Estimating the Impact of Whaling on Global Whale Watching*

Hsiao-I Kuo
Department of Senior Citizen Service Management
Chaoyang University of Technology
Taichung, Taiwan

Chi-Chung Chen
Department of Applied Economics
National Chung Hsing University
Taichung, Taiwan

Michael McAleer
Econometric Institute
Erasmus School of Economics
Erasmus University Rotterdam
and
Tinbergen Institute
The Netherlands
and
Institute of Economic Research
Kyoto University
and
Department of Quantitative Economics
Complutense University of Madrid

Revised: June 2011

* The authors wish to acknowledge the helpful comments and suggestions of three reviewers. The third author acknowledges the financial support of the Australian Research Council, National Science Council, Taiwan, and the Japan Society for the Promotion of Science.

Abstract

After the commercial whaling moratorium was enacted in 1986, whale watching became one of the fastest growing tourism industries worldwide. As whaling was regarded as an activity that is incompatible with whale watching, the possible resumption of commercial whaling caused an urgent need to investigate the potential negative effects of whaling on the whale-watching industry. We examine the potential impacts of whaling on the global whale-watching tourism industry using an unbalanced panel data model. The empirical results indicate that the resumption of commercial whaling has the potential for a negative effect on the global whale-watching industry, especially for nations that are engaged in commercial whaling.

Keywords: Global whale watching, Commercial whaling, Delay-difference equation, Unbalanced panel data.

Ⅰ. Introduction

Since the International Whaling Commission (IWC) moratorium on commercial whaling was enacted in 1986, whale watching has become the most economically viable and sustainable use of cetaceans (Parsons and Rawles, 2003). Whale watching is defined as tours by boat, air or from land, whether formal or informal, with at least some commercial aspects, to see, swim with, and/or listen to any of the some 83 species of whales, dolphins and porpoises (Hoyt, 1995, 2001). The industry is currently one of the fastest growing sectors of the international tourism market, which expanded rapidly throughout the 1990s.

Whereas only 31 countries and overseas territories practiced whale-watching operations in 1991, this had risen to 65 in 1994, and to 87 in 1998 (Hoyt, 1995, 2001). The number of whale watchers and tourism expenditure has increased from a little more than 4 million spending US$318 million in 1991, to 5.4 million tourists spending US$504 million in 1994, and to 9 million tourists spending US$1,059 million in 1998. In 2008, the new, country-by-country economic analysis shows more than 13 million people took whale watching tours in 119 countries worldwide, with more than US$2.1 billion expenditure (O'Connor et al., 2009).

Such explosive whale-watching growth has led to management problems, including too many close approaches and sometimes collisions with cetaceans, too many boats on the water in a limited area, strain on the infrastructure of local communities from too many visitors, and a lack of guidelines and regulations and/or enforcement of them (Hoyt, 2008). Since the late 1990s, researchers have tried to determine whether the whale-watching activities might lead to long-term negative impacts on whale and dolphin populations. Bejder et al. (2006) and Lusseau et al. (2006) indicated that repeated exposure of individuals to boat-based whale-watching led to long-term impacts on small, inshore populations of dolphins living in restricted

areas such as Doubtful Sound, New Zealand; eastern Vancouver Island, Canada; and Shark Bay, Australia. However, there is much that can be done to manage the development of whale-watching to minimize the risk from adverse impact, for instance, better regulation, better enforcement, and the education of whale-watching operators, passengers, and other mariners using their boat (Hoyt, 2008). The negative impact of whale-watching activities on whale and dolphin populations, therefore, can be controlled by useful management processes.

In recent years, some pro-whaling countries, including Japan, Iceland and Norway, have lobbied against the ban on commercial whaling moratorium in order to resurrect the whaling industry. The World Wide Fund (WWF, 2003) notes that whale-watching companies and the tourism industry believe that a resumption of whaling would have a significant negative impact on the growing whale-watching industry. There are two major opinions to show how the resumption of whaling might injure the growing whale watching industry. First, from a recreational and tourism perspective, whaling is usually regarded as incompatible with whale watching. From this perspective, whaling might reduce the number of whales available for watching, disturb or alter the regular activities of those animals, lead to negative attitudes of whale watchers or potential tourists towards whaling, and decrease the satisfaction of whale watchers (Hoyt and Hvenegaard, 2002).

Second, with respect to the attitudes of tourists towards whaling, Herrera and Hoagland (2006), Parsons and Rawles (2003) and Orams (2001) indicated that whale watchers reacted negatively to commercial whaling, and whale watchers were likely to be discouraged by activities such as whaling that directly compromise animal welfare. There are some surveys of whale watchers that show strong evidence that whale watchers do not accept the resumption of commercial whaling. For instance, in a survey of whale watchers in Iceland (Parsons and Rawles, 2003), 91.4% of whale

watchers would not take a whale-watching trip if Iceland were to resume hunting whales. Furthermore, Orams (2001) showed that 83% of yacht-borne visitors and 95% of aircraft-borne holidaymakers were resolutely opposed to the commercial hunting of whales in Tonga.

In previous research, there has been little consideration of how the resumption of commercial whaling might impact on the global whale-watching industry. Taking the reductions in the number of whales available for watching and the negative images of the whaling country into consideration, this paper examines the potential impacts of whaling on the global whale-watching tourism industry. First, as the species of whales that will possibly be available for whaling is the minke whale, the research target is focused on minke whales if the ban on commercial whaling ban is lifted. Before estimating a global whale-watching tourism demand model, a popular approach for estimating population dynamics of minke whales, namely the delay-difference equation model, is developed to calculate the size of the whale population. Second, in order to investigate the reactions of whale watchers to whaling countries, the influence of aboriginal and commercial whaling will be examined and compared.

As the whale-watching industry in each country began in different years, the data have an unbalanced panel structure, with varying numbers of observations over time for different countries. The unbalanced pooled data set consists of a total of 182 observations for 63 countries or territories in 1991, 1994, 1998, and 2008. The random effect approach is employed to estimate whale-watching tourism demand models. The econometric software package used is EViews 7.0.

