**THE MUTUAL RELATIONSHIP BETWEEN AIR TRANSPORT, TRANSIT TIME AND ECONOMIC GROWTH: EMPIRICAL EVIDENCE FROM SAARC COUNTRIES**.

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***ABSTRACT:*** *This paper weighs the im2portant factors of air cargo, transit time and economic growth of the SAARC Countries. The dependence of these factors on each other can increase economic growth rapidly. For this purpose we used panel data for the period of 34 years (1980- 2014). The study at hand employed panel vector error correction model (PVECM) to find out the long and short run association among projected variables. Furthermore, to know about the direction of relationship among proposed variables and panel granger test being utilized. The findings of the study showed that Air transport, freight and time to export are major determinant of economic growth of SAARC economies, moreover, granger causality test showed one unidirectional causality running form GDP to Air transport.*

**Keywords:** Air Cargo, Transit Lead Time, SAARC Countries, Penal data, Economic Growth.

**INTRODUCTION:**

We live in a sensitive age, where transportation is not bound to movement of physical goods only but a large number of humans and services move in a restricted time frame. The course that is used to move these assets is termed as transportation. After development of this pattern we can now establish a link between air cargo (AC), Lead time to import (LTI), economic growth (GDP) and how they affect each other. By zooming on economic indicators it can be seen that air cargo (AC), coupled with less transit time may directly help on economic growth. This observation can be termed as direct causation.

Data from South Asian countries has been collected to validate association in demand of air cargo, transit time and growth of economy [1,2,3,4,5]. Results may not present an accurate picture for the people, like, strategic planners of air cargo, airlines and airport managers by agreeing with results without giving due weightage to other factors like, nature and other formalities of the region in question.

The economic development depends upon three expected channels. These three are mainly, advancement and growth in industrial production and air cargo strategies means enhancement in units of production [6;7]. Secondly, economies thrive due to increased transportation facility, increased technological interaction. Thirdly, even smaller measures can produce bigger results and can earn bigger profits as a result of healthy sales. This phenomenon happens as firms do not use costly materials but earn greater profits due to increased market share. This is the reason this paper depicts the positive role of transportation to increase the economic growth.

However, a faction of literature is of the opinion that infrastructure has significant role in productions, that may be termed as the production function approach, for example [8], try to find out the effect of highways on cross state product

(GSP), found that relativity of GSP with relation to highways is 0.06 [9,10,11,12], also concluded the same relationship between income per capita and transport infrastructure by applying production function method. It is concluded that in highways there is a good impact on different factors of development [13,14,15] differ with this opinion. Whereas [16] found that in under developed countries, the public spending in logistics and transit cost increases growth in developing countries. [17] found a non-helping link between two in 43 developing countries between 1970 and 1990 [18] reflected that in African countries, investment in transportation give encouraging outcome than physical capital on the average. [19] Reflect that improving airport infrastructure has healthy impact on economic growth in china. [20,21,22,23] all stated that investment in airports, highways create employment opportunities and gives boost to manufacturing industry, giving rise to higher production and economic growth as well. Similarly, [24] also discover that spending on airport is a cause of reducing unemployment in the service sector.

