Spring 5-18-2012

The Impact of Local Environmental Quality on International Tourism Demand: The Case of China

Cong Huang
cnhuang@usfca.edu

The Impact of Local Environmental Quality on International Tourism Demand: The Case of China

Cong Huang

Department of Economics
University of San Francisco
2130 Fulton St.
San Francisco, CA 94117

email: *cnhuang@usfca.edu*

May, 2012

Abstract: This paper studies the impact of local environmental quality on international tourism demand based on a panel data set of tourist arrivals from ten foreign countries in 18 typical provinces in China over the period of 1999-2010. Ordinary Least Squares (OLS) with different specifications show that the growth of pollution has a negative and significant influence on the international tourism demand. More specifically, the air quality plays a crucial role in this relationship, whereas the water quality does not. In addition, similar results can be found after addressing the potential endogeneity between environmental quality and tourism with the use of the two-stags least squares (2SLS) technique in the study. Our empirical findings suggest that better environmental conservation policies by Chinese government are necessary to promote foreign tourism demand – an important element of economic growth in China.

The author would like to express my appreciation to tremendously potential Prof. Sunny Wong who is excellent supervisors in Economics Department. His excellent academic suggestions, contribution to my knowledge and moral support greatly help me.

1. Introduction

Tourism has become one of the fastest growing industries in the world with international tourists increasing from 25 million to 940 million since 1950. It generated US$919 billion in 2010 and this represented 30% of the world's exports of services (US$ 1 trillion a year) and 45% of the total services exports in developing countries (UNWTO, 2011)[1]. Currently, a lot of developing countries are looking to tourism as a promising avenue for economic and social development (UNCTAD, 2007)[2]. Thus, it is important that policymakers understand the factors affecting foreign tourism demand in order to purposely put tourism industry forward.

Although these elements and their impacts on international tourism demand have always been under discussion due to the importance of tourism industry, little mention is made of environmental quality which is one of the most important players in sustainable development. The sustainable development calls for both economic and environmental sustainability. Economics and environment cannot be separated. Therefore, to make it clear whether local environmental quality plays role in affecting international tourism inflows is quite necessary.

On the one hand, the impacts of local environmental quality on international tourism demand should be made sure and investigated. On the other hand, we need to know that tourism is playing a significant role in the achievement of the MDGs[3], in particular MDG 7- environmental sustainability (UNWTO, 2011). That is, the environmental quality is essential to tourism. Tourism can create beneficial effects on environment by assisting conservation through serving as a tool to finance the maintenance of natural environment (Connell et al., 2009; UNEP, 2001; Mathieson and Wall, 1984). This suggests that if local environmental quality does affect international tourism inflows, there may be two-way causality between environmental quality and tourism. If this is the case, potential endogeneity problem may need to be considered and solved to better evaluate how and how much the environmental quality affects the tourism.

---

[1] The World Tourism Organization (UNWTO) is a specialized agency of the United Nations and the leading international organization in the field of tourism.

[2] The United Nations Conference on Trade and Development (UNCTAD) was established in 1964 as a permanent intergovernmental body. It is the principal organ of the United Nations General Assembly dealing with trade, investment, and development issues.

[3] The Millennium Development Goals (MDGs) are eight international development goals that all 193 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015. They include eradicating extreme poverty, reducing child mortality rates, fighting disease epidemics such as AIDS, and developing a global partnership for development.

In this regard, my research will take these above as motivations for making sure the role environmental quality playing in the tourism, and evaluating what impact, environmental quality has on tourism based on panel data collected from China, in order to help provide a reference to design development policy in favor of both economic development and environmental protection. And the reasons why I choose China as my case study is, firstly, China, the world's most emerging economy, is also one of the most emerging tourist destinations of the world. The number of international arrivals staying at least one night has reached 55.66 million in 2010, increasing 9.4 percent from the previous year. And it is predicted that China will become the world's largest destination in the next five to seven years (UNWTO, 2011). Secondly, tourism is considered as one of the most significant foreign exchange earners by Chinese policy makers (Wen and Tisdell, 1996; Uysal et al., 1986), and moreover, China's growth of tourism revenue is much faster than its GDP growth (Figure 1). Thirdly, remarkable economic growth in China is accompanied by the damaging of environmental quality and sustainable development is greatly needed (Shan and Wilson, 2001). Lastly, tourism study about China is definitely limited.

2. Literature Review

It begins with a series of studies focusing on the role tourism playing in economic development, which can lead to a better understanding of the importance of tourism industry in current world. Then, it goes to the studies about the determinants of tourism demand, which can provide a good choice of control variables in affecting tourism. In the end, previous studies of the relationship between tourism and environmental quality are briefly introduced. And based on these relevant literatures, appropriate model and techniques can be set up and selected to conduct the estimations.

2.1 Tourism and Its Important Role in Economic Development

Tourism is a complex economic and social phenomenon specific to modern civilization, and is characterized by a high momentum both nationally and globally (Carmen, 2011). Many governments in developing countries expect that tourism can contribute to economic growth. And there is substantial literature to deal with the topic about tourism. Tourism industry is regarded as a source of scarce financial resources, job creation, foreign exchange earnings, and technical assistance (Sinclair, 1998). Also, by comparing relative growth performance of 14 tourism countries within 143 countries, the research developed by Brau, Lanza, and Pigliaru

(2003) indicated that economics in tourism countries grow faster than other sub-groups (OECD[4], Oil Exporting, LDC[5]).