The remainder of the paper is as follows. Section 2 presents a brief illustration of whaling and whale-watching tourism. Section 3 introduces the econometric approaches and data set. The results of the empirical estimation are analyzed in Section 4. Finally, concluding remarks and policy implications are given in Section 5.

Ⅱ. Whaling and Whale-watching Tourism

At the beginning of the 20th Century, the global whale population dramatically declined due to commercial whaling activities that were fueled by the growing demand for whale meat and oil, as well as new technological developments in whale catching skills. The Blue whale, Humpback whale, Fin whale, Right whale and Sei whale have each subsequently become endangered species (The World Conservation Union, 2006). Primarily for this reason, the IWC moratorium on commercial whaling was enacted in 1986.

Under the IWC rules of the commercial whaling moratorium, aboriginal whaling conducted by communities in several countries, including Denmark (Greenland), the Russian Federation (Siberia), St. Vincent and the Grenadines (Bequia), and the USA (Alaska), who hunted for subsistence purposes, were recognized by the IWC. Aboriginal whaling quotas must be approved by a 3/4 majority vote at an IWC meeting. However, despite the IWC global moratorium on commercial whaling, whales have still been caught commercially in Japan and Norway over the past 20 years. Japan continues to catch hundreds whales annually, exploiting a loophole for "scientific research", and sells whale products of meat and oil commercially in Japan, while Norway conducts an openly commercial hunt under a legal objection to the moratorium (World Wildlife Fund, 2003; Hoyt, 2008). In addition, Iceland has also begun to hunt whales through the "scientific" loophole in 2002, and commenced commercial whaling in 2006 (Humane Society of the United States, 2008).

Besides hunting whales through the "scientific" loophole or engaging in commercial whaling, several countries with strong whaling interests, such as Japan, Iceland and Norway, have applied pressure to lift the ban on commercial whaling to resurrect the whaling industry. In order to achieve the pro-whaling majority, Japan has

had to invest heavily in recruiting nations to support their efforts to abrogate the moratorium (Humane Society of the United States, 2007). Six pro-whaling countries, including St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Grenada, the Dominican Republic, Antigua and Barbuda, proposed a bill that would allow 0.5% of the whale population to be hunted. Such a proposal was signed with Iceland, Norway, Japan, and Russia during the 58th conference of the IWC in 2006. The resumption of commercial whaling must be approved by a 3/4 majority vote, so that the pro- and anti-whaling nations, numbering 33 and 32, respectively, have enabled the commercial whaling ban to still hold.

Two distinct groups, one in favour of 'sustainable' whaling and one completely opposed to any killing of whales, continue to debate at the IWC and other political arenas (Cisneros-Montemayor et al., 2010). As these pro-whaling countries strive to abrogate the commercial whaling moratorium, whale catching activities may once again be allowed in the near future. If the submission declaring the moratorium no longer necessary is passed, the whale-watching industry may be threatened by whaling.

Japan, Iceland, and Norway are pro-whaling countries with strong whaling interests. During the 1990s and 2000s, commercial whaling and whale-watching occurred simultaneously in Norway and Japan. Whale-watching became more important in these two countries in the same period. However, the annual growth of whale-watching industries in these two countries might serve as evidence of the negative impacts of the resurrected whaling on whale-watching industries. First, Asia has emerged as the world's important new whale watching destination in the past two decades. The number of whale watchers has increased from 10,992 in 1991 to over 1 million in 2008 (making it 8% of global whale watchers), and accounting for $66 million in total expenditure (O'Connor et al., 2009).

In Asia, the number of whale watchers has grown at an astonishing 17% per annum since 1998. However, in the whaling country of Japan, the number of whale watchers has grown since 1998 at an average annual rate of 6.4%, from 102,785 in 1998 to 191,970 in 2008 (O'Connor et al., 2009). Furthermore, comparing the European region and the specific country - Norway, an annual growth in Norway (4.8% per year) was less than the average growth in the European region (7.1% per year) since 1998 (O'Connor et al., 2009).

In the other pro-whaling country - Iceland, whaling has been banned since 1989 amid international pressure (Björgvinsson, 2003). However, the strong whaling interest pushed against the ban to hunt whales through the "scientific" loophole in 2002, and commenced commercial whaling in 2006 (Humane Society of the United States, 2008). On the contrary, the whale-watching industry in Iceland began in 1991, with various species, including the blue, fin, humpback, minke whales, and orcas, and then became a major whale-watching destination in Europe. Iceland became one of the fastest growing whale watch destinations in the world (Hoyt, 2008). The number of whale watchers in Iceland increased from 100 tourists spending US$ 17,000 in direct expenditures in 1991, to 30,330 tourists spending about US$3.5 million in direct expenditures in 1998 (Hoyt, 2001).

In 1998, Iceland had already shown an explosive growth in the whale watching industry compared to 1994 (251% per year) (Hoyt, 1995, 2001). Since then, the number of whale watchers grew slightly with an annual average increase of 14%, from 30,330 in 1998 to 114,500 in 2008 (O'Connor et al., 2009). The decreasing annual average growth rate might show the negative impact of whaling on whale-watching industry, which was resumed in 2002.

As mentioned above, these data might serve as evidence of the negative impacts of the resurrected whaling on whale-watching industry in these three pro-whaling

countries. As the whale-watching industry has provided considerable income for economies and created a positive image, the importance of whale-watching to the tourism economy has been recognized. In addition, if commercial whaling is allowed in the future, more catches of whales may result in fewer whales for whale watching, and possibly even removing some other whales, and decreasing the attraction of whale-watching tourism. Taking the reductions in the number of whales available for watching and the negative images of the whaling country into consideration, the impacts of whaling on the global whale-watching tourism industry will be investigated in this paper.

Ⅲ. Model and Data

A. Model of Global Whale-Watching Tourism Demand

The purpose of this paper is to develop a global whale-watching tourism demand model and to estimate the impacts of whaling on global whale watching. The demand for tourism, as for other goods and services, depends on the prices of goods and consumer income. Basic economic theory shows that demand for most "normal" goods or services is negatively related to the price of the goods or services, and positively related to consumer income (Lim, 1997; Waggle and Fish, 1998). Schiff and Becken (2011) indicate that prices and tourist income are the most commonly used variables to explain tourism demand. Furthermore, as for whale watching tourism, to view whales in the cetaceans' natural habitat is the primary focus of whale-watching activity (Herrera and Hoagland, 2006). Based on the observation of whale-watching behaviour, whale-watching demand model for a specific country is a function of prices, income, whale ecological characteristics, and other factors, such as

environmental opinion corrected by whale conservation objectives.

