CIRJE-F-634

Estimating the Impact of Whaling on Global Whale Watching

Hsiao-I Kuo
Chaoyang University of Technology

Chi-Chung Chen
National ChungHsing University

Michael McAleer
Erasmus University Rotterdam
and Tinbergen Institute
and CIRJE, Faculty of Economics, University of Tokyo

August 2009

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 ChungHsing University
Taichung, Taiwan

Michael McAleer

Econometric Institute
Erasmus School of Economics
Erasmus University Rotterdam
and
Tinbergen Institute
The Netherlands
and
Center for International Research on the Japanese Economy (CIRJE)
Faculty of Economics
University of Tokyo

August 2009

* The third author whishes to acknowledge the financial support of the Australian Research Council and the National Science Council Taiwan.

****** Corresponding author.

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 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 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 whaling.

Keywords: Global Whale Watching, Whaling, Delay-Difference Equation Model.

JEL Classifications: Q32, Q22, C22.

Ⅰ. Introduction

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). 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). 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$1059 million in 1998.

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). In addition, Iceland has also began 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, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Grenada, the Dominican Republic, and 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 58^{th} 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. However, because these pro-whaling countries continue striving 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, whale watching will be threatened by whaling.

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. From a recreational and tourism perspective, whaling is usually regarded as incompatible with whale watching as whaling might reduce the number of whales available for watching, disturb or alter the regular activities of those animals, and lead to negative attitudes of whale watchers or potential tourists towards whaling (Hoyt and Hvenegaard, 2002). The reductions in whale populations and the wary responses of whales to whale-watching boats in whaling activities certainly diminish the potential number of whales for whale watching, and decrease the satisfaction of whale watchers (Hoyt and Hvenegaard, 2002).

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, since 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.

The data sample is an unbalanced pooled data set, which consists of a total of 120 observations for 63 countries or territories in 1991, 1994, and 1998. The random effect approaches is employed to estimate whale-watching tourism demand models. The econometric software package used is EViews 5.0. The remainder of the paper is organized as follows. Section 2 introduces the econometric approaches and data set. The results of the empirical estimation are analyzed in Section 3. Finally, concluding remarks and policy implications are given in Section 4.

Ⅱ. Empirical Model and Data

A. The 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. Furthermore, Herrera and Hoagland (2006) indicated that the primary focus of whale-watching activity is to view whales in the cetaceans’ natural habitat. Based on the observation of whale-watching behavior, the 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. 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. Therefore, whale population is used as a proxy for the whale-watching ecological characteristic. Moreover, 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, it will have a negative effect on the whale-watching tourism industry.

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 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 GDP of domestic and foreign tourists. The impacts of GDP on whale-watching demand need to be aggregated. The manner in which we accommodate this global whale-watching demand function is given below.

Suppose the whale-watching demand function in any country can be separated into two groups, domestic and international tourism, the associated demand functions are given as follows:

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

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

where $i, j = 1,...,N$, $i \neq j$ and $t = 1,...,T_i$. 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 GDP in origin country *i*, and is also the GDP in destination country *i*; $IGDP_{jt}$ is the 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:

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

where $LGDP_{it}$ is the linear combination of GDP in the whale-watching destination country *i* ($DGDP_{it}$) and origin country *j* ($IGDP_{jt}$). Since the $LGDP_{it}$ should be calculated by taking into account a basket of GDP worldwide, the $LGDP_{it}$ is particularly 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 $DGDP_i$.

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 model to be estimated can be expressed as

$$y_{it} = \alpha_0 + \sum_{k=1}^{K} \beta_k x_{kit} + \alpha_i + \varepsilon_{it} , \qquad (4)$$

where $i = 1, ..., N$, and $t = 1, ..., T_i$ and, by assumption, $E\left[\varepsilon_{it}\right] = 0$ and $Var\left[\varepsilon_{it}\right] = \sigma_{\varepsilon}^2$. The subscript *i* is the country and *t* denotes the time period of observation. 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.

