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Financial portfolio approach to optimal tourist market mixes

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Abstract

This study applied a financial portfolio theory to estimate optimal market mixes to minimize the instability of inbound tourist market demand. An empirical analysis was applied to inbound tourists to Taiwan. The results shed light on diversification in tourism market and offer tourism authorities and policy-makers explicit guidelines for risk management in the destination planning process. Specifically, using optimal mixes with various return/risk options can facilitate a more stable pattern of arrivals from foreign countries. To achieve the Doubling Tourist Arrivals Plan, introduced by the Taiwanese government in 2002, the tourism authorities should take the high-return/high-risk option and shift available resources to Japan. More policy implications are provided to guide tourism authorities and policy makers.

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1. Introduction

International tourism plays a significant role in the economic development of many destination countries. It becomes an important source of business activities, contributing to income and generating employment. The tourism industry, however, shows considerable instability in demand (Sinclair, 1999). It is desirable that tourist arrivals keep increasing and contributing to the growth of income and employment. Decreased arrivals can adversely affect a local economy, with an especially substantial effect if one of the primary tourist markets sees a sharp decrease in international arrivals. Accordingly, efforts should be made to alleviate the level of fluctuation in tourist demand. Thus, the goal of volatility management for tourist arrivals from different source countries needs to be incorporated into the tourism planning process. A destination country should attract a distribution of nationalities, so the total level of volatility in tourist arrivals is minimized.

The instability of demand for international tourism may be the result of changes in exchange rates, prices, economic upheavals, political unrest, and promotional activity among other things (Sinclair, 1999). The instability pattern of arrivals can differ by nationality because tourists from each country are sensitive in different ways to changes in these variables (Board, Sinclair, & Sutcliffe, 1987). For economic, political, and social changes, different tourist nationalities have different levels of volatility, or risk, as measured by the variations in demand. Policy makers in charge of the long-term development of the tourism industry should make good use of available resources to attract a distribution of tourists by nationalities to minimize the volatility of tourism demand.

Minimizing instability in tourism demand is quite similar to stock investors trying to choose optimal portfolios that minimize return volatility. Mutual fund managers decide on optimal stock mixes that minimize return volatility (risk), based on a financial portfolio theory. In general, the portfolio theory helps investors choose the proportion of their total investment budgets to allocate to different securities. Tourism policy makers may be able to borrow the portfolio theory for deciding optimal market mixes.
In developing a financial portfolio theory, Markowitz (1952, 1959), the 1990 Nobel Laureate in economics, suggested that particular combinations of securities could reduce the overall level of instability of returns, because each security has a unique level of risk and expected return. He defines risk as a variation in return in the theory. Simply put, the portfolio theory recommends that investors construct security mixes that have minimum risks for any level of return, or maximum return for any level of risk. In the contemporary finance world, the portfolio theory has become the most popular tool to build risk-minimizing portfolios of securities, given the expected returns of the individual securities. Sets of these optimal portfolios comprise an efficient frontier, which specifies the maximum return for any risk level from the possible investments (Fig. 1). Among the optimal points on the efficient frontier, some investors may prefer lower-risk, lower-return portfolios; others, medium-risk and medium-return portfolios. Still others may choose high-risk, high-return portfolios. Given the knowledge of the investor’s return/risk trade-off and estimates of the expected return and risk associated with each security, portfolio analysis can determine optimal mixes of securities for the investor (Board et al., 1987).

The basic principles of the financial portfolio theory can be applied to optimal foreign tourist market mixes. Similar to stock markets, tourist markets have different levels of return (arrivals) and risk (instability). Even though return and risk in tourism cannot be defined in exactly the same way as in the finance field, Jang, Morrison, and O’Leary (2002, 2004) provide a hint about an application of finance-related idea to tourism research. Indeed, Jang et al. (2002, 2004) explained how return and risk concepts in finance can be applied to tourism. What they actually employed in their study includes profitability measured with mean travel expenditure, risk gauged with the standard deviation, and coefficient of variance (CV) using both mean and standard deviation. Along the similar line, we use the number of arrivals as the tourist market return and the standard deviation of a mean arrival as volatility, or market risk, in this study. As in selecting an optimal combination of securities, portfolio analysis can help determine the optimal tourist market mixes to minimize variance in demand.

