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Tourism and Trade: Cointegration and Granger Causality Tests

HABIBULLAH KHAN, REX S. TOH, and LYNDON CHUA

This study uses Singapore data to examine cointegration and causal relationships between trade and tourist arrivals. This was done with respect to ASEAN, the United States, Japan, the United Kingdom, and Australia. We discovered that, contrary to the findings of others done with data from Australia, cointegration between tourism and trade exists but is not common. Granger causality is even rarer. Nevertheless, we found a strong link between business visits and imports, because businesspeople who intend to export must visit the host country. Conversely, imports encourage the exporters to visit their markets to strengthen trade ties. Business travelers appear to be selling rather than buying, because business arrivals Granger-cause imports but not exports. We also found no correlation or Granger causality within integrated trading blocks, because their integrated economies do not allow them to be treated as trading partners in the traditional sense.

Keywords: *cointegration; Granger causality; tourism; trade; Singapore*

St. Augustine once noted, "The world is like a book. He who stays at home reads only one page." Thus, since time immemorial, there has been an irresistible urge to travel, some of which has been well documented. In particular, when Marco Polo (1254-1324) traveled from Venice to Beijing, he was known mostly to have followed the Silk Road to China, simply because traders had successfully used it for centuries. After his return at the end of a 24-year sojourn, his memoirs, recognized as the greatest travelogue ever written, raised much curiosity and generated even more east-west trade. This raises two interesting questions: does trade encourage travel, and does travel in return generate trade?

The World Tourism Organization (WTO) has defined *tourism* as the activities of persons traveling to and staying in places outside their usual environment for not more than 1 consecutive year. This is done for leisure, business, and other purposes unrelated to locally remunerated work (WTO 2004). The World Tourism Organization also limited the definition of tourism to travel by individuals *between* countries and *across* national boundaries (WTO 1999). Bull (1994) further restricted tourism to the movement of people to locales other than normal living places for at least 24 hours. Thus, these definitions, taken together, exclude *domestic* tourism; foreigners arriving for work, long-term

study, or migration; and those just passing through. This collective definition of tourism is appropriate for Singapore, the subject of our study, because it is a city-state with no "domestic" tourism to speak of, and day-trippers from Malaysia visiting Singapore are not counted. Although there are many other reasons for travel (medical services, education and training, student study tours, transit, and so on), it is widely recognized that the two most important reasons for travel are pleasure and business.

Tourists of all sorts directly consume goods and services. For example, inbound visitors purchase services such as lodging and transportation. They also purchase goods such as souvenirs, food, and gasoline, some of which need to be imported. Business visitors may be negotiating sales or purchases of goods or services, or may be setting up joint ventures. Governmental agents may be negotiating bilateral or multilateral trade agreements. Thus, business travel may lead to increased international trade.

Vacation travel can also generate increased imports (Vellas and Becherel 1995). For instance, when a foreign tourist orders a Singapore sling at the famous Raffles Hotel in Singapore, the Beefeater Gin used is imported from England, the Cherry Heering comes from Denmark, and the pineapple is trucked in from Malaysia. In fact, for Singapore, out of every dollar spent by a tourist, 36 cents leak out to purchase foreign goods and services (Khan, Phang, and Toh 1995).

Conversely, when there is much trade between two countries in physical goods (for example, Singapore buys wool from Australia) or services (for example, Australia buys maritime insurance from Singapore), there will be even more business travel between the two countries. Businesspeople may return for leisure purposes or take their families to visit the countries where they do business. Or Singaporeans may be curious as to how Australians shear wool from their sheep,

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prompting a visit for leisure. And then there are luxury seekers, for example, those who may travel to Switzerland to buy expensive watches (Chul, Uysal, and Weaver 1995).

