BIODIVERSITY AND A TRAVEL COST EVALUATION OF TOURISM: THE CASE OF CHANGBAISHAN MOUNTAIN BIOSPHERE RESERVE, CHINA

by

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ABSTRACT

Recreational value of an outdoor site is reflected in a visitor's willingness to pay for the visit. This can sometimes be estimated using the Travel Cost Methodology (TCM) as the consumer's surplus under the site demand curve. Based on a case study of Changbaishan Mountain Biosphere Reserve (CMBR) located in Northeast China, this paper focuses on the recreational values of tourism using the Travel Cost Method and speculates about the extent to which this value depends on the biodiversity present in CMBR.

1. INTRODUCTION

Application of the travel cost method (TCM) to value protected areas and outdoor recreational sites has now become relatively common in Western countries. But apart from initial research undertake by Xue (1997) for Changbaishan Mountain Biosphere Reserve (CMBR) located in Northeast China, there have been no such studies for China. The purpose of this paper is to use Xue's data to estimate the recreational tourism value of CMBR using the Travel Cost Method and to speculate about the extent to which this value depends on the biodiversity present in CMBR.

Considerable gaps exist in our knowledge about the value of biodiversity as a drawcard for tourism even though biodiversity valuation has been designed as a key part of studies of countries by UNEP (1993). Generally, biodiversity in a nature reserve has four categories of values: i.e. direct value of extractive goods, direct value of non-extractive services, indirect value of ecological functions and non-use values including existence value, bequest value and option value (Xue, 1999). A nature reserve is an important facility for conserving biodiversity and also a resort location for tourism. Recreational value is one of the non-extractive services of biodiversity, and is an important characteristic for a nature reserve.

Using TCM this article highlights the substantial economic value of CBMR for tourism, a value believed to depend largely but not exclusively on its conservation of biodiversity. This biodiversity is characterised by the extent of the variety and the number of relatively unique species and ecosystems there. As yet no satisfactory means have been devised or applied to value these various characteristics or attributes as variables. Instead, particular protected areas, species or ecosystems have been valued. A characteristics-type of approach as for example pioneered by Lancaster (1996), might have potential for determining the importance of various attributes of biodiversity as generators of tourism demand. This is not done here but it is noted as a gap in current tourism analyses of the value of nature conservation. Site valuation using TCM is undertaken and information is reported which suggests that most of the tourism value of CMBR is attributable to the biodiversity characteristics present.

TCM has been applied in many governmental institutions of the United States and it reveals that the average outdoor recreational value for one person-day in the country is US $34 in 1987 (Walsh *et al.,* 1990). A study funded by the UK National Forestry Commission evaluates the recreational values of the 900,000 ha of six forests under the commission by TCM and the result indicates the total recreational values in the year of 1988 is up to 53 million pounds (Willis and Benson, 1988; Bateman, 1992). Another study reveals the wildlife attributes of each forest are estimated to contribute about 38 per cent of the total recreational value (Willis and Benson, 1989). TCM is usually used to value a given site, such as the study on Achray Forest in the middle of Scotland (Hanley, 1989). The method can also be used to value a group of sites. Examples are the study of lakes in eastern Texas, (Seller *et al.,* 1985), and the studies on recreational lakes in the United States (Smith *et al.,* 1986). Tobias and Mendelsohn (1991) used TCM to measure the value of ecotourism at Monteverde Cloud Forest Reserve in Costa Rica. They found domestic recreational visits alone represented an annual value of between US$97,500 and $116,200, and foreign visitation represented an additional US$400,000 to $500,000 annually.

The Changbaishan Mountains are situated in the northeast of China straddling the border with North Korea. The position can be seen on the map of the area shown in Figure 1.

[Insert Figure 1]

The CMBR is a typical example of an intact primary natural forest ecosystem. It is a rare natural protected area in the Asia and Europe Continent, and includes the highest mountain in north-east China, Bai Yun. This is a volcano, 2,691 metres high with a large and deep crater lake at the summit which is actually half in Korea and half in China. CMBR is covered by ancestral forests and thousands of hot springs, and displays typical altitude vegetation zones in a temperate climate, and also alpine tundra in the far east. CMBR is important for science and evolution, and also is an attractive recreational site because of the large area of primary forests, altitudinal differences of natural landscapes, rare fauna and flora, and special volcanic relics. There are more than 300 species of vertebrate animals as well as more than a thousand species of plants for medicinal use, many of which are valuable Chinese herbal ingredients[1]. Since the reserve opened the north slope of Baitou Peak for tourism in 1982, visitation has increased. There are now around 200,000 visiting per annum and the total visitor numbers to 1996 amounted to 1.6 million, of which many were from abroad. CMBR was established in 1960 and was incorporated in the World Biosphere Reserve Network in 1980. Each Biosphere Reserve in the Network fulfils three basic functions, which are complementary and mutually reinforcing:

- a conservation function - to contribute to the conservation of landscapes, ecosystems, species and genetic variation;
- a development function - to foster economic and human development which is socio-culturally and ecologically sustainable;
- a logistic function - to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development[2]

The CMBR therefore has as one aim the conservation of the biodiversity of the forest ecosystems. In addition the biodiversity has an important direct non-extractive service value for science, culture and recreation, as well as remarkable indirect values in ecological functions and non-use values such as existence, bequest and option values. This paper aims to reveal the non-extractive service value of recreation through a case study in CMBR and aims to evaluate what portion of this value can be attributed to the biodiversity qualities of the reserve.

2. Description of the Valuation Methodology for Recreational Value of Biodiversity

2.1 Travel Cost Methodology

In this study, the Zonal Travel Cost Method is used to measure the recreational value in terms of the economic welfare measure, the consumer surplus. This is a measure of the visitors'

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[1] http://www.chinarainbow.com/english/lyuyou/zdmsh.htm
[2] http://www.euromab.org/brprogram/what.html

willingness to pay for the recreation above the price currently charged. This value is a minimum valuation of the site as it does not include the non-use values or the extractive use values.

In order to estimate a value for the recreation use of Changbaishan Mountain Biosphere Reserve, a demand curve is needed. It is not possible to directly estimate a demand curve for the site since there is no variation in the price of admission. Only one point on the demand curve can be obtained corresponding to the present entry fee. The travel cost methodology enables a demand curve to be derived for different entry fees, based on the actual costs involved for travel to the site. This is achieved in a two step procedure. Once the site demand curve (stage II) is estimated then the calculation of consumers' surplus can be done.

