The Incentive to Declare Taxes and Tax Revenue: The Lottery Receipt Experiment in China*

Junmin Wan†

Osaka University

June 6, 2006

*This paper is a revised version of the chapter 8 of my doctoral dissertation in Osaka Uninvesity in 2004.

†I would like to thank Kazuo Ogawa for his advice, guidance, and encouragement during the writing of this paper. I am also grateful to Charles Yuji Horioka, Shinsuke Ikeda, Wako Watanabe of Osaka University and Atsushi Kajii of Kyoto University for their valuable comments. Thanks are also due to seminar participants at Osaka University for their helpful suggestions. This paper was presented at 2004 Autumn Meeting of Japanese Economic Association at Okayama University on 26 September 2004, and I give thanks to (discussant) Toshiki Watanabe of Chuo University and the seminar particimpants for their useful advice. Any remaining errors here are my responsibility. Correspondence: (e-mail) wan@osipp.osaka-u.ac.jp (tel/fax) +81-6-6850-5839

Abstract

We examine the validity of a new system of taxation called lottery receipts in China theoretically and empirically. Tax collection is difficult as the Chinese government difficultly monitors the actual economic dealings. To bring out the private information on transaction known only to a seller and a buyer, the government has set up a lottery receipt system which has been tried out in many areas. If the net revenue from a lottery receipt is invested in pure public goods, the lottery receipt will been purchased even if the consumer has expected quasi-linear utility. By issuing a lottery receipt, the government may prevent tax evasion caused by conspiracies between firms and consumers and collect tax effectively. Estimation that avoided self-selection is performed based on panel data for different periods from a total of 39 districts in Beijing and Tianjin during 1998-2003. The lottery receipt system has significantly raised the operating tax, the real growths of operating tax and total tax revenues.

JEL classification: H26, D81, D82, C23

Keywords: information asymmetry, operating tax, receipt with lottery, quasi-linear utility, random trend (growth) model

1 Introduction

1.1 The Light and Shadow of China's Economy

China's economy has shifted to a market economy since 1978 to include the rural contract work system and private companies. Stock markets and special economic zones have been founded since the 1980s. In 1994, decentralization separated local and central government, including the taxation system. As shown in Fig. 1, after the 1978 shift to a market economy, high growth has been realized for more than 20 years. In 2005, China experienced 9.9% economic growth, and it is expected to achieve over 9% growth in 2006. However, as shown in Figs. 2 and 3, the budget deficit has become a serious concern. Moreover, Fig. 4 shows the transition of Gini's coefficient, which measures the degree of economic inequality in China. Clearly, the degree of economic inequality in China is growing. To sustain future economic growth, these two significant issues must be resolved. The implementation of an efficient and fair tax collection system might serve as an effective and reasonable means toward solving China's economic problems; however, at present the country lacks such a tax collection system. Economists have warned of the seriousness of the deficit and inequality issues in China. In February 2004, Shiller (2004) provided six pieces of advice regarding the Chinese economy,[1] and his first recommendation was the creation of an effective taxation system. Similarly, Krugman (2004) noted that "since there is no tax collection system anyway, a possibility that the China government

[1] See Shiller (2004) for details.

itself will go bankrupt is not zero, either." [2]

1.2 Issues in Taxation

Even if the government understands the importance of tax collection, if the technical and intellectual ability to create a tax collection system is lacking, the effort will fail. To collect an operating tax (similar to a consumption tax, i.e., about five percent of total sales), income tax, and wealth tax the government needs to obtain private and corporate financial records of transactions, income, and wealth. However, unless the government is willing to pay the significant cost of monitoring the economic dealings and the collection process, such information will not materialize. Owing to the asymmetry of information between government and taxpayer, individuals might be tempted to underreport the amount of taxes due. For example, there is the issue of 'kuroyon' in Japan, which refers to the fact that the rates of income recorded for salaried workers, farmers, the self-employed, and politicians are about 90, 60, 40, and 10 percent, respectively. The taxation issue is often a point of contention in Japan and it has been studied for many years. In relation to the 'kuroyon issue,' it has been hotly debated in Japan whether a corporate enterprise tax system based on sales, salary, etc., and a taxpayer numbering system should be introduced; however, this argument does not progress easily. When building a tax collection system, a government must make taxpayers cooperate in providing accurate financial information and must design and provide an incentive mechanism that can mitigate informational asymmetry.

[2] See Krugman (2004) for details.

1.3 Tax Evasion in China

For many years mainland China has been wrestling with the issue of capturing a fair tax base. The government first issued a guideline requiring "an official receipt printed with lottery number" (You Jiang Fa Piao, in Chinese, hereafter we call it "lottery receipt") as a means of organizing tax collection.[3] The government incorporates a lottery ticket into an official receipt, hence the lottery receipt is not only an official receipt but also a public lottery ticket simultaneously. The central government first mentioned on March 4, 1989, that the experiments with lottery receipt would be held in some areas so as to strengthen the tax collection.[4] Discussion and preparation took ten years prior to the launch of the experiment. On January 1, 1998, the new receipt system came into effect in Haikou City, Hainan Province, which is one of the most open cities in China. The central government evaluated the system's performance and has since increased the trial area incrementally across the nation. According to my May 2003 research using the search engine Google.com, by the end of 2002 there were over 80 big-city-level local tax bureaus countrywide (out of approximately 662) where the experiment is underway. In other words, 12 percent of local tax bureaus are conducting

[3]According to "The Act of China Taxation," receipt is defined as a certificate of the monetary transaction, is the primary proof for financial accounting and a tax audit, and is managed with printing, issue, and storage by the taxation bureau. The system of requiring a receipt with lottery transactions appeared in Taiwan in the 1960s, in order to improve tax collection efficiency; Taiwan still uses this system today.

[4]See Note of Mainland China Government in 1989 for details. The original sentence is written in Chinese, "State Council's notice on the main points of economic reform presented by State Commission for Restructuring the Economic System in 1989." In this notice, it is pointed that "to strengthen the private firms' tax collection, the lottery receipt system can be tried out in some cities."

the lottery receipt experiment (see Table 1).[5]

Accompanying the lottery receipt experiment, the "Act of China Taxation" was revised, and since May 1, 2001, the "New Act of China Taxation" has been enacted. The detailed enforcement rules for the new act came into effect on October 15, 2002. A new 23rd article has since been added to the new act, which provides that "the equipment which prevents tax evasion should be actively installed." Specifically, this "equipment which prevents tax evasion" is a patented machine that issues an official receipt (printed) with a public lottery number.[6]

The experiments were conducted in depth in three of China's largest cities: Beijing, Shanghai, and Tianjin. In Beijing, one district (out of 18) has been conducting the experiment since January 1, 2001; seven districts since August 1, 2002; and the remaining 10 districts have been issuing lottery receipts since October 1, 2002. At first, mainly service industries, such as food service businesses issued lottery receipts. However, in Shanghai, the experiment began in October 1, 2002, and since January 1, 2003, it has grown to include other service industries such as beauty salons and real estate agencies. In Tianjin, Tanggu (one district of Tianjin) began the

[5]By the end of 2002, only Beijing and Shanghai had been experimental areas at the provincial or state level, according to data from the China Taxation Bureau. Information regarding the experiments in other areas has not been reported yet as formal statistical data. The figure in Table 1 was obtained from the news media. Because these are not government statistics, caution is required when interpreting the information. Therefore, this table approximates the state of the experiments throughout country.