The increases in income, enhances purchase power and service sector growth as a result [25]. Transportation being a key factor in economic, means that this sector will leave a significant impact on GDP growth that may be termed as reverse causation, for example [26], studying regarding the factors for optimum demand, concluded by using a recursive computable general equilibrium model, that higher transportation income are dependent on higher economic growth and inflation. Especially, [26] discovered that 1% GDP growth produce 0.99% capital formation in transportation sector. Likewise, [27] found that per capita state expenditure on transportation and communication increases with GDP per capita, with other pointers using cross sectional and time series data on 27 week and limited income economics between 1980 and 1986. All these studies brings out a strong connection between air cargo and growth of economy, perhaps in both the directions. The relationship between income and transportation is significant to examine for both econometrics and economic reasons. As the term is bidirectional, the consistent estimates cannot be made. Secondly, zooming economies, the concerned people must keep in mind the direction of relation to be able to arrive at realistic results, for example if it is decided to grow transportation after growth in economy, whereas it was actually growth in transport that would have stabilized economy, the results would be unrealistic. It is therefore important to establish the flow among economic growth and transportation or GDP per capita level in advance. Applying, [28], the relationship between transportation and income as discussed above has added to our wisdom [29]. The study has targeted SAARC countries, i.e. Afghanistan, Bangladesh, India, Pakistan, Nepal, Srilanka, Maldives and Bhutan. Together they from south Asian association for reginal cooperation (SAARC, 2016). Most empirical papers have seen the relationship between air transportation, time utilized and the economic growth [5] and higher middle income countries [30] with slight focus on comparatively under developed and poor countries. The south Asian countries have been neglected and a rare evidence is available that any such study has been carried out for these countries.

For this study following research objectives are stated. To find out the impact of air cargo on GDP of SAARC countries. To find out the impact of lead transit time on GDP of SAARC countries. To find out the impact of time to import of goods and services on GDP of SAARC countries.

**LITERATURE REVIEW:**

There is a general concern that air cargo helps economic growth, however the process is lazy [3] and some haphazard studies have been done in this field. [31] scrutinized the relation between employment and air transportation using granger causality tests and discovered that the enhanced airport traffic has a direct impact on employment. [30] Observed the relationship among the economic growth and air cargo demand in Brazil and found that increase in cargo volumes and GDP are interrelated. Similarly, [32] also studied association in Brazil utilizing time series data between economic growth and domestic cargo, the outcome suggested that the results are unidirectional, from economic growth to domestic cargo demand. There has been an, increase in air take off in south Asia, it has increased from 154700 in 1973 to 912858 in 2014 (World Bank, 2016). There are some other papers that do not give clear results on a link between transportation and different measures of economic growth. This is despite the economic and political chaos experienced by few of these countries over the past 40 years under investigation. According to Boeing (2014), almost 4% of the world's air cargo traffic in tonnage and the same proportion in tonnages kilometers were traded only in the South Asian market. In 2014, 2688 million ton-km air freight was traded in South Asia with the highest percentage contribution of 64 by India, 14% by Sri Lanka, 10% by Bangladesh, and almost 8% was contributed by Pakistan. The air passengers in 1973 amounted to 5.14 million but in 2014 this number rose to 99.15 million (World Bank, 2016).

[34] Conduct a Granger-causality test in a “general method of moments” (GMM) framework to study the relationship between road density and agricultural productivity growth of 290 districts in rural India in 1971–1994. They observed that the flow of traffic intensity is more towards more agriculture producing areas, likewise, [35] worked on the same lines for 48 state of USA, observe that the flow is unidirectional. [36] Support this argument as their observations are on similar lines. However, [37] carried out studies but their results do not support earlier argument and confirm unidirectional granger causality from GDP to demand to domestic air transport in Brazil from 1996 to 2006 [29].

As no concrete conclusion can be drawn from all the above mentioned studies. There is thus a need to carry out an in depth study, by using larger and realistic data to bring out the factual relationship between transportation and GDP. The results may not be same for developing and developed countries. The study should target EU-15 countries between 1970 and 2008. As these countries have stable economies and well-structured transportation sector. The results so obtained can be pitched against the results obtained for developing countries. Now steady nation’s results may vary from a developed countries results.

The conclusion, thus drawn will greatly help logistics developers. There are several factors that are considered crucial in logistics, however a number of relevant factors cannot be neglected, like expenses involved, time spend on import and export, technologies used in import and export, techniques used and other people involved in the field in completing certain task.

Transportation is however the key factor and all others revolve around this key factor. This effort is the first of its kind that has been made to define a link between logistics strategies with import and export, time and techniques and the effect of GDP. The numerous logistic strategies has been targeted both at national and international level. The results will obvious help improve our system by pointing out grey area.