The global whale-watching tourism demand model can be written as

$$W_{it} = \alpha_0 + \beta_1 GDP_{it} + \beta_2 TE_{it} + \beta_3 Minke_{it} + \beta_4 AW_{it} + \beta_5 CW_{it} + \alpha_i + \varepsilon_{it}, \qquad (5)$$

where W_{it} is the number of whale watchers in country or overseas territory i during year t; GDP_{it} is the Gross Domestic Product in whale-watching destination country

i; TE_{it} is the per capita of total whale-watching expenditure, which is the price proxy for travel costs; and $Minke_{it}$ is the Minke whale population available for watching in each whale-watching area. 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.

B. A 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; and Horan and Shortle, 1999). The following delay-difference equation model is based on Conrad and Bjørndal (1993). The general form of this delay-difference equation model is given as

$$Y_{t+1} = (1-m)Y_t + R(Y_{t-\tau}), \tag{6}$$

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 (6) 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 as a generalized logistic function when modeling 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 (6) 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 (6) is modified as equation (7):

$$Z_{t+1} = (1-m)Z_t + R(Z_{t-\tau}), \tag{7}$$

In order to estimate the adult Minke whale population using equation (7), 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 by 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 by Conrad and Bjørndal (1993) and Horan and Shortle (1999), while K is defined as the adult Minke whale population in year 1986.

C. Data

The sample is an unbalanced pooled data set, which consists of a total of 120 observations for 63 countries or territories in 1991, 1994, and 1998. The data on the number of whale watchers (W_{it}), and per capita total expenditure of whale-watching (TE_{it}) were collected from the Hoyt(1995, 2001) reports, which are approved by the Whale and Dolphin Conservation Society (WDCS) and International Fund for Animal Welfare (IFAW), respectively. Gross Domestic Product (GDP_{it}) in constant 1995 US dollars was obtained from the statistical database of world development indicators (WDI) supplied by the World Bank (2004).

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 commercial whaling on the whale-watching industry does not consider Iceland’s whaling in this paper.

Another important explanatory variable is the Minke whale population for whale watching ($Minke_{it}$). 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, and 1998 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, and 1998 can be obtained and included in the whale-watching tourism demand model (equation (5)).

The estimated results of the adult Minke whale population using equation (7) 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, and 1998 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 120 observations for 18 countries or territories in 1991, 39 countries or territories in 1994, and 63 countries or territories in 1998. Descriptive statistics are presented in Table 4.

Ⅲ. 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.

The impacts of whaling on global whale-watching tourism demand are derived from the number of Minke whales available for watching, and the negative images of aboriginal and commercial whaling countries. First, the coefficients for the Minke whale population are positive and significant (from 0.28 to 0.33). In other words, regarding the impacts of the reductions of Minke whale population by whaling, the results show that if one Minke whale were caught by whalers, there would be a reduction in whale-watching tourism demand of about 0.28–0.33 watchers. Second, *AW* and *CW* are dummy variables used to capture the effects when some countries engage in aboriginal whaling and commercial whaling on tourism. The estimated coefficients for *AW* are negative and significant in all scenarios (from -50012.60 to -50794.89), which suggests a significant negative effect of aboriginal whaling on whale-watching tourism. Furthermore, the effects of another whaling activity, commercial whaling (*CW*), were also found to be significantly negative (from -81843.34 to -84100.97). The estimates confirm the sensitivity to a country engaging in whaling activities that directly harms animal welfare.

In addition, the results confirm that one of the important determinants of whale-watching tourism flows is the gross domestic product (GDP) in each whale-watching destination. The estimated coefficients (all around 0.02) are statistically similar and highly significant in the four scenarios. Furthermore, another important determinant is the per capita total whale-watching expenditure in each whale-watching country. The estimated coefficients are negative and significant in all scenarios, which suggest that whale watchers are sensitive 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 2008 to 2047, as given in Appendix A. Moreover, the caught population of Minke whales in the current period are based on the whale population in the previous year, and are also provided in Appendix A.