The idea that international tourism and trade may be closely interlinked and causally related is not new. Our investigation reveals that there is some published literature on this topic. On a generic basis, Gray (1970) explored the idea that international travel is a component of international trade, then went on to investigate the impact of international travel on the economy. Keintz (1971) discovered that the total value of trade is a strong predictor of the demand for travel to the United States. Thirty years later, Turner and Witt (2001), working on New Zealand data, also found that international trade plays a major role in influencing the demand for business travel. Webber (2000) elegantly examined possible cointegrations between exchange rate volatility and tourism demand. Following up on the Kulendran study (1996), in which only cointegration analysis was used, Kulendran and Wilson (2000) investigated *both* the correlational as well as the bidirectional causal relationships between international travel (business, holiday, and total) and international trade. They used data from Australia with respect to its major trading partners (the United States, Japan, New Zealand, and the United Kingdom). Working with quarterly data from 1982 to 1997, they found numerous instances when international tourism and trade are both cointegrated as well as causally related.

In this article, we investigate how *international* tourism is *cointegrated* with total international trade (exports and imports) and how each *Granger-causes* the other. Simply put, cointegration is somewhat similar to correlation, in which two series move monotonically in tandem throughout time, and *no causation* is inferred. Granger causation, however, is *lagged* correlation, so that if one series precedes another, the first is inferred to *cause* the second. We use the Engle and Granger (1987) procedure to measure the former, and the Granger (1988) causality tests to detect the latter. We will use data from Singapore, which has one of the most open economies in the world (Toh, Khan, and Lim 2004), to investigate these correlational and causal relationships between tourism and trade. This is done with respect to Singapore's major trading partners—the Association of Southeast Asian Nations (ASEAN), the United States, Japan, the United Kingdom, and Australia, in descending order of importance.

The main but not only purpose of this study is to replicate the Kulendran and Wilson study (2000) on Australia. We used Singapore data to see whether international tourism and trade are cointegrated and Granger-cause one another to the same extent as in Australia. We also attempted to find commonalities. To make our results comparable to the findings of the Kulendran and Wilson study, we also used *quarterly* and *real* data during almost the same time *period*. We similarly *adjusted* for inflation and reported only for *business* and *holiday* visitors, and also the total. We also benchmarked against almost identical *countries* and used essentially the same *methodology*.

SINGAPORE DATA

Singapore is a small island city-state in Southeast Asia about 625 square kilometers in area with a densely concentrated population of slightly more than 4 million people. It

has a developed, dynamic, and very *open* economy based on technology, world-class communications, commerce, and trade. In fact, total trade in Singapore was more than 300% of its gross domestic product (Singapore Department of Statistics 2001), primarily because Singapore is a major entrepôt center. Tourism is one of the fastest growing industries in Singapore, growing an average of 15% annually in the past 30 years. Tourism contributes to roughly 7% of Singapore's gross domestic product and constitutes 14% of its labor force. In spite of the fact that Singapore has a very open economy, it has relatively high tourism multipliers. According to Khan, Phang, and Toh (1995), the income multiplier was 1.05, the output multiplier was 1.97, and the employment multiplier was 25. Thus, tourism plays a very important role in Singapore's dynamic economy.

To perform cointegration analysis and Granger causality tests, we collected time series quarterly data on trade separated into exports, imports, and total trade for the period from Q1 1978 to Q3 2000 (91 observations). To make the data truly comparable, all trade data were converted to *real* terms by deflating all quarterly trade data to the base year 1995. We also collected quarterly data on total tourist arrivals and separately for holiday travelers (40% of the total) as well as for business travelers (18% of the total), covering the period from Q1 1978 to Q3 2000 (91 observations). We did not collect separate statistics (Singapore Tourism Board 1999) for the following arrivals: transit (18% of the total), stopover (11% of the total), and visiting friends and relatives (5.2% of the total). These types of tourists are not part of our study.

