

Relationship between tourism and economic growth: cyprus



ABSTRACT

Although the relationship between international trade and economic growth has found a wide application area in the literature over the years, this can not be said about tourism and growth or trade and tourism. This study employs co-integration and Granger causality tests to examine long-run relationship between tourism, trade and growth, and the direction of causality among themselves for Cyprus. Results reveal that tourism is not co-integrated either with growth or trade whereas latter two are co-integrated and there is bidirectional causation between tourist arrivals and growth, between exports and growth and finally between exports and imports in Cyprus. Finally, results suggest unidirectional causation from tourist arrivals to export growth in Cyprus.

I. INTRODUCTION

International tourism and international trade are two major sources of foreign exchange for small countries as well as larger ones. Small countries, in particular small islands, have more dependency on tourism and trade than the larger ones since their economies are based on only a few sectors. For example, according to Kuznets (1966), as the country gets smaller, its dependency on international trade would increase. On the other hand, although many economists agree that small countries have similar advantages and disadvantages when compared to larger ones, there are differences in the origin of these disadvantages. Among common disadvantages are international tourism/trade dependency, vulnerability, high population growth rate, limited labor force, low labor efficiency, diseconomies of scale, low GDP (Gross Domestic Product), high dependency

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on imports of intermediate and consumption goods, and production of only a few basic goods/services.

The small size of a country, in terms of area and population, may be economically advantageous. The smallness of a state in terms of area and population may in fact be a source of comparative advantage rather than being a constraint on economic growth and development. Specifically, smallness may be more than compensated by certain unique characteristics possessed by small states. Export-oriented services tend to represent such uniqueness and, therefore, a basis for a potential comparative advantage (Mehmet and Tahiroglu 2002).

In the last few decades, some small states have been important service centers in banking, financial and trade services. Among them are Singapore, Hong Kong, Bahrain, Bermuda, Malta, Jersey and Cyprus. The tourism sector has been a locomotive industry for some small economies and the sole source providing a comparative advantage. Bermuda is a good example in the sense that it has emerged as a tourism center, successfully exploiting the ability to take advantage of a favorable climate and location. The strategic location of small states also serves as an important factor for providing banking and financial services. In the Mediterranean Sea, two examples of this category are the south of Cyprus and Malta. Bermuda, Bahrain and Jersey are among other states as studied by Bowe et al. (1998). On the other hand, in the north side of Cyprus, higher education emerged as number one sector contributing to national income of the country. Having restrictions on international trade and tourism industry with other countries, Turkish Cypriots living in the north of Cyprus succeeded in establishing and <https://assignbuster.com/relationship-between-tourism-and-economic-growth-cyprus/>

developing higher education institutions that attracts many foreign students from different regions of the world. Currently, there are six universities in North Cyprus where they attract students and academicians from more than 69 countries (SPO 2004).

International tourism not only contributes to economic welfare of countries but also to their socio-cultural, environmental and ecological activities (Lindberg and Johnson, 1997; Bull, 1991; Ryan, 1991; Pearce, 1989). Luzzi and Flückiger (2003) defines international tourism not as an industry but as a single, complex and differentiated product. It is complex because it includes a wide variety of goods and services, and differentiated because each destination has unique features. On the other hand, the purpose of tourism can be in different forms: Leisure tourism, business, visiting friends and relatives, education, conferences, or sports. Thus, international tourism is a major contribution to the welfare of countries in every field. As a result of these activities, tourists are likely to consume and purchase of goods/services that bring economic impact to every sector of countries such as transportation, accommodation, tour operators and shopping areas (See also Chang, 2000).

There is an unverified question of whether international tourism growth actually causes economic growth or does economic growth contributes to tourism growth instead. Empirical studies of the relationship between tourism and economic growth have been less rigorous in tourism literature (Oh, 2005). International tourism receipts are a major source of foreign exchange together with export revenues that well compensate current account deficits as well due to the fact that tourism spending serves as an

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alternative form of exports contributing to ameliorated balance of payments in many countries (Oh, 2005). On the other hand, since international tourism contributes to every sector of the economies, budget deficits also benefits from these activities via tax revenues. As McKinnon (1964) argues international tourism brings foreign exchange that can be used to import intermediate and capital goods to produce goods and services, which in turn leads to economic growth. Balaguer and Jorda (2002) prove the validity of tourism-led hypothesis for the Spanish economy where the Spanish economy is the second largest recipient of international tourist earnings (5.9% of its GDP) in the world after the United States (Oh, 2005). However, there is a question if this hypothesis can be proved for other countries. Therefore, the tourism-led hypothesis deserves further attention for the other economies.