The TCM relies on the assumption that the value people place on the site is represented by the amount they are willing to pay to travel to the site. So linking visitation with travel costs and other socio-economic variables enables a recreation value to be estimated. This constitutes stage I of the procedure. Then assuming that visitors would respond to an increase in entrance fees in the same way they respond to an increase in travel costs, the second stage demand curve for the actual site can be estimated.

Following the methodology initially described by Clawson and Knetsch (1996) the whole country was divided into 37 residential zones by administrative areas, including 28 provincial areas, and 9 municipal areas within Jilin Province where the reserve is located. The average income for each zone is known, as well as the distance to the reserve. The statistical data of all residential zones are shown in Table 1. The average travel cost and time taken from each zone can be calculated. Using this aggregate data the first stage demand estimation can be made which provides an indication of how demand for the reserve varies as the characteristics of the zones vary. Clawson and Knetsch (1996, p. 61) call this 'the demand curve for the whole recreation experience'. The second stage of the demand estimation derives a demand curve for the recreation site (CMBR) itself. The number of visitors at the present entry fee is one point on the demand curve for the site. In order to derive other points, the travel cost was incremented by various amounts and the number of visitors calculated. This was carried out for each individual zone until visitation from the zone was depressed to zero. The total visitation was then calculated by summing across all the zones for each increment. Since the zones at different distances do not exhibit a uniform change in demand for each incremental cost, the resulting relationship between the incremental amounts and total visitation is usually a decreasing non-linear function which is called the demand curve for the actual site (or site demand function). This is the second stage of the TCM and assumes that visitors would react to higher entrance fees in the same way they do to higher travel costs. Using the estimated site demand function the consumer surplus can be calculated as the area under the curve above the current costs. This is illustrated in Figure 2 where DD represents the demand curve and P_1 the current price.

[Insert Figure 2]

It is expected that zones that are closer to the site, which have lower travel costs, and hence usually higher rates of visitation, would exhibit a faster decrease in demand as the cost is incremented. This is because the amount of the increment constitutes a larger proportion of travel costs than for those visitors from a more distant zone.

2.2 Calculation of the Dependent Variable, Visitation Rate

On-site questioning of 3,131 visitors identified their zonal origin from which the dependent variable in the regression was calculated. The time period used was the full year 1996. Annex Table 1 indicates that total domestic visitation for the year was 176,000 persons. Assuming the same proportion as in the sample, the total number of visitors per residential zone (V_i) for 1996 can be calculated. This can be used as the dependent variable, or alternatively can be divided by the population for each zone to get the visit rate from each zone. Here the zonal visit rate (VR_i) has been calculated by dividing by the population in tens of thousands, resulting in a rate per ten thousand population.

- total number of visitors per residential zone = sample proportion × total visitation

$$V_i = \frac{n_i}{3131} \times 176000$$

- visit rate from each residential zone = $\dfrac{\text{total visitors per zone}}{100 \times \text{zonal population}}$

$$VR_i = \frac{V_i}{100 \times N_i}$$

2.3 Description of Independent Variables

The most important independent variable is the total travel cost. Travel time was also considered as well as the average zonal income.

2.3.1 Calculation of total travel costs

The zonal total travel costs include the following three items:

- Transportation costs based on the actual ticket prices in the Summer of 1996 for a round-trip by train and bus.
- Accommodation costs calculated by trip days multiplied by average standard accommodation hotel costs plus food.
- Entrance costs are the actual fees (50 yuan per person) charged by the reserve administration.

The details of these costs are shown in Annex Table 1.

2.3.2 Zonal average income

The average annual per capita wages for formal employees from the cities and provinces[3] are shown in Table 1. It is noted that these statistics are official wages and do not necessarily represent the people's full income.

It can be seen from Table 1 that the travel costs from some of the zones constitute a large proportion of the annual average wage rate for the region. In two thirds of the zones the travel costs are over 25% of the annual salary and in one quarter of the zones the travel costs are more than 40% of the annual salary. It is unreasonable to assume that people earning only the average wage would spend this much on a short holiday. The visitors to this special Biosphere Reserve are likely to earn well above the zonal average and so have far more discretionary income than the common worker. Many visitors also are entitled to reimbursement for their visitation expenditures. Hence, the assumption that the visitors' incomes are representative of the zonal population average incomes may not be applicable.

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[3] These are taken from the *1996 China Statistics Yearbook* (p. 117) and the *1996 China Labour Statistics Yearbook* (p. 141), China Statistical Publishing House, Beijing.

2.3.3 Consideration of Travel Time

Incorporating travel time into a travel cost analysis has received wide attention. Visitors from distant zones visit the site less frequently than those who live closer, because of the combined effect of transportation costs and travel time. The opportunity cost of scarce time acts as a separate deterrent at the margin to visiting more distant sites (Ward and Loomis, 1986). Failure to include travel time will bias the results. In 1987, the Department of Transport of UK, in a re-appraisal of the value of non-working time, advocated a standard average appraisal value of 43 percent of earnings, with slightly higher values for adults and people of working age, but a lower value for the retired and children. This amount is used by Willis and Benson (1989) to value non-working or leisure time forgone to visit the forest sites. Chavas *et al.* (1989) consider that the opportunity value of travel time is between 30%-50% of actual wage. But Smith *et al.* (1986) assume the opportunity cost of time is equal to the wage rate, and they find that assuming a fraction of the opportunity cost is not superior to using the full wage rate. In this study travel time has been arbitrarily valued at 40% of the average wage for each zone.

Travel time and travel cost cannot both be included in a regression analysis as discussed in section 3.1. Estimation has been carried out in this study in two ways: (i) using only travel costs (TC) and (ii) using travel costs plus travel time (TT) (but not on-site time) valued at 40% of the wage rate. On site time has been considered to be a benefit rather than a cost since CMBR is taken as a single destination trip. (See also section 4.3.2.)