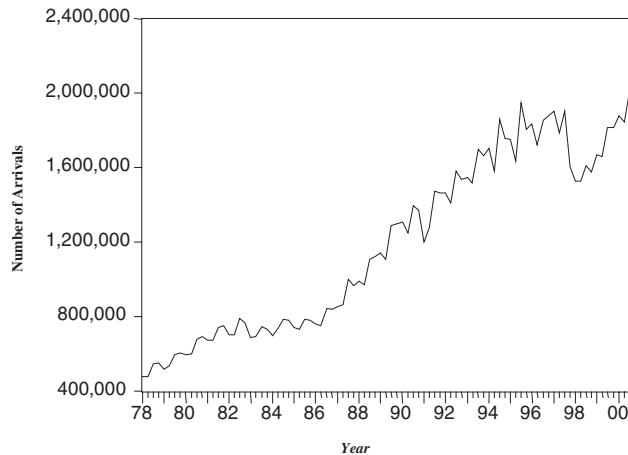
Note that for tourism statistics, we prefer to use the number of tourist arrivals, which is well documented through the compulsory completion of disembarkation cards. This is preferred over tourist expenditures calculated from sporadic small-scale tourist expenditure surveys, which tend to be subject to sampling, nonresponse, as well as measurement errors. Note that Kulendran and Wilson (2000) also chose to use tourist arrivals to document the level of tourism. All data were also seasonally adjusted to eliminate spikes in visitor arrivals so that long-term equilibrium in cointegration patterns can be better discerned. Logarithmic transformations were made before applying the various statistical procedures.

Tourist Arrivals and International Trade Patterns

We present the total tourist arrivals to Singapore from 1978 to 2000 in figure 1. The total number of visitors to Singapore consistently and rapidly increased, but it had dips in 1991 because of the Gulf War and between 1997 and 1999 because of the Asian financial crisis.

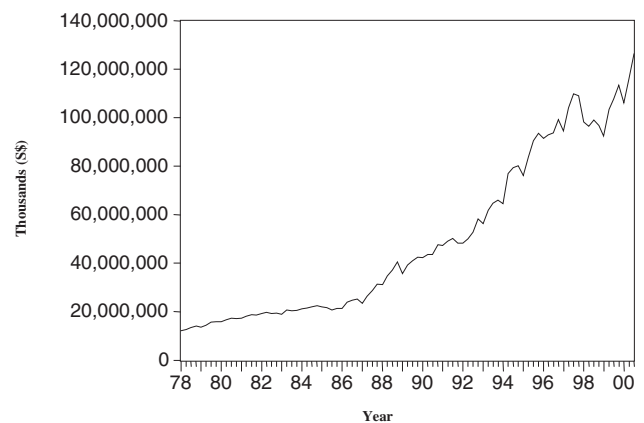
Singapore's international trade volumes (in dollars deflated to the base year 1995) from 1978 to 2000 are shown in figure 2. Note that trade also consistently and rapidly increased but had the same dips in 1991 and 1997-1999. If the tourism and trade time series had different patterns, our analyses would end here, because clearly tourism and trade are not related. But because the time series move in tandem, they could be closely cointegrated and could even suggest causal relationships. We thus proceeded to engage in more sophisticated technical analyses of the time series data.

FIGURE 1
TOTAL TOURIST ARRIVALS TO SINGAPORE,
1978-2000



Source: Singapore Tourism Board (various years).
Note: Land arrivals (mainly day-trippers) from Malaysia through the causeway are excluded.

FIGURE 2
TOTAL VOLUME OF TRADE FOR SINGAPORE,
1978-2000



Source: Singapore Trade Development Board (various years).