The application of the financial portfolio theory is not absolutely new in travel and tourism research, but only a few studies have used the theory for optimizing regional tourism (Board et al., 1987; Board & Sutcliffe, 1991; Sinclair, 1999) and mitigating seasonality (Jang, 2004), until recently. Earlier studies using the portfolio theory for tourism have primarily dealt with specific objectives such as bed-night demand optimization and seasonality minimization. However, to make wide use of the theory in the tourism industry, it is critical to apply it using readily available data. In that respect, this study uses easily obtained tourist arrival data. Also, the uniqueness of this research among the few financial portfolio studies in tourism is that it attempts to segment foreign tourists by nationality, as often is done in the industry, and to propose an efficient frontier to tourism authorities to optimize tourist arrivals, so that they can use the frontier as a long-term guide for development and resource allocation. That is, this research provides more practical and realistic solutions to achieve destination policy-makers’ objectives of stable foreign tourism demand on a long-term basis.

Thus, the primary goal of this research is to propose and demonstrate a practical tool to help the tourism industry understand optimal foreign tourist market mixes through the financial portfolio technique. This study explores the volatility and tourist arrivals associated with Taiwanese inbound tourist markets and applies the financial portfolio theory to estimate optimal market mixes that will minimize the instability of tourist demand. Each portfolio is associated with a different expected level of arrivals and level of instability, depending on the weight taken by its component markets. The optimal mix solutions sought in this study are based upon tourist arrivals in Taiwan during 1996–2005 (a 10-year period).

This study is organized in the following sections: The next section briefly describes the Taiwanese tourism development and its contribution to economic growth in Taiwan. Section 3 presents foreign tourism demand for Taiwan. Financial portfolio theory and objective function are addressed in Section 4. Section 5 shows empirical results, and Section 6 concludes this study. The final section offers some limitations and future research direction.

2. Tourism development and Taiwanese economy

Traditionally, Taiwan has been known as an export-oriented economy (Ghartey, 1993; Jin, 1995), and the tourism sector has never been considered a leading industry in Taiwan. Nonetheless, Kim, Chen, and Jang (2006) have showed that the tourism industry contributed to the
Taiwanese economy. According to annual statistics from the Tourism Bureau of Taiwan (2003, 2004), tourism revenues accounted for 4.39% of the gross domestic product (GDP) in 1996 and 5.31% of the GDP in 2001. These figures exceeded the contribution of agriculture to the GDP in each year, showing that tourism has become a major industry in Taiwan.

Kim et al. (2006) further demonstrated that tourism expansion in Taiwan has a long-run equilibrium relationship with economic growth, and moreover, tourism expansion and economic growth reinforce each other. In other words, tourism development strengthens the Taiwanese economy, and an expanding economy also enhances the tourism industry. These empirical findings offered important guidance for government and private tourism policy makers and authorities in Taiwan. Because of the long-running equilibrium relationship and the two-way causality between tourism and economic development, both the tourism segment and other major industries require attention to stimulate both the tourism sector and the overall economy. The Tourism Bureau of Taiwan (2005, p.29) reports that “tourism activities generated a total of 279,147 full-time jobs in the food and beverage, transportation, retail trade, and lodging service industries in 2000.”

The Taiwanese government introduced the Doubling Tourist Arrivals Plan in 2002 in order to promote Taiwanese tourism. The Doubling Tourist Arrivals Plan aimed to double the number of foreign tourist arrivals in Taiwan, luring five million foreign visitors to Taiwan by 2008, and in the process, energizing the job market and the overall economy. However, the tourism industry in Taiwan took a huge hit because of the outbreak of severe acute respiratory syndrome (SARS) in 2003 (Chen, 2007; Chen, Jang, & Kim, 2007; Chen, Kim, & Kim, 2005). Chen (2007) reported that after the SARS outbreak on April 22, 2003, the number of foreign visitors to Taiwan plunged from 258,023 in March to 110,632 in April, representing a 57% drop, and to 40,250 in May, an 84% drop over 2 months.

The tourism market in 2004 recovered from the significant damage of the SARS outbreak, and total foreign tourist arrivals reached 2.95 million, an increase of 0.7 million over 2003 for an annual growth of 31.25%. In 2005, an unprecedented 3.38 million foreign tourists visited Taiwan, moving a step closer to the goal of the Doubling Tourist Arrivals Plan. To attract more foreign tourists, the Tourism Bureau further introduced another tourism promotion plan in 2005, the Tourism Flagship Plan, to promote the nation’s top attractions and cultural festivals (Tourism Bureau of Taiwan, 2005).

3. Foreign tourism demand for Taiwan

To understand the recent foreign tourism demand for Taiwan, Table 1 shows a breakdown of the recent tourist arrivals and Table 2 shows the growth rates of foreign tourist arrivals between 1996 and 2005. As illustrated in Tables 1 and 2, Taiwan’s tourism expansion, measured by total tourist arrivals, demonstrates sustained growth over the last 10 years, except for 1998, 2001, and 2003, due to the 1997–98 Asian financial crisis, the September 11 terrorist attacks in 2001 in the US, and the SARS outbreak in 2003, respectively.