[6]The inventor of the lottery receipt machine is Dai Haiping. He applied for a patent on April 28, 1998, and the China Patent Bureau authenticated the patent on February 21, 2001. This machine can issue the receipt with a special number that is used for a random drawing. The value written on the receipt is reported to the consumer, the firm, and the tax bureau simultaneously. The consumer can use the lottery receipt and the special number to investigate the status of the prize by telephone or via the Internet.

experiment on January 1, 2003, and the other districts have started since 2004. Today, the scope of areas conducting the lottery receipt experiment has expanded to many areas.

In this paper, we first analyze theoretically whether the new taxation system in China is well run, then we empirically examine the effect of the new system on tax collection using the "natural experiment" method based on panel data consisting of experimental and non-experimental areas. We found that the new system will work well, even if the consumer has quasi-linear preference and expected utility. In addition, we found that the lottery receipt experiment has caused not only operating tax revenues but also the growths of operating tax and total tax revenues to increase significantly.

The structure of this paper is as follows. Section 2 performs a theoretical consideration. Section 3 describes the data, the model, and the method of econometric estimation. Section 4 shows the results, and Section 5 discusses the policy implications and concludes.

2 Theoretical Frameworks

2.1 Previous Research

Morgan (2000) presentes a mechanism for financing public goods by means of a taxable lottery for consumers with quasi-linear preferences. Morgan (2000)'s mechanism is proved to be more efficient than a voluntary taxpayer system in regard to raising funds for welfare improvement. Morgan and Sefton (2000) further confirm this theory by experiments. Prior to these studies, Friedman and Savage (1948) and Kahneman and Tversky (1979)

analyze lottery purchases; however they do not consider the issue of producing an official receipt with lottery as a way to track sales or business tax.

2.2 The Mechanism of Tax Declaration by Lottery Receipt in China

2.2.1 Issues

In an economic transaction (without lottery), there are three types of agent: the firm, the consumer, and the government. The government does want to know the transaction volume between the firm and the consumer to collect the operating (sales) tax. It is assumed that there are infinite homogeneous firms, and that these firms seek profit maximization within a competitive market. It is also assumed that there is a sufficiently large and homogeneous body of consumers. When a consumer buys a product from a firm, the information on the purchased quantity "v" is shared with the company. The government cannot know about this sale unless it applies a sufficiently large monitoring cost. Although social public welfare will increase if all consumers pay their taxes voluntarily to produce optimal public goods, the consumer has an incentive not to pay taxes (free rider incentive) because the government cannot supervise the trading volume between the consumer and the firm. It is assumed that the government collects, to the highest extent, sales tax "x" according to the purchased amount "v" (here the rate of operating (sales) tax is "x/v"), but that it cannot perform proper accounting unless it has correct information regarding the correct amount of "v." However, the

cost of monitoring "v" is larger than the tax revenues "x" and the information value of "v." [7] Therefore, the government will not act as the monitor of "v" and cannot fully collect the tax "x."

2.2.2 Purchase of Lottery Receipt

From the above section we know that the government's net tax revenue will be zero if the monitor cost is larger than the tax "x." Thus, the government issues the lottery receipt. Something like money or currency, the lottery receipt cannot be forged. When a consumer obtains a lottery receipt printed with the purchased amount "v," this receipt with "v" is copied into the government (the consumer declares the volume "v" and the tax "x"), thus the government receives the verifiable fact of "v" and can collect the tax "x." Consumers have probability of getting lottery prize from the government if they are in possession of the lottery receipt. The lottery receipt is essentially a public lottery, but it has some differences from regular public lottery. First, it is printed on an offical receipt. Second, its price is the sales tax "x." Fig. 5 shows the framework of the delivery of lottery receipts, and the behaviors of the government, the firm, and the consumer.

Accordingly, we can transfer the consumers' purchase problem of a lottery receipt into a purchase problem of pure public lottery. We analyze the consumers' purchase of lottery tickets using Morgan's framework (2000).[8]

[7] The information value of "v" here means that the correct value of "v" is essential to the national accounting. For example, The Bureau of Statistics in China adjusted the national accounting during 1978-2005 in January 2006 because the accounting on the service industry and GDP etc. was undervalued to a large degree.

[8] The author also analyzed the purchase of public lottery in the framework of Kahneman and Tversky (1979) and Guiggin (1991) and found the second order condition for the optimal lottery for government. See Wan (2004a) for details.

In this framework, the government sells fixed-prize raffle tickets (the prize amount is "R") and informs each consumer of "R" in advance. Consumer i has wealth w_i and quasi-linear preference. There are N consumers in this economy. Consumer i optimally chooses the amount to purchase $x_i \in [0,\ w_i]$, conditional on the fact that the purchases of other consumers are given. The probability of winning the prize is set to $x_i/x(N)$ ($x(N) = x_1 + ... + x_N$). The net revenues to the government for offering pure public goods is G=x(N)-R. The sales x(N) of the lottery are assumed to be large enough to cover the prize R. The problem of lottery purchase for consumer i can be set as the following expected utility maximization:

$$EU_i = w_i - x_i + [x_i/x(N)]R + h_i[x(N) - R], \tag{1}$$

where h_i is consumer i's utility from pure public goods. The first order condition with respect to x_i is

$$[x_i/((x(N))^2]R - 1 + h_i'[x(N) - R] \leq 0. \tag{2}$$

In equilibrium, N' consumers will purchase the amount $(x_i^*\ , ..., x_{N'}^*)$ of lottery tickets, respectively. If the first order conditions of N' consumers are added, we get

$$\sum_{i=1}^{N'} h_i'[x^*(N') - R] - N' + (N' - 1)[R/x^*(N')] = 0. \tag{3}$$

When the prize R is increased, the effect of prize R on the lottery sales x^*

and on the net government revenues, respectively,[9] are

$$\frac{\partial x^*(N')}{\partial R} \geq 1, \tag{4}$$

$$\frac{\partial G}{\partial R} = \frac{\partial x^*(N')}{\partial R} - 1 \geq 0. \tag{5}$$

As shown in equations (4) and (5), increasing the prize does not reduce the sales x^* and the governmental net revenue G, but it is unclear here whether the prize definitely increases G. Hence, it is necessary to clarify this property empirically.

We can consider that R=0 in areas where the lottery receipt experiment is not being conducted; thus Equation (5) can express the difference in tax revenues between areas where the experiment is and is not being conducted. Moreover, comparison within the areas of the experiment is also possible, and according to Equation (5), the tax revenue in areas of the experiment with large prizes is likely to be larger than (or equal to) that in areas of the experiment with lower prizes. Section 3 examines the effect of the lottery receipts, in other words, whether $\frac{\partial G}{\partial R} \geq 0$ is true.

3 Empirical Examinations

3.1 Probability of Winning a Prize, Amount of Prize, and the Data Set

To announce the amount of the prize beforehand can be considered a strategy of the government. For example, according to the pre-draw prize an-

[9] See Morgan (2000) for details.

nouncement by the Beijing Local Tax Bureau on July 17, 2002,[10] total prize money amounted to three million Yuan in August and September, and 10 million Yuan between August and December 2002. However, ex post facto, the total prize money paid out to the 67,129 winners in the whole city during 2002 was 1.67 million Yuan. The total actual prize was therefore only 16.7 percent of the announced prize.[11] Moreover, the pre-drawing prize announcement of the probability of winning the prize (namely, the ratio between the prize and the tax revenue) is a strategy of the government.

