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# Tourism and the Environment

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*Abstract:* This paper examines the effects of exogenous and endogenous tourism on welfare and the environment. Despite a gain from the terms-of-trade improvement, an exogenous tourism boom can harm the environment and hence lower welfare of domestic residents. To limit deteriorating the environment, a pollution tax is imposed. In the presence of endogenous tourism, the optimal pollution tax may exceed the marginal damage of pollution. The higher pollution tax can actually attract more tourists and hence improve domestic residents' welfare.

Key words: Endogenous tourism, the environment

JEL classifications: F11, Q38

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## **1. Introduction**

A recent report of the World Tourism Organization entitled “Tourism: 2020 Vision” analyzed the future of tourism in the twenty first century. It forecasted that 1.5 billion tourists will visit foreign countries annually by the year 2020. They will spend approximately US\$2 trillion per year. This represents about three times more tourists than the 663 million tourists recorded in 1999. The 2020 report indicates that the tourism industry will be the largest in the world. Tourism converts local goods and services into exports. This benefits the local communities by providing a source of income and a boost to the economy via an improvement in the tourism terms of trade.<sup>1</sup> To attract and accommodate tourists, there are strong incentives to site hotels and build tourist facilities near to hotspots, regardless of the environmental damage that may result. Furthermore, tourism is usually not managed well from an environmental perspective. Increasing visitor arrivals not only make the environment overcrowded but also cause the resources to be overexploited. Consequently, natural habitats are being increasingly destroyed and more pollution is being generated. It is often questionable whether local communities get enough revenue from tourists to outweigh the environmental costs incurred.

Many studies have made these points; for example, the TED case studies for Oman:<sup>2</sup> “Large influxes of tourists could seriously threaten the environment by stressing Oman’s delicate resources, such as water and land, too severely. There is also a cultural impact to consider as Western tourists interact with a Muslim society that has been isolated from the modern world until just thirty give years ago. How to balance these tough decisions is what confronts Oman as it tries to develop its tourism sector while maintaining its natural surroundings.” (p. 2) “The government’s policy then is to proceed slowly, limiting tourist numbers and cautiously adding to existing infrastructure all in an effort to minimize the environmental impact.” (p. 4)

The expansion in world tourism is increasingly posing a threat to the environment – particularly if tourism is not well planned and managed. If tourism ultimately destroys the environment, then tourists have no reason to visit these countries. In this paper, we consider a

user pay policy for managing the environment from the influx of tourists and a related issue we wish to study is the policy-induced impact on the degree of tourism. To achieve this, we endogenize tourism by introducing a visiting criterion: Foreign tourists will be attracted until their marginal utility of visiting is identical across all boundaries. Nevertheless, discussions on *endogenous* tourism remain absent from the literature. The purpose of this paper is therefore to fill this gap by considering an important question: Does a stricter regulation on pollution attract more tourists? Other issues are also discussed.

The paper is organized as follows. In section 2, we set out a general equilibrium model to examine the welfare and environmental effects of an exogenous rise in tourism. In general, despite the gain from a favorable movement in the terms of trade, tourism may lower welfare due to deterioration in the environment. To improve the environmental quality, we consider the effects of a pollution tax for an economy with endogenous flows of tourists. Section 4 provides conclusions.

## 2. The model

Consider a perfectly competitive economy that produces two goods, a tradable good  $X$  and a non-traded good  $Y$ . Let commodity  $X$  be the numeraire and the relative price of good  $Y$  be denoted by  $p$ . It is assumed that good  $Y$  creates pollution either through emissions or ecological destruction  $Z$ . Further it is assumed that pollution is a by-product and one unit of production of good  $Y$  generates one-unit pollution emission  $Z$ .<sup>3</sup> Since environmental pollution harms the community, a pollution tax,  $s$ , is imposed on producers. The after-tax revenue function is represented by:  $R(p, s) = \max \{X + pY - sZ: (X, Y) \in I(K)\}$ , where  $K$  is the given input vector and  $I(\cdot)$  denotes the technology set. Using the envelope property, we have:  $R_p(p, s) = Y$ , being the supply function of good  $Y$ , and  $R_s(p, s) = -Z$ , indicating the level of pollution emissions in the economy.