On the other hand, many studies in the literature proved the importance of international trade for economic growth well. Some support export-led hypothesis while others support import-led hypothesis for particular countries. Although results on the direction of relationship between international trade and economic growth are still again inconclusive (Balaguer and Jorda, 2002), these studies prove that international trade is crucial for economic growth of many countries (Shun and Sun, 1998; Xu, 1996; Jin, 1995; Bahmani-Oskooee and Alse, 1993; Marin, 1992; Chow, 1987). Recent theoretical literature provides two main mechanisms through which international trade may affect growth. The first is its effect on the rate of innovation. The second is its effect on the adoption rate of technologies from more advanced countries that also increases the economy's rate of total factor productivity growth (Proudman et al., 1998).

International tourism and international trade mean greater integration into the world economy which also brings benefits to the economies such as employment creation, foreign exchange earnings, government revenues, and income and employment multipliers (See also Clancy 1999). There have been numerous studies analyzing the effects of international tourism and trade sectors on especially developing economies. However, the linkages between international tourism and international trade did not find a wide application area in the literature (See Shan and Wilson, 2001). Do international tourist arrivals promote international trade, or does international trade promote tourist arrivals, or is there feedback causality among them? When international tourism leads to international trade, there will be an increase in import demand for foreign goods/services as well as an increase in export earnings through its service account of balance of payments. Another implication of international tourism for international trade is that it increases the image of domestic goods/services around the world which create new trade opportunities (Shan and Wilson, 2001; Kullendran and Wilson, 1998). On the other hand, when international trade leads to international tourism, this might happen through business travel which in turn causes holiday travels at later stages as a result of greater trade opportunities. Therefore, the relationship between international tourism and international trade is another issue that deserves further attention from the researchers.

Aim and Importance of the Study

Having the importance of this issue that deserves further attention, this study empirically investigates the possible co integration and causal link <https://assignbuster.com/relationship-between-tourism-and-economic-growth-cyprus/>

between international tourism, international trade and economic growth in a small island, the south of Cyprus, which has become a new member to European Union (EU) apart from May 1, 2004 and is a developed country with 15.1 billion US\$ GDP and 20,701 US\$ per capita income as of 2004 figures (Statistical Service, 2004).

There are important implications and motivations for doing this study: First, international trade plays an extremely important role amidst economic concerns, on the other hand, little mention is of international tourism, in spite of its importance among foreign expenditure items (Luzzi, 2003); and majority of empirical studies on tourism forecasting are built on tourism demand functions. As Shan and Wilson (2001) mention several areas remain incomplete in this sort of studies and hence deserve further studies. For example, first, the role of international trade as one of the determinants of tourism demand is not well recognized in these studies. Thus, this study will search the relationship of not only international tourism growth with economic growth but also with international trade growth in a small island.

Second, the econometric techniques used in the previous studies of international tourism are generally poor lacking new developments in econometrics such as co integration and Granger causality concepts (Shan and Wilson 2001; Lim 1997; Song et al. 1997; Witt and Witt 1995).

Additionally, this study is unique in the sense that it for the first time searches the link between international tourism, international trade and economic growth triangle at the same time by employing the latest econometric techniques in the field where previous empirical studies in the literature considered the link between any pair of them for particular

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countries (Oh, 2005; Shan and Wilson, 2001; Clancy, 1999; Andrew, 1997; Wagner, 1997; Zhou et al., 1997) till the moment.

Third, another implication of this study is that although there have been extensive studies (Andronikou, 1987; Ioannides, 1992; Clements and Georgiou, 1998; Ayers, 2000; Cope, 2000; Ioannides and Holcomb, 2001; Sharpley and Forster, 2003; Sharpley, 2002) analyzing the development and management of tourism in Cyprus; however, none of them has considered its impact on economic growth and international trade in the literature.

Furthermore, there are very few studies analyzing international trade and its effect on economic growth of Cyprus (Andrikopoulos and Loizides, 2000; Ayres, 1999; Pattichis, 1999; Asseery and Perdikis, 1991; Kamperis, 1989). Therefore, empirical studies deserve attention to be made for the South Cyprus economy. Yet, the results of this study for the first time are expected to give important implications for this island economy.