According to a report of the China Taxation Bureau on July 30, 2002,[12] the total prize amount paid out in all of the experimental areas throughout China was 30 million Yuan, and the increase in tax revenues brought about by the lottery receipts was 900 million Yuan between January 1 and June 30, 2002. The ratio of the prize to tax revenues (which can be seen as a kind of input output ratio) was about 1:30. In the experiment in the Huairou District of Beijing in 2001, 0.14 million Yuan was paid out in prizes and the tax revenue of six million Yuan was increased owing to providing a receipt with lottery purchases. The prize tax revenue ratio was about 1:40. Many Chinese mass media outlets announce information regarding the prizes. We cannot obtain detailed information on prizes at the provincial or state level for the entire country, thus we cannot perform an econometric analysis at the provincial level.

There are 18 districts in Beijing. Huairou, Chaoyang, Shunyi, Fengtai, Fangshan, Pinggu, Shijingshan, and Miyun have issued receipts with lottery

[10] See "Beijing Evening on July 17, 2002" for details.
[11] This may also be because the planned sale of lottery x* was not realized.
[12] See 'People's Daily', July 31, 2002 for details.

transactions since August 1, 2002. The other ten districts began issuing receipts on October 1, 2002. Therefore, the effect of the experiment on tax revenues can be estimated by district-level panel data (18 districts, 5 years, before and after the experiments).

One district of Tianjin, Tanggu has issued the receipt with lottery since January 1, 2003. The other districts of Tianjin have issued receipts with lottery purchases only since 2004. Tianjin is adjacent to Beijing both geographically and culturally. They are both cities under the direct control of the central government. According to Table 2, the populations, city scale, and income of these two cities are very similar. Therefore, we used Tianjin as a control area for a comparative analysis of before and after the experiments in Beijing. We obtained detailed information on the experiments, such as prize amounts and tax revenues, from the Tianjin Statistics Bureau, Tianjin Tax Bureau, Beijing Statistics Bureau, and Beijing Tax Bureau.[13] Therefore, we used the 6-year (1998-2003) district-level data (18 districts in Beijing and 21 districts in Tianjin) to empirically examine the effect of experiment.

The information on prize reported by mass media or estimated by the author,[14] is shown in Appendix A. In Tanggu of Tianjin, the prize was 75800 Yuan in 2003.

The definitions of variables are described in Appendix B. Summary

[13]Beijing Statistics Yearbook 1999-2004, Tianjin Statistics Yearbook 1999-2004, Beijing Public Finance Statistics Yearbook 2002-2004 and China Statistic Yearbook 1999-2004 are used.

[14]The author has used the prize reported by mass media to estimate the prize in the period without reporting by weighted average. The detailed information is available upon request.

statistics of the data are reported in Table 3. The main information before and after the experiments is summarized by district in Table 4. These two tables provide some indication of the effects of the experiment.

3.2 Empirical Specification and Estimation Method

Following Heckman and Hotz (1989), Papke (1994) and Wooldridge (2002), we used the following empirical model (random trend model or random growth model) to capture the effect of the experiments (Equation (5)), and obtained

$$y_{it} = c_i + \beta LRE_{it} + \gamma Z_{it} + g_i t + u_{it}, \tag{6}$$

where y_{it} is the log value of per capita real operating tax revenue in district i and the information from the lottery receipt experiment (LRE_{it}), Z_{it} is the controlled variable, g_i is the specific trend in the district, c_i is the specific time-invariant factor, and u_{it} is the white noise; they are all unobserved. When y_{it} and Z_{it} are level values, Equation (6) becomes a random trend model. Equation (6) becomes a random growth model when y_{it} and Z_{it} are log values. The first difference of Equation (6) becomes

$$\Delta y_{it} = \beta \Delta LRE_{it} + \gamma \Delta Z_{it} + g_i + \Delta u_{it}. \tag{7}$$

For a consistent estimator of β, the important condition is that the LRE_{it} is exogenous. As pointed out in Heckman and Hotz (1989) and Papke (1994), if there is a problem of self-selection regarding program participation, it is

very hard to obtain a consistent estimator of β. Here, there are two reasons to make LRE exogenous. Firstly, there are many preparations that must be made before the LRE starts. The timing of LRE is mainly determined by the degree of the preparation. Secondly, as everyone knows, China is a centralized country, and policy changes cannot occur in a state or a city unless the central government grants permission; moreover, no state or city has the freedom to accept or reject central government policy. Therefore, it can reasonably be said that LRE_{it} is exogenous. Moreover, because all of the samples used in the econometric analysis are areas that participated in the experiment, by using experiment information for different periods we can avoid the problem of self-selection and obtain a consistent estimator of the effect of the experiment.

Because error term Δu_{it} is the one difference of u_{it}, it becomes a series correlation.[15] The fixed effect of panel estimation considering this characteristic of the error term is used to estimate Equation (7). This method (Fixed Effect (within) regression with AR(1) disturbances) is explained in detail in Papke (1994) and Wooldridge (2002).

3.3 Variables used in the Empirical Tests

Δy_{it} is the one difference of y_{it} which is the level or log value of per capita real operating tax revenue in district i and is the dependent variable. ΔLRE_{it} is the dummy variable for an experiment district (1 for an experiment district, 0 for others) multiplied by the dummy variable for the experiment time (1 for experiment time, 0 for other time). ΔLRE_{it} is the independent variable.

[15] $Corr(\Delta u_{it}, \Delta u_{it-1}) = -0.5$. See page 283 of Wooldridge (2002) for details.

$\Delta Prize_{it}$ is the one difference of per capita real lottery prize; it is considered a proxy for capturing the experiment effect (ΔLRE_{it}) and is an independent variable.

To obtain a difference in difference (DID) estimator for β, Huairou in Beijing and Tanggu in Tianjin are dropped from the sample, because Huairou and Tanggu have different timing of LRE compared to other districts.

4 Estimated Results

Table 5 is the result of panel estimation based on the information for 17 districts in Beijing (excluding Huairo) and 20 districts in Tianjin (excluding Tanggu). The dependent variables are the first differences of the level and the logarithm of operating tax and total tax revenues, and the independent variables are the first differences of LRE, GDP, GDP of the 2nd sector and GDP of the 3rd sector; thus the value of the estimated coefficient of ΔLRE serves as the difference in the level between experiment and non-experiment areas. For operating tax revenue, the coeffiects of ΔLRE are significant, ranged from 84.355-105.676, and the elasticities of experiment is from 0.171 to 0.213. In the case of total tax revenue, the effect of the experiment is not significant, although the coefficient is positive. These results imply that the experiment has significantly raised operating tax revenue by over 17.1 percent but has no significant effect on total tax revenue. [16]

[16] I also have used the first difference of prize as a proxy for ΔLRE, but I have not obtained significant effect from prize. There may be two reasons. First, the prize is determined by the sales simultaneously thus it is endogenous. Second, the data on prize is not statistical data but estimated by the author, thus there are measurement error on the prize data. These estimation results are also avalaible upon request.