**Development of Hypotheses:**

H1: An increase in air cargo significantly impact the economic growth of SAARC Nations.

H2: Decrease in transit time significantly impact the economic growth of SAARC Nations.

H3: There is a significant association between import of goods and services and economic growth of SARRC economies.

**DATA COLLECTION AND METHODOLOGY:**

The study at hand employed various econometrical techniques to examine relationship between air transport, time to export and economic growth with promising look. As already brought out the association among air cargo, time and economic growth might be one sided or unidirectional, bidirectional or they may have no effect on each other at all. We however, look at all the aspects in all probable directions between air cargo volumes, time spent export and economic growth that produce three possible causality models [38]. The study is based on the data taken from the (WDI) from 1980 to 2014 and employed total three economic growth, ATF, and TE. To examine long and short run relationship between selected regressors and economic growth, this study has applied panel vector error correction model (VECM) as follows:

GDP = GDP per capita (constant 2010 US$)            I=Country in the panel

ATF = Air transport, freight (million ton-km)        t=Time period

TE = Time to export (days)  β1, β2, β3 = sloops of coefficients= Error term

**UNIT ROOT TEST:**

First of all we employed panel unit root test for the stationary checking purpose because non-stationary data can produce spurious results. Hence, the data are tested for potential stationary. There are various tests available to check stationarity of variables but each has some limitations. The “Levin, Lin and Chu” (LLC) and “Im, Pesaran and Shin” (IPS) [44]; [45] unit root tests are being utilized. LLC unit root test has an advantage of checking the heterogeneity among different cross-sections and consider serial correlation but in small sample size it has low power. We have used IPS to examine heterogeneity in small size of sample, it declines the serial correlation as well [45].

Our tests are based upon following equation 2:

Here i= Countries

t= Time Trend

 = time1 series of nations

= Optimal lags

= residuals

LLC test incorporates null hypothesis: β= 0 contrary to alternative: β<0. On the other hand, IPS test is applied based on equation 1, but β can be carried. LLC is not as better as IPS because of the heterogeneity among coefficients of β for all units in panel. Null hypothesis of IPS having: β1= 0 contrary to alternative: β1<0 .

**PANEL COINTEGRATION TEST:**

After checking stationary of data we have checked cointegration among projected variables to examine long run relationship. We applied Johansen Fisher and Kao co-integration test with null hypothesis of no co-integration. As all variables found stationary at 1(0). When the variables are integrated at same order such as first difference, then we test its co-integration with respect to panel and develop the model as follow.

=1, refer countries, =1 shows time, = intercept and show the trend.

**VECTOR ERROR CORRECTION MODEL (PANEL VECM):**

The findings of the co-integration tests help to find the causality between the variables which will be used in the next

step. Once the co-integration between the variables is identified then next step is to find the casual relationship with vector error correction model. In earlier time, simple regression had been used by the researchers, but running the simple regression on the non-stationary data is inappropriate as opined by the researchers. Because, that simple regression on the non-stationary data produced very high R-square and such results called as meaningless or spurious regression. Thus, [48]. Resolved the issue by fixing the spurious regression and provided the cure that such spurious regression can be avoided by taking the data into differentiated form. It is widely accepted that a non-stationary data can be converted into the stationary form either taking the first or second difference.

Although, the issue of spurious regression has been overcome by converting the data into stationary form with the help of first or second difference against the loss of vital information. Subsequently, [49] demonstrated that differencing also produced the powerless results for spurious association. Because, converting the data into another form by taking the differencing produced multiple issues such as correlation of error term, effect of the disequilibrium ignored and constant term omitted [49]. In order to get rid of spurious regression, the study deployed the most approach of panel co-integration and panel VECM by overcoming the loss of essential information. For the first time, [50] presented the error correction model to eliminate the constraints of differencing. The mechanism of the ECM approach stated that extension of disequilibrium in the system was adjusted in following period [50].