First, a larger whale population in the oceans will increase both the opportunity to contact cetaceans and the satisfaction of whale watchers, and thereby attract greater whale-watching tourism. Valentine et al. (2004) indicate that the total number of whales seen is one of numerous factors that contribute to whale tourist satisfaction. Therefore, in this paper, the whale population is used as a proxy for the whale-watching ecological characteristic. Second, as whale-watching is a category of ecotourism, whale-watching with strong environmental protection objectives may lead to a positive image in terms of animal welfare and attract more whale-watching tourists. On the contrary, if whaling is allowed in a whale-watching country, the impact on the whale-watching tourism industry will be investigated.

Third, another important component of the whale-watching price is the travel cost. However, due to the unavailability of travel cost data, per capita whale-watching expenditure is used as a proxy. Finally, the per capita Gross Domestic Product (GDP) of each origin country of whale watchers is the income variable used. Whale watchers in a specific destination may include both domestic and foreign visitors. Owing to the specific characteristics of whale watchers, the income variable consists of the per capita GDP of domestic and foreign tourists. The impacts of per capita GDP on whale-watching demand need to be aggregated. The manner in which we accommodate this global whale-watching demand function is given below.

It is assumed that the whale-watching demand function in any country can be separated into two groups, namely domestic and international tourism, so that the associated demand functions are given as follows:

$$WWD_{it} = f_1(P_{it}, DGDP_{it}, WP_{it}, ES_{it}), \quad (1)$$

$$WWI_{it} = \sum_{j=1}^{n} WWI_{ijt} = f_2(P_{it}, IGDP_{jt}, WP_{it}, ES_{it}), \quad (2)$$

Subscript *i* denotes the country and *t* denotes the time period of observation. WWD_{it} is the whale-watching tourism demand of domestic visitors in destination country *i*; WWI_{ijt} is the whale-watching tourism demand in destination country *i* from origin country *j*; WWI_{it} is the total foreign whale-watching tourists in country *i*; P_{it} is the price of whale-watching tourism in destination country *i*; $DGDP_{it}$ is the per capita GDP in origin country *i*, and is also the per capita GDP in destination country *i*; $IGDP_{jt}$ is the per capita GDP in origin country *j*; WP_{it} is the whale population in destination country *i*; ES_{it} is a dummy variable, and is 1 if the country is engaged in whaling, and 0 otherwise.

Therefore, the total whale-watching demand in destination country *i* will be the aggregate of equations (1) and (2), as follows:

$$\begin{aligned} WW_{it} &= WWD_{it} + \sum_{j=1}^{n} WWI_{ijt} = f_1(P_{it}, DGDP_{it}, WP_{it}, ES_{it}) + f_2(P_{it}, IGDP_{jt}, WP_{it}, ES_{it}) \\ &= f(P_{it}, LGDP_{it}, WP_{it}, ES_{it}), \end{aligned} \quad (3)$$

where WW_{it} is the total whale-watching tourism demand in destination country *i* at time *t*, $LGDP_{it}$ is the linear combination of GDP in the whale-watching destination country *i* ($DGDP_{it}$) and origin country *j* ($IGDP_{jt}$). As $LGDP_{it}$ should be calculated by taking into account a basket of GDP worldwide, $LGDP_{it}$ is very difficult to obtain. As the panel data set includes many countries, $LGDP_{it}$ in whale-watching destination *i* which accounts for a specific portion of the GDP in each origin country, including destination country *i* and all other origin countries *j*, can be substituted by the variable

$DGDP_i$. In addition, in order to estimate the effects of aboriginal whaling and commercial whaling on tourism respectively, two dummy variables were included to capture the perception effects of aboriginal and commercial whaling.

Therefore, in this paper, the global whale-watching tourism demand model is given as

$$WW_{it} = \alpha_0 + \beta_1 DGDP_{it} + \beta_2 P_{it} + \beta_3 WP_{it} + \beta_4 AW_{it} + \beta_5 CW_{it} + \alpha_i + \varepsilon_{it}, \qquad (4)$$

where $i = 1,...,N$, and $t = 1,...,T_i$ and, by assumption, $E[\varepsilon_{it}] = 0$ and $Var[\varepsilon_{it}] = \sigma_\varepsilon^2$. WW_{it} is the number of whale watchers in country or overseas territory i during year t; $DGDP_{it}$ is the per capita GDP in whale-watching destination country i; P_{it} is the per capita of total whale-watching expenditure, which is the price proxy for travel costs; and WP_{it} is the minke whale population available for watching in each whale-watching area.

As the species of whales that will possibly be available for whaling is the minke whale, the research target focuses on minke whales if the ban on commercial whaling ban is lifted. AW_{it} and CW_{it} are dummy variables included to capture the effects on tourism of aboriginal whaling and commercial whaling, respectively. A positive sign is expected for β_1 and β_3, and negative for β_2 and β_5. In addition, although the purpose of aboriginal whaling is for survival and not for commerce, the activities of aboriginal whaling disregard animal welfare directly. Therefore, the coefficient of aboriginal whaling (β_4) is expected to be negative.

As the whale-watching industry in each country began in different years, the data have an unbalanced panel structure, with varying numbers of observations over time for different countries. The unbalanced panel model allows different numbers of

observations for different whale-watching destinations. The data are incomplete in the sense that there are N countries observed over varying time period lengths T_i, for $i = 1,...,N$. In equation (4), α_0 represents the general intercept and α_i represents the country-specific intercepts that capture the effects of unmeasured time-invariant heterogeneity.