Table 6 shows the results of panel estimation based on the information for the 17 districts in Beijing and 20 districts in Tianjin. The dependent variables are the first differences of logarithm of operating tax revenues and total tax revenues, and the independent variables are the first differences of LRE, logarithm of GDP, GDP of the 2nd sector and GDP of the 3rd sector; thus the value of the estimated coefficient of ΔLRE serves as the difference in the growth rates between experiment and non-experiment areas. For operating tax revenues, there was about a significant 21.5-24.2 percent difference in the growth rates of the two groups of experiment areas. In the case of total tax revenue, there was a 10.4-11.6 percent increase. [17]

5 Conclusion

This paper examined, theoretically and empirically, the experiment of issuing a receipt with lottery purchases in China. When the revenue from the lottery is used to finance the public good, according to the proposal of Morgan (RES, 2000), even if a consumer has expected utility with quasi-linear preference, he or she will purchase a lottery ticket. By issuing receipts, the Chinese government can prevent the tax evasion caused by collusion between firms and consumers and can collect operating taxes effectively to some extent. Our empirical examination of 6-year data from 39 districts in Beijing and Tianjin indicated that operating tax revenue was significantly (17.1 percent) higher, and the real growth rates of operating tax total tax

[17] I also have used the first difference of prize as a proxy for ΔLRE , but I have not obtained significant effect from prize. It is considered that the volume of the prize is determined by the sales simultaneously thus it is endogenous, and the data on prize have measurement error. These estimation results are also avalaible upon request.

revenue were significantly (21.5, 10.4 percent, respectively) higher in experiment areas than in non-experiment areas. Moreover, because the data sets used were from all of areas that participated in the experiments, and because the estimations were based on different periods of participation, self-selection problems were avoided. Our analysis is similar to a kind of natural experiment.

The Chinese economy in the 20th century was quite experimental; for example, there was the socialist economy experiment, the market economy experiment, and the experiment with lottery receipts. By means of these experiments, the Chinese economy has both stagnated and grown. Although it is natural that some experiments will fail to an extent, it is obviously necessary to avoid failure if possible. Through the analysis of the data sets conducted in this study, the lottery receipt experiment can be judged as successful insofar as it increased operating tax revenues and the growths of operating tax and total tax revenues. Certainly, this new system of taxation will have a significant influence on future tax collection policies in China, and perhaps in other countries as well.

In future research, we must clarify theoretically and more specifically consumer preference for lottery ticket purchases and empirically apply those data to the information from the experiment and non-experiment areas for 2004. Moreover, we must obtain nationwide information and perform detailed analyses based on individual data, including attitudes toward the lottery receipt system. Additionally, because playing the lottery is a form of gambling, we must consider the social cost of gambling in relation to social

welfare.[18]

[18]However, the tax evasion is penalized in every country when it is dectected by government, thus the tax evasion is also a form of gambling.

References

Fisman, Raymond and Wei, Shang-Jin (2004) Tax Rates and Tax Evasion: Evidence from "Missing Imports" in China, *Journal of Political Economy*, 112(2), 471-496.

Guiggin, John (1991) On the Optimal Design of Lotteries, *Economica*, 58, 1-16.

Heckman, James J. and V. Joseph Hotz (1989) Choosing Among Alternative Nonexperimental Methods for Estimating the Impact of Social Programs: The Case of Manpower Training, *Journal of the American Statistical Association*, 84, 862-874.

Kahneman, Daniel and Amos Tversky (1979) Prospect Theory: A Descriptive Analysis of Decision Making under Risk, *Econometrica*, 47, 263-291.

Krugman, Paul R. (2004) The Misunderstanding of Chinese Economy, *Harvard Business Review*, March 2004, 76-82.

Morgan, John (2000) Financing Public Goods by Means of Lotteries, *Review of Economic Studies*, 67, 761-784.

Morgan, John and Martin Sefton (2000) Financing Public Goods through Lotteries: An Experiment, *Review of Economic Studies*, 67, 785-810.

Papke, Leslie E. (1994) Tax Policy and Urban Development: Evidence from the Indiana Enterprise Zone Program, *Journal of Public Economics*, 54, 37-49.

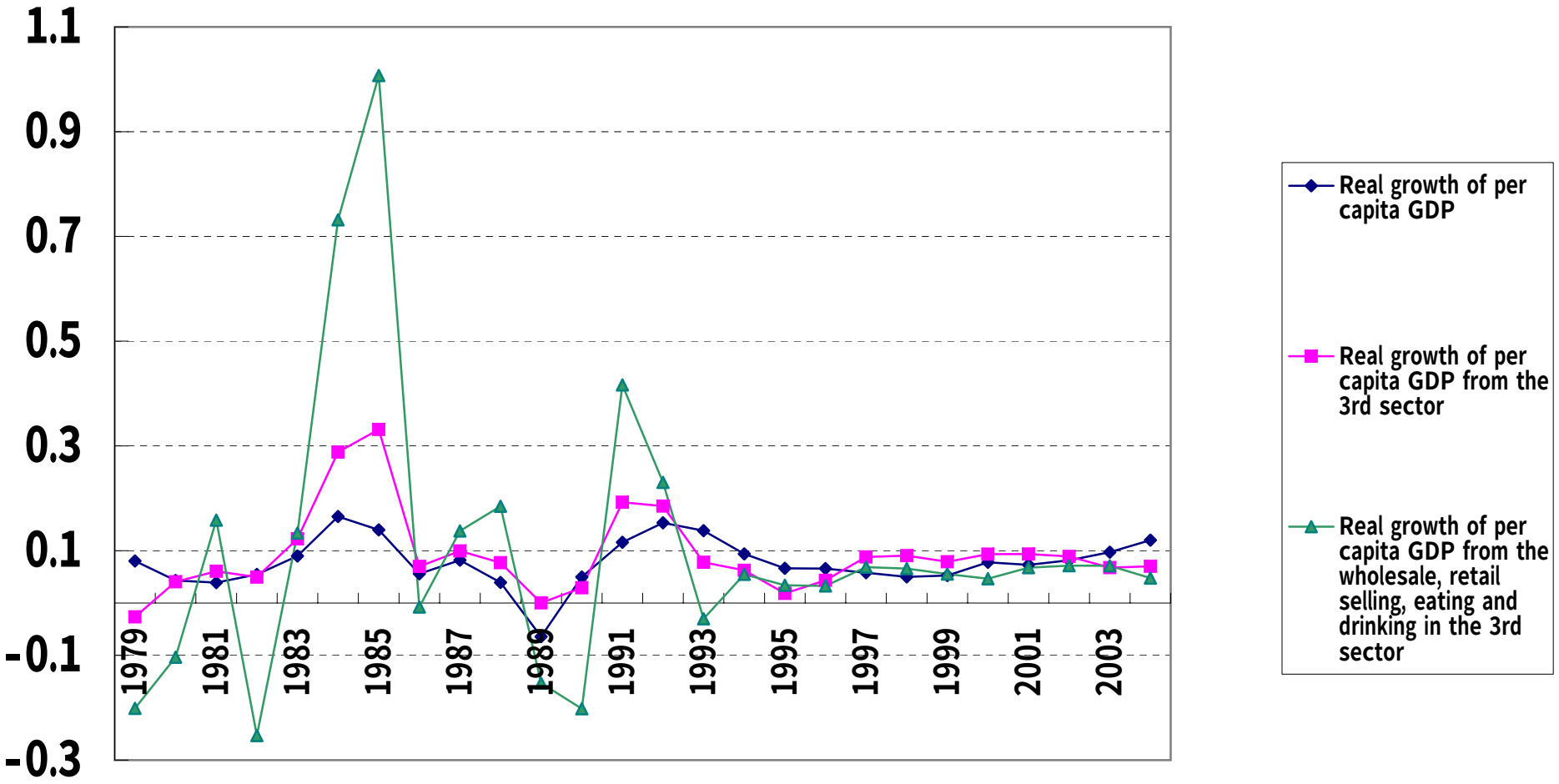
Shiller, Robert J. (2004) Fundamental Long-term Risks and the New Financial Order, *Policy Research*, No.10, 2004, China Center of Economic Research, Peking University.