The number of foreign tourist arrivals in Taiwan increased from 2,358,221 in 1996 to 3,378,118 in 2005, with an average yearly growth rate of 4.81%. Although the number generally increased, the growth of each market varied. During the 10-year period, the number of tourist arrivals by country of origin (nationality) in Table 1 shows the dominance of the Japanese market, which accounts for 34.7% of all visitors. Hong Kong is the second largest market (13.7%), followed by the US (12.8%), Thailand (4.5%), South Korea (4.0%), and Singapore (3.8%). The tourist arrivals from the top six markets account for 73.4% of all foreign visitors to Taiwan from 1996 to 2005. Fig. 2 plots the total tourist arrivals and tourist arrivals from major source countries.

We further find that the tourist arrivals from Japan, South Korea, and Malaysia/Indonesia dropped during the 1997–98 Asian financial crisis, and that the tourists from the US, Thailand, South Korea, the Philippines, Malaysia/Indonesia, Europe, and other inbound markets decreased after the 9/11 terrorist attacks in the US. Moreover, tourist arrivals from most countries, except for South Korea, the Philippines, and others, fell off after the SARS outbreak in 2003 (the overall rate of decrease: 17.55%).

Tourist arrivals from Singapore, Malaysia/Indonesia, South Korea, and Hong Kong expanded over the 10-year period, and their corresponding average growth rates (10.75%, 9.60%, 7.41%, and 7.02%, respectively) were all higher than that of the total tourist arrivals (4.81%). The standard deviation (volatility or risk) in most of the individual markets, except for Thailand, is higher than for the overall foreign tourist market. The volatility of the
South Korean market especially is more than twice the aggregate market volatility.

4. Financial portfolio theory and objective function

The portfolio analysis of Markowitz (1952, 1959) suggests portfolios with the maximum expected return for a given level of risk or the portfolio with the minimum variance for an expected return. Markowitz (1952, 1959) used a quadratic programming (QP) approach to solve the problem outlined above. We now pose a portfolio selection problem with (i) the variables that are the proportions of weights for each of the available risky assets, (ii) the quadratic objective function, which is the variance of return on the resulting portfolio, and (iii) the linear constraints.

To apply the portfolio theory to the foreign tourist market for Taiwan, we needed to divide the market into primary sub-markets. In this study, we examined ten individual markets (nationalities): Japan, Hong Kong, the

Table 1
Foreign tourist arrivals in Taiwan by nationality market: 1996–2005 (Unit: thousand)

| Year | Japan | Hong Kong | USA | Thailand | South Korea | Singapore | Philippines | Malaysia and Indonesia | Europe | Others | Total foreign tourist arrivals |
|------|-------|-----------|-----|----------|-------------|-----------|-------------|------------------------|--------|--------|------------------------------|
| 1996 | 918   | 263       | 290 | 121      | 127         | 78        | 112         | 106                    | 152    | 191    | 2358                         |
| 1997 | 906   | 260       | 304 | 122      | 99          | 82        | 119         | 109                    | 159    | 212    | 2372                         |
| 1998 | 827   | 280       | 309 | 129      | 63          | 87        | 126         | 97                     | 160    | 221    | 2299                         |
| 1999 | 826   | 320       | 318 | 138      | 63          | 86        | 123         | 129                    | 162    | 233    | 2411                         |
| 2000 | 916   | 361       | 360 | 133      | 84          | 95        | 84          | 165                    | 161    | 265    | 2624                         |
| 2001 | 971   | 431       | 339 | 117      | 83          | 97        | 69          | 146                    | 148    | 214    | 2615                         |
| 2002 | 986   | 462       | 354 | 106      | 80          | 107       | 74          | 152                    | 147    | 258    | 2726                         |
| 2003 | 657   | 323       | 273 | 98       | 93          | 79        | 80          | 105                    | 119    | 421    | 2248                         |
| 2004 | 887   | 417       | 383 | 103      | 148         | 117       | 87          | 137                    | 165    | 506    | 2950                         |
| 2005 | 1124  | 433       | 391 | 94       | 183         | 166       | 92          | 195                    | 172    | 528    | 3378                         |
| Total | 9019 | 3549      | 3319| 1160     | 1035        | 994       | 967         | 1343                   | 1546   | 3049   | 25,981                        |

Note: Numbers in parenthesis are mean market shares in the overall foreign tourist market.

