Omega = \Sigma + \Gamma + \Gamma', \tag{16}$$

where:

$$\Sigma = \lim_{n\to\infty} \tfrac{1}{n} \textstyle\sum_{t=1}^{n} E\,(u_t u_t'), \tag{17}$$

$$\Gamma = \lim_{n\to\infty} \tfrac{1}{n} \textstyle\sum_{k=1}^{n-1} \sum_{t=k+1}^{n} E\,(u_t u_{t-k}'), \tag{18}$$

$$\Lambda = \Sigma + \Gamma = (\Lambda_1, \Lambda_2) = \begin{bmatrix}\Lambda_{11} & \Lambda_{12}\\ \Lambda_{21} & \Lambda_{22}\end{bmatrix}. \tag{19}$$

The transformed series is obtained as:

$$y_{2t}^{*} = y_{2t} - (\Sigma^{-1}\Lambda_2)' u_t, \tag{20}$$

$$y_{1t}^{*} = y_{1t} - (\Sigma^{-1}\Lambda_2\beta + (0, \Omega_{12}\Omega_{22}^{-1})')' u_t. \tag{21}$$

The canonical cointegration regression takes the following form:

$$y_{1t}^{*} = \beta' y_{2t}^{*} + u_{1t}^{*}, \tag{22}$$

where:

$$y_{1t}^{*} = u_{1t} - \Omega_{12}\Omega_{22}^{-1} u_{2t}. \tag{23}$$

Therefore, in this context the OLS estimator of (22) is asymptotically equivalent to the ML estimator. The reason is that the transformation of the variables eliminates asymptotically the endogeneity caused by the long-run correlation of y_{1t} and y_{2t}. In addition (23) shows how the transformation of the variables eradicates the asymptotic bias due to the possible cross correlation between u_{1t} and u_{2t}.

4.6 Comparison of the Cointegration Regression Estimates

Estimates of the three estimates techniques are summarized in the Table 4:

Table 4 Comparison of the Cointegration Regression Estimates using Three Different Techniques

Technique	Coefficient	S.E.	Adj. R^2	Remarks
Fully Modified OLS	1.6958***	0.0204	0.6861	Significant & positive relationship
Dynamic OLS	1.7029***	0.0211	0.5101	Significant & positive relationship
Conical Cointegration Regression	1.7003***	0.0204	0.7116	Significant & positive relationship

Note: All the constants and coefficient estimates are significant at 1%, indicated by***.
Source: World Development Indicators, own construction

Results of all three estimation techniques (FMOLS, DOLS & CCR) for cointegrating regression shows a positive relationship between GDP and PAX. However, DOLS has increased explanatory power of PAX while the adjusted R^2 is highest using CCR. Our major concern, however, is to find the nature of relationship between GDP and PAX, that is found to be positive and significant using all three cointegration equation estimation techniques.

Table 5 Granger Causality Test Results

Null Hypothesis	F-Statistic	Prob.
GDP does not Granger Cause PAX	3.1048	0.022
PAX does not Granger Cause GDP	1.9468	0.115

Source: World Development Indicators, own construction

Results of Granger causality (in-sample approach), in table 5, show that GDP has the tendency to boost the number of passengers carried by aviation sector. While, the causality does not run in opposite direction. This implies that increase in economic activity in the Czech Republic outgrows the economic opportunities of local and international trade that lead to increased mobility of passengers via aviation. As evident from the analysis, economic growth holds valuable information to forecast aviation demand.

CONCLUSION

This paper investigated the cointegration and causality relationships between demand for aviation and economic growth in the Czech Republic. The outcome of this paper implies that aviation and economic growth are cointegrated in the long run and the relationship holds in the short run as well. This can be translated into a multiplier effect. Our innovation introduced into the empirical analysis of estimation of cointegrating vector using FMOLS, DOLS and CCR corroborates the findings in Marazzo et al. (2010) and Mehmood and Kiani (2013).

The positive relationship can be attributed to direct and indirect effects of aviation. Direct effects include transportation of labour force (implicitly of services) and goods. Indirect benefits include benefits that accrue to other industries through backward and forward linkages of aviation industry. This produces further impetus on economic activity and hence growth. In the case of the Czech Republic, the data reveals two breaks during 1989 and 1990, these can be attributed to after effects of oil shocks and increase in flight fares. Further research can be focused on capturing effects of such issues using statistical tools like Andrews (1993). However, this study has pioneering the research in the field of aviation using other sophisticated tools like Fully modified OLS, Dynamic OLS and Conical cointegration regression (CCR). The events that aviation industry should get policy attention to play its further ameliorated role in determining economic growth. Formal incentives should be given to aviation industry to increase its macroeconomic contribution. The scope of research on aviation can be extended by using cross country analysis.

References

ANDREWS, D. W. Tests for Parameter Instability and Structural Change with Unknown Change Point. *Econometrica*, 1993, Vol. 61, No. 4, pp. 821–856.

BENEŠ, L., BŘEZINA, E., BULICEK, J., MOJŽÍŠ, V. The Development of Transport in the Czech Republic. *European Transport*, 2008, Vol. 39, pp. 33–43.

DICKEY, D., FULLER, W. Distributions of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, 1979, Vol. 74, pp. 427–431.

ENGLE, R., GRANGER, C. Cointegration and Error Correction: Presentation, Estimation and Testing. *Econometrica*, 1987, Vol. 55, pp. 251–276.

JOHANSEN, S., JUSELIUS, K. Maximum likelihood Estimation and Inference on Cointegration with Application to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 1990, Vol. 52, pp. 162–211.

MARAZZO, M., SCHERRE, R., FERNANDES, E. Air Transport Demand and Economic Growth in Brazil: A Time Series Analysis. *Transportation Research*, 2010, Vol. 46, pp. 261–269.

MEHMOOD, B., KHAN, A., KHAN, A. Empirical Scrutiny of Demographic Dividend of Economic Growth: Time Series Evidence from Pakistan. *Romanian Review of Social Sciences*, 2012, Vol. 2, pp. 3–11.

MEHMOOD, B., KIANI, K. An Inquiry into Nexus between Demand for Aviation and Economic Growth in Pakistan. *Academicia*. 2013, Vol. 3, No. 10, pp. 200–211.

Oxford Economic Forecasting. *Economic Benefits from Air Transport in the Czech Republic*, London, UK, 2009.

PHILLIPS, P. C., PERRON, P. Testing For a Unit Root in Time Series Regression. *Biometrika*, 1988, Vol. 75, No. 2, pp. 335–346.

PHILLIPS, P. C., HANSEN, B. E. Statistical Inference in Instrumental Variables Regression with I(1) Processes. *The Review of Economic Studies*, 1990, Vol. 57, No. 1, pp. 99–125.

PARK, J. Y. Canonical Cointegrating Regressions. *Econometrica*, 1992, Vol. 60, No. 1, pp. 119–143.

SAIKKONEN, PENTTI. Asymptotically Efficient Estimation of Cointegration Regressions. *Econometric Theory*, 1991, Vol. 7, No. 1, pp. 1–21.

STOCK, J. H., WATSON, M. W. A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems. *Econometrica*, 1993, Vol. 61, No. 4, pp. 783–820.