2.2 Determinants of International Tourism Demand

Carey (1991), Crouch (1994), Witt (1995), Lim (1997), Mervan and Payne (2007), suggest that the development of tourism industry can be presented through tourist demand, which should be measured by the amount of tourist arrivals or the tourist receipts. Besides, the number of nights spent in the destination can also be included, but it has been seldom used as a dependent variable in the tourism demand function. As to the independent variables, in general, the prices of living cost and services at destination country, tourist's income level, exchange rate, and distance are always taken into account. Jud and Joseph (1974), Fuji and Mark (1981), and Carrey (1991) have found that income tends to be the most significant determinant. And what is more, Shareef and McAleer (2005) studied ethnic diversity, political and economic system, and environment have effects on the tourism demand and volatility in small island tourism economies. Also, Phakdisoth and Kim (2007) concluded that risk in destination; communication and transportation infrastructures, bilateral trade and geographical distance are the greatest force in affecting the amount of international tourist arrivals in Laos.

According to previous literature, the model for studying tourism demand should be dynamic. For example, Mervan and Payne (2007) incorporated the dynamics of tourism demand for lagged effects on supply constraints. And at the same time, Phakdisoth and Kim (2007) applied dynamic model: GMM-DIF for panel data in order to study international tourism demand in Laos. Also, Vanegas Sr, M. (2009) specified an autoregressive model with lagged variables. Moreover, most relevant papers about international tourism demand have specified 'international' as different countries, but not the whole level, such as the study developed by Daniel and Ramos in 2002. They studied the international tourism demand for Portugal destination and tourists from France, Germany, Netherlands, Spain and the UK are included in the model to specify the international demand.

---

[4] The Organization for Economic Co-operation and Development (OECD), including 34 members now, OECD uses its wealth of information on a broad range of topics to help governments' foster prosperity and fight poverty through economic growth and financial stability.

[5] Least developed country (LDC) is the name given to a country which, according to the United Nations, exhibits the lowest indicators of socioeconomic development, with the lowest Human Development Index ratings of all countries in the world.

Empirical studies on tourism forecasting are often built on a tourism demand function, and most econometric models are dynamic based on panel data. Also, the main determinants of international demand have been generally approved. However, several areas remain incomplete. Firstly, most of previous literatures only focus on the roles played by economic or political factors in tourism demand equation. The elements such as environmental quality, world cultural and natural heritages attractions have been paid little attention. Secondly, when referring to the destination, most studies just consider the number of tourist arrivals in the whole country but not specifying to different areas in the country. This is not that reasonable due to the existence of regional imbalance and disparities, especially in the developing countries. Lastly, there is little related economic research about international tourism demand in China.

2.3 The Relationship between Tourism and Environmental Quality

Almost all of the studies about the relationship between environmental quality and tourism are focusing on the causal direction from tourism to environment. However, no relevant literature is about the other way, that is, how environmental quality affects tourism. According to the study by Gartner (1996), one of the primary tourism attractions is satisfied environmental quality. Thus, when we refer to the factors affecting tourism demand, it is necessary to consider local environmental quality as one element.

Besides, we should know that tourism is also supposed to be a great force in protecting the environment through assisting conservation due to that the income from tourism can be invested in the protection of natural environment (Mathieson and Wall, 1984; Ward and Beanland, 1995; Cessford and Dingwall, 1997). Tourism is playing a significant role in the achievement of the MDG 7- environmental sustainability (UNWTO, 2011).

If this is true and environmental quality does play a role in making influence on tourism. There may be a two-way causality between environmental quality and tourism, implying that the potential endogeneity problem should be considered when analyzes the impacts of environmental quality on tourism.

From the review of relevant literature, we can find that tourism is one of the most important vehicles to promote economic and social development, especially in developing countries. And a better understand of the factors affecting the tourism demand would contribute to the development of tourism industry. Furthermore, as one great force in achieving sustainable development, environmental quality should be taken into consideration as an aspect that may

have effect on tourism demand. Besides, in order to quantify and evaluate the impact of environmental quality on tourism, a reasonable econometric model is vital to set up based on continuous panel data, and potential endogeneity problem may need to be considered. Taking all of these developments into account, this paper means to specify the role local environmental quality plays in international tourism demand in China. And it is hoped that this study would help to provide a good reference for more effective policy in developing China's tourism industry and even in promoting sustainable development.

3. Methodology

3.1 Data and Data Sources

The data used in this paper was mainly collected from 18 typical provinces (i = 1, 2… 18)[6] in China during summer 2011. Ten foreign countries (j = 1, 2…10)[7] are chosen and properly grouped. The tourist arrivals from each of these 10 countries to every 18 province in China over the period of 1999-2010 generate 2160 observations. Besides, provincial environmental quality indexes, and also a series of control variables in province i and country j are included.

The data about China is from National Bureau of Statistics of China, each Provincial Bureau of Statistics, and Municipal or Provincial Environmental Protection Bureau. And the data for the 10 foreign countries are taken from the dataset of the World Bank.

3.2 Key Independent Variables: Identification

The first five independent variables described in table 1: *codg, sootg, dustg,* so_2g and *pollutg* are the key variables in the analysis in this paper. Local environmental quality is hypothesized to have impacts on the number of foreign tourist arrivals: the growth of water and air pollution (*pollutg*) may reduce the amount of international tourist arrivals in China. To specify such influence, four different types (*cod, soot, dust,* so_2) of pollution have been chose to explain the water and air environmental quality in province i, respectively.