Wan, Junmin (2004a) Tax Revenue in China and the Incentive to Declare Taxes: The Lottery Purchase Receipt Experiment, September, 2004, Osaka University, mimeo.

Wan, Junmin (2004b) Habit, Information and Uncertainty: Some Evidence from Natural Experiments. Doctoral Dissertation in Osaka University, December 2004.

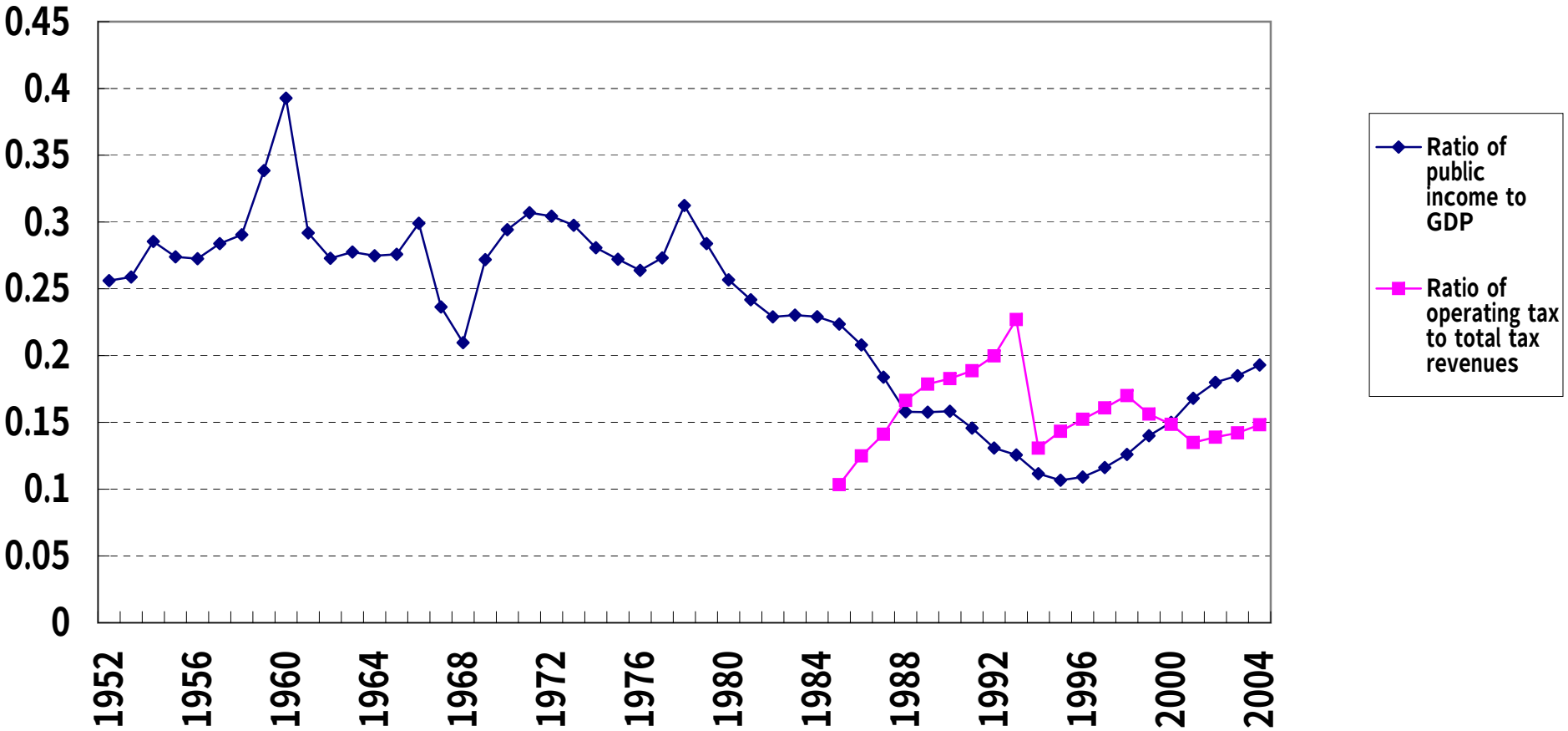
Wooldridge, Jeffrey M. (2002) Econometric Analysis of Cross Section and Panel Data, 2002, The MIT Press.

Figure 1: Real Growth in China, 1979-2004



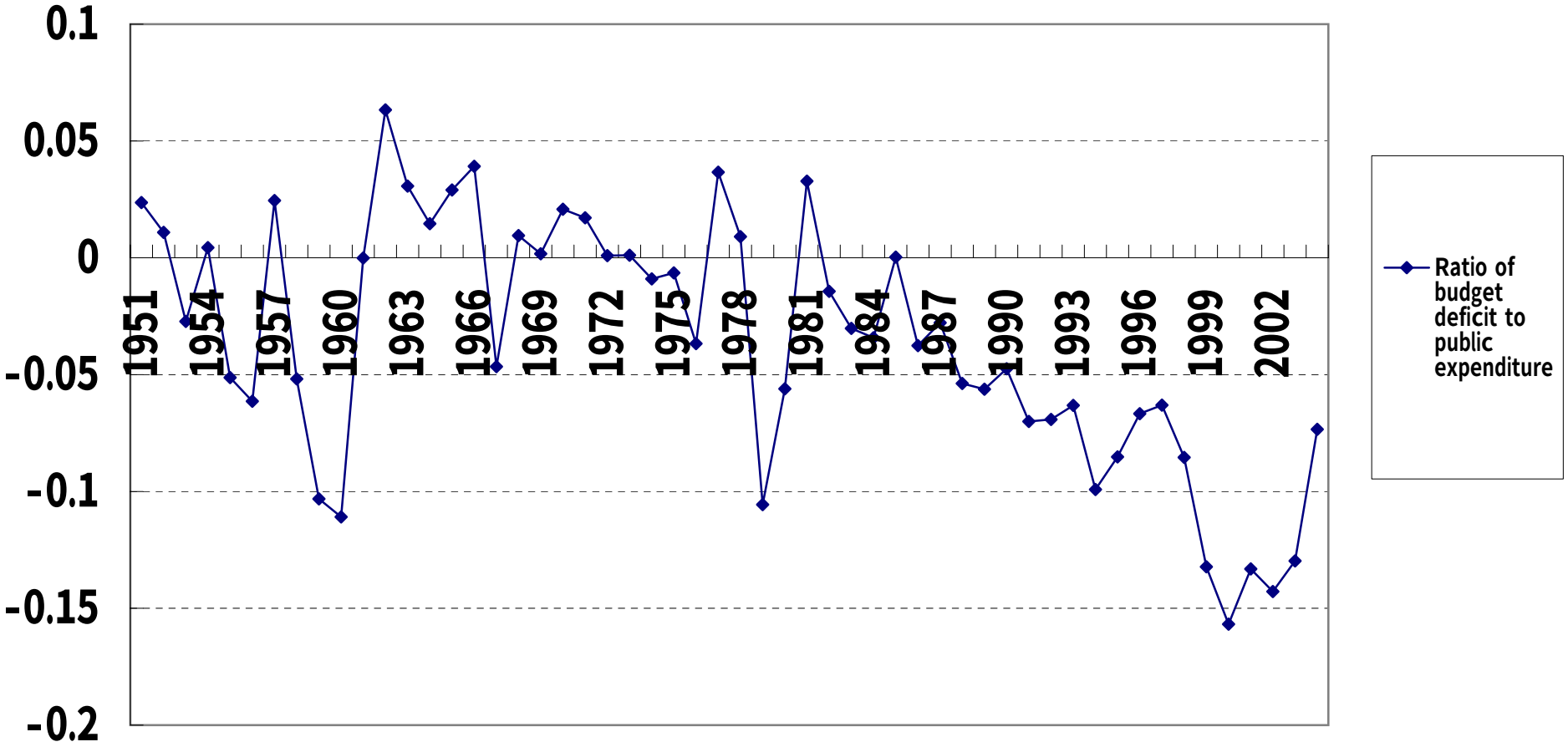
Source: China Statistics Yearbook, 1991-2005