The demand side of the economy is defined by consumption by domestic residents and foreign tourists. Both groups demand goods  $X$  and  $Y$ .<sup>4</sup> Let  $C_i$  and  $D_i$  denote the demand

for good  $i$ ,  $i = X, Y$ , by domestic residents and foreign tourists, and their utility functions are respectively:  $U(C_X, C_Y, Z)$  and  $U^*(D_X, D_Y, Z)$ , where pollution  $Z$  negatively affects the utility levels of both groups. For a given  $Z$ , the expenditure function of domestic residents is:  $E(p, Z, u) = \min \{C_X + pC_Y: U(C_X, C_Y, Z) = u\}$ , where  $u$  is the level of utility, and the corresponding demand for good  $Y$  is:  $E_p(p, Z, u) = C_Y$ , with  $E_{pp} < 0$  for the negatively sloped compensated-demand function. Notice that  $E_Z > 0$ , capturing marginal damage of pollution or equivalently marginal willingness to pay for reductions in pollution by domestic residents.<sup>5</sup> The tourists face the budget constraint,  $T = D_X + pD_Y$ , and this demand function for good  $Y$  is:  $D_Y = D_Y(p, Z, T)$ , where  $T$  denotes their spending in the visiting country with  $\partial D_Y / \partial p < 0$ ,  $\partial D_Y / \partial Z < 0$  and  $\partial D_Y / \partial T > 0$ .

Utilizing the above information, the equilibrium of the economy is given by

$$E(p, Z, u) = R(p, s) + sZ, \quad (1)$$

$$E_p(p, Z, u) + D_Y(p, Z, T) = R_p(p, s), \quad (2)$$

$$R_s(p, s) = -Z. \quad (3)$$

Equation (1) describes the budget constraint of the economy, showing that expenditure equals revenue which is adjusted for pollution tax and subsidy. The term  $sZ$ , is rebated to domestic residents in a lump-sum fashion. Equation (2) is the market-clearing condition for the non-traded good  $Y$ ,<sup>6</sup> while and equation (3) expresses the level of pollution emissions in the process of production of  $Y$ .

Equations (1) – (3) contain three unknowns,  $u, p, Z$ , with an exogenous specification of variable,  $T$ . We will examine the effects of an increase in  $T$  on the economy. The key variable of interest is the change in the welfare of domestic residents, which can be obtained by totally differentiating (1):

$$E_u du = D_Y dp - (E_Z - s)dZ, \quad (4)$$

where  $E_u > 0$ , being the inverse of the marginal utility of income. Two terms on the right hand side of equation (4) affect welfare: the terms-of-trade effect and the pollution externality. In the literature, tourism is considered as exports of services. As stated in Hazari and Sgro

(2004), a rise in tourism unambiguously improves domestic welfare via the tourism terms-of-trade effect. However, in the presence of tourism-related pollution, the traditional result does not necessarily hold. Pollution harms consumers, as measured by  $E_Z$  in equation (4), but it also brings revenue to the government through the pollution tax,  $s$

The tourism terms-of-trade effect in equation (4) can be obtained by differentiating equation (2):

$$(E_{pp} + \partial D_Y / \partial p - R_{pp})dp = -E_{pu}du - (\partial D_Y / \partial T)dT - (E_{pZ} + \partial D_Y / \partial Z)dZ + R_{ps}ds, \quad (5)$$

where  $R_{pp} > 0$  for the positively sloped supply function and  $E_{pu} > 0$  by assuming that good  $Y$  is normal in consumption. Note that  $R_{ps} (= \partial Y / \partial s) < 0$  since the pollution tax is a cost for producing good  $Y$ . Furthermore, the effects of pollution on consumption of good  $Y$  for domestic residents and foreign tourists, i.e.,  $E_{pZ} (= \partial C_Y / \partial Z)$  and  $\partial D_Y / \partial Z$ , can have any sign because they can be substitutes, complements or independent goods. Equation (5) shows that the price of good  $Y$  is influenced by the demand factors, such as domestic real income  $u$ , tourist spending  $T$  and the pollution level  $Z$ , as well as the supply factor via the pollution tax  $s$ .

