MODELING THE ECONOMY OF A TOURISM-ORIENTED, FOREST DEPENDENT REGION

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ABSTRACT. —This paper attempts to model the effects of environmental policies on a small, tourism-oriented, forest-dependent region. The interactions among economic activity, environmental quality, and tourism activity are examined by considering both environment and tourism endogenous. A two-sector computable general equilibrium model is developed and used to simulate the impact of environmental policies. We conducted simulation experiments under two scenarios: (A) environmental damage in the region is due to activity in the forest sector; and (B) activities from both forest and composite sector affect the local environment. Results indicate that an increase in environmental tax in the forest sector benefits the regional economy under scenario A. The converse holds true under scenario B. On the other hand, an increase in environmental tax in the composite sector hurts the regional economy under the assumption that environmental damage in the region is due to the activity in the forest sector and benefits the regional economy when environmental damage is assumed to occur from activities of both forest and composite sectors.

INTRODUCTION

In the recent past, concerns for the environment have prompted many researchers to model the economy-wide effects of environmental policies related to agriculture and other resource activities (see Merrifield 1988; Bergman 1995; Tobey and Reinert 1991; Tsigas et al. 1996). However, very few studies have been conducted to model the impacts of environmental policies related to tourism activities. One of the reasons is that many people think of tourism as an industry that does not harm the environment (UNEP 1992). On the contrary, tourism is an industry with components including travel, accommodation and catering, leisure and entertainment, construction, manufacturing, food processing, and forest recreation (Peter 1990) Activities related to these components may have an impact on the environment.

Many researchers have investigated the effect of tourism on regional or national economies (see Johnson and Moore 1993; Archer and Fletcher 1996; Adams and Parmenter 1995; Zhou et al. 1996; Lindberg and Johnson 1997). However, they did not consider that environmental quality would be affected by tourism activities and that changes in the environmental quality could in turn affect the tourism sector. In other words, earlier studies modeled tourism as an exogenous activity. Environmental impacts associated with tourism activities may alter the attractive features of the resource and thus influence the experiential quality of that resource from a user perspective. For example, when a wilderness lake becomes more accessible to users, it can no longer offer the same experience of distance and separation from human habitation (Farrell and Runyan 1991). Environmental damages and associated experiential degradation of a recreation resource may have a significant impact on the level of visitation, thereby affecting the overall economy of a region. This suggests that it is appropriate to consider tourism as an endogenous activity that may be responsive to a set of economic and environmental variables.

It is very well documented that activities related to resource sectors (agriculture, forestry, or mining) may cause damage to the environment. Therefore, public agencies often impose restrictions such as taxes on inputs or outputs,

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standards on management practices, and even preservation or closure of areas from production to control environmental damage. For example, the government of Alberta chose to restrict logging activity near the Rocky Mountain foothills because of environmental concerns. A proposed coal mine near Jasper National Park, Canada, has attracted much criticism from environmentalists. It was thought that the new mine would adversely affect wildlife habitat and thus alter the experiential quality of the national park. In the Pacific Northwest region of the United States, large tracts of forest areas are closed to logging activity to protect the habitat of the spotted owl. The arguments that intensive use of pesticides and fertilizers in agriculture causes ecological damage have led the U.S. government to undertake an acreage reduction program in the agricultural sector.