And fourth, Cyprus problem has been at the agenda of world countries for more than 40 years. Now, the south of Cyprus became a member of the EU whereas the north of the island does not benefit the EU regulations. Thus, this situation will continue to deserve attention from the world countries and the results of this study are also expected to give important messages to policy makers.

The paper proceeds as follows. Section II overviews the literature on international tourism, international trade and growth and gives brief summary of tourism and trade in Cyprus. Section III defines data and

methodology of the study. Section IV provides results and discussions and the paper concludes with Section V.

II. TOURISM, TRADE AND GROWTH

Evidence from Literature

This section attempts to provide a review of the literature with an emphasis on international tourism, international trade and economic growth. Exports and international tourism receipts postulate the existence of various arguments for which both exports and international tourism receipts become a main determinant of overall long run economic growth. More specifically, export revenues and international tourism receipts bring in foreign exchange which can be used to import capital goods in order to produce goods and services, leading in turn to economic growth (Balaguer and Jorda, 2002; Xu, 1998). Thus, international trade and international tourism can be thought of one within the other that together contributes to economic growth. Exports plus imports divided by GDP is a well known measure for openness of a country (See Yanitkaya, 2003). Since small economies have more trade dependency, the openness rate of these countries is also higher than larger ones. Recent theoretical literature provides two main mechanisms through which international openness may affect growth. The first is its effect on the rate of innovation. The second is its effect on the adoption rate of technologies from more advanced countries that also increases the economy's rate of total factor productivity growth (Proudman et al. 1998).

Whether export promotion leads to economic growth has been subject to considerable debate in the development and growth literature. Newly

industrialized Asian countries – in particular, Hong Kong, Singapore, Korea, Taiwan, Malaysia and Thailand – can be cited as examples of countries experiencing export-led growth (ELG). This strategy of growth has doubled their standards of living in every ten year cycle. Many studies have tested the ELG hypothesis for economic growth to search for the relationship between export growth and economic growth. Extensive empirical studies in the literature have adopted the concept of causality proposed by Granger (1969) and Sims (1972) to detect the causal relationship between exports and output. Many of the studies in the empirical literature show conflicting results. Furthermore, although exports are a component of GDP and thus lead directly to the growth of output, while some studies found support for the export-led growth hypothesis (i. e. Chow, 1987; Bahmani-Oskee and Alse, 1993; Xu, 1996), some others have found negative relationship, even for the economies that are well known for their export promoting policies (i. e. Jung and Marshall, 1985; Darrat, 1986; Ahmed and Kwan, 1991; Dodaro, 1993).

The new trade theory has contributed to the theoretical relationship between exports and growth regarding effects on technical efficiency (Doyle 2001). Rivera-Batiz and Romer (1991) show that expansion of international trade increases growth by increasing the number of specialized production inputs. However, this outcome is ambiguous when there is imperfect competition and increasing returns to scale (Doyle 2001). Krugman (1979), Dixit and Norman (1980) and Lancaster (1980) show economies of scale as a major cause of international trade, hinting the validity of the growth-led exports hypothesis. There are extensive empirical studies of the Trade-Led Growth

(TLG) hypothesis which fail to produce conclusive findings (Giles and Williams 1999; Deme 2002). Some empirical studies in the literature confirmed the TLG hypothesis for some countries whereas some others rejected it for some other countries, while, on the other hand, some studies in the growth literature support the ELG hypothesis and while some others investigate the Import-Led Growth (ILG) hypothesis (Deme 2002).

In the last decade, in addition to cross-country applications, time series and causality analyses examining the export and economic growth relationship has gained importance. Additionally, the concept of the ILG hypothesis was also practically considered in addition to the ELG hypothesis having the fact that imports are mainly vital for raw materials, as well as intermediate goods and capital goods which are used in the production process of exported goods and services. This mechanism stimulates economic growth for many countries. In the work of Bahmani-Oskooee and Alsee (1993), bidirectional causality between export growth and economic growth was empirically tested.