ECONOMETRIC METHODOLOGY FOR COINTEGRATION AND GRANGER CAUSALITY TESTS

Testing for the Order of Integration

Seasonal adjustments were done on all time series data using the Census X-11 method, and logarithmic transformations were performed on the data. We tested each series for unit roots by performing the Dickey-Fuller (DF) or Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller 1979), done on level series and first-order differenced series successively. To select the number of lag differenced or augmented terms, the equation with the minimum Akaike's information criterion (AIC) was chosen. Furthermore, the residuals were checked to make sure that they constituted white noise with constant variance. Durbin-Watson (D-W) tests were conducted to rule out autocorrelations (serial correlations throughout time). We then tested the hypothesis $H_0 : \gamma = 0$ against $H_1 : \gamma < 0$. If we could not reject the null hypothesis $H_0 : \gamma = 0$, it meant that $\gamma = 0$ and the series γ_t contained a unit root. We continued to apply the same procedure on the first-order differenced series of γ_t , second-order differenced series, and so on until we found a stationary differenced series with no unit roots. When checking for the order of integration of each series, if we rejected it at first differences, then the particular series is integrated of order 1 or $I(1)$.

Testing for Cointegration

Cointegration between two variables implies a long-run equilibrium relationship, deviations from which must be stationary. Using the procedure defined by Engle and Granger (1987), for two series to be cointegrated, both series need to be integrated of the same order, 1, or greater. If both series are stationary or integrated of order zero, there is no need to

proceed to test for cointegration, because standard time series analysis can be used. If both series are integrated at different orders, we may conclude noncointegration (Enders 1995). To test for cointegration, the long-run relationships between two variables are estimated, and the residuals from the regressions are tested for stationarity. To determine stationarity or the order of integration of these residuals, we run the autoregression of the residuals.

As with unit root testing for the order of integration, if we could not reject the null hypothesis that the residual contains a unit root, we concluded that the two series are not cointegrated. The rejection of the null hypothesis implies a stationary residual sequence, leading to the conclusion that the two variables are cointegrated. The testing procedure for the residuals is similar, because it uses the DF or ADF test. The critical values for checking stationarity in the residuals are, however, different from the ordinary DF and ADF tests, and are adapted from MacKinnon (1991). This is because ordinary ADF critical values tend to overreject the null hypothesis of noncointegration.

Testing for Granger Causality

Cointegration is a necessary but not sufficient condition for Granger causality in that mere correlation does not imply causation. Granger (1988) introduced a useful method to test for Granger causality between two variables. The basic idea is that if changes in X precede changes in Y , then X could be a cause of Y . This involves an unrestricted regression of Y against past values of Y , with X as the independent variable. A restricted regression is also required in the test, regressing Y against past values of Y only. This is to verify whether the addition of past values of X as an independent variable can contribute significantly to the explanation of variations in Y (Pindyck and Rubinfeld 1998).

In the test for Granger causality, we estimated the two regressions to test the null hypothesis that "X does not cause Y" by using the sum of square residuals from each regression

TABLE 1
COINTEGRATION RELATIONSHIPS BETWEEN
TOURISM AND TRADE FOR SINGAPORE

Relationships	Category
Total arrivals ↔ Real total trade	Nil
Total arrivals ↔ Real imports	Japan
Total arrivals ↔ Real exports	Australia, United Kingdom
Business arrivals ↔ Real total trade	Japan, United States
Business arrivals ↔ Real imports	Overall, Japan
Business arrivals ↔ Real exports	Nil
Holiday arrivals ↔ Real total trade	Australia
Holiday arrivals ↔ Real imports	Nil
Holiday arrivals ↔ Real exports	Australia

to calculate the F statistic, then tested whether the group of coefficients is significantly different from zero. The null hypothesis will be rejected if they are significantly different from zero, implying that X causes Y .

In Granger causality tests, vector error correction (VEC) models are estimated to determine the number of lag terms required to obtain the best fitting model for the unrestricted regression. This is done by checking the AIC. The appropriate number of lag lengths is then used in Granger causality tests, in which the restricted and unrestricted regressions are estimated to determine the F statistic and respective p values. In the F test, the null hypothesis is rejected when the p value is less than 10%. A rejection of the null hypothesis would mean that the first series (for example, total arrivals) Granger-causes the second series (for example, real total trade).