On the other hand, it is generally believed that tourism is a “green” sector that does not harm the environment. Tourism is also often characterized as an economic activity that employs relatively simple technologies, draws abundant domestic labor, requires limited capital investments, earns substantial net foreign exchange, and constrains industrial expansion and thus urbanization (Eadington and Redman 1991). As a result, it is not common to see protests against the expansion of activities related to the tourism sector. For example, restrictions on the number of visitors to a national park or on the development of recreational facilities in and around the park are not common. However, a close observation of any tourism-dependent region suggests that activities related to tourism impact the local environment. Rapid growth in tourism, for example, has caused an increase in forest fires and extinction of plant species in Mediterranean forests; led to more forest felling and forest fires in the Himalayas; and resulted in the damage of coral reefs in Kenya, Madagascar, and Seychelles (UNEP 1992). These environmental impacts of tourism, underestimated in the past, are now receiving attention. For example, Page et al. (1996) have noted that if visitor numbers and tourism development are allowed to continue, it will cause serious and irreversible harm to Banff National Park’s ecological integrity and its value as a national park. Based on their recommendations, the Heritage Minister of the government of Canada announced a series of restrictions on the use of Banff National Park. These include establishing limits and reservation systems on the most popular hiking trails, eliminating all sport fishing, closing some hotels/campgrounds, and capping the permanent population of the town of Banff at 10,000. The following discussion suggests that regulations on tourism-related activities are required to ensure sustainable tourism development. Failure to incorporate the environmental impacts of tourism and the feedback effects on tourism in economic analysis may result in overestimating the role of tourism in regional economies.

This study attempts to provide a theoretical framework to model the interactions among economic activity, the environment, and tourism. First, the model incorporates linkages between the tourism sector and environmental damage and focuses on the implications for the regional economy. Second, the study considers two types of environmental damage functions: (1) it assumes that economic activity related to resource sectors affects the local environment; and (2) it considers that activities of both the resource and tourism sectors affect the environment. By conducting simulation experiments, the study shows that impacts of an environmental policy, such as an increase in an environmental tax, differ under these two types of environmental damage functions. The emphasis is placed on a tourism-oriented, resource-dependent region where the resource and tourism sectors compete for a scarce resource such as public land. Finally, the study points out a number of areas where future research is needed in extending and applying the model to a particular region.

The paper is organized as follows: the second section presents a general model of the economy of a resource-dependent region; the third section discusses the details of an operational model and data used in simulation experiments; the fourth section presents simulation results; finally, a brief summary is provided along with conclusions and suggestions for further research.

MODEL SPECIFICATION

The model is kept as simple and general as possible so that emphasis can be made on the interactions between the economy and environment and their impact on tourism. A small regional economy with two productive sectors is considered: the resource sector (R), which includes industries such as forestry, and the composite tourism sector

(C). The resource sector is assumed to be a net exporter and a price taker in the international market. We assumed that all goods and services produced by the composite tourism sector are consumed in the domestic market and thus treated as a nontraded sector. Tourists from external regions who visit the region also consume these goods and services, but they do so within the regional market. This implies that a change in the number of visitors causes a shift in the demand for tourism goods and services in the region. The regional economy consists of two factors of production: a composite input consisting of labor and capital (L); and land (D). It is assumed that both inputs are used in each sector and mobile across sectors. Furthermore, it is considered that all factor endowments are fully employed between the two sectors. For the sake of simplicity, labor mobility across regions is ignored.

Production Functions of the Economy

The first and second parts of equation (1) define, respectively, the production of resource output and composite tourism output. It is assumed that production functions are well behaved and homogenous degree one.

(1) $R = R(L,D) \qquad C = C(L,D)$

Factor Markets

Equations (2) and (3) show that factor inputs are fully employed between the two sectors of the region. Equation (4) indicates that factor proportions depend on relative changes in factor prices. With constant returns to scale, the product of α_{ij} and levels of output give total factor demands.

(2) $a_{LR}R + a_{LC}C = L$

(3) $a_{DR}R + a_{DC}C = D$

(4) $a_{ij} = a_{ij}(W,V)$

where α_{ij} = input i required to produce a unit of j; i = L,D; j = R, C; W = wage; and V = rental rate of land.

Zero Profit Conditions

Equations (5) and (6) show that the product of α_{ij} and factor prices give unit costs. Since the production functions are homogeneous degree one, the value of output must be exhausted once factors are paid. In other words, in a competitive equilibrium, unit costs equal market prices.

(5) $a_{LR}W + a_{DR}V = P_R$

(6) $a_{LC}W + a_{DC}V = P_C$

where P_i = unit price of i and i = R, C.