Figure 2: Ratio of Public Income to GDP and Ratio of Operating Tax to Total Tax Revenues in China, 1952-2004



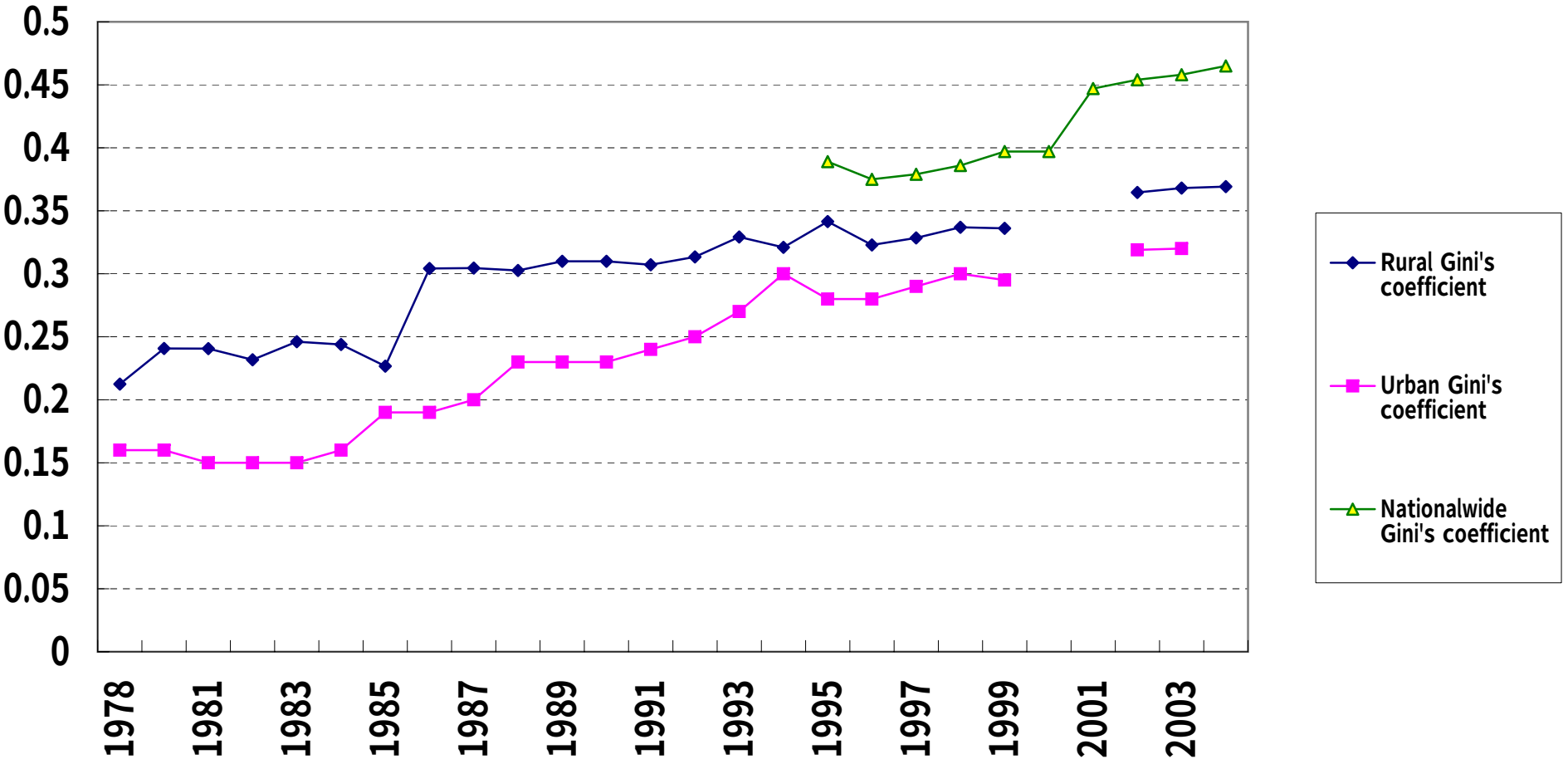
Source: China Statistics Yearbook, 1991-2005

Figure 3: Ratio of Budget Deficit to Public Expenditure, 1951-2004



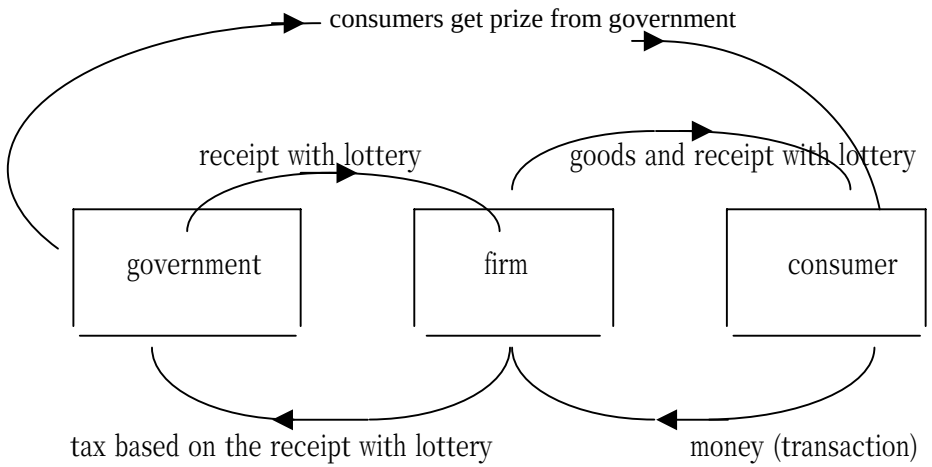
Source: China Statistics Yearbook, 1991-2005

