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The Lottery Receipt Experiment in China

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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 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 consumers and firms and collect tax effectively. Estimation is performed based on panel data for different periods from a total of 37 districts in Beijing and Tianjin during 1998-2003. The lottery receipt experiment has significantly raised the business tax, the growths of business tax and total tax revenues.

JEL classification: H26, D81, D82

Keywords: tax evasion, business tax, lottery receipt experiment, 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.[1] After the 1978 shift to a market economy, high growth (averagely 9.6%) has been realized for 1979-2004 period. In 2005, China experienced 9.9% economic growth, and it is expected to achieve over 9% growth in 2006. However, as shown in Fig. 1, the budget deficit has become a serious concern. The central government has been a budget deficit since 1982, and the ratio of budget deficit to public expenditure was at the peak of -15.7% in 2000.

Moreover, the Gini's coefficient which measures the degree of economic inequality in China has shown a upward trend. The Gini's coefficient was 0.21 in rural sector and 0.16 in urban sector in 1978, 0.31 in rural sector and 0.21 in urban sector in 1990, 0.37 in rural sector and 0.32 in urban sector in 2003. The nationwide Gini's coefficient was 0.39 in 1995, 0.40 in 2000 and 0.47 in 2004. Clearly, the degree of economic inequality in China is growing and has reached a dangerous line.

To sustain future economic growth and stability, these two significant issues must be resolved. The implementation of an efficient and fair tax

[1] From Fig. 1, the ratio of public income to GDP has changed to be in an upward trend since 1994, it may be caused by this decentralization.

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, and his first recommendation was the creation of an effective taxation system. Similarly, Krugman (2004) noted that "since there is almost no tax collection system anyway, a possibility that the China government itself will go bankrupt is not zero, either."

1.2 Tax Evasion

Although the government understands the importance of tax collection, with the lack of the technical and intellectual ability to create a tax collection system, all the efforts would be a vein. To collect a business 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.

Woller (1999) points that China's shirking tax burden is partly due to nearly endemic levels of tax evasion. 'So Taxing' (1989) points that in 1989, the tax authorities of Shanghai seized the books of 10,361 private businessmen and found that 8,953 of them had evaded tax. 86% of the 163,000

registered businessmen in Shanghai (3.2% of the city's workforce) may have evaded taxes, probably 100% of the unregistered ones did. According to Li (1995), the tax evasion in China is estimated to have caused the government a loss of around 100 billion Yuan a year.

Fisman and Wei (2004) examines the relationship in China between the tariff schedule and the "evasion gap," which is defined as the difference between Hong Kong's reported exports to China at the product level and China's reported imports from Hong Kong. They have found that a one-percentage-point increase in the tax rate is associated with 3 percent increase in evasion.

Due to so serious tax evasion in China, it is difficult for the government to capture the real economic activity, thus there is a part of economy which can not be counted into national accounting but become underground. Bajada and Schneider (2005) find that the size of the underground economy in average 1991-1995 and in average 2000-2001 in China are in 10.2% and 13.4% of the official GDP, respectively. Based on the first census 'China Economic Census 2004,' China National Statistical Bureau adjusted the national accounting during 1978-2004 in January 2006. For example, the accounting on GDP and on the service industry was undervalued to a large degree, 14.39% of and 13.33% of GDP in 2004, respectively.[2]

[2]The GDP was re-estimated based on the informaion including the number of nation-wide employees. In 2004, the GDP was 15.99 trillion Yuan, but 2.3 trillion Yuan was totally undervalued and of which 2.13 trillion Yuan was from the service industry.

1.3 Lottery Receipt Experiment

For many years mainland China has also been wrestling with the issue of capturing a fair tax base. The government first issued a guideline requiring "an official receipt printed with public lottery number" (You Jiang Fa Piao, in Chinese, hereafter we call it "lottery receipt") as a means of organizing tax collection. 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 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 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.

The mainland China 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.[3] 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 the author's May 2003 research using the

[3]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."

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 the lottery receipt experiment (LRE hereafter, also see Appendix A).[4]

Accompanying the LRE, 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.[5]

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

[4]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 Appendix A 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.

[5]The inventor of the lottery receipt machine is Haiping DAI. 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.