Environmental Damage

A conventional notion is that only activities related to resource sectors (such as logging, mining, and oil and gas extraction) cause significant damage to the local environment, while tourism does not affect the environment. However, as discussed in the introduction, the tourism sector may also cause significant damage to the environment. Therefore, two types of environmental damage functions are considered. First, it is assumed that land

use and the level of output in the resource sector affects the environment. Second, it is considered that land use and the level of output in both sectors affect the environment.

(7) $E = E(a_{DR}, R)$ $\quad E = E(a_{DR}, R, a_{DC}, C)$

where E = environmental damage.

For the sake of simplicity, the model does not consider the dynamics of environmental impacts. The ability of the environment to assimilate environmental damage may change over time. The assimilation rates may also vary with the nature of the impact.

Tourism Activity

Equation (8) defines tourism activity and contains two scenarios. In both cases, it is assumed that visitors are responsive to changes in the price of the composite tourism good. For example, the rise in airfares and hotel costs may cause a decrease in the number of visitors. Therefore, the price of tourism goods and services is included in both cases. With regard to environmental damage, it is expected that the level of tourism activity depends on the quality of the site, which is affected by activities related to producing sectors of the economy. For example, a decline in the water quality (for example, due to sludge disposal from a local pulp mill or soil erosion from logging activities) of the river systems may have a negative impact on sport fishing activity. Therefore, environmental damage is considered as one of the determinants of tourism activity. However, in the first part of equation (8), it is assumed that only the environmental damage associated with the resource sector's activity influences the level of tourism. In the second part, tourism is shown to depend on the environmental damage associated with the activities of both resource and tourism sectors.

(8) $T = T(E_R, P_C)$ $\quad T = T(E_R, E_C, P_C)$

where T = tourist activity or tourists or visitors; E_i = environmental damage associated with the production of i; and i = R, C.

The changes in the environment in response to activities in the resource or tourism sectors may affect visitors differently because visitors have diverse objectives. For example, hunters may appreciate more clearcut areas while bird watchers and hikers may like to have old growth forests.[2] On the contrary, Bostedt and Mattsson (1995) have found that a decrease in the size and increase in the number of clearcuts has positive impacts on tourism. This suggests that the relationship between the changes in the environment and the number of visitors may be nonlinear. Those complex relationships are not considered in this modeling exercise and it is simply assumed that environmental damage would have a negative impact on tourism.

Demand for Goods and Services

Equation (9) shows that the demand for tourism goods and services arises from households within the region and outside visitors. Consistent with consumption and demand theory, both regional income (Y) and the price of the tourism good are included in the demand function.

(9) $C = C(Y, P_C, T)$

[2] Peter Boxall, Canadian Forest Service. Edmonton, AB, Canada. Personal communication.

Regional Income

Equation (10) indicates that regional income equals the sum of the value of output in both producing sectors.

(10) $Y = (R\ P_R + C\ P_C)$

MODEL TRANSFORMATION

A convenient way of determining the comparative static effects of changes in exogenous variables is by transforming the general model into its proportional change form. The model requires relatively little data in its proportional change form and the results of comparative statics can be interpreted as elasticities. However, this format introduces linear approximation errors and thus is valid for only small changes in the exogenous variables. Since simulation experiments conducted later in this study deal with only 1 percent changes in exogenous variables, approximation errors are expected to be small (see Hertel et al. 1992 for details on linear approximation errors). Model transformation involves total differentiation, manipulation, and rearranging the equation of the system (see Johansen 1960 for details).[3]

Model transformation resulted in a system of eight equations with eleven variables (Y, P_c, P_R, R, C, W, D, E, T, L, and D). Since the number of variables was greater than the number of equations, L, D, and P_R variables were treated as exogenous. In solving the system of equations for changes in endogenous variables, we used a set of hypothetical values for parameters used in the model. In assigning values, we assumed that the resource sector was land intensive while the tourism sector was labor intensive. A Cobb-Douglas functional form was assumed for production and utility functions, and thus a unit value was assigned to the elasticities of substitution and the elasticities of demand for the tourism good. Similarly, we gave unit values for the elasticities of environmental damage with respect to each economic activity, and for tourism with respect to the environmental damage and the price of the tourism related good. One should be aware that model results may be sensitive to the parameter values chosen for simulation experiments. However, we thought that the use of the same set of parameters in both scenarios of environmental damage may not alter the general result of the analysis. We used GEMPACK 5.1 software to carry out the simulation experiments.