In this study, data is panel based and stationary of all the variables are confirmed at first difference, similarly, co-

integration between the variables also present. Thus, Panel VECM is most appropriate model in order to dig out the short run as well as long run causalities between the anticipated variables. That is why, vector error correction models are applied in order to evaluate these instead of following the unrestricted VAR. Because, VECM assumes restricted VAR approach which enforce the limitations for the existence of long run association among the variables. The following is the equation of the Panel VECM model.

Here

= First difference

K= Optimal lags based on SIC

Equation 1 restricts us to long and short run directional relationship. For instance, in long run Air transport, freight does granger cause economic growth but in other case all co-efficient of are equal to zero. While for reverse checking of causality, the index volatility of price index does not granger cause export, all co-efficient of are equal to zero. The present situation of long run and short run of causality test through significance of t-test on coefficient λ and error correction term ECTit is found.

**GRANGER CAUSALITY TEST:** The granger causality test is employed in order to predict the relation of two time series so that the determination of hypothesis can be done. So the below mentioned equation is developed.

Here t represents time, economic growth is being represented with Yt, while Xt represents all independent variables over time, lags of gdp are shown with Xt-j &Xt-m, while lags of all independent variables are shown though Xt-p &Xt-s and  for time t, are white noise vector.

**RESULTS AND INTERPRETATION:**

Descriptive statistics:

**Table 1**

|  |  |  |  |
| --- | --- | --- | --- |
|  | LNGDP | LNATP | LNTE |
| Mean | 5.231183 | 11.88252 | 2.800731 |
| Median | 5.976370 | 12.00000 | 2.802901 |
| Maximum | 55.00000 | 99.00000 | 33.00000 |
| Minimum | 1.000000 | 1.000000 | 1.000000 |
| Std. Dev. | 3.296124 | 7.718442 | 2.354137 |
| Skewness | 9.639821 | 8.125033 | 11.30341 |
| Kurtosis | 147.9163 | 94.09575 | 145.6228 |
| Jarque-Bera | 315243.6 | 124156.3 | 163343.3 |
| Probability | 0.000000 | 0.000000 | 0.000000 |

Correlation

**Table 2**

|  |  |  |  |
| --- | --- | --- | --- |
| Correlation | LNGDP | LNATP | LNTE |
| Probability |  |  |  |
| LNGDP | 1.000000 |  |  |
|  | ----- |  |  |
| LNEGS | 0.286556 | 1.000000 |  |
|  | 0.0003 | ----- |  |
| LNTE | 0.082852 | 0.200811 | 1.000000 |
|  | 0.3007 | 0.0114 | ----- |

Data Stationary Test:

**Table 3**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Series | Levin, Lin & Chu Test | | | | Im, Pesaran and Shin Test | | | | Result |
| Level | | First difference | | Level | | First Difference | |
| T-stat | Prob.  Value | T-stat | Prob.  value | T-stat | Prob.  Value | T-stat | Prob.  Value |
| GDP | 0.98428 | 0.8375 | -11.088 | 0.0000 | -12.9290 | 0.0000 | -0.85173 | 0.1972 | I(1) |
| AT | -0.5210 | 0.3012 | -12.880 | 0.0000 | -2.31009 | 0.104 | -15.6843 | 0.0000 | I(1) |
| TE | 1.13020 | 0.8708 | -2.2137 | 0.0134 | -0.37466 | 0.354 | -6.04709 | 0.0000 | I(1) |

We employed panel VECM model to examine long run and short run causality. LLC and IPS panel unit root tests are being utilized to know stationary of the projected variables. Table 1 represents descriptive statistics of the study. Table 2 represents the correlation test of the study. Table no. 3 represents results of LLC and IPS of unit root tests that is at level and first difference. Based on the results of LLC and IPS, it is asserted that all the variables (GDP, AT, TE) when at level these are non-stationary but after applying the first difference on all variables turn stationary at first difference.