---

[6] 18 provinces (in order): 1.Beijing 2.Tianjin 3.Inner Mongolia 4.Jiangsu 5.Anhui 6.Fujian 7.Shandong 8.Henan 9.Hubei 10.Guangxi 11.Hainan 12.Chongqing 13.Guizhou 14.Yunnan 15.Shanxi 16.Gansu 17.Qinghai 18.Xinjiang.

[7] 10 countries (in order): 1.Japan 2.Korea 3.Thailand 4.U.S. 5.Canada 6.U.K. 7.France 8.Germany 9.Russia 10.Australia.

Firstly, '*cod*' is the quantity of chemical oxygen demand (COD). Commonly, COD determines the amount of organic pollutants found in surface water (e.g. lakes and rivers) or wastewater, making COD a useful measure of water quality. And it is the most severe water pollution in China (Ministry of Environmental Protection of China, 2010). In this paper, *codg* is calculated through the equation: *codg = ln(cod) - ln(cod[_t-1])*, representing the growth (%) value in the year *t* compared with the preceding year, and so do the *sootg, dustg, so2g* and *pollutg*.

Secondly, '*soot*' is the solid particle aerosol formed from fuel combustion. It is also known as "smoke dust" because its particle size is much smaller than the dust. Soot can be used to indirectly and partly measure the carbon monoxide (CO) and carbon dioxide (CO_2) emissions when there is no available data about CO and CO_2 emissions in China.

Thirdly, '*dust*' is the fine particles formed during mechanical processes, and can be dispersed (suspended) as solid particles in the air for a certain time. According to the air pollution control science, the dust is classified as three categories based on its particle size: particulate matter 10 (PM10), solid particles in the air with particle size less than 10μm; dust fall, particle size greater than 30μm; total suspended particulate matter (TSP), i.e. all solid particles in the air with size less than 100μm. Generally, PM10 is the most important international index to measure air quality index. However, there is no available related record in China, so here in this paper, the dust emissions should be used.

3.3 Functional Form

$$lnta_{ijt} = \beta 0 + X_{ijt}\delta + Z_{ijt}\gamma + a_{ij} + u_{ijt}$$

Where, *Xijt* = (*pollutg, codg, sootg, dustg, SO2g*); *Zijt* = (*lngdp, lngpp, exrchange, infprov, infcy, lnlrailroad, lnlhighway, cultrued, natured, location, asia, time, timsq*)

3.4 Methodology: OLS with Different Specifications and 2SLS

Since my data set is across 18 provinces and 10 countries over the year 1999-2010, province and country will be controlled through adding provincial (*i* = 1, 2…18) and country (*j* = 1, 2…10) dummies. Also, the 10 tourist origin countries can be separated into 2 groups, which

belong to Asian countries and non-Asian countries.[8] So in the analysis, OLS with different specifications will be applied, respectively.

As what has been analyzed before, environmental quality variables may be endogenous. Thus, 2SLS will be used for potential endogeneity. Because there is no good instrument has been found, so the X_{ijt} are instrumented by the lagged variables: X_{ijt-1}, X_{ijt-2} and X_{ijt-3} since they are considered as predetermined variables.

4. Interpretations of Results

4.1 Comparisons in OLS

From Table 2, we can see that none of the environmental quality variables is significant when only provincial destinations are controlled. However, when we come to Table 3, in which provinces and tourist origin countries are both controlled the proxy for air quality: *dustg* and so_2g become negatively significant at 1% level, but the water quality index is still insignificant. According to the values of coefficients, we can find that every 1% growth of dust and sulfur dioxide emissions will reduce foreign tourist arrivals by 0.13% and 0.31%, respectively.

This implies that not only the provincial destinations matter but also where the foreign tourists come from is very important to the results. Thus, following, foreign countries are specified as two groups through adding one dummy variable (*asia*): Asian country and non-Asian country. The results in Table 4 and 5 have shown that if the country belongs to Asia (*asia* = 1) all the environmental quality variables are insignificant. On the contrary, when the country is non-Asian, the growth of pollution has a significant negative impact on international tourism demand, but only the air quality index: the growth of sulfur dioxide makes sense in this relationship.

4.2 Comparisons in 2SLS

By comparing Table 2, 3, 4, and 5 with corresponding specifications Table 6, 7, 8 and under 2SLS, we can investigate that the results under 2SLS are similar as the OLS. For example, in Table 7, the 1% growth of pollution will lower foreign tourist arrivals by almost 1.24%. And

[8] Asian countries: (country code) 1.Japan 2.Korea 3.Thailand 9.Russia; non-Asian countries: 4.U.S. 5.Canada 6.U.K. 7.France 8.Germany 10.Australia. Since most areas of Russia are in Asia, so here in this paper, I consider Russia as Asian country.

still only the air quality proxy: the growth of soot, dust and sulfur dioxide emissions plays a role in such an effect, but not the water quality.

4.3 Control Variables

On the one hand, from Table 3 and 7, we can see that the *natured* dummy is insignificant while the *cultured* dummy is highly significant. For example, in table 7 if one province in China does have World Cultural Heritage, the amount of international tourist arrivals to this province will increase by almost 3%.

On the other hand, when compare the results of control variables in Table 4 and 5, or Table 8 and 9, which consider the tourist origin countries as Asian and non-Asian groups, we can investigate that the *cultured* dummy is significant when the foreign country belongs to non-Asia, but not for Asian countries.