SIMULATION RESULTS

One of the policy instruments governments have in regulating the activities of producing sectors is tax. For example, an imposition of an environmental tax per unit of output would cause an increase in the marginal cost of production and thus a decrease in the production of output. This study simulated the impact of a 1 percent environmental tax (Z_i, where i = R, C) in each of the sectors of the regional economy. In each case, the impacts are investigated under two scenarios. In the first case, environmental damage is assumed to occur from the activity of the resource sector (Resource-Environment (RE) Scenario). In the second, environmental damage depends on the activities of both the resource and composite tourism sectors (Integrated Tourism-Environment (ITE) Scenario). Table 1 reports the impacts of the tax in each of the producing sectors on several variables. The values are percentage changes with respect to a 1 percent change in the tax.

[3]The details of model transformation can be obtained from the principal author upon request.

Table 1. —Impact of 1 percent increase in environmental tax on each of the producing sectors (in percent changes)

Variable	Tax in resource sector		Tax in tourism sector	
	RE Scenario[a]	ITE Scenario[b]	RE Scenario	ITE Scenario
Regional income (Y)	0.0137	-0.0021	-0.0530	0.0083
Price of composite (Pc)	0.0023	-0.0047	-0.0091	0.0183
Resource output (R)	-0.1022	-0.0058	0.3962	0.0226
Composite output (C)	0.0885	0.0051	-0.3433	-0.0196
Wage (W)	0.0120	-0.0043	-0.0671	-0.0038
Land rent (D)	-0.0291	-0.0066	0.0923	0.0053
Environmental Damage (E)	-0.0796	0.0023	0.3086	-0.0088
Tourism (T)	0.0772	0.0025	-0.2994	-0.0095

RE = Resource-environment; ITE = Integrated Tourism-Environment.

[a] Environmental damage is assumed from the resource sector.
[b] Environmental damage is assumed from both the resource and composite tourism sectors.

Columns 1 and 2 of Table 1 show the impact of a 1 percent increase in environmental tax in the resource sector, under RE and ITE scenarios respectively. Since the parameters used in the simulations are hypothetical, we will not focus on the absolute changes in these variables. Instead, we will emphasize the differences between the two scenarios. The results show that in both cases the output in the resource sector falls; the demand for the tourism good increases; and the returns to land decline. Nevertheless, the RE scenario experiences a larger increase in demand for tourism and larger declines in resource sector output and returns to land than the ITE scenario. These differences can be explained by focusing on the source of the environmental damage.

In the RE scenario, the reduction in the activity of the resource sector causes an improvement in the environment. The improvement in the environment has a positive effect on tourists in the region. Although the increase in the price of the tourism good discourages tourists, the results show that this effect is completely offset by the expansion in tourism associated with an improvement in the environment. Therefore, an overall increase in the number of visitors is produced. The results show that the expansion of the tourism sector, which leads to an increase in regional income, compensates for the decrease in the output of the resource sector. The stimulus for the tourism sector comes from two sources. First, with a contraction in the resource sector, some factors of production are shifted to the tourism sector. Since the tourism sector is assumed to be labor intensive, the increase in the tourism sector generates more demand for labor than the demand for land. Consequently, there will be an increase in the wage rate and a fall in the rental rate of land. Second, an improvement in the environment also stimulates tourism activity.

In the ITE scenario, the effect of the tax in the resource sector is shown to have a negative effect on the environment. The improvement in the environment generated by the contraction of the resource sector is offset by the environmental damage associated with the expansion of the tourism sector. This may have a depressing effect on the number of visitors and thus on the demand for the tourism good. Furthermore, the expansion in the tourism sector is not shown to offset the contraction of the resource sector. Therefore, there is a decline in returns for factors of production and an overall reduction in the regional income. In sum, the results suggest that the tax policy in the resource sector benefits the regional economy under the RE scenario and hurts it in the ITE scenario.