Chang (2000) added imports to the relationship between exports and GDP and founded a bidirectional relationship between income and exports, income and imports, and exports and imports in the case of Taiwan. Arize (2002) found a long run convergence and therefore a long run equilibrium relationship between exports and imports using data for 50 countries around the world. This was parallel to the findings of Fountas and Wu (1999), Granger (1986), Gould and Ruffin (1996) and Husted (1992). Howard (2002) worked on the causality between exports, imports and income (GDP) in Trinidad and Tobago, a petroleum exporting country where oil export booms <https://assignbuster.com/relationship-between-tourism-and-economic-growth-cyprus/>

raise income levels but are usually followed by a slump. He found a unidirectional Granger causation from exports to income and bidirectional causation between exports and imports, and imports and income. He also hinted to the importance of the relationship between export growth and income due to a promotion of export sector as a key to economic growth and development in most of the developing countries.

Chow (1987) found a bi-directional causality export growth and economic growth for Hong Kong, Israel, Singapore, Taiwan and Brazil, unidirectional causality from export to economic growth for Mexico and no causality between these two for Argentina using the Sims procedure. Jung and Marshall (1985) used Granger causality tests and supported the ELG hypothesis for four out of thirty seven developing countries under consideration. They also found significant output growth and export growth relationship for three countries, an export-reducing growth relationship for six countries and a growth-reducing exports relationship for three countries. The empirical literature on ELG world wide generally shows that export growth plays an important role in economic growth, although many countries have recently adopted liberalization in their trade policies. Empirical studies also proved that developing countries with favorable export growth have experienced high economic growth rates. Therefore, this shows that exports are one of the major sources of foreign currency for national economies.

Recently, few studies have applied new developments in econometrics including co integration and Granger Causality procedures to tourism studies (Shan and Wilson 2001). The effect of international tourism on economic growth of countries has found limited application area in the literature. <https://assignbuster.com/relationship-between-tourism-and-economic-growth-cyprus/>

Balaguer and Jorda (2002) tested international tourism as a long run economic growth factor for Spain using co integration and Granger causality techniques. They confirmed the tourism-led hypothesis through co integration and causality testing for the Spanish economy. They also confirmed that economic growth in Spain has been sensible to persistent expansion of international tourism. On the other hand, Hazari and Sgro (1995) developed a model that indicated that world demand for tourism would have a positive effect on the long run economic growth of a small economy. Shan and Wilson (2001) found bidirectional causation between international travel and international trade for China. They also imply that trade flows do not link with tourism in China. Therefore, Shan and Wilson (2001) suggest that previous tourism studies using single equation approaches may lead to biased estimates since they fail to consider possible feedbacks between trade and tourism, because international trade (both exports and imports) and international tourism are found to reinforce each other in many countries.

Tourism and Trade in Cyprus

Cyprus has an open, free-market, serviced-based economy with some light manufacturing. It promotes its geographical location as a “ bridge” between West and East, along with its educated English-speaking population, moderate local costs, good airline connections, and telecommunications. In the past 20 years, the economy has shifted from agriculture to light manufacturing and services. The service sector, including tourism, contributes 75. 7% to the GDP and employs 70. 7% of the labor force (Statistical Service, 2004). Over the years, the services sectors, and tourism <https://assignbuster.com/relationship-between-tourism-and-economic-growth-cyprus/>

in particular, provided the main impetus for growth. Trade is vital to the Cypriot economy - the island is not self-sufficient in food and has few natural resources. Thus, as it is one of the characteristics of small islands, Cyprus has heavy dependency on foreign trade. As is typical of island nations with strong tourism sectors, Cyprus runs consistent merchandise trade deficits which are partially offset by strong surpluses in services trade with foreigners, but the net result of these two largest components of the current account balance is a current account deficit because the services surplus is smaller than the trade deficit. In 2003, Cyprus ran a current account deficit which was about 3.4 % of its GDP (Statistical Service, 2004).