5. Summary and Conclusions

Does environmental quality have impact on international tourism demand in China? Results based on my panel data of the amount of tourist arrivals in 18 typical provinces from 10 foreign countries over the period of 1999-2010 suggest that it does, though more detailed interpretations needed. And there are five important findings from this paper:

(1) The pollution has a negative impact on international tourism demand in China, implying that when local environmental quality gets worse the amount of foreign tourist arrivals would decrease. Therefore, better environmental conservation policies by Chinese government are necessary to promote tourism industry.

(2) More specifically, the air quality plays a crucial role in this relationship, whereas the water quality does not. So the improvement of air quality is more effective in attracting international tourists coming to China.

(3) China's splendid culture and long history is more attractive than natural scenery to foreign people. Thus, it is necessary to preserve and develop more cultural tourism projects and process strategic promotions.

(4) Not only the destination (provinces) matters, but also where the foreign tourist comes from (foreign countries) is quite important. So it is wise to understand the cultures of foreign countries in order to promote the tourism in China.

6. Limitations

Even though some significant results that are encouraging have been found, there are some issues that need to be resolved. Firstly, most of the 10 tourist origin countries belong to developed countries, this is far from enough. More LDCs are needed, especially the countries in Africa and South America, in order to make the research more persuadable. Secondly, when it comes to selection bias, there could be some unobservable variables that could be a part if one is likely to traveling China or not. Finally, although lagged variables have been applied under 2SLS for potential endogeneity problem between environmental quality and tourism, one real instrumental variable may still need to be found to make the study more complete.

References

Brau, R., A. Lanza, and F. Pigliaru, 2003, "How fast ar the Tourism Countries Growing? The Corss-Country Evidence,"CRENoS Centro Ricerche Economiche Nord Sud, *working paper*, No.03-09, http://www.crenos.it/working/pdf/03-09.pdf

Carey, K. "Estimation of Caribbean Tourism Demand: Issuers and Methodology", *Atlantic Economic Journal*, 19, (3), 1991, pp. 32-40.

Carmen, S. (2011) Tourism and its influence upon macro-environment in Romania, *Annales Universitatis Apulensis Series Oeconomica*, 13(1), 142-54.

Cessford, G. R. and Dingwall, P. R. (1997), *Impacts of visitors on natural and historic resources of conservation significance: Part 1*, Wellington, N.Z: Department of Conservation.

Connell, J. Page, S. J. and Bentley, T. (2009), Towards sustainable tourism planning in New Zealand; Monitoring local government planning under the Resource Management Act, *Tourism Management*, 30(6), 867-877.

Crouch, G. "The Study of International Tourism Demand: A Review of Findings", *Journal of Travel Research*, 33 (1), 1994, pp. 12-23

Daniel, A, Ramos, F. "Modeling Inbound International Tourism Demand Portugal", *International Journal of Tourism Research*, 4, 2002, pp. 193-2009.

Fuji, E. Mark, J. "Forecasting Tourism Demand: Some Methodological Issues", *The Annals of Regional Science*, 15(2), 1981, pp. 72-82.

Gartner, W. C. (1996), *Tourism Development: Principles, Processes, and Policies*, New York: Van Nostrand Reinhold.

Jud, G., Joseph, H. "International Demand for Latin American Tourism", *Growth and Change*, 5(1): 1974, pp. 25-31.

Lim, C. "Review of International Tourism Demand Models", *Annals of Tourism Research*, 24 (4), 1977, pp. 835-849.

Mathieson, A. and G. Wall (1984). Tourism: Economic, Physical and Social Impacts. New York:

Longman.

Mervar, A. Payne, J. "An Analysis of Foreign Tourism Demand for Croatian Destination: Long-run Elasticity Estimates", *Working Paper*, 2007, pp. 1-20.

Nuno Carlos LEITÃO. "Does Trade Help to Explain Tourism Demand? The Case of Portugal", *Theoretical and Applied Economics*, Volume XVII (2010), No. 3(544), pp. 63-74.

Phakdisoth, L., Kim, D. "The Determinants of Inbound Tourism in Laos", *ASEAN Economic Bulletin*, 24 (2), 2007, pp. 225- 237.

Shan, J. Z. and Wilson, K. (2001) Causality between trade and tourism: empirical evidence from China, *Applied Economics Letters*, 8, 279-83.

Shareef, R , McAleer, M. "Modelling International Tourism Demand and Volatility in Small Island Tourism Economies", *International Journal of Tourism Research* 7, 2005, pp. 313-333.

Sinclair, M.T., 1998, "Tourism and Economic Development: A Survey," *Journal of Development Studies*, 34 (5): 1-51.

Uysal, M., Wei, L. and Reid, L. M. (1986) Development of international tourism in PR China, *Tourism Management*, 7, 113-19.

Vanegas Sr, M. "Tourism Demand Response by Residents of Latin American Countries", *International Journal of Tourism Research*, 11, 2009, pp. 17-29.