Finally, the change in the level of pollution is determined from equation (3):

$$dZ = -R_{sp}dp - R_{ss}ds, \quad (6)$$

where  $R_{ss} (= -\partial Z / \partial s) > 0$ . Since pollution is considered as a by-product in production of good  $Y$ , the higher price will result in more pollution emissions, as stated in the first term on the right hand side of equation (6). In addition, the pollution tax lowers the production of good  $Y$  and hence less pollution is emitted.

By solving equations (4), (5) and (6), we obtain the effect of tourism on the price of the non-traded good:

$$dp/dT = -E_u(\partial D_Y / \partial T)/J > 0. \quad (7)$$

where  $J < 0$ .<sup>7</sup> A boom in tourism immediately creates a shift in the demand for good  $Y$  and hence its relative price increases. This price effect renders a repercussion on the supply of good  $Y$ , which results in more pollution emissions. This can be seen from (6):

$$dZ/dT = -R_{sp}(dp/dT) > 0. \quad (8)$$

Using the tourism terms-of-trade effect in equation (7) and the pollution-externality effect in equation (8), the effect of tourism on domestic residents' welfare is, as follows:

$$E_u(du/dT) = D_Y(dp/dT) - (E_Z - s)(dZ/dT). \quad (9)$$

In equation (9), the terms-of-trade effect of tourism is always favorable to domestic residents. However, the pollution-externality effect is ambiguous in terms of its effect on welfare, depending on the relative magnitudes of marginal damage and revenue from the tax on pollution. When  $E_Z < s$ , the tourism expansion improves welfare because the gain of tax revenue outweighs the loss from pollution damage. More importantly, when  $E_Z > s$ , tourism may reduce welfare if marginal damage of pollution becomes severe or tax on pollution is set at a low level.<sup>8</sup>

### 3. Environmental Regulations and Endogenous Tourism

Since a boom in tourism may lower welfare of domestic residents via a deterioration in the environment, policies for regulating pollution emissions and preserving the environmental quality are warranted. In this section, we consider this issue by endogenizing the tourism activity  $T$  as a choice variable by tourists. To make the analysis tractable, a Cobb-Douglas form is used to show aggregate consumption. Let the aggregate demand be  $D = D_X^\alpha D_Y^{1-\alpha}$ , where  $0 < \alpha < 1$ , and the tourists' utility function is specified as:  $U^*(D_X, D_Y, Z) = D^{1-\eta} / (1 - \eta)Z$ , with  $\eta < 1$ . Note that the utility level is deflated by the quality of the environment.<sup>9</sup> This yields the tourists' demand for good  $X$  and  $Y$  as:  $D_X = \alpha T$  and  $D_Y = (1 - \alpha)T/p$ , and the corresponding indirect utility function is:  $V^*(p, Z, T) = (k/Z)(T/p^{1-\alpha})^{1-\eta}$ , where  $k = [\alpha^\alpha (1 - \alpha)^{1-\alpha}]^{1-\eta} / (1 - \eta)$ . Here, pollution has no direct impact on the demand for goods, but it affects the level of utility. Tourists' spending in the local economy continues to increase until their marginal utility of spending equals the reservation level,  $\beta$ , in visiting another tourist destination, that is,  $\partial V^* / \partial T = \beta$ . This gives:

$$k(1 - \eta) / T^\eta p^{(1-\alpha)(1-\eta)} Z = \beta. \quad (10)$$

Notice that the marginal utility of tourists' spending in equation (10) is a decreasing function of  $T$ , and it is also inversely related to the price of good  $Y$  and the pollution level  $Z$ .