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 742 to 1086 persons. Furthermore, the average change in tourism demand decreased by about 823–1077 persons during 2021–2030.

Ⅳ. 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 significantly reduced by between 0.28 and 0.33 watchers as each Minke whale is hunted. The figures indicate that the average damage levels owing to the whale population decreases by hunting were between 0.28 and 0.33. 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 742 to 1086 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.

Second, with respect to the attitudes of whale watchers in response to nations engaging in whaling, there is strong evidence that whale watchers do not accept whaling. The empirical results show that both aboriginal whaling for subsistence purposes and commercial whaling would result in significant negative effects on the whale-watching industry. Consequently, any resumption of whaling that changed the protected status would likely damage the whale-watching industry seriously.

The potential impacts of commercial whaling on whale-watching may be mainly derived from the reduction in the whale population available for watching and the negative attitudes of watchers towards whaling. From the results of the negative impacts of watchers' attitudes and the decreasing whale populations available for watching, an even more noteworthy point is that the negative attitudes towards whaling would likely result in an extreme threat to whale-watching tourism. Furthermore, comparing the negative impacts of aboriginal whaling and commercial whaling on tourism, the reduction in whale-watching tourism arising from commercial whaling was more severe than the damage of aboriginal whaling.

Herrera and Hoagland (2006) indicated that, if the IWC moratorium is lifted, whale stocks seem unlikely to be threatened seriously by the resumption of commercial whaling, because 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. If commercial whaling is allowed in the future, the major threat to the growing whale-watching industry may arise from adverse images towards hunting whales for commercial purposes.

During the 1990s, commercial whaling and whale-watching occurred simultaneously in Norway and Japan. However, whale-watching became more important in these two countries in the same period. In 1998, Norway had more than 22,000 whale watchers spending US$ 12 million, while 102,000 watchers in Japan spent about US$33 million (Hoyt, 2001). As the Minke whale is one of the major whale-watching species in Norway and Japan, if commercial whaling is allowed in the future, more catches of Minke whales would result in fewer Minke whales for whale watching, and possibly even removing some other whales, and decreasing the attraction of whale-watching tourism.

Iceland is a pro-whaling country with strong whaling interests. However, whaling has been banned in Iceland since 1989 amid international pressure (Björgvinsson, 2003). 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. The number of whale watchers in Iceland increased from 100 tourists spending US$ 17,000 in direct expenditures in 1991, to 60,550 tourists spending about US$ 8.5 million in direct expenditures in 2001 (Hoyt, 2001; Björgvinsson, 2003). Moreover, Björgvinsson (2003) estimated the total value of whale watching for Iceland's economy to be around US$ 14 million in 2001.

As the whale-watching industry has provided considerable income for economies and created a positive image for Iceland, the importance of whale watching to the tourism economy has been recognized by Icelandic tourism industries (Parsons and Rawles, 2003). However, whaling was resumed by Iceland in 2002, and the whale-watching industry might yet again be threatened by whaling. As Minke whales in Iceland are the mainstay of the whale-watching industry around Húsavik (Hoyt and Havenegaddar, 2002), reductions in the Minke whale population would influence whale-watching tourism directly. Moreover, the empirical results suggest that the whale-watching industry would be affected significantly by negative images towards whaling.

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 engaging in whaling. 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. As for whale watchers in Iceland, for instance, Björgvinsson (2003) indicate that foreigners comprise 85–90% of whale watchers, and Icelanders the remaining 10–15%. Therefore, reductions in foreign watchers might not only damage the growing whale-watching industry, but also damage other Icelandic tourism-related sectors, such as the airline and hotel industries.