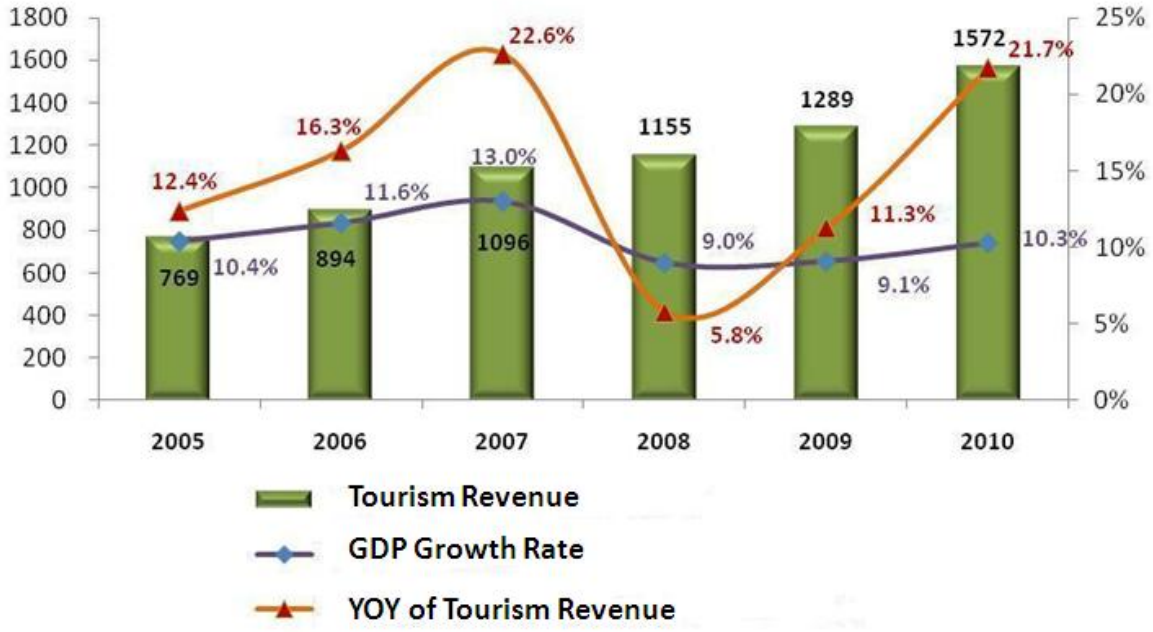
Ward, J. C. and Beanland, R. A. (1995), *Biophysical Impacts of Tourism*, Canterbury, N.Z: Lincoln Environmenal.

Wen, J. and Tisdell, C. (1996) Spatial distribution of tourism in China: economic and other influences, *Tourism Economics*, 2(3), 235-50.

Witt, S. Witt, C. "Forecasting Tourism Demand: A Review of Empirical Research", *International Journal of Forecasting*, 11, (3), 1995, pp. 447-475.

Appendix

Figure 1: China's Tourism Revenue and GDP Growth (2005-2010, RMB Billion)



Source: National Bureau of Statistics of China; ResearchInChina

Table 1: Summary Statistics

Variable	Description	Mean	Standard Deviation	Min	Max
Dependent Variable					
$lnta_{ijt}$	The (log) of the number of tourist arrivals in province *i* from country *j* at time *t*	9.479208	1.807536	2.19723	14.5822
Variables of Interest					
$pollutg_{it}$	The growth (%) of water and air pollution emissions in average (10 thousand tons) in province *i* at time *t*	-0.0074513	0.1005735	-0.396204	0.383235
Water Quality Variable					
$codg_{it}$	The growth (%) of the quantity of chemical oxygen demand (10 thousand tons) in province *i* at time *t*	0.0032507	0.1916712	-0.364119	2.326489
Air Quality Variables					
$sootg_{it}$ **(invisible dust)**	The growth (%) of soot emissions (10 thousand tons) in province *i* at time *t*	-0.0317565	0.1461175	-0.698687	0.719123
$dustg_{it}$ **(visible dust)**	The growth (%) of dust emissions (10 thousand tons) in province *i* at time *t*	-0.0578633	0.2629743	-1.089119	2.058388
$SO2_{it}$	The growth (%) of sulfur dioxide emissions (10 thousand tons) in province *i* at time *t*	0.0211087	0.1451552	-0.651183	1.003754
Control Variables					
$lngdp_{jt}$	Proxy for income level: the (log) of the GDP per capita (current US$) in country *j* at time *t*	9.885667	0.9690668	7.19968	10.9578
$lngpp_{it}$	Proxy for prosperity : the (log) of the gross product per capita (current US$) in province *i* at time *t*	7.383156	0.7857271	5.70038	9.32527
$exrchange_{jt}$	Change (%) of exchange rate between China and country *j* at time *t* (base currency: yuan)	0.0097433	0.075665	-0.177656	0.26096
$infprov_{it}$	Inflation rate (%) in province *i* at time *t*	.0044246	.0314164	-.097353	.053908
$infcy_{jt}$	Inflation rate (%) in country *j* at time *t*	-0.0042177	0.0437623	-0.429996	0.045727
$lnlrailroad_{it}$	Proxy for transportation condition: the (log) of length of railroad (km) per km^2 in province *i* at time *t*	-4.522776	0.9514516	-7.31673	-2.32053
$lnlhighway_{it}$	The (log) of length of highway (km) per km^2 in province *i* at time *t*	-1.009792	1.03779	-4.37902	1.09647

Variable	Description	Mean	Standard Deviation	Min	Max
$cultured_{it}$	1 if the number of World Cultural Heritage[9] in province i at time $t > 0$	0.6111111	0.4876109	0	1
$natured_{it}$	1 if the number of World Natural Heritage in province i at time $t > 0$	0.2592593	0.4383296	0	1
$location_i$	1 if province i is located in coastal area in China	0.3333333	0.4715137	0	1
$asia_j$	1 if country j belongs to Asia	0.3986111	0.4897258	0	1
time	=(1,…, 12) when the year =(1999,…, 2010)	6.5	3.452852	1	12
timesq	=(1, 4,…, 144) when the year =(1999, 2000…, 2010)	54.16667	46.1099	1	144

[9] The World Heritage list includes 936 properties forming part of the cultural and natural heritage which the World Heritage Committee considers as having outstanding universal value.