Figure 4: Gini's Coefficinet in China, 1978-2004



Source: China National Statistical Bureau, World Bank

Figure 5: The Delivery of the Receipt with Lottery in China



Source: drawn by author

Table 1: The areas with lottery receipt experiment in China

(author's search using the search engine Google.com in May 2003)

	number of districts (cities)	number of districts (cities) with lottery receipt experiment	the rate of experiment (percent)
Nationalwide	2858	228	7.98
Beijing	18	18	100
Tianjin	18	0	0
Hebei	172	16	9.3
Shanxi	119	0	0
Neimenggu	101	0	0
Liaoning	100	28	28
Jiling	60	5	8.33
Heilongjiang	130	11	8.46
Shanghai	20	20	100
Jiangshu	108	0	0
Zhejiang	88	0	0
Anhui	106	4	3.77
Fujian	84	13	15.48
Jiangxi	99	18	18.18
Shandong	139	25	17.99
Henan	158	7	4.43
Huben	101	13	12.87
Hunan	122	9	7.38
Guangdong	122	26	21.31
Guangxi	110	0	0
Hainan	20	3	15
Congqing	40	1	2.5
Sichuan	180	0	0
Guizho	86	5	5.81
Yunan	128	4	3.13
Xizhuang	73	0	0
Sanxi	107	0	0
Ganshu	86	5	5.81
Qinghai	43	0	0
Ningxia	24	0	0
Xinjiang	96	0	0

Note: It is from author's search using the search engine Google.com in May 2003. It is not statistical data, some notes are needed.

Table 2: Main Indicators in Beijing and Tianjin

2002	Beijing	Tianjin
Population	14.253 million	9.191 million
GDP	321270 million Yuan	205120 million Yuan
Per capita GDP	22541 Yuan	22380 Yuan
Growth rate of per capita GDP	0.08	0.11
Total tax revenues	53400 million Yuan	37590 million Yuan

Source: Beijing Statistics Yearbook 2003, Tianjin Statistics Yearbook 2003

Table 3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
year	234	2000.5	1.711	1998	2003
id	234	20	11.279	1	39
tax_revenue	234	68741.2	95007.3	8227	560802
operating_tax	234	27135.0	42110.0	1617	245595
gdp	234	1098818	1338951	109560	8928950
second_sector_gdp	228	395879	517506.9	10879	3548992
third_sector_gdp	227	590613	919634.8	441177	6930939
population	234	52.947	32.012	5.089189	178.400
cpi	234	101.514	2.886	98.504	107.349
prize	234	53655.4	250105.6	0	2459359
real_revenue	234	1468.776	2265.315	191.177	16869.1
real_operating_tax	234	494.761	535.920	37.868	3023.158
real_gdp	234	27604.4	51258.6	1809.553	446171
real_secondary_gdp	228	9025.306	18950.110	249.309	151936.7
real_third_gdp	227	10751.8	13838.370	1506.524	113645
real_prize	234	0.071	0.243	0	1.469
experiment	234	0.158	0.366	0	1
after	234	0.333	0.472	0	1
LRE	222	0.153	0.361	0	1
Δ LRE	185	0.092	0.290	0	1
Δ Total tax revenue	195	195.836	479.143	-2299.958	3884.141
Δ Operating tax revenue	195	72.694	136.708	-331.952	853.4906
Δ GDP	195	4450.627	11301.380	-1569.283	100726.2
Δ GDP of 2nd sector	190	1092.556	2869.211	-5249.051	20467.8
Δ GDP of 3rd sector	188	1643.723	2658.830	-561.109	20976.3
Δ real_prize	195	0.071	0.227	-0.350	1.232
log_revenue	234	6.805	0.883	5.253	9.733
log_operating_tax	234	5.753	0.945	3.634	8.014
log_gdp	234	9.629	0.952	7.501	13.008
log_second_gdp	228	8.406	1.166	5.519	11.931
log_third_gdp	227	8.856	0.836	7.318	11.641
Δ log(Total tax revenue)	195	0.152	0.192	-0.274	0.827
Δ log(Operating tax revenue)	195	0.136	0.270	-0.774	1.604
Δ log(GDP)	195	0.151	0.065	-0.134	0.481
Δ log(GDP of 2nd sector)	190	0.116	0.201	-0.692	1.276
Δ log(GDP of 3rd sector)	188	0.156	0.070	-0.103	0.388

Source: Author's calculations based on Beijing Statistics Yearbook, 1999-2004, Tianjin Statistics Yearbook, 1999-2004, and Beijing Public Finance Statistics Yearbook, 2002-2004.

Table 4: The Growth Rate of Per Capita Tax Renenue in Beijing and Tianjian Before and After the Experiment

District	Time	Variable	Obs	Mean	Std. Dev.	Min	Max
Beijing (excluding Huairou)	before 2002	Δlog(Operating tax revenue)	51	0.134	0.280	-0.491	0.712
		Δlog(Total tax revenue)	51	0.229	0.181	-0.124	0.688
	2002, 2003	Δlog(Operating tax revenue)	34	0.263	0.273	0.006	1.604
		Δlog(Total tax revenue)	34	0.170	0.190	-0.246	0.794
Tianjin (excluding Tanggu)	before 2002	Δlog(Operating tax revenue)	60	0.142	0.167	-0.163	0.757
		Δlog(Total tax revenue)	60	0.152	0.134	-0.274	0.540
	2002, 2003	Δlog(Operating tax revenue)	40	0.020	0.328	-0.774	0.505
		Δlog(Total tax revenue)	40	0.043	0.240	-0.232	0.827

Source: Author's calculation based on the processed data

Table 5: The Effect of Lottery Receipt Experiment on Tax Revenue (37 Districts in Beijing and Tianjin, 1998-2003, Random Trend Model)

	Dependent variable = Δ Operating tax revenue						Dependent variable = Δ Total tax revenue		
	Fixed Effect	Elasticity	Fixed Effect	Elasticity	Fixed Effect	Elasticity	Fixed Effect	Fixed Effect	Fixed Effect
Δ LTE	105.676	0.213	102.416	0.207	84.355	0.171	118.031	115.324	94.548
	(36.758)***		(36.289)***		(36.915)**		(133.737)	(134.142)	(139.782)
Δ GDP			0.004					0.006	
			(0.002)**					(0.007)	
Δ GDP of 2nd Sector					0.013				0.039
					(0.006)**				(0.023)
Δ GDP of 3rd Sector					0.025				-0.010
					(0.010)**				(0.041)
Constant	44.496		30.786		-2.808		178.03	148.455	140.912
	(11.970)***		(13.901)**		(19.476)		(46.812)***	(52.278)***	(72.504)*
Observations	148		148		142		148	148	142
Number of groups	37		37		36		37	37	36
R-sq: within	0.070		0.101		0.165		0.070	0.013	0.032
between	0.166		0.117		0.257		0.105	0.294	0.073
overall	0.098		0.121		0.194		0.010	0.044	0.037
rho_ar	-0.147		-0.164		-0.176		0.352	0.349	0.347

Note: Standard errors are in parentheses; *, **, *** denote significant at the 10%, 5% and 1% levels, respectively.