*Panel Co-integration test (KAO co-integration test)*

**Table 4**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob. |
| ADF |  |  | 2.627658 | 0.0043 |
|  |  |  |  |  |
| Residual variance | | | 1.974943 |  |
| HAC variance | |  | 0.100364 |  |
| Null Hypothesis: There is no co-integration | | | | |
|  |  |  |  |  |

Johansen Fisher Panel Co-integration Test

**Table 5**

|  |  |  |
| --- | --- | --- |
| Hypothesized No. of CE(s) | Fisher Stat. \*  (from trace test) | Fisher Stat.\*  (from max-Eigen test) |
| None | 45.94 [0.000] | 34.82 [0.000] |
| At most 1 | 19.96 [0.010] | 14.89 [0.061] |
| At most 2 | 15.95 [0.043] | 15.95 [0.043] |

Note: No cointegration is the null hypothesis for panel co-integration test. Optimal lags for Fisher and Kao Panel Co-integration tests based on SIC are 2 and 2 respectively.

Before continuing to the Panel vector error correction model to deal with long run co-integration between Air transport, Time to export and economic growth, it is necessary to discover order of integration of series. Table 5 represents the outcomes of unit root test showed that whole variables of model are non-stationary at levels and turn stationary at first difference. While the lag length criteria SIC proposed five as optimal lags. Next step is to test the presence of long run association amongst variables. This study utilized [51] and Kao co-integration to look whether there exists co-integration relationship or not. This co-integration methodology mainly centered to discover the number of Co-integration vectors in the framework. Table 4 indicates the outcomes of KAO and test of Johansen Co-integration in the view of Trace statistics and Max Eigenvalue correspondingly. Both test demonstrated the long run association among non-stationary variables entering in model. The null hypothesis of no co-integration was rejected: alternative hypothesis is accepted at 5% level of significance by co-integration tests. Results indicated that there exist long run association among Air transport, Time to export and GDP per capita.

Normalized long run relationship of PVECM

**Table 6**

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | Coefficients | Standard Errors | T-value |
| ln ATP(-1) | 0.5792 | 0.1116 | 5.1811 |
| ln TE(-1) | -0.7083 | 0.3883 | -1.9249\* |
| C | 4.067 |  |  |
| CointEq1 | -0.1283 | 0.055 | -2.3029 |
| R-squared | 0.48 |  |  |
| F-statistic | 4.36 |  |  |
| Note: \* indicates 10% level of significance |  |  |  |
| Serial correlation test LM test | 30.29 (0.4343) |  |  |
| Heteroscedasticity test ARCH test | 231.77 (0.2630) |  |  |

Table 6 indicates that Air transport is the most vital factor of economic growth of SAARC economies. The impact of Air transport on economic growth is significant at 1% level of significance. The coefficient (0.57) of ln (ATP) demonstrates that 1% increase in ATP prompts to 57 percent increment in economic growth over the long run. It implies that Air transport is an important element in economic growth of SAARC economies. While Time to export is also significantly and negatively associate with economic growth at 10% level of significance. The coefficient (-0.70) of ln (TE) demonstrates that 1% increase in TE leads over to decrease 70 percent in economic growth over the long run.

The ecmt-1 coefficient demonstrates how rapidly dependent variables come back to equilibrium and it ought to have a negative sign with high significance level. The coefficient of ECT term -0.12 seems to be highly significant at 5% level of significance. Profoundly significantly negative indication of the error correction term strengthens the presence of long-run relationship among the factors. Nonetheless, the speed of change from earlier year’s disequilibrium in economic growth to current year’s equilibrium is just 12%.