We also conducted simulation experiments by imposing an environmental tax in the tourism sector. Again, the impact of the tax policy was investigated under the two scenarios as explained above. In the RE scenario, the environmental tax causes a significant decline in the tourism sector and an expansion in the resource sector. Unlike the case of the tax in the resource sector, the tax in the tourism sector causes a decline in the wage rate and an increase in the rental rate of land. The results also show that under the RE scenario, the expansion of a polluting sector, R, causes significant damage to the environment and therefore a reduction in tourism activity. Furthermore, the expansion in the resource sector is not shown to offset the contraction of the composite sector. As a result, we notice a decline in regional income. On the other hand, under scenario B the impact of a tax in the composite sector actually improves the environment. This suggests that the improvement in the environment due to the contraction of the tourism sector offsets the damage associated with the expansion of the resource sector. Thus an overall improvement in regional income is noticed. In sum, the results suggest that the tax policy in the tourism sector hurts the regional economy under the RE scenario but benefits it in the ITE scenario.

CONCLUSIONS

Recently, environmental impacts of tourism have been receiving more attention. However, very few studies have been conducted to model the interactions between tourism and environmental damage. This study provides a framework to model the interactions among economic activity, the environment, and tourism in the context of a tourism-oriented, resource-dependent region. In particular, the model considers both environmental damage and tourism as endogenous variables. We investigated interactions under two types of assumptions about environmental damage. First, it was assumed that environmental damage in the region is largely due to the activity related to the resource sector. Second, it was considered that activities from both the resource sector and the tourism sector affect the local environment. Using a simple computable general equilibrium model and conducting simulation experiments, we showed that the effect of a policy change differs under these two assumptions. The results indicate that an increase in an environmental tax in the resource sector benefits the regional economy if one assumes that environmental damage only comes from the resource sector activity. The converse holds under the assumption that damage to the environment occurs from both resource and tourism sector activities. On the other hand, while an increase in an environmental tax in the tourism sector hurts the regional economy under the first assumption, the tax policy benefits the regional economy under the second assumption. These findings have important implications for sustainable tourism management decisions.

The model developed in this study is simple and very general in nature. Depending upon the region, time frame, and issue under investigation, several extensions can be made:

1. The regional economy can be disaggregated into more sectors and factors of production. For example, the composite tourism sector can be subdivided into recreation, manufacturing, and the service sector. Resource sectors can also be disaggregated into forestry, mining, oil and gas, and agriculture. Similarly, combined labor inputs can be disaggregated into labor and capital. Labor can be divided into skilled and unskilled labor. The mobility of unskilled and skilled labor across sectors varies.
2. Depending on the short-run or long-run scenario, factor markets can be modeled under different scenarios. For example, capital can be sector specific in the short run, but it is mobile across sectors in the long run. In the very long run, capital can be mobile across the regional boundaries. Therefore, in the very long run, issues such as international migration and foreign flow of capital may have to be considered.
3. If the resource-dependent region has market power in the international market for its exports, it is appropriate to consider the price of the resource sector endogenous. For example, in modeling the economy of British Columbia, several researchers have considered the price of the wood products sector as endogenous (see Percy 1986).
4. A variety of flexible functional forms can be used to specify production technology, household preferences, and environmental damage. They include Constant Elasticity of Substitution (CES), Constant Ratio of Elasticity of Substitution Homothetic (CRESH), Generalized Leontief, and Translog functions.

5. Savings, investment, trade balance, and various types of social accounts can be included in the model along with the government sector. In some cases it may be appropriate to model these issues in a dynamic setting. GEMPACK 5.1 or MPSGE/GAMS software are now available to handle dynamic analysis.

6. Modeling environmental damage and tourism activity requires input from various disciplines. For example, information on marginal damage to the environment due to additional logging, mining, or oil drilling have to be obtained from experts in those areas. Modeling marginal emissions from various production activities, pollution assimilation rates, and threshold limits of the environment involves interdisciplinary research. Furthermore, issues such as an increase in the probability of forest fire associated with visitors and extent of damage under alternate production activities can also be incorporated in extended models.

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