Cyprus enjoys a wide range of natural resources in terms of landscape, traditional folklore, gastronomy, culture and a pleasant climate. Over the last 40 years, Cyprus has emerged as a major Mediterranean summer-sun destination (Sharpley, 2002). The successful growth of international tourism underpinned a remarkable socio-economic development on the island (Sharpley, 2002; Ayers, 2000; Seekings, 1997; Kammass and Salehi-Esfahani, 1992; Ioannides, 1992). Thus, the tourist industry in Cyprus is one of the most dynamic sectors of the economy and one of the main driving forces behind economic growth. Having this fact, the Cyprus Tourist Organization has drawn up a Strategic Plan for Tourism for the 2000-2010 period. As a marketing plan, it addresses every conceivable relevant aspect (Smith and Zwart 2002). Among the targets of this plan are to increase real revenue to CYP (Cyprus pound) 1.8 billion in 2010, to increase average spending per tourist to CYP 512 in 2010, to lessen the extent of the tourism sector's dependence on the season by realizing a 33% to 40% decrease in tourist

arrivals during the peak season (from July to September) and a simultaneous increase during the remaining period to a level of about 250, 000 tourists per month, to increase the number of tourist arrivals to 4 million in 2010 and to increase the share of return visits to 35% in 2010.

However, tourism sector has recently experienced a downturn in Cyprus largely as a result of the terrorist attacks in the U. S. and the economic slow-down in Europe. For example, total tourist arrivals showed a decline by 10.3% in 2002. Due to the events of 11 September, the year 2001 showed an increase of only 0.39%. The tourists who visit Cyprus originate mainly from Central and Northern Europe, particularly the UK (United Kingdom) and Germany. In 2004, 56.7% of total tourist arrivals (2.3 million tourists) to Cyprus were from the UK where 6.9% were from Germany and 5.7% were from Greece. International tourism receipts of Cyprus were almost 1.9 billion US\$ in 2004 where these experienced a fall between 2002 and 2004 (Statistical Service, 2004)..

Cyprus, due to its small domestic market and the open nature of its economy, considers access to international markets as of utmost importance. As a result, foreign trade has always been one of the main sectors of the Cypriot economy, contributing considerably to the economic growth of the island. Trade balance in Cyprus has been consistently unfavorable since before 1960. Given its large and expanding trade deficit, Cyprus was fortunate to have a large and growing surplus in its invisibles account, enough even to offset the trade deficit in 1987 and 1988. The major factors contributing to this surplus were tourist receipts, receipts from transfers, and income from other goods and services (such as foreign
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military expenditures in Cyprus, and foreign exchange from offshore enterprises). Trade balance was also chronically unfavorable even after 1974[1]. There were decline in exports of Cyprus after 2000s as well. The share of goods and services exports in GDP was 55. 0% in 2000, 51. 4% in 2002 and 46. 4% in 2003 (Statistical Service, 2004). The main domestic exports of Cyprus are agricultural exports, especially citrus fruits and potatoes, and manufactured products, most importantly clothing, footwear, chemicals, and machinery. The EU is the main market for the exports of Cyprus. Among the EU members in export market of Cyprus are UK (24. 4% in 2003), France (11. 0% in 2003), Germany (7. 2% in 2003), Greece (6. 4% in 2003) and Poland (3. 7% in 2003). The other major block of countries to which the exports of Cyprus continued to do well is the Arab countries. On the other hand, Cyprus is dependent on imports for many raw materials, consumer goods, transportation equipment, capital goods, and fuels. The share of goods and services imports in GDP was 60. 2% in 2000, 59. 5% in 2002 and 57. 8% in 2003. The imports of Cyprus mainly come from Russia (36. 2% of total imports in 2003), Greece (6. 4% of total imports in 2003), UK (5. 3% of total imports in 2003), Germany (5. 2% of total imports in 2003) and Italy (5. 1% in 2003) (Statistical Service, 2004).

III. DATA AND METHODOLOGY

Data used in this paper are annual figures covering the period 1960 – 2003 and variables of the study are real gross domestic product (GDP), real trade volume (exports plus imports), real exports, real imports and total tourists visiting and accommodating in tourist establishments of Cyprus. Data are taken from World Bank Development Indicators CD-ROM (World Bank, 2004)

and Statistical Service of Cyprus (Statistical Service, 2004) and variables are all at 1995 constant US \$ prices.

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) [2] Unit Root Tests are employed to test the integration level and the possible co-integration among the variables (Dickey and Fuller 1981; Phillips and Perron 1988). The PP procedures, which compute a residual variance that is robust to auto-correlation, are applied to test for unit roots as an alternative to ADF unit root test.