The fixed effects model treats the country-specific intercepts, α_i, as fixed to be measured, which is equivalent to the regression coefficients of $N-1$ nominal variables representing the countries, while the random effects model treats them as a random component of the error term. The fixed effects model is equivalent to applying OLS to the data transformed by subtracting the country-specific means from the origin data, while the equivalent transformation for the random effects model consists of subtracting only a fraction of the country-specific means (Hsiao, 2003). As there are many countries with relatively short time periods included in this paper, the fixed effects model wastes information. Furthermore, the random effects model is asymptotically efficient relative to the fixed effects model (Tuma and Hannan, 1984). Therefore, random effects estimation is used to investigate the whale-watching tourism demand models in this paper.

B. Bio-economic Model of Whale Population

One of the most popular dynamic whale population models is the delay-difference equation model, which has been used in many studies (Clark, 1976; Conrad, 1989; Conrad and Bjørndal, 1993; Horan and Shortle, 1999). The following delay-difference equation model is based on Conrad and Bjørndal (1993), where the general form of this delay-difference equation model is given as

$$Y_{t+1} = (1-m)Y_t + R(Y_{t-\tau}), \qquad (5)$$

where Y_t is the adult minke whale population in year *t*, *m* is the mortality rate, and $R(Y_{t-\tau})$ is a recruitment function which indicates that the adult minke whale population in year $t+1$ is function of the adult whale population in year $t-\tau$. Therefore, equation (5) shows that the adult minke whale population in year $t+1$ will be the survival adult minke whale population in year *t* plus the recruitment number when there is no any whale hunting activity.

The recruitment function is assumed to be a generalized logistic function when modelling whale populations (Conrad and Bjørndal, 1993), and is given as $R(Y_{t-\tau}) = rY_{t-\tau}[1-(\frac{Y_{t-\tau}}{K})^{\alpha}]$. The IWC believes that the parameter α will be 2.39 as the maximum recruitment occurring, while *r* is the intrinsic growth rate, and *K* is a positive parameter.

However, equation (5) must be modified when commercial harvest occurs. Define X_t as the number of commercial harvest, and Z_t as an escapement, so that $Z_t = Y_t - X_t$. Equation (5) is modified as follows:

$$Z_{t+1} = (1-m)Z_t + R(Z_{t-\tau}), \qquad (6)$$

In order to estimate the adult minke whale population using equation (6), some parameters, including *m*, *r*, *K*, α and τ, need to be obtained. The mortality rate (*m*) for minke whale ranges from 0.06 to 0.10, $\tau = 7$, based on the studies in Bjørndal and Conrad (1998) and Horan and Shortle(1999), while α will be 2.39, as discussed above. The intrinsic growth rate (*r*) will be simulated from 0.15 to 0.2 based on the studies in Conrad and Bjørndal (1993) and Horan and Shortle (1999), while *K* is

defined as the adult minke whale population in year 1986.

C. Data

A special survey of whale watching, which included the statistics of worldwide tourism numbers, expenditures, and expending socioeconomic benefits, was implemented by Hoyt in 1991, 1994 and 1998, and O'Connor et al. in 2009. These reports were approved by International Fund for Animal Welfare (Hoyt, 1992, 1995, 2001; O'Connor et al., 2009). As the whale-watching industry in each country began in different years, the data have an unbalanced panel structure, with varying numbers of observations over time for different countries. The total of 182 observations consists of 18 countries or territories in 1991, 39 countries or territories in 1994, 63 countries or territories in 1998, and 62 countries or territories in 2008. The 63 countries or territories in 1998 in our sample had a total of 5,907,666 watchers, which accounts for 65.64% of whale watchers worldwide. In addition, the 62 observations in 2008 had a total of 9,015,889 watchers, which accounts for 69.35% of whale watchers worldwide.

For each country, the number of whale watchers (WW_{it}) and per capita total expenditure of whale-watching (P_{it}) were collected from the Hoyt (1995, 2001) and O'Connor et al. (2009) reports. The number of whale watchers indicates people participate in whale watching, which is defined here as the observation of any of the 83 species of cetaceans in their natural habitat from any type of platform, such as small boat, sailboats, cruise ships, inflatables, kayaks, helicopters and airplanes, in-water swimming, as well as from land-based sites (Hoyt, 2001). In addition, the tourist expenditures includes whale watching tickets (direct expenditures) and expenses incurred by tourists during as well as immediately before and after whale

watching (indirect expenditures). Tourist expenditures depend on the length of stay in the whale watching destination and, therefore, on the attractiveness and the price level of the destination.

Per capita GPD ($DGDP_{it}$) in constant 2000 US$ was obtained from the statistical database of world development indicators (WDI) supplied by the World Bank (2011). Dummy variables for aboriginal whaling (AW_{it}) and commercial whaling (CW_{it}) take the value 1 in the country while this country was engaged in hunting whales for purposes of subsistence or commerce, respectively, and 0 elsewhere. Norway and Japan conducted commercial whaling over the past twenty years, while aboriginal whaling was approved in Denmark (Greenland), the Russian Federation (Siberia), St. Vincent and the Grenadines (Bequia), and USA (Alaska). We note, in passing, that Iceland resumed hunting whales through the "scientific" loophole in 2002, and commenced commercial whaling in 2006. Therefore, the impact of such commercial whaling on the whale-watching industry in Iceland's whaling will be also investigated in this paper.

Another important explanatory variable is the minke whale population for whale watching (WP_{it}). As estimating the abundance of whales that spend most of their time below the surface is difficult, IWC can only provide the minke whale population in specific years and areas applying numerous methods, for instance, ships and aircrafts for use in the Revised Management Procedure (RMP), and a combination of visual and acoustic techniques (IWC, 2008).

Table 1 lists the minke whale population in specific years and areas by IWC. However, in order to obtain the minke whale population in 1991, 1994, 1998, and 2008 in each maritime area, the delay-difference equation model is first constructed to estimate the minke whale population around the world. Then, combining the IWC's figures for estimated minke whale populations in different areas with the global adult

population of minke whales by estimating the delay-difference equation model, the minke whale population in different areas in 1991, 1994, 1998, and 2008 can be obtained and included in the whale-watching tourism demand model (as given in equation (4)).