[Insert Table 1]

The travel time opportunity cost has been calculated as follows:

$$\text{Total work hours per year} = \text{No of working days} \times \text{Average workday hours}$$
$$= 254 \times 8$$
$$= 2032 \text{ hours}$$

$$\text{Average zonal hourly wage per person} = \frac{\text{avge wage per year}}{2032} \times 40\%$$

$$\text{Total travel hours} = \text{hours by train or bus} + \text{hours for transit} + \text{on-site time}$$

(as shown in Table 1, column 3)

$$\text{Value of travel time per person} = (\text{total travel hours} - 36) \times \text{average hourly wage}$$

Since on-site time has not been included in the travel cost analysis and visitors, on average, spend one night and two days at the Reserve, 36 hours have been deducted from the total travel hours.

3. ANALYSIS OF RECREATIONAL VALUE

3.1 Travel Cost Stage I regression

The first stage regression relates visitation rates to travel cost and other variables. The data for the CMBR includes total population, travel cost, and travel time. It can be seen from the correlation matrix in Table 2 that there is almost perfect correlation between the travel cost and travel time. Hence, both variables cannot be included in the regression as the estimation would have almost perfect multicollinearity.

[Insert Table 2]

There is a low correlation between either of the possible dependent variables (V, VR) and the average zonal wage, which suggests also that the visitors to CMBR are not the 'average' for the zone in terms of wages.

Since only zonal averages for income and travel distance and time are available it is necessary to build an aggregate travel cost model. This can provide an indication of how demand for the reserve varies as the characteristics of the zones vary. However there are limitations to using aggregate data. Hellerstein (1995, p. 621) points out that if only averages and sums are available, then only linear models can be estimated consistently. If additional information on the distribution of the aggregate data is available then the set of models can be expanded to include non-linear functional forms. This data is not available in this case.

3.1.1 Linear initial regressions

When linear regressions were estimated (taking into account Hellerstein's warning) none were particularly good. Average income was not a significant variable when included in a multiple regression with either travel costs or travel costs plus time as shown in Table 3 where t values are shown in parentheses.

[Insert Table 3 about here]

3.1.2 Non-linear initial regressions

Non-linear estimation produced a much better fit to the data as shown in Table 4.

[Insert Table 4]

In both the linear and non-linear estimations, it can be seen that the inclusion of the value of travel time does not improve the estimation, with the first equation in each of the above tables giving the best fit. Durbin-Watson values of 1.7 indicate no autocorrelation problem for n = 37 and two independent variables.

3.2 Travel Cost Stage II Demand Curve Derivation

The first regression equation from Table 3 relating visit rates to total travel cost only, and the first equation from Table 4 have been used to derive separate demand curves for the CMBR (the demand curve for the recreation resource). Various entry fee levels can be represented by incrementing the travel cost values for each zone until visitation drops to zero[4]. For each increment the visitation rate for the zone can be calculated and all the zones summed to obtain the total visitation rate at that increment. These values are shown in Annex Tables 2 and 3. Annex Table 2 shows the estimated visitation rates at various increments above the present entry fee starting from a first stage linear estimation, whereas Annex Table 3 similarly shows the estimated visitation rate calculated from the initial non-linear first stage equation.

3.2.1 Stage II estimations and consumer surplus from initial linear regressions

The estimated functions connecting the increments (P) with the estimated total number of visitors (V) (for linear initial estimation) are shown in Table 5.

[Insert Table 5]

From Table 5 it can be seen that the log-linear form and the quadratic form of the demand curve give similar statistics and appear to fit the data better than the first two equations estimated. However they both have a problem of autocorrelation, but since the procedure

[4] It is important to keep incrementing until the visitation drops to zero since otherwise the summations of the visitation quantity data will be truncated. This may simply result in an inaccurate estimation of the demand function and hence consumer surplus, or else may result in points representing only a limited section of the demand curve making the choice of functional form in the estimation difficult due to extrapolation. This difficulty of finding the correct functional form due to only having a narrow band of values for the independent variable, has occurred in Beal (1995). Beal limited her increments to a maximum of $20 instead of finding the increment value (or entry fee) for which visitation becomes zero.

simply requires integration to find the area under the curve, the presence of autocorrelation will not be a problem.

It was decided to use the log-linear form for the site demand curve originating from a linear first stage estimation. The relationship between price (P = increment) and quantity (V = number of visitors) is therefore

$$P = e^{7.424}\, e^{-0.000003402V} = 1674.93\, e^{-0.000003402V}.$$

This estimated demand curve and the total demand (from Annex Table 2) are plotted in Figure 3.

[Insert Figure 3]

The consumer surplus is calculated as the area under this curve in the first quadrant. Since the increments are plotted against the estimated total visitation, this is the area above the present entry price.

The consumer surplus, or area under the function is:

$$\int_0^{1.2m} 1674.93e^{-0.000003402V}dV = 1674.93\left[\frac{e^{-00.000003402\times 1.2m} - 1}{-0.000003402}\right]$$

$$= 492336860.7[e^{-4.0824} - 1]$$

$$= 48.4 \text{ m yuan}$$

3.2.2 Stage II estimations and consumer surplus from initial non-linear regressions

The estimated functions connecting the increments (P) with the total visitors (V) (for non-linear initial estimation) are shown in Table 6.

[Insert Table 6]

Using the final equation the consumer surplus may be calculated as follows:

$$\int_0^{102370} 3918.9 - 339.7\ln V\ dV = [3918.9 - 339.7V(\ln V - 1)]_0^{102370}$$

$$= 34.78 \text{ m yuan}$$

This value of consumer surplus is much less than the one estimated from an initial linear regression which was not a particularly good fit to the data even though it may have the property of consistency. This latter, lower value is therefore taken as the minimum measure of the recreation value of CMBR.

The estimated demand function P = 3918.9 - 339.7 lnV and the total demand from Annex Table 3 are plotted in Figure 4.

[Insert Figure 4]

4. RESULTS AND DISCUSSION

4.1 Results of Valuation

Total travel expenses

By calculation, the total travel costs of all domestic visitors to CMBR in 1996 is 114.75 million yuan as shown in Annex Table 1.

Total consumer surplus

The consumer surplus value in Section 3.2.2 was found to be 34.78 million yuan.

Total travel time costs

The total value of travel time was calculated to be 8.61 million yuan using
(travel hours – 36) × Average hourly wage × 40% × zonal visitation numbers to CMBR. The average hourly wage is described in Section 2.3.3 and other data is found in Table 1.