To regulate the damage to the environment, we consider the effects of the pollution tax under endogenous tourism. The change in tourism can be obtained by totally differentiating equation (10):

$$\eta dT = (1 - \eta)p(\partial D_Y/\partial p)dp - (T/Z)dZ, \quad (11)$$

where  $\partial D_Y/\partial p = -(1 - \alpha)T/p^2$ . Equation (11) indicates that both the relative price of the non-tradable good and the level of pollution adversely affect tourists' spending in the local economy.

Using equations (4) – (6) and (11), we can examine the effect of the pollution tax on the relative price of the tradable good  $Y$ :

$$dp/ds = -E_u\{\eta R_{ps} - [\eta(m/p)(E_Z - s) + (\partial D_Y/\partial T)(T/Z)]R_{ss}\}/\Delta, \quad (12)$$

where  $m = pE_{pu}/E_u < 1$ , expressing the domestic residents' marginal propensity to consume good  $Y$ .<sup>10</sup> Note that  $\partial D_Y/\partial T = (1 - \alpha)/p > 0$  and  $\Delta > 0$  by the stability condition.<sup>11</sup> Hence, from equation (12), we have  $dp/ds > 0$  when marginal damage of pollution is larger than the pollution tax (i.e.,  $E_Z > s$ ). The intuition for this result is as follows. An increase in the pollution tax directly raises cost of producing good  $Y$ , thereby lowering its production as shown in the first term  $R_{ps}$  ( $= \partial Y/\partial s$ ) in equation (12). Consequently, pollution emissions are reduced, measured by  $R_{ss}$  ( $= -\partial Z/\partial s$ ) in the last bracket term in equation (12). This in turn raises welfare of domestic residents and foreign tourists, which increases demand for good  $Y$ . Both the supply and demand forces in equation (12) raise the relative price of good  $Y$ .

Similarly, solving equations (4) – (6) and (11), we can obtain the effect of the change in the pollution tax on pollution emissions:

$$dZ/ds = E_u R_{ss}\{\eta[E_{pp} + (1 - m)(\partial D_Y/\partial p)] + (1 - \eta)p(\partial D_Y/\partial p)(\partial D_Y/\partial T)\}/\Delta < 0. \quad (13)$$

The increase in the pollution tax directly lowers the supply of good  $Y$ , and due to the increased relative price in equation (12) the higher tax lowers demand for good  $Y$ . These two effects make production of good  $Y$  to fall, yielding smaller pollution emissions.



Utilizing (12) and (13), we can consider the welfare effect of the pollution tax. From equation (4), we have:

$$E_u(du/ds) = D_Y(dp/ds) - (E_Z - s)(dZ/ds). \quad (14)$$

In the absence of tourism ( $D_Y = 0$ ), the welfare effect of the pollution tax in (14) depends on the values of  $E_Z$  and  $s$ . This implies that the optimal rate of pollution tax, denoted by  $s^o$ , is  $s^o = E_Z$ . Hence, the damage caused by pollution can be internalized by a tax on it. However, when the tourism activity exists in the economy, the optimal pollution rate is divergent from the marginal environmental damage as perceived by the domestic consumers. Since  $dp/ds > 0$  and  $dZ/ds < 0$  by equations (12) and (13), a rise in the pollution tax unambiguously improves welfare when the tax rate is initially set too low and/or marginal damage of pollution is too high (i.e.,  $E_Z > s$ ). In fact, due to the presence of tourism, welfare of domestic residents can be increased by raising the tax rate more than  $E_Z$ . The optimal rate of the pollution tax can be then derived by setting  $du/ds = 0$  in (14):

$$s^o = E_Z - D_Y(dp/ds)/(dZ/ds). \quad (15)$$

Because  $dp/ds > 0$  and  $dZ/ds < 0$ , we have  $s^o > E_Z$ . Hence, for the economy with tourism, the optimal pollution tax is larger than the marginal damage  $E_Z$ .<sup>12</sup> This result provides the intuition for the result that a better environment attracts more tourists. Formally, from equation (11), we can derive the effect of the pollution tax on tourism:

$$dT/ds = [(1 - \eta)/\eta]p(\partial D_Y/\partial p)(dp/ds) - (T/\eta Z)(dZ/ds). \quad (16)$$