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

1.4 Contribution and Structure of this Paper

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 may 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 business tax revenues but also the growths of business tax and total tax revenues to increase significantly.

The structure of this paper is as follows. Section 2 presents related literature the inovation in China. Section 3 performs a theoretical consideration. Section 4 describes the data, the model, and the method of econometric estimation. Section 5 shows the results, and Section 6 discusses the policy implications and concludes.

2 Related Literature and Inovation

2.1 Related Literature on Tax Evasion

Allingham and Sandmo (1972) and Yitzhaki (1974) are pioneers in analyzing that a risk-averse taxpayer choose an optimal unreported income to maximize the expected utility under the governmental auditing. Since then there are enormous theoretical and empirical studies on tax evasion. Andreoni et al. (1998) make a comprehensive survey of this literature. It has been theoretically found that the tax enforcement, auditing, tax rate, income level and social norms etc. should have impacts on tax evasion. Chapter 2 of Cowell (1990) makes a list for the empirical studies of the extent of tax evasion and the black economy in nineteen major countries. Crane and Nourzad (1994), O'Higgins (1989), and Alm et al. (1991) emprically examine the determinants of income tax evasion in U.S., U.K, and Jamaica, respectively.

As pointed out by Ishi(1981), there is the issue of 'kuroyon' in Japan, which refers to the fact that the capture rates of taxale income recorded for salaried workers, farmers and the self-employed are about 90, 60, and 40 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,' as discussed in Horioka and Sekita (2006), 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.

2.2 Inovation in China

Up to date, the researches on tax evasion has been focused on the effects of governmental monitoring, punishment and consumer's attributes on the tax evaders. It is the first time that the LRE in China has been tried to give the taxpayers' incentive to voluntarily declare the tax base by not inflicting punishment but giving a prize (public lottery) simultaneously. There still have been neither theoretical nor empirical research on this new system.

3 Theoretical Framework

3.1 Purchase of Lottery

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 business tax.

3.2 Tax Declaration by Lottery Receipt

3.2.1 Tax Evasion due to Too High Monitoring Cost

In an economic transaction (without lottery), it is assumed that there are three types of agent: the firm, the consumer, and the government. The gov-

ernment does want to know the transaction volume between the firm and the consumer to collect the business (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 business (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."[6] Therefore, the government will not act as the monitor of "v" and cannot fully collect the tax "x."

3.2.2 Issuing and 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." Therefore, when building a tax collection system, a government must try to make taxpay-

[6]The information value of "v" here means that the correct value of "v" is essential to the national accounting.

ers cooperate in providing accurate financial information and must try to design and provide an incentive mechanism that can mitigate information asymmetry. Here, the government is assumed to issue a lottery receipt to gather the information on sales.[7]

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 (to get receipt means that 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. 2 shows the framework of the delivery of lottery receipts among 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 (2000)'s framework.[8] 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

[7]In reality, the goverment mornitors the tax evaters at the same time, issues lottery receipt. For simplicity without lossing generality, it is assumed that the government does not make monitoring. Another reason for this assumption is that there are not any data on the governmental monitoring in the empirical analysis.

[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. The detailed results are available upon request.

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

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

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

with strict inequality provided $N' > 1$. 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 LRE 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. Sections 4 and 5 examine the effect of the lottery receipts, in other words, whether $\frac{\partial G}{\partial R} \geq 0$ is true.

4 Empirical Examinations

4.1 Probability of Winning a Prize, Amount of Prize

To announce the amount of the prize beforehand can be considered a strategy of the government. For example, according to the pre-draw prize announcement by the Beijing Local Tax Bureau on July 17, 2002,[10] total prize

[9] See Morgan (2000) for details.

[10] See "Beijing Evening on July 17, 2002" for details.

money amounted to three million Yuan in August and September, and 10 million Yuan between August and December in 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) may be 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 transactions since August 1, 2002. The other ten districts began issuing

[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.

receipts on October 1, 2002. Therefore, the effect of the experiment on tax revenues can be estimated by district-level panel data (18 districts, 6 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 1, 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.

4.2 The Data Set

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. Beijing Statistics Yearbook 1999-2004, Tianjin Statistics Yearbook 1999-2004, Beijing Public Finance Statistics Yearbook 2002-2004 and China Statistics Yearbook 1999-2004 are used. 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,[13] is shown in Appendix B. In Tanggu of Tianjin, the prize was 75,800

[13]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.