Table 2
Growth rate of foreign tourist arrivals (Unit: percentage)

| Residency | Japan | Hong Kong | USA | Thailand | South Korea | Singapore | Philippines | Malaysia and Indonesia | Europe | Others | Total foreign tourist arrivals |
|-----------|-------|-----------|-----|----------|-------------|-----------|-------------|------------------------|--------|--------|------------------------------|
| 1997      | −1.35 | −1.11     | 4.74| 1.12     | −21.81      | 4.35      | 7.05        | 2.17                   | 4.49   | 11.23  | 0.59                         |
| 1998      | −8.71 | 7.80      | 1.57| 5.26     | −36.42      | 6.34      | 5.53        | −10.75                 | 0.59   | 4.26   | −3.10                        |
| 1999      | −0.05 | 14.26     | 3.05| 7.34     | 20.67       | −1.35     | −2.60       | 33.25                  | 0.96   | 5.32   | 4.90                         |
| 2000      | 10.90 | 12.97     | 13.13| −3.47 | 9.96       | 10.55     | −31.64      | 27.59                  | −0.49  | 13.55  | 8.82                         |
| 2001      | 5.99  | 19.17     | 5.60| −12.59  | −1.25       | 1.98      | −17.80      | −11.51                 | −8.24  | −19.00| −0.36                        |
| 2002      | 1.53  | 7.39      | 4.33| −9.12   | −3.06       | 10.96     | 7.44        | 3.68                   | −0.62  | 20.24  | 4.28                         |
| 2003      | −33.37| −30.11    | −22.94| −7.00 | 15.89      | −26.67    | 7.76        | −30.72                 | −19.06 | 63.25  | −17.55                       |
| 2004      | 35.04 | 29.06     | 40.30| 4.78    | 59.43       | 48.42     | 8.72        | 30.29                  | 38.79  | 20.30  | 31.25                        |
| 2005      | 26.71 | 3.75      | 2.12| −9.24   | 23.24       | 42.19     | 5.83        | 42.45                  | 4.58   | 4.36   | 14.50                        |

Mean: 4.08 7.02 4.52 −2.55 7.41 10.75 −1.08 9.60 2.33 13.72 4.81
Maximum: 35.04 29.06 40.30 7.34 59.43 48.42 8.72 42.45 38.79 63.25 31.25
Minimum: −33.37 −30.11 −22.94 −12.59 −36.42 −26.67 −31.64 −30.72 −19.06 −19.00 −17.55
Standard deviation: 19.81 16.50 16.69 7.38 27.77 22.62 14.23 24.91 15.53 21.98 13.31
USA, Thailand, South Korea, Singapore, the Philippines, Malaysia/Indonesia, Europe, and others (all other countries). We further considered that the expected return and the variance of any optimal solution in a portfolio model depend on a combination of the above markets’ demands.

To quantify the individual market demands, we considered both the growth rates of arrivals from different countries and the number of tourist arrivals. We decided, however, not to use the growth rates, because the resultant mixes may not provide practical, meaningful solutions for Taiwan. If growth rates had been used, the growth rate of Singapore (10.75%) would have to be treated as higher return than the growth rate of Japan (4.08%), which would indicate that Singapore is a much more important market than Japan, despite its small market size. In reality, however, Japan, which generates more arrivals (return), should be more important. In other words, the optimal solutions are decided purely by the variance-covariance combination of growth rate, assuming that the number of arrivals from countries is almost the same. Thus, using the growth rates may lead to erroneous solutions for Taiwan. In addition, the number of arrivals in tourism can be understood as comparable to return on investment (ROI) in the stock market, even though arrivals represent the static size of demand and ROI means changes in stock price. Tourist arrivals coming from a source country—from a destination perspective—are the number of tourists that a destination gains from that market (the country), whereas ROI from a stock is what an investor earns from the stock investment. It is reasonable to consider arrivals in tourism as analogous to the ROI in the stock market. Thus, the study decided to use the number of tourist arrivals to Taiwan from individual countries (markets).

Nevertheless, it is necessary to note the exact difference between the tourist arrivals of this study and the return of Markowitz’s financial portfolio theory. As mentioned above, the return of the portfolio theory represents the rate of return from investing in stock, but tourist arrival is different from a real financial return because investment is not considered. Therefore, what this study pursues is not to examine solutions for optimal financial returns on tourism investment but to find tourist arrival instability solutions through an application of an underlying idea included in the financial portfolio theory.

The algorithm of the financial portfolio theory applied to foreign tourist markets is as follows: The weight of each individual market within the portfolio plays an important role in determining the overall arrivals. First, the expected return (mean arrivals) of a portfolio comprising n markets is the weighted average of the expected return of each market in the portfolio:

$$E(r_p) = \sum_{i=1}^{n} w_i E(r_i),$$  \hspace{1cm} (1)

where $E(r_p)$ is the expected return of the portfolio, w_i the proportion of market i in the portfolio, $E(r_i)$ the expected return on market i, and n the number of markets in the portfolio.