Unless the researcher knows the actual data generating process, there is a question concerning whether it is most appropriate to include constant term and trend factor in the unit root process (Enders 1995). It might seem reasonable to test the existence of a unit root in the series using the most general of the models. That is,

(1)

where y is the series; t = time (trend factor); a = constant term (drift); $\hat{\mu}t =$ Gaussian white noise and p = the lag order. The number of lags “ p ” in the dependent variable was chosen by the Akaike Information Criteria (AIC) to ensure that the errors are white noise. One problem with the presence of the additional estimated parameters is that it reduces degrees of freedom and the power of the test.

On the other hand, the researcher may fail to reject the null hypothesis of a unit root ($\hat{\mu} = 0$) because of a misspecification concerning the deterministic part of the regression. Therefore, Doldado, Jenkinson and

Sosvilla-Rivero (1990) also suggest starting from the most general model to test for a unit root when the form of the data generating process is unknown. The general principle is to choose a specification that is a plausible description of the data under both the null and alternative hypotheses (Hamilton 1994). If the intercept or time trend is inappropriately omitted, the power of the test can go to zero (Campbell and Perron 1991). “ Reduced power means that the researcher will conclude that the process contains a unit root when, in fact, none is present” (Enders 1995: 255). A linear combination of integrated variables are said to be co-integrated if the variables are stationary. Many economic models entail such co-integrating relationships (Enders 1995).

On the other hand, Perron (1989, 1990) and Perron and Vogelsang (1992) suggest that a structural break in the mean of a stationary variable is more likely to bias the DF-ADF tests towards the non-rejection of the null of a unit root in the process. Perron (1990) argues that ignoring the effects of structural breaks can lead to inadequate model specifications, poor forecast, spurious unit root test results and improper policy implications. Thus, Perron (1990) proposes an integration level test for structural break, which is known as the “ Perron test” and provides the appropriate critical values[3]. In this study, Perron (1990) test was employed to see if the order of integration is changed by the structural break. The use of the Perron (1990) test in this study is justified by the fact that intervention of Turkey in 1974 had significant effects on the Cypriot economy. Perron (1990) suggest two types of methods to measure the effect of structural breaks: (i) the additive outlier model, which is recommended for series exhibiting a sudden change in

mean, and (ii) innovation outlier model, which is suggested for a gradual change in the series (See also Perron and Vogelsang, 1992). The additive outlier model was used in this study due to the fact that intervention of Turkey in 1974 was a sudden event. Thus, in this study it is assumed that there might be a structural break in 1974 for the variables under consideration.

Perron (1990) test was carried out in two steps. First, residuals were estimated using OLS (ordinary least squares) as follows:

(2)

Where $DU_t = 1$ if $t > T_b$ and 0 otherwise. T_b is the point where the break occurs. And Second, the following modified regression models were run by using OLS. The test of negativity of $\hat{\beta}_1$ is checked by using appropriate critical values reported in the study of Rybinski (1994, 1995):

(levels) (3)

(first differences) (4)

Where $(DUTB)_t = 1$ if $t = T_b + 1$ and 0 otherwise. T_b is the break year (1974 in this study), $DUTB$ is dummy variable for the break year, $\hat{\beta}_1$ is the residual obtained from equation (2) using OLS and u_t is the error term.

After the order of integration is determined, co-integration between the variables should be tested to identify any long run relationship. Johansen trace test is used for the co-integration test in this paper. Cheung and Lai (1993) mention that the trace test is more robust than the maximum eigen

value test for co-integration. The Johansen trace test attempts to determine the number of co-integrating vectors among variables. There should be at least one co-integrating vector for a possible co-integration. The Johansen (1988) and Johansen and Juselius (1990) approach allows the estimating of all possible co-integrating vectors between the set of variables and it is the most reliable test to avoid the problems which stems from Engel and Granger (1986) procedure[4]. This procedure can be expressed in the following VAR model:

(for $t = 1, \dots, T$) (5)

Where $X_t, X_{t-1}, \dots, X_{t-K}$ are vectors of current and lagged values of P variables which are $I(1)$ in the model; $\alpha_1, \dots, \alpha_{K-1}$ are matrices of coefficients with $(P \times P)$ dimensions; α_0 is an intercept vector[5]; and ϵ_t is a vector of random errors. The number of lagged values, in practice, is determined in such a way that error terms are not significantly auto-correlated. Adding X_{t-1}, \dots, X_{t-K} and $\alpha_1 X_{t-2}, \dots, \alpha_{K-1}$