To perform the analyses, we used the econometric package Eviews (Version 3.1). In the interest of parsimony and readability, we have intentionally left out all the technical specifications related to our modeling. Those who are econometrically inclined can consult the references we have provided, particularly Engel and Granger (1987), Granger (1988), and Kulendran and Wilson (2000).

EMPIRICAL RESULTS AND DISCUSSION

Proceeding to examine all relationships between Singapore and other five benchmarked countries that are integrated of the same order (typically of the order 1), we obtained the results shown in Tables 1 and 2.

Figures 1 and 2 suggest that tourist arrivals and trade seem to be moving in tandem throughout time. Cointegration test results reported in table 1, however, show that overall, only total business arrivals and real imports are significantly cointegrated. Also overall, Granger causality test results reported in table 2 indicate that there is 2-way Granger causality between the two. This should not be surprising, because businesspeople who want to export their goods to Singapore must visit the country, and Singapore attracts businesspeople from the countries from which it imports.

In the case of Japan, total arrivals from Japan to Singapore are cointegrated with real imports from Japan. The same can be said for business arrivals and real total trade. This is true as well for business arrivals and real imports (see

TABLE 2
GRANGER CAUSALITY TEST RESULTS BETWEEN
TOURISM AND TRADE FOR SINGAPORE

Category	Granger Causality	Significance Level (%)
Overall	Real imports → Business arrivals	5
Overall	Business arrivals → Real imports	10
Japan	Real total trade → Business arrivals	1
Japan	Real imports → Business arrivals	1
Australia	Real exports → Total arrivals	1

Table 1). Granger causality test results outlined in Table 2 also show that Singapore's real total trade with Japan Granger-causes business arrivals from Japan, whereas real imports from Japan Granger-cause business arrivals from Japan, ostensibly to strengthen trade ties.

Patterns of cointegration and Granger causality are also seen with Australia. Table 1 shows that total arrivals from Australia are cointegrated with real exports, and holiday arrivals from Australia are cointegrated with real total trade as well as real exports. Granger causality test results in Table 2 also indicate that real exports to Australia lead to total arrivals from Australia, validating our earlier conjecture that people may travel out of curiosity to countries from which they import.

Table 1 shows that there are rare patterns of cointegration with the United Kingdom and the United States. In the case of the United Kingdom, total arrivals and real exports are cointegrated, whereas for the United States, business arrivals and real total trade are cointegrated. Table 2 shows that there are no significant causal relationships between Singapore and these two countries as far as tourism and trade are concerned. In the case of ASEAN, there is no evidence of cointegration or Granger causality whatsoever (see Tables 1 and 2). This is mostly because Singapore acts as an entrepôt center for neighboring countries such as Malaysia and Indonesia, importing and exporting on their behalf from one of the world's busiest and most efficient ports (Toh, Phang, and Khan 1995). Tourist arrivals from the neighboring ASEAN countries (particularly Malaysia) are often motivated by family relations and transit arrangements, and visit for pure pleasure and shopping.

CONCLUSION

The results of our study on cointegration and Granger causality reveal several important insights. First, merely looking at patterns of tourist arrivals and trade during an extended period may lead to misleading conclusions. Thus, even though figures 1 and 2 appear to suggest that tourism and trade for Singapore are highly correlated, our cointegration tests show that they are mostly *not* significantly cointegrated, because there is a lot of statistical noise (more about this later). The policy implication for Singapore is that for the most part, trends in international tourism cannot be used to predict the volume of international trade in the future and vice versa. Even in rare instances when cointegration exists, causation cannot be implied.