Yuan in 2003.

The definitions of variables are described in Appendix C. Summary statistics of the data are reported in Table 2. The main information before and after the experiments is summarized by district in Table 3. These two tables provide some indication of the effects of the experiment.

4.3 Empirical Specification and Estimation Method

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

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

where y_{it} is the level value of per capita real business tax revenue in district i, LRE_{it} is the information on experiment, Z_{it} are the controlled variables with level values, g_i is the specific trend in the district, c_i is the specific time-invariant factor, u_{it} is the white noise. c_i, g_i and u_{it} are all unobserved. When y_{it} and Z_{it} are log values, Equation (6) becomes a random growth model.

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 three reasons to bring LRE close to be 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. Thirdly, 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 serious self-selection and tend to obtain a consistent estimator of the effect of the experiment. Therefore, it can reasonably be said that LRE_{it} is exogenous to a large degree.

Because error term Δu_{it} is the one difference of u_{it}, it becomes a series correlation.[14] The fixed effect of panel estimation considering this characteristic of the error term is used to estimate Equation (7). This method is the fixed effect within regression with AR(1) disturbances explained in detail in Papke (1994) and Wooldridge (2002).

4.4 Variables used in the Empirical Tests

The methods of making the variables for estimation are summarized in Appendix C. Δy_{it} is the one difference of y_{it} which is the level or log value of per capita real business tax revenue in district i and is the dependent variable. ΔLRE_{it} is the dummy variable for an experiment district (1 for

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

an experiment district, 0 for others) multiplied by the dummy variable for the experiment time (1 for experiment time, 0 for other time).[15]

To obtain a difference in difference 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.[16] Thus, we finally use a data set of 37 districts for 6 years.

5 Estimated Results

Table 4 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 business 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 business 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 business tax revenue by over 17.1 percent

[15] ΔLRE_{it} is the independent variable. $\Delta Prize_{it}$ 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.

[16] The estimation results are almost unchanged when Huairou and Tanggu are included in the sample, and these results are also available upon request.

but has no significant effect on total tax revenue.[17]

Table 5 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 business 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 business tax revenues, there was about a significant 21.5-24.2 percent increase in the growth rates of the experiment areas. In the case of total tax revenue, there was a 10.4-11.6 percent increase.[18]

6 Conclusion

The literature on tax evasion has been focused on the effects of governmental monitoring, punishment and consumer's attributes on the tax evaders. It is the first time that the LRE in China has been tried to give the taxpayers' incentive to voluntarily declare the tax base by not inflicting punishment but giving a prize (public lottery) simultaneously.

This paper examined, theoretically and empirically, the effect of LRE on

[17]The author also has used the first difference of prize as a proxy for ΔLRE, but he has not obtained significant effect from prize. There may be two reasons. First, the amount of 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 would be large measurement error on the prize data. These estimation results are also avalaible upon request.

[18]The author also has used the first difference of prize as a proxy for ΔLRE , but has not obtained significant effect from prize. Same reasons as in Footnote 17 are considered. These results are also avalaible upon request.

tax revenues (implicitly on tax evasion) in China. When the revenue from the public lottery printed on an official receipt is used to finance the public good, even if a consumer has expected utility with quasi-linear preference, he or she will purchase a lottery receipt. By issuing lottery receipt, the Chinese government can prevent the tax evasion caused by collusion between consumers and firms and can collect business taxes effectively to some extent. Our empirical examination of 6-year data from 37 districts in Beijing and Tianjin indicated that business tax revenue was significantly (over 17.1 percent) higher, and the real growth rates of business tax and total tax revenues were significantly (over 21.5 and over 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 to a large degree. Thus, our analysis is similar to a kind of (quasi) 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 LRE can be judged as successful insofar as it increased business tax revenues and the growths of business 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.[19] Additionally, because playing the lottery is a form of gambling, we must consider the social cost of gambling in relation to social welfare.[20]

[19]Aanlysis based on individual data has been a research project of Center of Excellence program in Osaka University. The first survey on 1,500 Chinese households was performed in March 2006. The author is making econometric analysis using this micro data set.