Table 6: The Effect of Lottery Receipt Experiment on Growth of Tax Revenue, (37 Districts in Beijing and Tianjin, 1998-2003, Random Growth Model)

	Dependent variable = Δlog(Operating tax revenue)			Dependent variable = Δlog(Total tax revenue)		
	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect	Fixed Effect
ΔLTE	0.234	0.242	0.215	0.109	0.116	0.104
	(0.083)***	(0.085)***	(0.095)**	(0.055)*	(0.056)**	(0.062)*
Δlog(GDP)		-0.255			-0.206	
		(0.470)			(0.312)	
Δlog(GDP of 2nd Sector)			0.041			-0.031
			(0.151)			(0.099)
Δlog(GDP of 3rd Sector)			0.113			0.112
			(0.514)			(0.334)
Constant	0.080	0.112	0.058	0.130	0.160	0.109
	(0.027)***	(0.070)	(0.083)	(0.018)***	(0.046)***	(0.052)**
Observations	148	148	142	148	148	142
Number of groups	37	37	36	37	37	36
R-sq: within	0.067	0.076	0.061	0.034	0.038	0.035
between	0.114	0.072	0.101	0.149	0.024	0.140
overall	0.080	0.076	0.071	0.044	0.030	0.042
rho_ar	-0.068	-0.070	-0.070	0.085	0.092	0.101

Note: Standard errors are in parentheses; *, **, *** denote significant at the 10%, 5% and 1% levels, respectively.

Appendix A: Reported and Estimated Prize by District in 2002, 2003, 2004

	Prize reported by media (homeapge, newspaper)	Prize in Yuan in 2002 (the italic is estimated value)	Prize in Yuan in 2003 (the italic is estimated value)
Dongcheng	2002/10/1-2002/12/31: 212500; 2003/4/11-2003/4/18: 62500	212500	*850000*
Xicheng	2002/10/1-2002/12/10: 100000; 2002/10/1-2003/1/31: 295000; 2003/1/1-2003/2/28: 193600; 2003/1/1-2003/12/31: 1237000	*198200*	1237000
Congwen	2002/10/1-2002/12/31: 88400; 2003/1/1-2003/12/31: 586800	88400	586800
Xuanwu	2002/10/1-2003/12/31: 122650	*24530*	*98120*
Chaoyang	2002/8/1-2002/8/29: 47000; 2003/1/1-2003/1/31: 157300; 2004/1/1-2004/6/10: 1929010	*455388*	*2459359*
Fengtai	2003/1/1-2003/6/30: 332960; 2004/1/1-2004/12/31: 1780000	*86708*	*665920*
Shijingshan	2003/1/1-2003/10/31: 320150; 2003/1/1-2003/12/31: 385950	*36548*	385950
Haidian	2002/10/1-2002/12/31: 297800; 2003/1/1-2003/12/31: 2256300; 2005/1/1-2005/1/31: 1230000	297800	2256300
Mentougou	2002/10/1-2002/12/31: 11700; 2003/1/1-2003/5/31: 55000	11700	*132000*
Fangshan	2002/8/1-2002/9/9: 8400; 2003/1/1-2003/9/30: 78860; 2002/8/1-2004/7/19: 238000	*31795*	*139113*
Changping	2002/10/8-2003/1/31: 89740; 2002/10/8-2003/10/30: 300190; 2002/10/8-2004/8/3: 1046870	*65703*	*283858*
Shunyi	2002/8/1-2002/12/26: 100900; 2002/8/1-2003/4/22: 170000; 2003/1/1-2003/7/14: 122430	*104379*	*230345*
Tongzhou	2002/10/1-2002/11/6: 7700; 2002/10/1-2003/9/29: 162400	*31792*	*162400*
Daxing	2002/10/1-2002/12/25: 33000; 2002/10/1-2003/11/21: 261950	*35357*	*229285*
Pinggu	2002/8/1-2002/10/22: 7000; 2002/10/1-2003/1/31: 34800; 2002/8/1-2003/11/14: 114700	*26557*	*89265*
Huairou	2001/1/1-2001/12/31: 140000; 2002/8/1-2002/8/31: 8000; 2004/1/1-2004/7/22: 344270	*40000*	*358133*
Miyun	2004/1/1-2004/5/31: 153000	*19575*	*210058*
Yanqing	2002/10/1-2003/1/16: 11000; 2005/1/1-2005/3/31: 93400	*9340*	*189394*
Reported total prize (all districts)	2002/8/1-2002/12/31: 1669700; 2003/1/1-2003/12/31: 1117000; 2004/1/1-2004/12/31: 41769600	1669700	1117000
Estimated total prize (all districts)		*1776273*	*10563301*

Note: The italic values are estimated by the author with the reported data in mass media.

Appendix B: Definition of Variables

Variable	Definition
year	1998, 1999, 2000, 2001, 2002, 2003
id	the number of district; 1, 2, ⋯, 39
tax_revenue	nominal total tax revenues by district, (10,000 Yuan)
operating_tax	nominal operating tax revenues by district, (10,000 Yuan)
gdp	nominal GDP by district, (10,000 Yuan)
second_sector_gdp	nominal GDP of the second sector by district, (10,000 Yuan)
third_sector_gdp	nominal GDP of the third sector by district, (10,000 Yuan)
population	population by district, (10,000 persons)
cpi	consumer price index, (1998=100)
prize	prize by district, (Yuan, per district)
real_revenue	=tax_revenue/population/cpi*100, (Yuan, per capita)
real_operating_tax	=operating_tax/population/cpi*100, (Yuan, per capita)
real_gdp	=gdp/population/cpi*100, (Yuan, per capita)
real_secondary_gdp	=second_sector_gdp/population/cpi*100, (Yuan, per capita)
real_third_gdp	=third_sector_gdp/population/cpi*100, (Yuan, per capita)
real_prize	=prize/population/cpi*100, (Yuan, per capita)
experiment	dummy, 1 for the experiment district, 0 for the non-experiment district
after	dummy, 1 for the experiment period, 0 for the non-experiment period
LRE	=experiment*after
Δ LRE	=LRE(t)-LRE(t-1)
Δ Total tax revenue	=real_revenue(t)-real_revenue(t-1)
Δ Operating tax revenue	=real_operating_tax(t)-real_operating_tax(t-1)
Δ GDP	=real_gdp(t)-real_gdp(t-1)
Δ GDP of 2nd sector	=real_secondary_gdp(t)-real_secondary_gdp(t-1)
Δ GDP of 3rd sector	=real_third_gdp(t)-real_third_gdp(t-1)
Δ real_prize	=real_prize(t)-real_prize(t-1)
log(Total tax revenue)	=log(real_revenue)
log(Operating tax revenue)	=log(real_operating_tax)
log(GDP)	=log(real_gdp)
log(GDP of 2nd sector)	=log(real_secondary_gdp)
log(GDP of 3rd sector)	=log(real_third_gdp)
Δ log(Total tax revenue)	=log(Total tax revenue)(t)-log(Total tax revenue)(t-1)
Δ log(Operating tax revenue)	=log(Operating tax revenue)(t)-log(Operating tax revenue)(t-1)
Δ log(GDP)	=log(GDP)(t)-log(GDP)(t-1)
Δ log(GDP of 2nd sector)	=log(GDP of 2nd sector)(t)-log(GDP of 2nd sector)(t-1)
Δ log(GDP of 3rd sector)	=log(GDP of 3rd sector)(t)-log(GDP of 3rd sector)(t-1)

Note: t, t-1, means t period and t-1 period, respectively.