Table 2: OLS with Controlling Provinces

	1	2	3	4	5	6	7
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution		-0.07689					
		[0.325]					
growth of chemical oxygen demand (water)			-0.00004				0.00498
			[0.104]				[0.104]
growth of soot (air)				-0.04434			0.01049
				[0.207]			[0.216]
growth of dust (air)					0.13172		0.13756
					[0.100]		[0.098]
growth of SO2 (air)						-0.28126	-0.29752
						[0.199]	[0.208]
log of GDP	0.50770***	0.50757***	0.50770***	0.50773***	0.50790***	0.50706***	0.50723***
	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]
log of gross provincial product	0.70009	0.68397	0.70008	0.68877	0.75244*	0.66678	0.72284
	[0.436]	[0.444]	[0.436]	[0.441]	[0.438]	[0.437]	[0.443]
change of exchange rate	-0.2463	-0.26171	-0.2463	-0.25368	-0.20183	-0.32788	-0.28417
	[0.414]	[0.414]	[0.414]	[0.413]	[0.412]	[0.417]	[0.416]
provincial inflation rate	0.39931	0.38576	0.3993	0.38753	0.3679	0.35858	0.32685
	[0.871]	[0.870]	[0.871]	[0.872]	[0.874]	[0.870]	[0.875]
country's inflation rate	0.06658	0.06846	0.06658	0.06347	0.07269	0.06949	0.07655
	[1.041]	[1.041]	[1.042]	[1.042]	[1.039]	[1.033]	[1.033]
log of the length of railroad per km²	0.10541	0.10491	0.1054	0.10303	0.09803	0.1063	0.09961
	[0.165]	[0.165]	[0.165]	[0.165]	[0.165]	[0.166]	[0.167]
log of the length of highway per km²	0.01638	0.01195	0.01638	0.01491	0.02172	-0.01008	-0.00559
	[0.121]	[0.123]	[0.121]	[0.121]	[0.121]	[0.123]	[0.123]
number of World Cultural Heritage>0	1.78270**	1.81064**	1.78273**	1.80372**	1.72815**	1.85872***	1.79820**
	[0.707]	[0.719]	[0.710]	[0.716]	[0.708]	[0.714]	[0.726]
number of World Natural Heritage>0	0.04224	0.04466	0.04224	0.04602	0.00397	0.02664	-0.01518
	[0.272]	[0.272]	[0.272]	[0.272]	[0.274]	[0.272]	[0.276]
provincial location is in coastal areas	0.28593	0.29161	0.28594	0.28576	0.30762	0.33266	0.35732
	[0.333]	[0.334]	[0.334]	[0.334]	[0.335]	[0.338]	[0.342]
time	0.13583**	0.14197**	0.13583**	0.13830**	0.12761**	0.15624***	0.14781**
	[0.058]	[0.063]	[0.059]	[0.059]	[0.057]	[0.060]	[0.061]
timesq	-0.00975**	-0.00995**	-0.00975**	-0.00977**	-0.00976**	-0.01066***	-0.01070***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Constant	-1.09185	-1.01503	-1.09185	-1.0423	-1.45844	-0.98161	-1.36997
	[3.058]	[3.090]	[3.059]	[3.078]	[3.082]	[3.068]	[3.106]
Observations	1,980	1,980	1,980	1,980	1,980	1,980	1,980
R-squared	0.572	0.572	0.572	0.572	0.5723	0.5724	0.5727
Robust standard errors in brackets							
*** p<0.01, ** p<0.05, * p<0.1							