Finally R-square value indicating that there is 48% variation into model just because of projected independent variables while, model is also free from serial correlation and Heteroscedasticity

Panel VECM based Granger Causality Test:

Granger Causality Test: SAARC economics

**Table 7**

|  |  |  |  |
| --- | --- | --- | --- |
| Null hypothesis | F-statistics | Prob. | Decision |
| ln ATP does not Granger Cause lnGDP | 4.20 | 0.52 | Unidirectional |
| ln GDP does not Granger Cause lnATP  ln TE does not Granger Cause lnGDP  ln GDP does not Granger Cause lnTE | 12.65  3.51  1.62 | 0.02  0.62  0.89 | Causality  No  Causality |

Table 7 Shows results of Panel VECM base granger causality test, results indicating that there exists a short run causality running from lnGDP to ln ATP in short run while no causality among lnTE and lnGDP in short run.

Forecast Error Variance Decompositions.

**Table 8**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Bb |  |  |
| Period | S.E. | GDP | ATP | TE |
|  |  |  |  |  |
| 1 | 1.278113 | 100.0000 | 0.000000 | 0.000000 |
| 2 | 1.310284 | 98.12436 | 1.874561 | 0.001080 |
| 3 | 1.349362 | 95.60711 | 4.391820 | 0.001066 |
| 4 | 1.427920 | 92.91453 | 6.957190 | 0.128283 |
| 5 | 1.468562 | 90.59051 | 9.174523 | 0.234963 |
| 6 | 1.548745 | 89.75434 | 9.833926 | 0.411737 |
| 7 | 1.657833 | 88.41088 | 10.82066 | 0.768462 |
| 8 | 1.703381 | 87.18876 | 12.06949 | 0.741754 |
| 9 | 1.758445 | 86.18739 | 13.07119 | 0.741421 |
| 10 | 1.815883 | 85.20110 | 14.00978 | 0.789121 |
|  |  |  |  |  |

Table 8 demonstrates variance decomposition outcomes. It’s an econometric strategy first time frequently utilized after VAR model. The main goal is forecasting. With this approach, business analyst could observe the amount of forecast error variance of each factors can be disclosed by exogenous shock to other factors.

Table 8 shows that in primary time frame, economic growth of SAARC economies traits 100% of its changes to its own specific shock rather than to any factors. However, from second period to onward till period ten ATP continuously attributes to change in economic growth (proxies by GDP) by increasing trend, therefore it can be argued that ATP is a dominant factor to observe economic growth.

**DISCUSSION AND CONCLUSION:**

The study determines the Granger causal relationship among determinants like air cargo, transit time associated with GDP of the South Asian countries. The empirical results are in favor of our literature as a long-run unilateral Granger causality is directing from economic growth. As compared to the previous studies, we didn't observe any bi-directional causality relationship between economic growth and its determinants. So, this confirms our hypothesis that causality and dimensions of spatial analysis matter.  The SAARC region with very low income and high population appears to have some measurable changes in the related small logistics sector that do not have a significant influence on the big size of GDPs comparing with relevant countries.

Likewise, our results give indication that there is no short run causal relationship among transportation mode, time to import or export, and GDP and that the long-run impacts on time to import, export activity only with a time lag of four and five years respectively. These are very crucial findings suggesting us policy insinuations for relevant departments, development houses as well as for logisticians, seaports, airports, transport planners, freight forwarders, governments, and policy makers of SAARC member economies. The countries of this region have mean growth rate of 6% annually, and that is continuously growing for several years now. Also, it is predicted to increase even rapidly in nearby future because this is a disposable income per capita. The interested prospective stakeholders are needed to make safe investment, to plan and overcome logistics infrastructure for supporting an increase in transport demand. In short, a clear relationship is detected between transportation and level of development. We inferred that all SAARC members have not completely achieved their desired level of development.

By using Granger causality on panel data from 1980 to 2014 the research found that import, export and their related transport services have impact on growth of GDP of SAARC countries. Although, the evidence is found in long run while the results are not supported in short run. Furthermore unidirectional relation offers insight into the significance of and the context of causality and spatial dimensions. In future other factors such as foreign direct investment can be studied using rigorous multivariate methods in econometrics.

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