The estimated results of the adult minke whale population using equation (6) with alternative mortality rates ($m = 0.06 \text{ or } 0.1$) and intrinsic growth rates ($r = 0.15 \text{ or } 0.20$) are shown in Table 2. Four possible scenarios of the adult minke whale population are simulated here. According to fluctuations in the global adult minke whale population in different years (Table 2), the total minke whale population in different areas in 1991, 1994, 1998, and 2008 based on the IWC's figures of estimated minke whale population in different areas (Table 1) are presented in Table 3.

The sample is an unbalanced pooled data set, which consists of a total of 182 observations for 18 countries or territories in 1991, 39 countries or territories in 1994, 63 countries or territories in 1998, and 62 countries or territories in 2008. Descriptive statistics are presented in Table 4.

IV. Empirical Results

As explained in Section 2.1, we estimate the whale-watching tourism demand model using random effects on unbalanced panel data. Table 5 shows the results of a random effects unbalanced panel data model for investigating determinants of the whale-watching demand and estimating the impacts of whaling on global whale-watching tourism demand.

Two dimensions of the impact of whaling on whale-watching could be compared here, including the number of minke whales available for watching (WP) and the negative images of aboriginal and commercial whaling countries (AW and

CW). First, the coefficients for the minke whale population are positive and significant (from 0.14 to 0.17). The results show that whale watchers are significantly reduced by about 0.14 to 0.17 watchers for one minke whale caught by whalers. Second, *AW* and *CW* are dummy variables used to capture the effects on tourism when some countries engage in aboriginal whaling and commercial whaling. The estimated coefficients for *AW* are negative, but are not significant in all scenarios (ranging from -6343.80 to -6867.53), which suggests the aboriginal whaling does not significantly affect whale-watching tourism. Furthermore, the effects of another whaling activity, commercial whaling (*CW*), were also found to be significantly negative (from 98601.64 to -100717.88). The estimates confirm the sensitivity to a country engaging in commercial whaling activities that directly harms animal welfare.

In addition, the results confirm that one of the important determinants of whale-watching tourism flows is per capita GDP (*DGDP*) in each whale-watching destination. The estimated coefficients are similar and statistically significant in the four scenarios (ranging from 4.91 to 4.95). The results show that whale-watching tourism demand is positively influenced by consumer income. Furthermore, another important determinant is the per capita total whale-watching expenditure (*P*) in each whale-watching country. The estimated coefficients are negative and statistically significant in all scenarios (from -15.95 to -16.84), which suggest that whale watchers are negatively related to the tourism price of whale-watching.

Additionally, if we want to investigate the range of reductions in whale watchers arising from the decline in the minke whale population by the possible resumption of commercial whaling, the catches of minke whales should be estimated under IWC rules. According to the Revised Management Procedure (RMP) regulation of the IWC in 2008 (http://www.iwcoffice.org/conservation/rmp.htm), the possible ratio for commercial whaling in relation to the minke whale is about 0.5% of its total adult

population. Applying the delay-difference equation model enables us to estimate the total adult population of minke whales from 2009 to 2047, as given in Appendix A. Moreover, the caught populations of minke whales in the current period are based on the whale population in the previous year, and are also provided in Appendix A. Appendix A show that the hunting population alters with little variation in the coming 40 years. For example, the hunting populations are about 3500 heads in scenario 1.

The reductions in whale watchers, therefore, can be calculated by multiplying the estimated coefficients of the minke whale population by the minke whale catch. Table 6 presents the whale catches and the reductions in whale watchers by whaling in the coming decades. For instance, during 2010–2020, the average impact of decreasing whale populations on whale-watching tourism demand ranges from 396 to 568 persons. Comparing to the overall number of whale watchers of about 13 million in 2008, if the commercial whaling resumes, the decreasing whale populations induce about 47,124 to 67,592 watchers in 119 countries worldwide.

V. Conclusions and Policy Implications

The major purpose of this paper was to develop a global whale-watching tourism demand function using an unbalanced panel data model, and to estimate the impacts of whaling on global whale-watching tourism demand. The estimates provided useful insights into how the possible resumption of commercial whaling might impact on the rapidly growing tourism industry of whale watching. Several results from the alternative empirical procedures have been analyzed.

First, as to the effects of the reductions in the minke whale population by whaling, the empirical results indicate that whale-watching tourism demand has been statistically significant reduced by between 0.14 and 0.17 watchers as each minke

whale hunted. In addition, if the permissible catch commercial whaling is about 0.5% of the estimated population size, the average impacts of decreasing whale populations on whale-watching tourism demand per year range from 396 to 568 persons.

As expected, whaling would certainly decrease the potential number of whales, and result in avoidance responses to whale-watching boats (Hoyt and Hvenegaard, 2002). Therefore, fewer whales, fewer species of whales, or more wary whales would reduce the satisfaction and attraction of whale watchers. The minke whale is one of the major whale-watching species in Norway and Japan, and also the mainstay of the whale-watching industry around Húsavik in Iceland (Hoyt and Havenegaddar, 2002) If commercial whaling were to be allowed in the future, the reductions in the minke whale population would also influence the whale-watching tourism directly.

Second, with respect to the attitudes of whale watchers in response to nations engaging in whaling, there is strong evidence showing that whale watchers do not accept commercial whaling activities. The empirical results show commercial whaling would result in severe negative effects on the whale-watching industry. Consequently, the resumption of commercial whaling that changed the protected status would likely damage the whale-watching industry seriously. It may reasonably be concluded that the resumption of commercial whaling has potentially severe negative effects on the global whale-watching industry, especially for countries that are engaged in commercial whaling.

Herrera and Hoagland (2006) indicated that, if the IWC moratorium were to be lifted, whale stocks seem unlikely to be threatened seriously by the resumption of commercial whaling as the limits of allowed catches would be implemented. On the contrary, as observed by Hoyt and Hvenegaard (2002) and Parsons and Rawles (2003), the knowledge that whaling is sanctioned in a nation might discourage whale watchers from making visits, as whale-watching proponents are concerned as much about the

notion of whaling, as with the level of whaling effort or the number of hunts.