The Icelandic Tourist Industry Association considers that the resumption of whaling would induce a negative image for Iceland and cause great damage to the Icelandic tourism industry (World Wildlife Fund, 2003). Care must, therefore, be taken by the Icelandic government, and other 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.

Table 1. IWC 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 Whales (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
North Atlantic					
	1991	175181	166600	171100	160100
	1994	159824	149665	156101	143825
	1998	189609	188745	196099	197241
West Greenland					
	1991	8156	8756	7105	7324
	1994	7441	7866	6483	6580
	1998	8828	9920	8144	9023
North West Pacific and Okhotsk Sea					
	1991	22090	20250	22090	20250
	1994	20154	18192	20154	18192
	1998	23909	22942	25317	24948

Table 4. Descriptive Statistics for 1991, 1994 and 1998

Variable	Year	N	Mean	Std. Dev.	Min	Max
Watcher (person)	1991	18	26726.2	78004.5	100	335200
	1994	39	39306.8	101566.2	100	446000
	1998	63	93772.5	187862.2	150	1000000
GDP (million USD)	1991	18	579499.4	1207845.9	0.00	5090000
	1994	39	855834.4	1733962.7	0.00	7150000
	1998	63	1228427.2	2448037.5	0.00	8290000
TE (USD)	1991	18	1409.38	1947.21	30.45	7582.12
	1994	39	878.35	1372.94	26.25	6950.00
	1998	63	477.45	1141.37	7.44	8422.69

Table 5. Estimates of Tourism Demand for Whale Watching

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Constant	58755.6***	57544.4***	58751.1***	57559.6***
	(3.60)	(3.57)	(3.58)	(3.53)
GDP	0.02***	0.02***	0.02***	0.02***
	(3.02)	(3.04)	(3.02)	(3.04)
TE	-25.98***	-25.01***	-26.46***	-25.62***
	(-2.73)	(-2.91)	(-2.77)	(-2.97)
Minke	0.28**	0.32**	0.29**	0.33***
	(2.06)	(2.35)	(2.31)	(2.87)
AW	-50458.58***	-50794.89**	-50012.60***	-50246.11**
	(-2.67)	(-2.54)	(-2.67)	(-2.53)
CW	-81843.34***	-84019.30***	-82024.60***	-84100.97***
	(-3.11)	(-3.14)	(-3.15)	(-3.20)

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	1040.2	2329	742.9	3699	1054.2	3343	1086.5
2021-2030	3477	973.6	2583	823.9	3292	938.2	3315	1077.4
2031-2040	3551	994.3	2717	866.7	4252	1211.8	3269	1062.4
2041-2047	3616	1012.5	2766	882.4	3284	935.9	3321	1079.3

Appendix A

Total Adult and Hunting Populations of Minke Whale from 2008-2047 (Unit: head)

Years	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	population	Hunting population	population	Hunting population	population	Hunting population	population	Hunting population
2007	718943	-	422122	-	877650	-	606254	-
2008	729553	3595	429576	2111	882667	4388	620154	3031
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

REFERENCES

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

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

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

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

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

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

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

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

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

Hoyt, Erich, and Glen T., Hvenegaard, "A Review of Whale-Watching and Whaling with Applications for the Caribbean," *Coastal Management*, 30:4 (2002), 381–399.

Hsiao, Cheng, *Analysis of Panel Data* (Cambridge: Cambridge University Press, 2003).

Humane Society of the United States, “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 (2007).

Humane Society of the United States, “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 (2008).

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

Orams, Mark B., “From Whale Hunting to Whale Watching in Tonga: A Sustainable Future?” *Journal of Sustainable Tourism* 9 (2001), 128–146.

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

The World Bank, The World Development Indicators (WDI) Database, accessed at http://web.worldbank.org/, December 7, 2004 (2004).

Tuma, Nancy B., and Michael T., Hannan, *Social Dynamics: Models and Methods* (New York: Academic, 1984).

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