Other expenses

There are some other expenses for visitors, mainly photography, shopping for souvenirs, local art and crafts, native products, cultural T-shirts and others, which reflect the characteristics of the site. A survey showed each visitor spends 80 yuan on average for these purchases.

Total other expenses = total domestic visitors to CMBR in 1996 × average expenses
= 176000 × 80
= 14.08 million yuan

Total recreational value for domestic tourism

Total recreational value	=	travel cost	+	consumer surplus	+	travel time value	+	other expenses
	=	114.75	+	34.78	+	8.61	+	14.08
	=	172.22 (million yuan/year)						

4.2 Recreational value of biodiversity for CMBR

CMBR is characterised by its rich biodiversity, especially the primary forest ecosystem. However the total recreational value above cannot all be attributed to this biodiversity because there are other famous geological and geomorphologic features in the reserve, such as waterfalls, hot springs and the volcanic crater lake called "Sky Lake". To identify the value of biodiversity, some of the questions in the questionnaire were designed to investigate visitors' main preferences for the alternative recreational resources. Questions aimed to find out the motivation for visiting the CMBR from a choice of four. There were 416 respondents with the following percentages showing main preferences for the different options.

1) the intact forest ecosystem & typical zonal vegetation at various altitudes; 39%
2) the wild animals, e.g. possibly tigers and other endangered animals; 28%
3) the wild plants, especially ginseng and other rare plants; 20%
4) the geological sites such as Sky Lake, waterfalls, hot springs; 13%

The first three are components of the biodiversity present in CMBR. These results suggest that the major portion of the tourism motivation for visiting CMBR can be attributed to these characteristics. If we assume that the main reasons given by visitors surveyed for visiting CMBR indicate the prime source of their tourism or recreational value from the reserve, then

Total recreational value from biodiversity = Total tourism value × 87%
= 172.22 × 87%
= 149.83 million yuan/year

However, this value should only be regarded as indicative. The numbers used are use values and do not include the option value of (say) visiting the park because of other attributes that might be experienced. As mentioned in the introduction, more definitive results require the development of more sophisticated analyses and techniques for the valuation of the tourism and recreational economic value of biodiversity.

4.3 Discussion

4.3.1 Definition of recreational value

In this study the recreational value includes two parts: total value to consumers from visiting CMBR as revealed by their expenses including travel time cost; and consumer surplus which is the additional amount consumers are willing to pay to visit CMBR. These represent the complete willingness to pay for the recreation resource whereas the consumer surplus alone will underestimate the recreational value of the reserve. This was found to be about 172.22 million yuan per year.

Under the definition of full value, the domestic recreational value for biodiversity in CMBR was found to be 149.83 million yuan per year. This reflects the intrinsic recreational value of biodiversity in the reserve.

4.3.2 Issue of multiple destination trips

Although many outdoor recreation trips have a single primary destination, multiple destination trips, where there is a choice about which site to visit, are common. Sorg *et al.* (1995) found that 20% of cold water fishermen in Idaho were on multiple destination trips. The consumer surplus emanating from multiple destination trips is a large component of total site value (Mendelsohn *et al.,* 1992). Sorg et al (1995) using the contingent valuation method, found that multiple destination visitors actually placed a higher marginal value on the measured recreation site than single destination users of that site.

In this study CMBR has no close substitutes and a visit to the reserve may be considered as a single destination trip. The multiple destination issue is ignored and on-site time has not been included as a cost. Among the 3,131 survey respondents, there were 64.5% from Jilin Province in which the reserve is located, 18.2% from Liaoning and Heilongjiang, two neighbouring provinces of Jilin, and 8.8% from Beijing. So 91.5% of visitors can be regarded as having the CMBR as their sole destination because there is no other attractive recreational site near the reserve. The other 8.5% of visitors are from more than 20 other provinces or regions, and would possibly have other destinations for meetings or recreational visiting. Due to this small proportion, the multiple destination trip issue is not taken into account in this paper.

4.3.3 Recreational value of foreign visitors

CMBR is of international recreational significance with a lot of foreign visitors especially from the South Korea. In 1996, the number of foreign visitors was 71,312, constituting 28.8% of total visitors. These visitors have higher travel costs and they generate producer surplus for providers of recreation related products and services as well as contributing to consumer surplus. Recreational value for foreign visitors has not been dealt with in this paper. So, actually, the estimate for recreational value calculated on domestic visitors is not the whole recreational value of the reserve or of biodiversity within the reserve.

4.4 Conclusion and comment

This study has found the consumers' surplus value for CMBR using the Zonal Travel Cost methodology to be 34.78 million yuan (US $4.2 m). This is considered to be a minimum estimate. The total biodiversity recreational value of the reserve has been found to be 149.83 million yuan (US $18.2 m). These valuations are for only one year (1996) and therefore are static estimates. In the longer term those values can be expected to increase.

The recreational value estimation in China is mainly based on visitors' travel costs involving bus and train travel. The availability of public transport is important for visitation in China since most people depend on public transportation. When suitable public transport is available to visit a recreation site, a higher consumer surplus value will be found for biodiversity recreation. But those sites that are not easy to access now, or are currently short of tourism facilities, will display a lower recreational value even if they possess a rich biodiversity. This paper has found a biodiversity recreation value for CMBR in 1996. With further development in ecotourism infrastructure, and improvements in transportation in the future, this value is likely to increase. With rising incomes in China and more leisure-time as China develops, Chinese demand for recreation in CMBR can be expected to grow and the tourism value of CMBR to rise. In addition, there is opportunity in the future to evaluate the recreational value of biodiversity in other more remote sites when ecotourism is better developed. It follows that current tourism economic values of protected areas in China are likely to understate considerably the long-term recreational values of these areas or the discounted present sum of future tourism economic values of such areas which far exceeds their current annual recreational economic value (see also Tisdell 1995).

Figure 1

Map showing the position of
Changbaishan Mountain Biosphere Reserve
in northeast China on the border of Korea.