Second, the variance of returns of the portfolio depends on the variance and covariance of markets in the portfolio. Thus, for a two-market portfolio, the variance of the portfolio returns can be expressed as

$$\text{Var}(r_p) = \sigma_p^2 = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1w_2 \text{Cov}(r_1, r_2),$$ \hspace{1cm} (2)

where $\text{Var}(r_p)$ is the variance of returns of the portfolio; $\sigma_i^2$ the variance of returns of market i; $\text{Cov}(r_1, r_2)$ the covariance of returns between markets 1 and 2, which measures the extent to which returns of markets 1 and 2 move together; $\rho_{12}$ the correlation coefficient between returns of markets 1 and 2; $w_1$ and $w_2$ the weights of markets 1 and 2, respectively, where $w_1 \geq 0$ and $w_2 \geq 0$ and $w_1 + w_2 = 1$.

When $\text{Cov}(r_1, r_2) = 0$, returns of markets 1 and 2 are not correlated. It is obvious that the variance of the portfolio returns would be

$$\text{Var}(r_p) = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2.$$ \hspace{1cm} (3)

Since $0 \leq w_1 \leq 1$ and $0 \leq w_2 \leq 1$, $w_1^2 \leq w_1$, and $w_2^2 \leq w_2$. Accordingly, the variance of returns of the portfolio would be less than the weighted sum of the variances of the individual markets. Correlation coefficient ($\rho_{12}$) is bounded between $-1$ and 1. When $\rho_{12} < 1$, then the variance of the portfolio will be less than the weighted sum of the individual markets. Apparently, if arrivals from different markets are negatively correlated, the benefits (reduction in portfolio variance) from diversification will be greater. When $\rho_{12} = -1$ (perfectly negative correlation), the portfolio variance will fall to zero.

Now we must discover all possible efficient portfolios that can be formed from the available markets. An efficient portfolio will offer the maximum expected arrivals for varying levels of risk and offer minimum risk for varying levels of expected arrivals (see Fig. 1). To find all possible efficient portfolios, we must calculate the expected arrivals and variance of each market and the pair-wise covariances between markets. After computing the expected arrivals and the variance/covariance matrix, the problem is reduced to the optimization of a quadratic function subject to constraints. The variance and expected returns of individual efficient portfolios can be calculated based on the following model:

Objective function: \hspace{0.5cm} Min $\sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j \neq i}^{n} w_i w_j \text{Cov}(r_i, r_j)$, \hspace{1cm} (4)

Subject to:

$$\sum_{i=1}^{n} w_i = 1,$$ \hspace{1cm} (5)
\sum_{i=1}^{n} w_i E(r_i) = E(r_p), \quad (6)

w_i \leq C1i, \quad i = 1, \ldots, n, \quad (7)

and

w_i \leq C2i, \quad i = 1, \ldots, n. \quad (8)

When varying the expected arrivals of the portfolio \( E(r_p) \), the algorithm given above will enable us to identify the composition of a range of portfolios, from the one with the highest expected arrivals to the minimum variance portfolio. This allows tourism marketers to select the level of risk and expected arrivals that are consistent with their preferences.

For the constraints of each market, as given in Eqs. (7) and (8), we decided that the weights (\( w_i \)) of individual markets have subjective upper and lower limits, as tourism marketers view them. To allow the flexibility of changes in weights for markets, we used the highest possible market weights as upper constraints, set by the highest market shares during the last 10 years times 1.5 (assuming 50% growth in market share), whereas we used the lowest market weights as lower constraints, decided by the lowest market shares during the same 10-year period minus 50% of the lowest market shares (assuming 50% loss). (See upper limits and lower limits in Table 4.) Again, the 50% growth and loss assumptions for this study are subjective, as decided by the authors, so other constraints can be applied to different destinations in practice, depending upon their unique situations and prospects. In addition, different levels of constraints can be applied to individual markets, if necessary.

5. Optimal tourist market mixes

Before seeking optimal tourist market mixes, mean yearly arrivals from different markets and their variance/covariance matrices were calculated (see Table 3). Mean arrival represents the demand size of each tourist market. Each market showed a different level of demand during the 10-year period. The Japanese market had the highest mean number of arrivals, followed by Hong Kong and the US. Among major foreign tourist markets, Thailand, South Korea, Singapore, and the Philippines were relatively small markets for Taiwan. However, the larger the mean number of arrivals, the higher the variance in arrivals on average. For example, Japan showed a mean arrival number of about 901,900, but its standard deviation was also the largest, which indicated the most serious instability over the period. On the other hand, Thailand’s mean visitors to Taiwan were about 116,000, but its variability was close to the lowest, meaning that Thailand was among the least volatile markets.