In this paper, the results show that an even more noteworthy point is that the negative attitudes towards commercial whaling would likely result in an extreme threat to whale-watching tourism. Such a perception of whaling would probably result in a decrease in whale-watching demand in the commercial whaling countries. These results agree with the findings of Persons and Rawles (2003) and Orams (2001) for Iceland and Tonga, respectively. Therefore, if commercial whaling were to be allowed in the future, the major threat to the growing whale-watching industry may arise from adverse images towards hunting whales for commercial purposes.

The sample period in the empirical analysis consisted of annual data in 1991, 1994, 1998, and 2008. The empirical results suggested that the whale-watching industry would be affected significantly by negative images towards commercial whaling. During the period, commercial whaling and whale-watching occurred simultaneously in Norway and Japan over the past 20 years. However, the annual growth of whale-watching industries in these two countries might serve as evidence of the negative impacts of the resurrected whaling on the whale-watching industry. For instance, comparing the whale-watching industries in Asia and the whaling country, Japan, an annual growth in Japan (6.4% per year) was less than the average growth in the Asian region (17% per year) since 1998 (O'Connor et al., 2009).

A comparison between Norway and Iceland provides further insights. The whale-watching industry in Norway began in 1988, 3 years earlier than in Iceland. In 1994, the number of whale watchers reached 11,227 people in Norway, while there were only 200 tourists in Iceland (Hoyt, 1995). However, during the 1990s, the numbers of whale watchers visiting Iceland (30,330 people) quickly and easily surpassed the number of whale watchers in Norway (22,380 people). Higham and Lusseau (2007) indicated that this might be due, at least in part, to Norway's standing in the

international community as a country that has long supported and practised commercial whaling.

Whaling was banned in 1989 in Iceland, but resumed in 2002. During this period, the whale-watching industry began in Iceland in 1991. Hoyt (1995, 2001) showed that Iceland in 1998 had already shown an explosive growth in the whale watching industry compared with 1994 (251% per year). Since then, the number of whale watchers grew slightly with an annual average increase of 14%, from 30,330 in 1998 to 114,500 in 2008 (O'Connor et al., 2009). The decreasing annual average growth rate might show the negative impact of whaling in Iceland, which was resumed in 2002. As the whale-watching industry provides considerable income for economies and created a positive image for Iceland, the importance of whale watching to the tourism economy is recognized by the Icelandic tourism industry (Parsons and Rawles, 2003). Care must, therefore, must be taken in the whale-watching industry by Iceland's government, as they resumed commercial whaling in 2006.

The annual growth in Norway (4.8% per year) since 1998 was less than for the European region (7.1% per year) (O'Connor et al., 2009). It may, therefore, reasonably be concluded that the whale-watching industries in Japan and Norway might grow more rapidly if they do not resume commercial whaling activities.

A further important point to note was the values of total income of whale-watching tourism and hunting whales. The total income from Norway whale-watching tourism (direct plus indirect expenditure) would be a total of US$12 million in 1998 (Hoyt, 2001). Toolis (2001) cited the Norwegian commercial whaling catch having a value of US$6 million per year which, if this value were correct, equates to only 50% of the value provided by whale-watching in Norway. In addition, the total income from Japan whale-watching tourism would be a total of US$33 million in 1998 (Hoyt, 2001). However, commercial hunting of whales in Japan (when one excludes a £ 6.3

million subsidizing grant given to the whaling industry) generated a total income of approximately £ 21.7 million per year (The Economist, 2000). Comparing the total income of whale-watching tourism to the revenue of commercial whale hunting, the commercial whaling revenue brings in about 90% of the income generated by whale-watching tourism in Japan. In short, the total incomes of whale-watching tourism were greater than the values of hunting whales, both in Norway and Japan.

Parsons and Rawles (2003) indicated that whale watchers would not only avoid whale watching, but also boycott trips to a country that hunted whales. In addition to the whale-watching industry, therefore, whaling activities would impact negatively on other tourism industries and tourism-related sectors. For instance, as for whale watchers in Iceland, Björgvinsson (2003) indicated that foreigners comprised 85–90% of whale watchers, and Icelanders the remaining 10–15%. Reductions in foreign watchers might not only damage the growing whale-watching industry, but also damage other tourism-related sectors, such as the airline and hotel industries. Care must, therefore, be taken by the pro-whaling countries not to destroy a nation's reputation, in general, pose a threat to the success of whale-watching and ecotourism, and weaken the development of domestic and international tourism, and other tourism-related business.

References

Bejder L.A., H. Samuels, N. J. Gales, R. Mann, M. Connor, J. Heithaus, C. Watson-Capps, M. Flaherty, and M. Krützen, 2006, "Decline in Relative Abundance of Bottlenose Dolphins Exposed to Long-term Disturbance," *Conservation Biology*, 20:6, 1791-1798.

Björgvinsson, A., 2003, "Iceland, Whale v/s Whale Watching," accessed at http://www.global500.org/news_83.html, May 20, 2008.

Bjørndal, T., and J.M. Conrad, 1998, "A Report on the Norwegian Minke Whale Hunt," *Marine Policy*, 22:2, 161–174.

Cisneros-Montemayor, A.M., U.R. Sumaila, K. Kaschner, and D. Pauly, 2010, "The Global Potential for Whale Watching," *Marine Policy*, 34, 1273-1278.

Clark, C.W., 1976, "A Delay-Recruitment Model of Population Dynamics, with an Application to Baleen Whale Populations," *Journal of Mathematical Biology*, 3:3, 381–391.

Conrad, J.M., 1989, "Bioeconomics and the Bowhead Whale," *Journal of Political Economy*, 97:4, 974–987.

Conrad, J.M., and T. Bjørndal, 1993, "On the Resumption of Commercial Whaling: The Case of the Minke Whale in the Northeast Atlantic,"*Arctic*, 46:2, 164–171.

The Economist, 2000, "The Politics of Whaling," *The Economist*, accessed at http://www.economist.com/node/359915, March 23, 2011.

Herrera, G.E., and H. Porter, 2006, "Commercial Whaling, Tourism, and Boycotts: An Economic Perspective," *Marine Policy*, 30:3, 261–269.