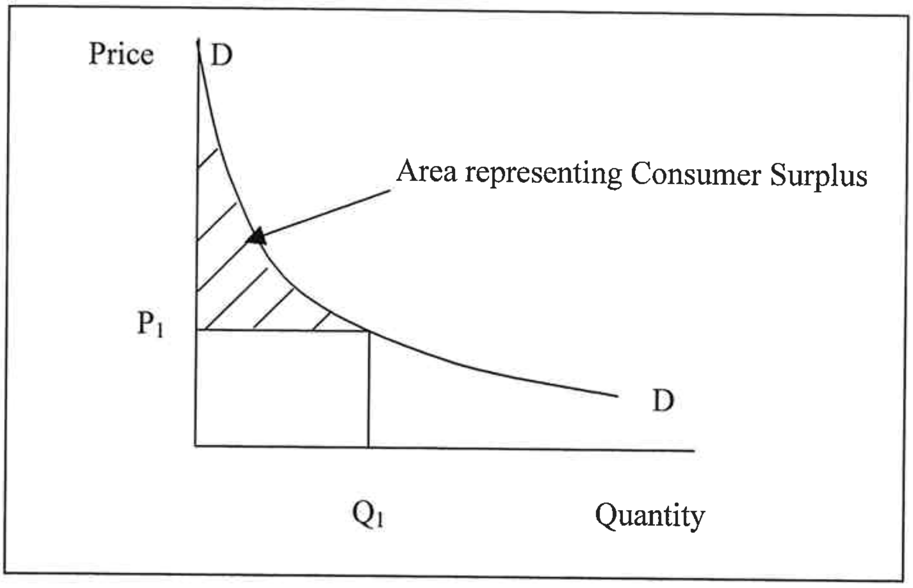

Figure 2: Consumer Surplus

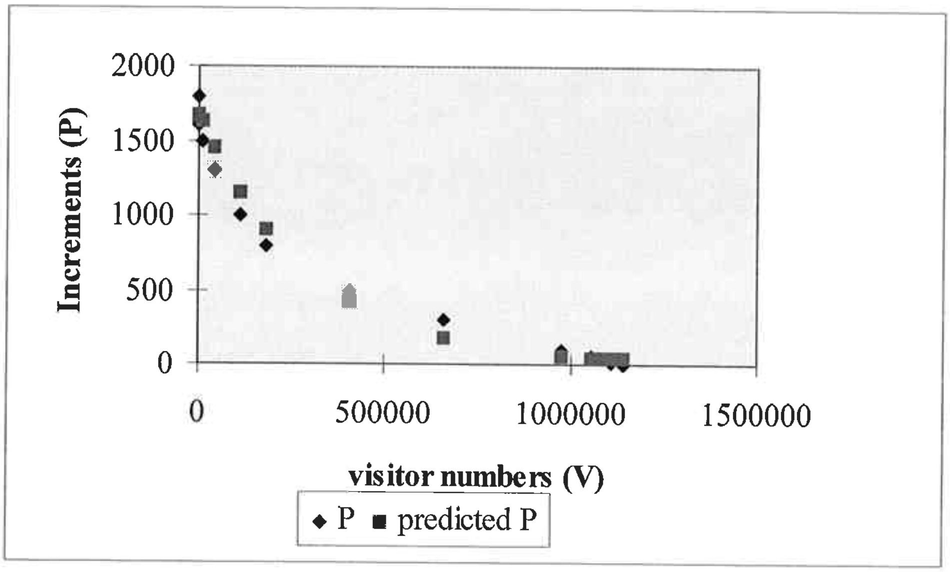

Figure 3: Plot of demand and estimated demand

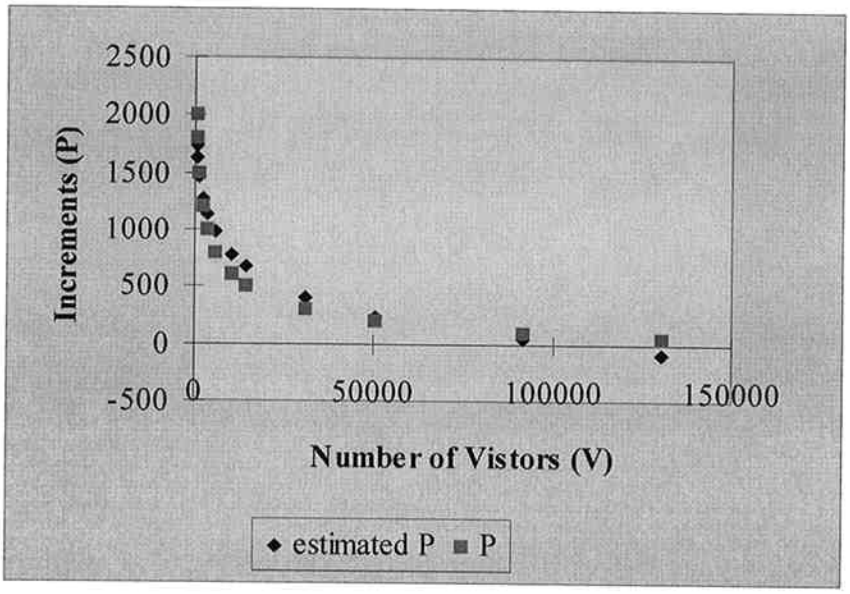

Figure 4: Plot of demand curve and total estimated demand from an initial non-linear estimation.