Table 3: OLS with Controlling Provinces & Countries

	1	2	3	4	5	6	7
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution		-0.11755					
		[0.264]					
growth of chemical oxygen demand (water)			-0.00447				0.00143
			[0.063]				[0.062]
growth of soot (air)				-0.08258			-0.02139
				[0.162]			[0.168]
growth of dust (air)					0.12461		-0.13351*
					[0.081]		[0.078]
growth of SO2 (air)						-0.30861*	-0.31208*
						[0.167]	[0.174]
log of GDP	0.74051***	0.73818***	0.74046***	0.74288***	0.74258***	0.73106***	0.73381***
	[0.216]	[0.216]	[0.216]	[0.216]	[0.216]	[0.217]	[0.218]
log of gross provincial product	0.72806*	0.70423*	0.72750*	0.70651*	0.77672**	0.69472*	0.74107*
	[0.390]	[0.397]	[0.391]	[0.395]	[0.393]	[0.391]	[0.397]
change of exchange rate	-0.52114	-0.54653	-0.52139	-0.53509	-0.4766	-0.61759*	-0.57449*
	[0.334]	[0.336]	[0.334]	[0.334]	[0.333]	[0.339]	[0.339]
provincial inflation rate	0.29035	0.26914	0.28977	0.2669	0.26174	0.2444	0.20735
	[0.708]	[0.708]	[0.708]	[0.710]	[0.710]	[0.708]	[0.713]
country's inflation rate	-1.25453	-1.24667	-1.25423	-1.26345	-1.2536	-1.2323	-1.23347
	[1.172]	[1.172]	[1.172]	[1.172]	[1.170]	[1.165]	[1.165]
log of the length of railroad per km²	0.07082	0.0698	0.07046	0.06655	0.0641	0.07078	0.06259
	[0.118]	[0.119]	[0.118]	[0.119]	[0.118]	[0.119]	[0.119]
log of the length of highway per km²	0.0001	-0.00658	0.00001	-0.00269	0.00503	-0.02857	-0.0243
	[0.098]	[0.098]	[0.098]	[0.098]	[0.098]	[0.098]	[0.098]
number of World Cultural Heritage>0	1.92069***	1.96308***	1.92335***	1.95995***	1.86951***	2.00287***	1.95829***
	[0.540]	[0.549]	[0.542]	[0.545]	[0.541]	[0.543]	[0.550]
number of World Natural Heritage>0	0.02924	0.03308	0.02929	0.03617	-0.00711	0.01269	-0.02467
	[0.212]	[0.213]	[0.212]	[0.213]	[0.214]	[0.213]	[0.216]
provincial location is in coastal areas	0.38016	0.38912	0.38082	0.37962	0.40041	0.43259*	0.45453*
	[0.246]	[0.246]	[0.247]	[0.247]	[0.248]	[0.248]	[0.251]
time	0.11486**	0.12437**	0.11526**	0.11921**	0.10700**	0.13784**	0.13068**
	[0.053]	[0.058]	[0.054]	[0.054]	[0.053]	[0.055]	[0.056]
timesq	-0.00953***	-0.00985***	-0.00955***	-0.00955***	-0.00954***	-0.01056***	-0.01058***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Constant	-1.09185	-1.01503	-1.09185	-1.0423	-1.45844	-0.98161	-1.36997
	[3.058]	[3.090]	[3.059]	[3.078]	[3.082]	[3.068]	[3.106]
Observations	1,980	1,980	1,980	1,980	1,980	1,980	1,980
R-squared	0.572	0.572	0.572	0.572	0.5723	0.5724	0.5727

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 4: OLS with Asian Countries

	1	2	3	4	5	6	7
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution		0.18439					
		[0.519]					
growth of chemical oxygen demand (water)			0.02535				0.02554
			[0.131]				[0.130]
growth of soot (air)				0.09702			0.13721
				[0.316]			[0.315]
growth of dust (air)					0.1442		0.13822
					[0.149]		[0.143]
growth of SO2 (air)						-0.20527	-0.26884
						[0.306]	[0.308]
log of GDP	1.00251***	1.00569***	1.00278***	1.00091***	1.00420***	0.99738***	0.99541***
	[0.234]	[0.235]	[0.234]	[0.235]	[0.235]	[0.235]	[0.236]
log of gross provincial product	0.34364	0.37977	0.34615	0.36609	0.4042	0.32263	0.40843
	[0.869]	[0.881]	[0.868]	[0.875]	[0.875]	[0.871]	[0.882]
number of World Cultural Heritage>0	0.42862	0.30628	0.40127	0.33397	0.40311	0.56806	0.42538
	[1.351]	[1.385]	[1.372]	[1.385]	[1.345]	[1.358]	[1.401]
number of World Natural Heritage>0	0.02113	0.01753	0.02131	0.01496	-0.02179	0.00636	-0.0479
	[0.490]	[0.490]	[0.490]	[0.492]	[0.493]	[0.490]	[0.494]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	792	792	792	792	792	792	792

*** p<0.01, ** p<0.05, * p<0.1

Note: In this table (Table 4), and also the following 5 tables, some variables are omitted. Only the variables that would be mentioned in the conclusions have been reported here.

Table 5: OLS with non-Asian Countries

	1	2	3	4	5	6	7
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution		-0.36319*					
		[0.216]					
growth of chemical oxygen demand (water)			-0.02038				-0.01243
			[0.050]				[0.048]
growth of soot (air)				-0.20257			-0.12021
				[0.131]			[0.135]
growth of dust (air)					0.09714		0.11323
					[0.079]		[0.074]
growth of SO2 (air)						-0.39800***	-0.35972**
						[0.145]	[0.147]
log of GDP	0.31852*	0.30403*	0.31796*	0.33098*	0.32109*	0.29288*	0.30539*
	[0.175]	[0.176]	[0.175]	[0.175]	[0.175]	[0.176]	[0.176]
log of gross provincial product	0.95201***	0.87779***	0.94923***	0.89344***	0.98929***	0.91166***	0.92255***
	[0.219]	[0.223]	[0.220]	[0.218]	[0.223]	[0.218]	[0.222]
number of World Cultural Heritage>0	2.08832***	2.19286***	2.09861***	2.16588***	2.04735***	2.15407***	2.15228***
	[0.336]	[0.346]	[0.339]	[0.339]	[0.339]	[0.343]	[0.352]
number of World Natural Heritage>0	0.06642	0.07947	0.06672	0.08369	0.03801	0.04734	0.02649
	[0.118]	[0.117]	[0.118]	[0.119]	[0.121]	[0.121]	[0.125]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	1,188	1,188	1,188	1,188	1,188	1,188	1,188