To concurrently understand the demand and instability level of each market, we used the CV, which is the standard deviation divided by its mean (the mean arrival in this study) (Brigham & Gapenski, 1988; Jang et al., 2002, 2004). The standard deviation simply measures the dispersal of the expected arrival numbers around the mean, while the CV serves as an instability-to-arrival ratio. The CV indicates the relative risk per arrival and provides a more meaningful basis for comparison when the mean arrivals of markets are not the same. As presented in Table 3, Europe, the US, Thailand, and Japan show the lowest levels of CV, indicating the least relative instability of demand.

Similarly, risk-adjusted mean arrival, which is mean arrival divided by standard deviation, indicates the relative demand level of each market after adjusting for instability. Mathematically, risk-adjusted mean arrival is simply a

| Variance–covariance matrix | Japan | Hong Kong | USA | Thailand | South Korea | Singapore | Philippines | Malaysia and Indonesia | Europe | Others |
|----------------------------|-------|-----------|-----|----------|-------------|-----------|-------------|-----------------------|--------|--------|
| Japan                      | 13,339| 4503      | 3169| (358)   | 2130        | 2164      | (468)       | 2598                  | 1056   | 1713   |
| Hong Kong                  | 4503  | 5270      | 2159| (568)   | 728         | 1258      | (1174)      | 1670                  | 92     | 4219   |
| USA                        | 3169  | 2159      | 1419| (167)   | 681         | 794       | (318)       | 959                   | 337    | 2415   |
| Thailand                   | (358) | (568)     | (167)|208    | (329)       | (218)     | (168)       | (138)                  | 53     | (1364) |
| South Korea                | 2130  | 728       | 681 | (329)   | 1266        | 669       | (93)        | 504                   | 196    | 3225   |
| Singapore                  | 2164  | 1258      | 794 | (218)   | 669         | 637       | (163)       | 622                   | 183    | 2211   |
| Philippines                | (468) | (1174)    | (318)|168    | (93)        | (163)     | (141)       | (315)                  | 113    | (907)  |
| Malaysia and Indonesia     | 2598  | 1670      | 959 | (138)   | 504         | 622       | (315)       | 876                   | 183    | 1649   |
| Europe                     | 1056  | 92        | 337 | 53      | 196         | 183       | 113         | 183                   | 197    | 147    |
| Others                     | 1713  | 4219      | 2415| (1364)| 3225        | 2211      | (907)       | 1649                  | 147    | 14,964 |

Mean yearly arrivals (A) 901.9 354.9 331.9 116.0 103.5 99.4 96.7 103.5 96.7 134.3 154.6 304.9
Standard deviation (risk) (B) 115.5 72.6 37.7 14.4 35.6 25.5 20.3 25.5 20.3 30.7 29.6 14.0 122.3
Coefficient of variance (CV) (B/A) 0.13 0.20 0.11 0.12 0.34 0.25 0.21 0.34 0.21 0.22 0.09 0.40 0.40
Risk-adjusted mean arrivals (A/B) 7.8 4.9 8.8 8.0 2.9 3.9 4.8 4.5 4.5 11.0 2.5

Note: 1. Parenthesis means negative numbers. 2. Others in the last column mean all other countries that are not included in the previous columns.
reciprocal of CV. Thus, Europe, the US, Thailand, and Japan are at the highest level, meaning that the four markets have the highest expected arrival numbers after considering instability.

As presented in Table 3, the signs of the covariance were mostly positive, except for Thailand and the Philippines, indicating that tourist arrivals from most markets were positively correlated over the 10-year period. In applying the financial portfolio theory, negative or low positive correlation among the markets can effectively reduce the instability of arrivals. Some instability reduction effects, however, can be still expected if markets are not perfectly correlated. To obtain the minimum variance and covariance at a certain level of mean arrival subject to constraints, QP was used in this study, as explained in the previous section. There are many software packages available for QP; we used the Solver program, which was developed as an extended version of Microsoft Excel for optimization problems.

An infinite number of optimal market mixes may satisfy the objective of QP and its constraints. As shown in Table 4, a set of the mix solutions were found for obtaining the minimum variances of mean market arrivals. With the upper and lower limits from Table 4, point A was identified with mean yearly market arrivals of 300 and its standard deviation of 42.79. As mean arrivals go up following points B and C, standard deviations go down, unlike our expectation, indicating that points A and B are not optimal mixes. At point C, the minimum variance portfolio, which offers a standard deviation of 35.62 and an expected mean market arrival of 304, was achieved under the upper and lower constraints. At that point, the US should top the market share (20.6%), followed by the Japanese market (14.6%), Europe (10.5%), and Malaysia/Indonesia (9.5%).