[20]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.

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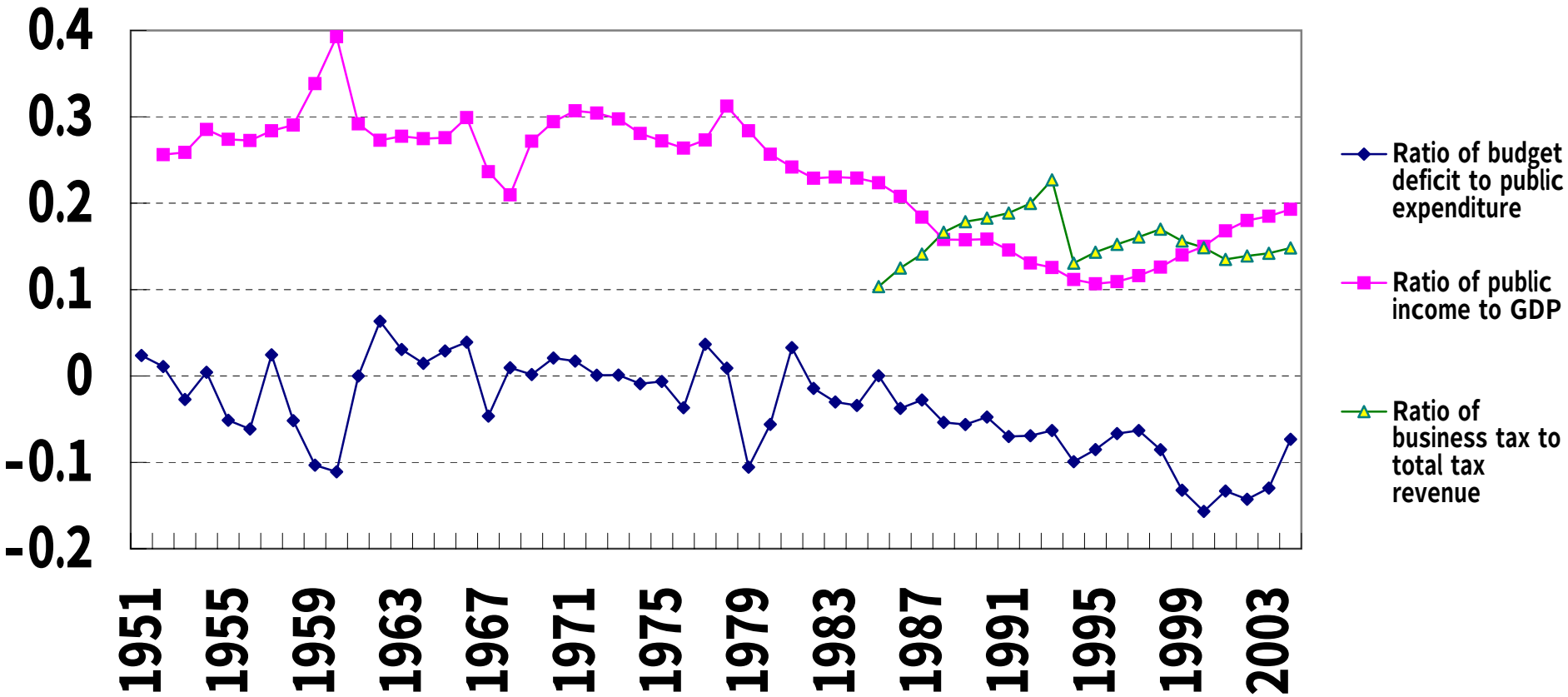
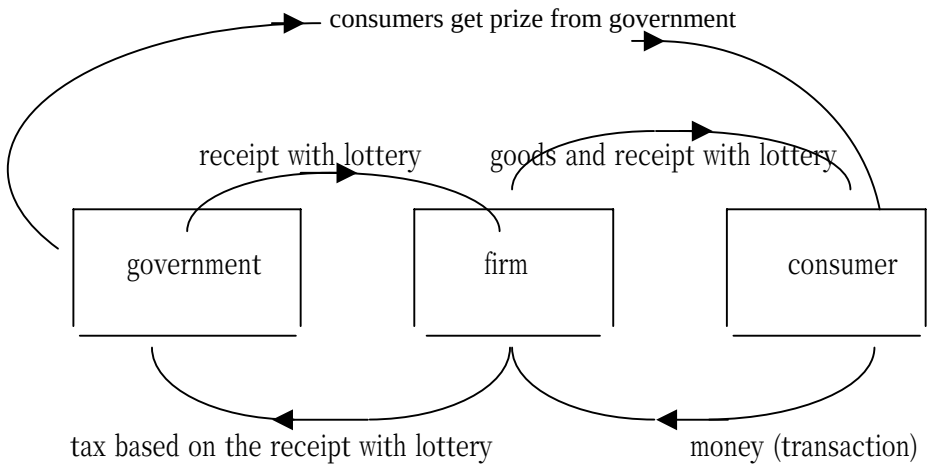
Figure 1: Budget Deficit, Public Income andTax Revenues in China, 1951-2004