*** p<0.01, ** p<0.05, * p<0.1

Table 6: 2SLS with Controlling Provinces

	1	2	3	4	5	6
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution	-1.04636					
	[0.898]					
growth of chemical oxygen demand (water)		0.03977				0.1061
		[0.252]				[0.223]
growth of soot (air)			-1.08897			-0.36045
			[0.718]			[0.585]
growth of dust (air)				-0.73850*		-0.58414*
				[0.408]		[0.331]
growth of SO2 (air)					-0.72434	-0.25814
					[0.539]	[0.430]
log of GDP	0.46803***	0.47070***	0.46851***	0.46871***	0.46850***	0.46791***
	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]
log of gross provincial product	-0.14001	0.08747	-0.23651	-0.15436	-0.08747	-0.27673
	[0.519]	[0.502]	[0.533]	[0.513]	[0.517]	[0.540]
number of World Cultural Heritage>0	3.09302***	2.74275***	3.16748***	3.04962***	2.97618***	3.16985***
	[0.826]	[0.766]	[0.834]	[0.801]	[0.807]	[0.831]
number of World Natural Heritage>0	-0.08256	-0.13104	0.09968	0.05055	-0.15398	0.08858
	[0.396]	[0.395]	[0.421]	[0.408]	[0.394]	[0.418]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	1,620	1,620	1,620	1,620	1,620	1,620

*** p<0.01, ** p<0.05, * p<0.1

Table 7: 2SLS with Controlling Provinces & Countries

	1	2	3	4	5	6
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution	-1.24395*					
	[0.734]					
growth of chemical oxygen demand (water)		-0.05524				0.02359
		[0.170]				[0.151]
growth of soot (air)			-1.07759*			-0.36426
			[0.591]			[0.465]
growth of dust (air)				-0.76457**		-0.55146**
				[0.331]		[0.258]
growth of SO2 (air)					-0.75230*	-0.31498
					[0.431]	[0.352]
log of GDP	0.33989	0.39702	0.37095	0.35882	0.35055	0.34104
	[0.256]	[0.266]	[0.262]	[0.261]	[0.263]	[0.260]
log of gross provincial product	0.04714	0.31066	-0.00826	0.06412	0.13478	-0.0485
	[0.457]	[0.452]	[0.470]	[0.458]	[0.461]	[0.476]
number of World Cultural Heritage>0	3.16888***	2.79251***	3.17922***	3.07493***	2.99801***	3.21384***
	[0.649]	[0.602]	[0.653]	[0.637]	[0.637]	[0.652]
number of World Natural Heritage>0	-0.09421	-0.15442	0.07761	0.03723	-0.17527	0.05333
	[0.292]	[0.291]	[0.313]	[0.301]	[0.291]	[0.311]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	1,620	1,620	1,620	1,620	1,620	1,620
*** p<0.01, ** p<0.05, * p<0.1						

Table 8: 2SLS with Asian Countries

	1	2	3	4	5	6
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution	-2.28524					
	[1.613]					
growth of chemical oxygen demand (water)		-0.28291				0.0679
		[0.346]				[0.300]
growth of soot (air)			-1.49697			-0.34386
			[1.362]			[1.002]
growth of dust (air)				-1.1437		-0.67134
				[0.732]		[0.528]
growth of SO2 (air)					-1.3424	-0.90219
					[0.857]	[0.615]
log of GDP	0.60522**	0.69102**	0.64978**	0.63311**	0.62832**	0.60317**
	[0.283]	[0.299]	[0.288]	[0.290]	[0.296]	[0.287]
log of gross provincial product	-0.37331	0.09855	-0.34164	-0.27882	-0.22263	-0.43526
	[1.038]	[1.052]	[1.062]	[1.056]	[1.056]	[1.081]
number of World Cultural Heritage>0	2.55618	1.03755	2.03695	1.92858	1.81518	2.37097
	[2.107]	[1.667]	[2.097]	[1.896]	[1.844]	[2.103]
number of World Natural Heritage>0	-0.0019	-0.07986	0.22652	0.19074	-0.12641	0.11166
	[0.663]	[0.665]	[0.698]	[0.678]	[0.668]	[0.694]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	648	648	648	648	648	648
*** p<0.01, ** p<0.05, * p<0.1						

Table 9: 2SLS with non-Asian Countries

	1	2	3	4	5	6
Variables	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*	*lnta*
growth of pollution	-0.58946					
	[0.506]					
growth of chemical oxygen demand (water)		0.08102				-0.01418
		[0.127]				[0.109]
growth of soot (air)			-0.65047*			-0.32217
			[0.369]			[0.342]
growth of dust (air)				-0.46551**		-0.45004**
				[0.202]		[0.186]
growth of SO2 (air)					-0.29945	0.07516
					[0.306]	[0.265]
log of GDP	-0.04765	-0.00187	-0.01336	-0.03212	-0.0394	-0.02706
	[0.199]	[0.193]	[0.192]	[0.192]	[0.197]	[0.194]
log of gross provincial product	0.31309	0.42082	0.24102	0.2897	0.36521	0.21881
	[0.241]	[0.226]	[0.248]	[0.231]	[0.234]	[0.253]
number of World Cultural Heritage>0	3.22540***	3.06796***	3.28327***	3.21898***	3.14688***	3.30012***
	[0.397]	[0.363]	[0.399]	[0.388]	[0.382]	[0.408]
number of World Natural Heritage>0	-0.13673	-0.15632	-0.02381	-0.04651	-0.17316	0.0199
	[0.120]	[0.118]	[0.142]	[0.131]	[0.118]	[0.139]
Provincial Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Country Dummy	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	972	972	972	972	972	972

*** p<0.01, ** p<0.05, * p<0.1