Because of  $dZ/ds < 0$  in equation (13), a better environment is indeed good for attracting tourists. However, due to  $dp/ds > 0$  from equation (12), the higher the relative price of the non-tradable, the lower the demand for tourism. Nonetheless, if tourists weight the environment quality more than the relative price of the non-traded good (i.e.,  $\partial D_Y/\partial p$  is small), then stricter pollution regulations could attract more tourists.

#### **4. Conclusions**

This paper has examined the effects of tourism on domestic residents' welfare and the environment. Since tourism is exports of services, an expansion of tourism gives a gain in the terms of trade. However, this may induce more production of the non-traded good, causing environmental damage. If the damage is severe, tourism can reduce welfare of domestic residents. To preserve the environment and attract tourists, pollution regulations are necessary. We find that for the economy with endogenous tourism, the optimal pollution tax is larger than the marginal damage of pollution as perceived by the domestic consumers. The higher pollution tax can actually attract more tourists and hence improve domestic residents' welfare.

## Footnotes

1. See Hazari and Sgro (2004) for the literature on tourism.
2. All quotations are taken from *Trade and Tourism in Oman*, TED Case Studies, <http://gurukul.ucc.american.edu/ted/omantour.htm>.
3. Another way to model pollution is to treat it as a productive factor. See, for example, Yohe (1979), Yu and Ingene (1982) and Khan (1996).
4. In the literature of tourism, it is often assumed that tourists demand for non-traded goods only. Nonetheless, tourists also purchase tradable goods when they are a bargain.
5. See Hatzipanayotou, et al. (2002) for related applications.
6. Studies on non-traded goods in general-equilibrium settings can be found, for example, in Komiya (1967) and Batra (1973, 1984).
7. Following Dei (1985), the adjustment for the non-tradable price of good  $Y$  is:  $\dot{p} = \rho A(p)$ , where the dot denotes a time derivative,  $\rho$  is the speed of adjustment and  $A$  is the excess demand for good  $Y$  by domestic residents and foreign tourists, i.e.,  $A = E_p(p, Z, u) + D(p, Z, T) - R_p(p, s)$ . From (1) – (3), we can solve for  $u$  and  $Z$  as functions of  $p$  for given  $T$  and  $s$ . A necessary and sufficient condition for stability is:  $dA/dp < 0$ . By using (4) – (6), we obtain:  $dp/dA = E_u/J$ , where  $J = E_u[E_{pp} + \partial D/\partial p - R_{pp} - R_{sp}(E_{pZ} + \partial D/\partial Z) + E_{pu}[D + R_{sp}(E_Z - s)]]$ . Hence for stability, it requires  $J < 0$ .
8. Taxes on pollution emissions are usually low in many developing countries.
9. In a recent survey by the Hong Kong Tourist Association, foreign tourists complained the deteriorated air quality in Hong Kong.
10. Because the expenditure function  $E(\cdot)$  is continuous in  $u$  and  $p$ , we have:  $m = pE_{pu}/E_u = p(\partial E_p/\partial E)$ .
11. Similar to the case in footnote 5, excess demand for the non-traded good  $Y$  is defined as:  $A = E_p(p, Z, u) + D(p, Z, T) - R_p(p, s)$ . From (4) – (6) and (11), we obtain:  $dp/dA = -E_u\eta/\Delta$ . Hence, stability requires  $\Delta > 0$ .

12. This optimal tax rate maximizes welfare of domestic residents. Following Neary (1993), the welfare expression in (14) can be written as:  $E_u(du/ds) = (dZ/ds)(s - s^o)$ , where  $dZ/ds < 0$ . Hence,  $du/ds > (<) 0$  when  $s < (>) s^o$ . This indicates that  $u$  is maximized at  $s^o$ .

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