To achieve point C, when compared to data from 2005, Taiwan should increase arrivals from the US, Thailand, South Korea, Singapore, the Philippines, Malaysia/Indonesia, and Europe while decreasing from Japan and Hong Kong. The point warrants the most stable arrivals across the markets but the least arrivals are expected. At point F, the Japanese market becomes the largest (21.1%), with a rapid drop for Singapore. When the volatility level goes up following points G, H, and I, the market shares of South Korea, Singapore, Malaysia/Indonesia, and Europe rapidly decrease, while the Japanese market quickly captures the largest share. At point I,

| Point | Mean yearly market arrivals (A) | Standard deviation (risk) (B) | Mean arrivals–instability ratio (AIR) (A/B) | Expected maximum total market arrivals |
|-------|---------------------------------|--------------------------------|---------------------------------------------|--------------------------------------|
| A     | 300                             | 42.79                          | 7.01                                        | 2186                                 |
| B     | 303                             | 36.74                          | 8.25                                        | 2207                                 |
| C     | 304                             | 35.62                          | 8.53                                        | 2215                                 |
| D     | 305                             | 35.76                          | 8.53                                        | 2222                                 |
| E     | 310                             | 35.79                          | 8.66                                        | 2258                                 |
| F     | 350                             | 39.94                          | 8.76                                        | 2550                                 |
| G     | 400                             | 45.38                          | 8.82                                        | 2914                                 |
| H     | 450                             | 50.92                          | 8.84                                        | 3278                                 |
| I     | 500                             | 57.29                          | 8.73                                        | 3643                                 |
| J     | 550                             | 64.32                          | 8.55                                        | 4007                                 |
| K     | 600                             | 71.68                          | 8.37                                        | 4371                                 |
| L     | 647                             | 81.03                          | 7.98                                        | 4713                                 |

Note: UL and LL denote the upper limit (C1) and lower limit (C2).
Japanese tourist arrivals show more than a 40% share of the overall markets, but Hong Kong, South Korea, Singapore, and Malaysia/Indonesia decrease down to their bottom constraints. That is, in order to realize point I, Taiwanese tourism authorities need to focus on Japan, the US, Thailand, the Philippines, and Europe. At points J and K, the Japanese market continues growing but the USA and Europe lose their shares. At point L, the greatest mean arrival (647) is achieved, but instability (81.03) is also maximized. To achieve point L, Taiwan should focus on the Japanese market (58.4%), maintain efforts on Thailand (8.6%) and the Philippines (8.2%), but minimize weights for the rest of the countries. Overall, the extreme risk-taking policy makers would pursue the point L, by seeking the suggested market shares at L, so that they can reach the most arrivals possible. On the other hand, extreme risk-avoiders will seek point C to reach the lowest instability level.

Arrival–instability ratio (AIR) was then calculated as mean yearly market arrival divided by standard deviation to measure the relative arrival level after adjusting for instability. The ratio should provide better information for comparison because it considers arrivals and instability at the same time. The points F, G, H, and I were identified as the highest level, all above 8.7 in the AIR. Thus, as optimal foreign tourist arrivals, selecting one point between F and I, depending on the destination’s demand-instability preference, is appropriate. If the policy makers, however, have a strong preference for the high-arrival/high-instability option, they can choose point L or for the low-arrival/low-instability mix, they can choose point C.

Based upon the arrival data, mean market arrivals for 2005 (463.7) were calculated using a weighted average method of summing products of arrival from each country and its weight. Total arrivals in 2005 were 3.378 million, so the expected total market arrivals from foreign countries were estimated by proportional equations. For example, at point I (mean arrivals: 500), total arrivals would be 3.643 million ( = 3.378 x 500 /463.7). In other words, the maximum expected arrivals at point L under the current upper and lower limits would be 4.713 million, which is slightly lower than the Taiwanese Doubling Tourist Arrivals Plan of five million.

The efficient frontier, the line connecting all the optimal tourist market mixes of Table 4, was generated (see Fig. 3). Any portfolio mix that lies on the frontier has the least instability, defined as the least variation in arrivals. Any points in the interior of the frontier line are not efficient, because points on the frontier guarantee more arrivals at the same level of instability or less instability at the same level of arrivals. Thus, policy makers should choose any points that fall along the frontier by allocating their available resources, as suggested by the optimal mix solutions of Table 4. As explained earlier, the optimal mix depends on an individual’s return/risk (arrival/instability, in this study) trade-off preference. Thus, the points between F and I are highly recommended as results of the AIR, which represent relatively high levels of arrivals after adjusting for instability.