Second, cointegration between tourism and trade exists but is not common. For Singapore, tourism and trade were cointegrated in only 9 out of a total of 9 Rows \times 5 Benchmarked Countries = 45 Possible Combinations (see Table 1). Granger causality is even rarer in that it was found in only five instances (see Table 2). This is because cointegration is a necessary but not sufficient condition for Granger causality. Thus, we are *not* able to validate Kulendran and Wilson's (2000) findings suggesting that cointegration and Granger causality between international tourism and trade are common. In the case of Singapore, apparently, there is a lot of statistical noise. In particular, a previous study (Toh, Khan, and Ng 1997) showed that with respect to visitor arrivals in Singapore, the exchange rate elasticity was -0.3023 , suggesting that the higher the relative value of the Singapore dollar, the lower the demand for travel to Singapore. It also showed that the income elasticity of demand was 3.1742 , suggesting that the wealthier the visitor-generating countries, the greater the desire for their residents to visit Singapore. They found that the relative exchange rates and the changing incomes of the visitor-generating countries jointly explained away 94% of the variation in visitor arrivals. In other words, in the case of Singapore, factors other than international trade have a more compelling impact on the number of visitors. If one wanted to forecast tourism demand, there are independent variables other than international trade that provide better explanatory power.

Third, there appears to be the greatest amount of cointegration and Granger causality between business arrivals and imports, particularly imports leading to business arrivals. The weakest link is between holiday arrivals and trade. This should not be surprising because the purpose of holiday travel is for pleasure, not business. In fact, Turner and Witt (2001) found that contrary to a priori expectations, imports had a *negative* impact on leisure tourism demand. In fact, they speculated that imports may actually be a substitute for leisure travel. We conclude from *our* study that tourism and trade are sometimes intertwined, but this is mainly in the case of business visits and in particular with respect to imports. After all, Marco Polo was a trader turned adventurer.

Fourth, a very recent study by Toh, Khan, and Lim (2004) on shift-share analysis by purpose of visit found that Singapore is experiencing positive net shifts in business travel due to positive tourism mix and allocation effects. But in the case of Singapore, as we have seen, business travelers go there mostly to sell, not to buy. The same study also found that Singapore's meetings, incentives, conventions, and exhibitions (MICE) market is thriving. Therefore, as a policy implication, Singapore should use the MICE market to sell its goods and services so that business travelers to Singapore will end up buying as well as selling.

We conclude that the results from our cointegration and Granger causality tests on tourism and trade data in Singapore differ from those of Kulendran and Wilson (2000) done on tourism and trade data in Australia. This is in spite of the fact that we intentionally replicated their study as closely as possible. They found that cointegration exists in 20 instances and Granger causality in 13, whereas we found cointegration in only 9 cases and Granger causality in only 5. Apparently, international tourism and trade are more cointegrated and causally related in the case of Australia than in the case of Singapore. Also, for Singapore, we were able to find 3 cases

of Granger causality between imports and tourist arrivals, versus only 1 for exports and tourist arrivals. In the case of Australia, Kulendran and Wilson (2000) were able to find 4 instances of Granger causality between exports and tourist arrivals, versus only 1 for imports and tourist arrivals. Thus, results tend to be country specific in that people come to Singapore to sell, whereas people go to Australia to buy.

We were, however, able to validate two of Kulendran and Wilson's (2000) findings. First, compared to holiday travel, business travel is more correlated and causally related with trade—selling in the case of Singapore and buying in the case of Australia. Second, Kulendran and Wilson (2000) found no Granger causality whatsoever between tourism and trade for Australia and New Zealand. They attributed this to the Common Economic Relationship (CER) agreement, and they speculated that their integrated economies do not allow them to be treated as trading partners in the traditional sense. We, too, found no correlation or Granger causality between tourism and trade for Singapore and the trading block ASEAN, of which it is a part. We wonder whether one would find similar results within the European Union or any other common market.

Finally, we conclude that although we have found some common traits, results and findings are essentially idiosyncratic to the data. A general pattern of cointegration and Granger causality will emerge only when more studies than the two that have been done are conducted on other countries. For further research, we therefore recommend more empirical studies of the same nature. Only by a process of replication can we determine whether there is a strong relationship between tourism and trade, and, if there is, discern a general pattern.

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