Higham, J.E.S., and D. Lusseau, 2007, "Urgent Need for Empirical Research into Whaling and Whale Watching," *Conservation Biology*, 21:2, 554-558.

Horan, R.D., and J.S. Shortle, 1999, "Optimal Management of Multiple Renewable Resource Stocks: An Application to Minke Whales," *Environmental and Resource Economic*s, 13, 435–458.

Hoyt, E., 1995, *The Worldwide Value and Extent of Whale Watching: 1995*, Bath: Whale and Dolphin Conservation Society.

Hoyt, E., 2001, *Whale Watching 2001: Worldwide Tourism Numbers, Expenditures, and Expanding Socioeconomic Benefits*, Yarmouth Port, MA: International Fund for Animal Welfare.

Hoyt, E., 2008. 'Whale Watching', *Encyclopedia of Marine Mammals*, 2nd Edition (Perrin, W.F., B. Würsig and J.G.M. Thewissen, eds.) Academic Press, San Diego, CA, pp. 1223-1227.

Hoyt, E., and G.T. Hvenegaard, 2002, "A Review of Whale-Watching and Whaling

with Applications for the Caribbean," *Coastal Management*, 30:4, 381–399.

Hsiao, C., 2003, *Analysis of Panel Data*, Cambridge: Cambridge University Press.

Humane Society of the United States, 2007, "The 2007 International Whaling Commission Meeting Highlights," accessed at http://www.hsus.org/marine_mammals/save_whales_not_whaling/learn_more/2007_IWC_highlights.html, May 20, 2008.

Humane Society of the United States, 2008, "Iceland and Whaling: Consequences and Background," accessed at http://www.hsus.org/marine_mammals/save_whales_not_whaling/iceland_whaling/iceland_and_whaling.html, May 20, 2008.

International Whaling Commission, 2008, accessed at http://iwcoffice.org/conservation/estimate.htm, May 25, 2008.

IUCN-The World Conservation Union, 2006, "Summary Statistics for Globally Threatened Species," www.iucnredlist.org/search/search-basic.

Lim, C., 1997, "Review of International Tourism Demand Models," *Annals of Tourism Research*, 24:4, 835–849.

Lusseau, D., E. Slooten, and R.J. Currey, 2006,"Unsustainable Dolphin Watching Tourism in Fiordland, New Zealand", *Tourism in Marine Environments*, 3, 173-178.

O'Connor, S.R., H. Campbell, and T. Cortez Knowles, 2009, "Whale Watching Worldwide: Tourism Numbers, Expenditures and Expanding Economic Benefits," a special report from the International Fund for Animal Welfare, Yarmouth, USA. Prepared by Economists at Large. Yarmouth, International Fund for Animal Welfare.

Orams, M.B., 2001 "From Whale Hunting to Whale Watching in Tonga: A Sustainable Future?" *Journal of Sustainable Tourism*, 9, 128–146.

Parsons, E.C.M., and C. Rawles, 2003, "The Resumption of Whaling by Iceland and the Potential Negative Impact in the Icelandic Whale-Watching Market," *Current Issues in Tourism*, 6:5, 444–448.

Schiff, A., and S. Becken, 2011, "Demand Elasticity Estimates for New Zealand Tourism," *Tourism Management*, 32, 564–575.

Song, H., and G. Li, 2008, "Tourism Demand Modelling and Forecasting - A Review of Recent Research," *Tourism Management*, 29:2, 203–220.

The World Bank, 2011, The World Development Indicators (WDI) Database, accessed at http://web.worldbank.org/, April 2, 2011.

Toolis, K., 2001, "Eat or Save It ?" *The Guardian* (Weekend Pages).

Tuma, N.B., and T.M. Hannan, 1984, *Social Dynamics: Models and Methods* ,New York: Academic.

Valentine, P.S., B. Alastair, M. Curnock, P. Arnold, and A. Dunstan, 2004, "Getting Closer to Whales - Passenger Expectations and Experiences, and the Management of Swim with Dwarf Minke Whale Interactions in the Great Barrier Reef," *Tourism Management*, 25, 647–655.

Waggle, D., and M. Fish, 1998, "International Tourism Cross Elasticity," *Annals of Tourism Research*, 25(4), 191–195.

World Wide Fund, 2003, "Whale Watching: A Future for Whales?" accessed at www.panda.org, May 28, 2008.

Table 1

IWC Figures for Estimated Total Minke Whale Populations in Different Areas

Area	Year	Minke Whale Population (Unit: head)
Southern Hemisphere	1986	761,000
North Atlantic	1996	174,000
West Greenland	2005	10,800
North West Pacific and Okhotsk Sea	1989	25,000

Source: International Whaling Commission (2008), available from http://iwcoffice.org/conservation/estimate.htm .

Table 2

Adult Population of Minke Whale (Unit: head)

Years	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	r=0.15, m=0.06	r=0.15, m=0.1	r=0.20, m=0.06	r=0.20, m=0.1
1986	712699	557311	760182	660353
1987	669937	501580	714571	594317
1988	629741	451422	671697	534886
1989	591956	406280	631395	481397
1990	556439	365652	593511	433257
1991	523053	329087	557900	389932
1992	491670	296178	524426	350939
1993	462169	266560	492961	315845
1994	477201	295635	508994	350295
1995	497054	321813	535081	387928
1996	519526	343704	567355	423787
1997	542961	360732	602870	455071
1998	566132	372829	639411	480392
1999	588148	380238	675339	499268
2000	608389	383372	709472	511783
2001	626438	382732	740984	518355
2002	643966	385556	771003	528880
2003	660980	390941	799394	542699
2004	677286	397989	825428	558505
2005	692586	405923	847982	574978
2006	706561	414123	865784	591102