Table 1: **Sampling data statistics and visiting rates of residential zones**

Residential zones	population in 1995 (millions)	1995 avge wage (yuan/per capita)	Total travel Time (hours)	total cost (yuan /trip)	sampling number (persons)	1996 visiting quantity to CMBR (trips)	visiting rate to CMBR in 1996 (o/0000)
Changcun, Jilin Pro.	6.78	5119	79	573	494	27773	40.96
Jilin, Jilin Prov.	4.34	4635	74	514	301	16914	38.97
Siping, Jilin Prov.	3.15	3562	71	551	66	3714	11.79
Liaoyuan, Jilin Prov	1.25	3649	68	498	60	3379	27.03
Tonghua, Jilin Prov.	2.28	4026	48	385	161	9046	39.68
Baishan, Jilin Prov.	1.32	3781	45	357	286	16069	121.73
Songyuan,Jilin Prov	2.59	4338	103	722	37	2077	8.02
Baicheng, Jilin Prov	1.99	3303	110	808	19	1074	5.40
Yanbian, Jilin Prov.	2.22	4030	48	330	595	33446	150.66
Heilongjiang Prov.	37.01	4145	99	752	272	15294	4.13
Liaoning Prov.	40.92	4911	87	617	297	16695	4.08
Beijing Munic.	12.51	8144	124	1158	275	15458	12.36
Tianjin Munic.	9.42	6501	120	1094	39	2200	2.34
Hebei Prov.	63.47	4839	144	1352	17	950	0.15
Shanxi Prov.	30.77	4721	151	1457	6	334	0.11
Inner-Mongolia Reg.	22.84	4134	156	1526	7	387	0.17
Shandong Prov.	87.05	5145	131	1257	50	2811	0.32
Shanghai Munic.	14.15	9279	158	1688	14	787	0.56
Jiangsu Prov.	70.66	5943	150	1554	27	1518	0.21
Zhejiang Prov.	43.17	6619	188	1862	7	387	0.09
Anhui Prov.	60.13	4609	172	1620	3	176	0.03
Fujian Prov.	32.37	5857	216	2299	3	176	0.05
Jiangxi Prov.	40.63	4211	206	2145	1	53	0.01
Henan Prov.	91.00	4344	168	1557	31	1742	0.19
Hubei Prov.	57.72	4685	183	1795	5	282	0.05
Hunan Prov.	63.92	4797	194	1958	3	176	0.03
Guangdong Prov.	68.68	8250	215	2284	28	1566	0.23
Guangxi Reg.	45.43	5105	222	2397	5	282	0.06
Hainan Prov.	7.24	5340	248	2627	1	53	0.07
Sichuan Prov.	113.25	4645	207	2162	8	458	0.04
Guizhou Prov.	35.08	4475	221	2383	4	229	0.07
Yunnan Prov.	39.90	5149	239	2671	1	53	0.01
Shaanxi Prov.	35.14	4396	182	1769	2	106	0.03
Gansu Prov.	24.38	5493	200	2116	4	229	0.09
Qinghai Prov.	4.81	5753	208	2186	1	53	0.11
Xinjiang Reg.	16.61	5348	256	2937	1	53	0.03
Tibet Reg.	2.40	7382	328	3444	0	0	0

Table 2: **Correlation Matrix of Variables**

	Visit Rate VR	Number of visitors V	Average Wage Y	Travel Cost TC	Travel Time t
Visit Rate	1				
Visiting Quantity	0.767296	1			
Average Wage	-0.28102	-0.14223	1		
Travel Cost	-0.54871	-0.64931	0.419691	1	
Travel Time	-0.58715	-0.66107	0.405316	0.993555	1

Table 3: Linear Regressions Estimated

Regression Equation	F	p-value	R^2	$\bar{R}^2$	D-W
VR = 46.39 - 0.0217 TC (4.75) (-3.88)	15.078	0.00044	0.301	0.281	2.22
VR = 45.6 - 0.0197TT (4.74) (-3.87)	14.96	0.0001	0.300	0.279	2.22
VR = 52.38 - 0.00147Y - 0.0207TC (2.87) (-0.39*) (-3.32)	7.43	0.00210	0.304	0.263	2.27
VR = 50.06 - 0.001106Y - 0.0190TT (2.74) (-0.289*) (-3.29)	7.33	0.00226	0.301	0.260	2.26

TT = travel cost plus value of travel time but not including on-site time
* = not significant at 5% level
D-W = Durbin-Watson statistic

Table 4: Non-linear regressions estimated

Equation	F	R^2	$\bar{R}^2$	D-W
lnVR = 8.054 + 2.889lnY - 4.66 lnTC (1.652*) (4.54) (-20.36)	223	.93109	.92691	1.675
ln VR = 5.060 + 3.196lnY - 4.563lnTT (1.027*) (4.94) (-20.26)	221	.93044	.92623	1.704
VR = 214.5 + 6.26lnY - 35.58lnTC (1.47*) (0.325*) (-5.099)	16.4	.490	.460	2.27
ln VR = 3.046 + .000328Y - .00357TC (3.68) (1.97*) (-12.4)	80.2	.82939	.81905	1.149

TT = travel cost plus value of travel time but not including on-site time
* = not significant at 5% level
D-W = Durbin-Watson statistic
p-values for the F statistic are not quoted since they are all close to zero

Table 5: Estimated stage II regressions from initial first stage linear regressions

Regression Equation	F	R^2	$\bar{R}^2$	D-W
P = 2940.57 - 194.407lnV (9.38) (-7.41)	55.0	0.833	0.818	0.612
P = 1370.6 - 0.001302V (370.62) (-9.36)	87.5	0.888	0.878	0.314
ln P = 7.424 - 3.402×10^{-6} V (54.1) (-16.16)	261	0.963	0.959	0.636
P = 1526.16 - 0.00321V + 1.703×10^{-9} V^2 (22.17) (-7.35) (4.45)	128.59	0.963	0.955	0.670

p-values for the F statistic are not quoted since they are all close to zero

Table 6: **Stage II estimation from initial non-linear equation**

Equations	F	R^2	$\overline{R}^2$	D-W
$P = 1277.2 - 0.023745V + 9.175\times10^{-8}\ V^2$	10.8	0.682	0.619	0.378
(7.96) (-3.49) (2.46)	(0.0032)			
$\ln P = 7.023 - 2.64\times10^{-5}\ V$	85.5	0.895	0.885	0.281
(49.7) (-9.25)				
$\ln P = 11.96 - 0.631 \ln V$	172	0.945	0.939	0.459
(27.1) (-13.12)				
$P = 3918.9 - 339.7 \ln V$	187	0.944	0.939	0.258
(16.7) (-13.7)				

p-values for the F statistic are close to zero. The highest value is shown in parentheses and the others are of the order of 10^{-6} or less.