6. Implications and conclusions

Using the financial portfolio theory, this study illustrates how Taiwan, as a destination, can obtain optimal foreign tourist market mixes to minimize variability in visitor arrivals. As explained in the previous section, there could be a set of optimal market mix solutions. Taiwan tourism authorities can choose one of the obtained solutions, according to their return (arrivals)/risk (instability) preference. If they pursue a high-return/high-risk solution, they have to focus their efforts on the Japanese market. In addition, they need to increase the visitors from Thailand and the Philippines to mitigate the volatility of the Japanese market. To achieve the Doubling Tourist Arrivals Plan, Taiwan should take the high-return/high-risk option and shift available resources to Japan. The market shares of recent years shown in Table 1 indicate a rapid rise in the Japanese market, as suggested, but the share patterns of Thailand and the Philippines are not in the same direction that the optimal mixes demonstrate in Table 4.

If a medium return/medium risk is the target, the market weights of Japan and the US should be raised to slightly more than the current level. Also, increasing the number of tourists from Thailand and the Philippines would be necessary. For the low-return/low-risk option, tourism policy makers of Taiwan should allocate fewer resources for Japan and instead should use more resources for other markets, especially the US, to increase numbers of tourists. Overall, to stabilize tourism demand from foreign countries, Taiwan should maximize visitors from Thailand and the Philippines, regardless of return/risk preference, because the two countries show negative correlations to the rest of the countries, meaning that they can greatly contribute to smoothing out the fluctuations of foreign tourists to Taiwan.

As noted earlier, international tourism is an important part of generating income and employment in many countries. However, the instability of tourism demand
has been criticized as a critical drawback, leading to adverse effects on a local economy. Efforts have been directed toward increasing the diversification of tourism products, but studies as to how to mitigate the instability level have been rare. This study stresses volatility management for foreign tourist arrivals and illustrates how to achieve quantitative solutions using financial portfolio analysis. Even though the portfolio theory was not developed for the tourism market, portfolio mixes can give useful information to travel destinations, providing a better picture and understanding of each tourist market to help policy makers effectively devise strategies for long-term tourism development and also help policy makers focus on the concept of risk management.

After market mixes options are estimated, it is important to compare the actual mix of tourists to the optimal mix, which will allow consideration of current standing and future direction. This may provide guidelines for a marketing program aimed at influencing market distribution and, ultimately, making tourism a stable industry. The suggested mix of each market may serve as a guide or stimulus to policy makers to explore significant shifts in resources but probably cannot be implemented without modification. One such modification could involve specifying upper and lower limits for the weights of markets. The limits used in this study are only one example. Thus, they can be adjusted for policy-makers’ preferences.

7. Limitations and future research

Despite the practical importance of this study, there are some limitations. First, unlike stock markets, it is not possible to instantly adjust the market composition of tourist arrivals. Thus, the optimal market mix solutions can be used as a long-term objective, but not as a short-term goal. Second, tourist arrivals often follow a trend over time, but Markowitz’s portfolio theory is not designed to address any specific trend. Instead, the theory simply considers interrelationships among markets. Thus, the solutions on the frontier do not reflect trends that may be the reasons behind arrival patterns. That is why it is important to consistently monitor the frontier of the same destination by conducting analyses on a regular basis.

Third, even though special events, such as the Asian financial crisis, the September 11 terrorist attacks in the US, and the SARS outbreak, greatly and abnormally influence fluctuations in tourism demand, Markowitz’s portfolio theory used for this study does not focus on the abnormality caused by those events. Thus, this study does not pay attention to abnormal changes in tourism demand. However, the variance–covariance matrix for the portfolio solutions overall reflects specific fluctuations in demand and interrelationships with other markets. In this respect, this study addresses the instability of special events from an overall perspective.

Fourth, expected arrivals and instability level data are based upon historical means and variances, which may not be appropriate for future decision-making. Thus, a future study may use the most recent data and/or forecast data to obtain the most feasible mixes to accommodate the destination’s strategic plan. Also, locating actual portfolios and comparing them with the efficient frontier to see how close the actual portfolios have been to optimal solutions would be another meaningful future study. Lastly but not least, because this study focused on minimizing the tourist arrival instability, the implicit assumption is that each arrival from different countries brings equal economic benefit to the Taiwanese tourist market. Thus, it would be more practical to consider the expenditure level of tourists from different source countries as a future study.

This study may spur the application of the financial portfolio theory to tourism settings, which should improve travel and tourism business operations. To reinforce the practicality of the optimal mix solutions, more constraints should be included that are uniquely important to each destination. In addition, because the tourism market situation changes quite often, it is desirable to double-check the optimal portfolio mixes whenever major events happen in order to fine-tune the destination’s long-term development.

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