Table 3

Total Minke Whale Population in Different Areas in 1991, 1994, and 1998

Region/Area	Year	Scenario 1 r=0.15, m=0.06	Scenario 2 r=0.15, m=0.1	Scenario 3 r=0.20, m=0.06	Scenario 4 r=0.20, m=0.1
Southern Hemisphere					
	1991	558501	449363	558500	449363
	1994	509542	403686	509542	403685
	1998	604500	509093	640099	553611
	2008	778996	586580	883617	714674
North Atlantic					
	1991	175181	166600	171100	160100
	1994	159824	149665	156101	143825
	1998	189609	188745	196099	197241
	2008	244342	217473	270702	254625
West Greenland					
	1991	8156	8756	7105	7324
	1994	7441	7866	6483	6580
	1998	8828	9920	8144	9023
	2008	11376	11429	11242	11649
North West Pacific and Okhotsk Sea					
	1991	22090	20250	22090	20250
	1994	20154	18192	20154	18192
	1998	23909	22942	25317	24948
	2008	30811	26433	34949	32206

Table 4

Descriptive Statistics in 1991, 1994, 1998, and 2008

Variable	Year	N	Mean	Std. Dev.	Min	Max
Watcher (Unit: person per country or overseas territory)	1991	18	26726.2	78004.5	100	335200
	1994	39	39306.8	101566.2	100	446000
	1998	63	93772.5	187862.2	150	1000000
	2008	62	145417.6	249241.3	100	1635374
DGDP (Unit: USD per capita)	1991	18	12884.6	10295.43	0.0	34604.5
	1994	39	13145.2	11541.1	0.0	46174.0
	1998	63	14112.5	12204.8	0.0	53209.6
	2008	62	17798.2	15358.8	0.0	72575.3
P (Unit: USD per capita)	1991	18	1409.4	1947.2	30.5	7582.1
	1994	39	878.4	1372.9	26.3	6950.0
	1998	63	477.5	1141.4	7.4	8422.7
	2008	62	232.5	271.0	18.6	1405.2

Source: *DGDP* in constant 2000 US was obtained from the statistical database of WDI supplied by the World Bank (2011). For each country, the variables of *Watcher* and *P* were collected from the Hoyt (1995, 2001) and O'Connor *et al.* (2009) reports.

Table 5

Estimates of Tourism Demand for Whale Watching

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Constant	23270.05	23361.30	23071.40	23005.32
	(0.82)	(0.83)	(0.81)	(0.81)
DGDP	4.95***	4.93***	4.95***	4.91***
	(6.00)	(5.89)	(5.99)	(5.85)
P	-16.51***	-16.84***	-15.95***	-16.04***
	(-7.34)	(-6.66)	(-7.09)	(-6.56)
WP	0.14***	0.17***	0.14***	0.17***
	(2.85)	(3.42)	(2.53)	(2.75)
AW	-6719.65	-6343.80	-6867.53	-6405.50
	(-0.12)	(-0.11)	(-0.12)	(-0.11)
CW	-98601.65***	-98838.50***	-99449.52***	-100717.88***
	(-8.04)	(-8.00)	(-8.06)	(-8.02)

Notes: Numbers in parentheses are t-statistics. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 6

Average Reductions through Whaling of Minke Whales and Whale Watchers

Years	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Minke whales	Whale watchers	Minke whales	Whale watchers	Minke whales	Whale watchers	Minke whales	Whale watchers
2010-2020	3715	520.1	2329	395.9	3699	517.9	3343	568.3
2021-2030	3477	486.8	2583	439.1	3292	460.9	3315	563.6
2031-2040	3551	497.1	2717	461.9	4252	595.3	3269	555.7
2041-2047	3616	506.2	2766	470.2	3284	459.8	3321	564.6

Appendix A
Total Adult and Hunting Populations of Minke Whale, 2009-2047 (Unit: head)

Years	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	population	Hunting population	population	Hunting population	population	Hunting population	population	Hunting population
2009	738325	3648	436234	2148	880318	4413	632748	3101
2010	745138	3692	442452	2181	870050	4402	644138	3164
2011	749891	3726	448472	2212	851516	4350	654310	3221
2012	752525	3749	454424	2242	824816	4258	663155	3272
2013	753051	3763	460354	2272	790765	4124	670535	3316
2014	751562	3765	466255	2302	751069	3954	676342	3353
2015	748242	3758	472082	2331	708317	3755	680535	3382
2016	743349	3741	477781	2360	665752	3542	683141	3403
2017	737194	3717	483292	2389	626861	3329	684241	3416
2018	730143	3686	488587	2416	595073	3134	683946	3421
2019	722603	3651	493659	2443	573325	2975	682405	3420
2020	714999	3613	498506	2468	563547	2867	679805	3412
2021	707748	3575	503131	2493	566236	2818	676380	3399
2022	701225	3539	507536	2516	580313	2831	672397	3382
2023	695740	3506	511719	2538	603404	2902	668133	3362
2024	691513	3479	515680	2559	632466	3017	663864	3341
2025	688673	3458	519416	2578	664537	3162	659837	3319
2026	687252	3443	522926	2597	697278	3323	656261	3299
2027	687192	3436	526211	2615	729207	3486	653302	3281
2028	688363	3436	529271	2631	759582	3646	651068	3267
2029	690579	3442	532112	2646	788044	3798	649609	3255
2030	693619	3453	534739	2661	814210	3940	648920	3248
2031	697248	3468	537159	2674	837398	4071	648944	3245
2032	701235	3486	539377	2686	856598	4187	649590	3245
2033	705359	3506	541404	2697	870645	4283	650738	3248
2034	709420	3527	543248	2707	878451	4353	652257	3254
2035	713246	3547	544918	2716	879158	4392	654017	3261
2036	716689	3566	546425	2725	872184	4396	655888	3270
2037	719634	3583	547779	2732	857223	4361	657758	3279
2038	721993	3598	548991	2739	834315	4286	659527	3289
2039	723711	3610	550071	2745	804003	4172	661116	3298
2040	724762	3619	551029	2750	767550	4020	662465	3306
2041	725149	3624	551877	2755	727050	3838	663534	3312
2042	724905	3626	552623	2759	685362	3635	664301	3318
2043	724088	3625	553279	2763	645842	3427	664763	3322
2044	722778	3620	553851	2766	611940	3229	664930	3324
2045	721073	3614	554350	2769	586740	3060	664829	3325
2046	719084	3605	554784	2772	572503	2934	664496	3324
2047	716931	3595	555159	2774	570259	2863	663975	3322