Source: China Statistics Yearbook, 1991-2005

Figure 2: The Delivery of the Receipt with Lottery in China



Source: drawn by author

Table 1: Main Indicators in Beijing and Tianjin in 2002

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 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
tax_revenue	222	70325	97262	8227	560802
business_tax	222	27715	43139	1617	245595
gdp	222	1137669	1363700	109560	8928950
second_sector_gdp	216	409171	528148	10879	3548992
third_sector_gdp	215	612835	939894	44177	6930939
population	222	54	33	5	178
cpi	222	102	3	99	107
prize	222	53790	255712	0	2459359
real_revenue	222	1488	2322	191	16869
real_business_tax	222	495	547	38	3023
real_gdp	222	28483	52473	1810	446171
real_secondary_gdp	216	9243	19429	249	151937
real_third_gdp	215	11060	14153	1507	113645
real_prize	222	0.066	0.235	0	1.5
experiment	222	0.2	0.361	0	1
log_revenue	222	6.797	0.903	5.253	9.733
log_business_tax	222	5.736	0.962	3.634	8.014
log_gdp	222	9.652	0.965	7.501	13.008
log_second_gdp	216	8.418	1.179	5.519	11.931
log_third_gdp	215	8.874	0.853	7.318	11.641
after	222	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	185	198	490	-2300	3884
Δ Business tax revenue	185	72	136	-332	853
Δ GDP	185	4593	11585	-1569	100726
Δ GDP of 2nd sector	180	1120	2944	-5249	20468
Δ GDP of 3rd sector	178	1690	2723	-561	20976
Δ real_prize	185	0.067	0.215	0.000	1.232
Δ log(Total tax revenue)	185	0.153	0.194	-0.274	0.827
Δ log(Business tax revenu	185	0.136	0.269	-0.774	1.604
Δ log(GDP)	185	0.150	0.065	-0.134	0.481
Δ log(GDP of 2nd sector)	180	0.114	0.206	-0.692	1.276
Δ log(GDP of 3rd sector)	178	0.155	0.069	-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 3: The Growth Rate of Per Capita Tax Revenue in Beijing and Tianjin Before and After the Experiment

District	Time	Variable	Obs	Mean	Std. Dev.	Min	Max
Beijing (excluding Huairou)	before 2002	Δlog(Business 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(Business 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(Business 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(Business 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 4: The Effect of Lottery Receipt Experiment (LRE) on Tax Revenues (Random Trend Model, 37 Districts in Beijing and Tianjin, 1998-2003)

	Dependent variable = Δ Business 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 5: The Effect of Lottery Receipt Experiment (LRE) on Growth Rates of Tax Revenues (Random Growth Model, 37 Districts in Beijing and Tianjin, 1998-2003)

	Dependent variable = Δlog(Business 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: The Areas with Lottery Receipt Experiment (LRE) in China in 2002

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

	number of districts or cities	number of districts (cities) with lottery receipt experiment	the rate of lottery receipt 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.

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

District	Prize (by period) 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 C: Definition of Variables

Variable	Definition (method of making variable)
tax_revenue	nominal total tax revenues by district, (10,000 Yuan)
business_tax	nominal business 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_business_tax	=business_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 Business tax revenue	=real_business_tax(t)-real_business_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(Business tax revenue)	=log(real_business_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(Business tax revenue)	=log(Business tax revenue)(t)-log(Business 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.