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Annexure

Annex Table 1

The travel expenses to CMBR for the domestic visitors

Region	distance to nearby city (km)	trans-port cost (yuan /p)	food cost (yuan /p)	Hous -ing cost (yuan /p)	entry fee + service (yuan /p)	total travel costs (yuan /p)	total visitor in 1996 (people)	total trans-port cost (mill. yuan)	total travel cost in 1996 (mill. yuan)
Changcun, Jilin Pro.	477	291	132	100	50	573	27773	8.08	15.91
Jilin, Jilin Prov.	349	240	124	100	50	514	16914	4.06	8.69
Siping, Jilin Prov.	592	281	120	100	50	551	3714	1.04	2.05
Liaoyuan, Jilin Prov	480	236	112	100	50	498	3379	0.80	1.68
Tonghua, Jilin Prov.	277	155	80	100	50	385	9046	1.40	3.48
Baishan, Jilin Prov.	217	131	76	100	50	357	16069	2.11	5.74
Songyuan,Jilin Prov	626	350	172	150	50	722	2077	0.73	1.50
Baicheng, Jilin Prov	810	424	184	150	50	808	1074	0.46	0.87
Yanbian, Jilin Prov.		100	80	100	50	330	33446	3.34	11.04
Heilongjiang Prov.	719	388	164	150	50	752	15294	5.93	11.50
Liaoning Prov.	635	298	144	125	50	617	16695	4.98	10.30
Beijing Munic.	1623	750	208	150	50	1158	15458	11.59	17.90
Tianjin Munic.	1486	694	200	150	50	1094	2200	1.53	2.41
Hebei Prov.	1906	862	240	200	50	1352	950	0.82	1.28
Shanxi Prov.	2137	955	252	200	50	1457	334	0.32	0.49
Inner Mongolia Reg.	2291	1016	260	200	50	1526	387	0.39	0.59
Shandong Prov.	1843	837	220	150	50	1257	2811	2.35	3.53
Shanghai Munic.	2811	1224	264	150	50	1688	787	0.96	1.33
Jiangsu Prov.	2506	1102	252	150	50	1554	1518	1.67	2.36
Zhejiang Prov.	3000	1300	312	200	50	1862	387	0.50	0.72
Anhui Prov.	2456	1082	288	200	50	1620	176	0.19	0.29
Fujian Prov.	3972	1689	360	200	50	2299	176	0.30	0.40
Jiangxi Prov.	3628	1551	344	200	50	2145	53	0.08	0.11
Henan Prov.	2318	1027	280	200	50	1557	1742	1.80	2.71
Hubei Prov.	2852	1241	304	200	50	1795	282	0.35	0.51
Hunan Prov.	3210	1384	324	200	50	1958	176	0.24	0.34
Guangdong Prov.	3936	1674	360	200	50	2284	1566	2.62	3.58
Guangxi Reg.	4188	1775	372	200	50	2397	282	0.50	0.68
Hainan Prov.	4537	1915	412	250	50	2627	53	0.10	0.14
Sichuan Prov.	3671	1568	344	200	50	2162	458	0.72	0.99
Guizhou Prov.	4163	1765	368	200	50	2383	229	0.40	0.55
Yunnan Prov.	4802	2021	400	200	50	2671	53	0.11	0.14
Shaanxi Prov.	2788	1215	304	200	50	1769	106	0.13	0.19
Gansu Prov.	3436	1474	392	200	50	2116	229	0.34	0.48
Qinghai Prov.	3721	1588	348	200	50	2186	53	0.08	0.12
Xinjiang Reg.	5297	2259	428	200	50	2937	53	0.12	0.16
Tibet Reg.	5711	2384	560	450	50	3444	0	0	0
Total							176000	61.14	114.75

Annex Table 2

Estimated visitation numbers using VR = 46.39049 - 0.02172TC

$V = 100N_i VR$

increments P	0	20	35	50	100	300	500	800	1000	1300	1500	1600	1800
Changcun, Jilin Pro.	23015	22720	22499	22278	21542	18597	15652	11234	8289	3871	925	0	0
Jilin, Jilin Prov.	15288	15100	14958	14817	14346	12460	10575	7747	5862	3034	1149	206	0
Siping, Jilin Prov.	10843	10706	10604	10501	10159	8791	7422	5370	4001	1949	580	0	0
Liaoyuan, Jilin Prov	4447	4392	4352	4311	4175	3632	3089	2275	1732	917	374	103	0
Tonghua, Jilin Prov.	8670	8571	8497	8423	8175	7185	6194	4709	3718	2233	1242	747	0
Baishan, Jilin Prov.	5100	5043	5000	4957	4813	4240	3666	2806	2233	1373	799	513	0
Songyuan,Jilin Prov	7954	7841	7757	7672	7391	6266	5141	3453	2328	640	0	0	0
Baicheng, Jilin Prov	5739	5653	5588	5523	5307	4443	3578	2281	1417	120	0	0	0
Yanbian, Jilin Prov.	8707	8611	8539	8466	8225	7261	6297	4850	3886	2439	1475	993	28
Heilongjiang Prov.	111241	109633	108428	107222	103203	87125	71048	46933	30855	6740	0	0	0
Liaoning Prov.	134992	133214	131881	130548	126104	108329	90553	63889	46114	19450	1675	0	0
Beijing Munic.	26570	26026	25619	25211	23852	18418	12984	4832	0	0	0	0	0
Tianjin Munic.	21316	20907	20600	20293	19270	15178	11086	4948	856	0	0	0	0
Hebei Prov.	108058	105301	103233	101165	94272	66701	39130	0	0	0	0	0	0
Shanxi Prov.	45369	44032	43030	42027	38685	25319	11952	0	0	0	0	0	0
Inner Mongolia Reg.	30253	29261	28517	27773	25292	15371	5449	0	0	0	0	0	0
Shandong Prov.	166165	162384	159547	156711	147258	109443	71629	14907	0	0	0	0	0
Shanghai Munic.	13764	13149	12688	12227	10691	4544	0	0	0	0	0	0	0
Jiangsu Prov.	89297	86228	83926	81624	73950	43255	12561	0	0	0	0	0	0
Zhejiang Prov.	25677	23802	22395	20989	16300	0	0	0	0	0	0	0	0

Anhui Prov.	67370	64758	62799	60840	54310	28189	2069	0	0	0	0	0	0
Fujian Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Jiangxi Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Henan Prov.	114409	110456	107491	104527	94644	55114	15583	0	0	0	0	0	0
Hubei Prov.	42731	40223	38343	36462	30194	5120	0	0	0	0	0	0	0
Hunan Prov.	24691	21914	19831	17749	10807	0	0	0	0	0	0	0	0
Guangdong Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Guangxi Reg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Hainan Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Sichuan Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Guizhou Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Yunnan Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Shaanxi Prov.	27999	26472	25328	24183	20366	5102	0	0	0	0	0	0	0
Gansu Prov.	1051	0	0	0	0	0	0	0	0	0	0	0	0
Qinghai Prov.	0	0	0	0	0	0	0	0	0	0	0	0	0
Xinjiang Reg.	0	0	0	0	0	0	0	0	0	0	0	0	0
Tibet Reg.	0	0	0	0	0	0	0	0	0	0	0	0	0
increments	0	20	35	50	100	300	500	800	1000	1300	1500	1600	1800
totals	1140716	1106399	1081449	1056500	973334	660083	405658	180234	111291	42766	8220	2561	28

Annex Table 3
Estimated number of visitors V

using $\ln VR = 8.054454 + 2.889143 \ln Y - 4.656574 \ln TC$ and $V = 100N \exp(\ln VR)$

increments	0	50	100	300	500	800	1000	1200	1500	1800	2000
Changcun, Jilin Pro.	15923.50	10785.73	7528.84	2241.50	857.78	272.14	144.47	82.74	39.96	21.29	14.61
Jilin, Jilin Prov.	12688.94	8235.52	5545.15	1491.72	536.27	160.42	82.93	46.54	21.96	11.50	7.82
Siping, Jilin Prov.	3113.73	2077.89	1432.22	411.36	153.94	47.81	25.14	14.29	6.84	3.62	2.48
Liaoyuan, Jilin Prov	2121.71	1358.94	904.94	236.13	83.34	24.51	12.58	7.02	3.29	1.71	1.16
Tonghua, Jilin Prov.	17042.59	9651.71	5815.27	1164.99	353.40	90.77	43.91	23.43	10.45	5.25	3.49
Baishan, Jilin Prov.	11697.61	6353.54	3704.15	683.26	198.22	48.99	23.32	12.29	5.41	2.69	1.78
Songyuan,Jilin Prov	1285.15	940.89	702.47	254.81	110.86	39.88	22.44	13.46	6.85	3.80	2.66
Baicheng, Jilin Prov	266.01	201.13	154.50	61.14	28.23	10.79	6.25	3.84	2.01	1.14	0.80
Yanbian, Jilin Prov.	34114.77	17686.25	9945.99	1679.78	465.25	110.59	51.78	26.97	11.72	5.78	3.80
Heilongjiang Prov.	13321.02	9870.88	7448.18	2790.09	1240.61	456.28	259.48	156.85	80.61	45.03	31.69
Liaoning Prov.	60405.70	42023.90	30013.11	9544.54	3808.57	1257.94	680.22	395.20	193.99	104.66	72.28
Beijing Munic.	4244.58	3486.16	2886.21	1451.94	797.97	367.83	233.86	154.78	88.62	53.86	39.71
Tianjin Munic.	2172.10	1764.01	1445.41	702.74	376.41	168.63	105.66	69.09	38.98	23.42	17.16
Hebei Prov.	2326.61	1964.64	1668.85	915.05	537.45	267.13	176.60	120.77	71.98	45.18	33.92
Shanxi Prov.	741.39	633.59	544.26	310.04	187.67	96.60	65.05	45.19	27.46	17.51	13.27
Inner Mongolia Reg.	302.30	260.16	224.95	131.06	80.78	42.47	28.92	20.28	12.47	8.03	6.12
Shandong Prov.	5348.13	4459.82	3744.52	1974.05	1124.52	539.72	350.36	235.95	137.99	85.30	63.50
Shanghai Munic.	1210.40	1056.56	925.84	565.08	361.62	198.79	138.69	99.29	62.67	41.22	31.80
Jiangsu Prov.	2452.35	2116.11	1834.26	1077.99	669.02	354.60	242.57	170.75	105.50	68.20	52.08
Zhejiang Prov.	881.23	778.93	690.71	439.53	291.11	166.82	119.06	86.93	56.25	37.78	29.49
Anhui Prov.	824.94	716.06	624.15	373.97	235.74	127.29	87.94	62.44	38.99	25.43	19.52

Fujian Prov.	173.87	157.30	142.60	98.22	69.54	43.29	32.35	24.60	16.77	11.77	9.43
Jiangxi Prov.	116.19	104.37	93.98	63.16	43.80	26.56	19.56	14.68	9.84	6.81	5.41
Henan Prov.	1265.58	1092.37	947.12	557.13	346.02	183.56	125.62	88.46	54.69	35.36	27.01
Hubei Prov.	514.91	453.08	400.03	250.72	163.98	92.54	65.49	47.47	30.43	20.28	15.76
Hunan Prov.	407.30	362.17	322.98	209.71	141.25	82.62	59.64	43.98	28.82	19.56	15.37
Guangdong Prov.	1023.30	925.14	838.19	576.01	407.06	252.75	188.64	143.24	97.50	68.35	54.71
Guangxi Reg.	135.08	122.70	111.67	78.00	55.90	35.33	26.64	20.41	14.05	9.95	8.01
Hainan Prov.	16.00	14.66	13.45	9.67	7.11	4.64	3.56	2.78	1.95	1.41	1.15
Sichuan Prov.	414.45	372.60	335.76	226.31	157.31	95.67	70.57	53.04	35.63	24.69	19.63
Guizhou Prov.	73.26	66.51	60.50	42.18	30.18	19.03	14.33	10.97	7.54	5.33	4.29
Yunnan Prov.	73.47	67.39	61.91	44.75	33.04	21.69	16.71	13.05	9.22	6.67	5.44
Shaanxi Prov.	279.14	245.16	216.08	134.59	87.58	49.12	34.65	25.04	15.99	10.63	8.24
Gansu Prov.	160.09	143.59	129.12	86.34	59.62	35.96	26.40	19.76	13.20	9.11	7.22
Qinghai Prov.	31.02	27.92	25.19	17.05	11.89	7.26	5.37	4.04	2.72	1.89	1.51
Xinjiang Reg.	21.93	20.27	18.77	13.94	10.55	7.14	5.60	4.45	3.21	2.37	1.95
Tibet Reg.	3.83	3.58	3.35	2.60	2.04	1.45	1.17	0.95	0.71	0.54	0.45
totals	197194.20	130601.25	91504.67	30911.15	14125.64	5808.63	3597.55	2365.00	1366.28	847.13	634.73

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