An Economic Analysis of the Demand for Lotto in Korea and Its Policy Implications*

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Abstract: This paper develops models of the demand for lotto in Korea in order to explore economic issues such as revenue maximization, regressivity, addictiveness and the adequate size of the lottery market. Following Farrell et al. (1999) and Forrest et al. (2000a), we incorporate the expected price of a lotto ticket and lagged sales in the regression of current sales. Major findings are as follow. First, the size of lottery market in Korea is very small relative to the averages of the OECD, Asian countries, and countries with a GDP per capita between $20,000 and $40,000, respectively. This fact implies that there is room to enhance the efficiency of lotteries as a means to finance public goods. Second, the demand for lotto is found to be unit elastic in the short run, but it is inelastic in the long run. Consequently, any measure that increases the expected price of a lotto ticket (for instance lowering the ratio of sales allocated to prizes) may increase lotto sales in the long run. The finding that the price elasticity is greater in the long run than

Key words: Lotto Demand, Price Elasticity of Demand, Revenues Maximization, Regressivity, Addictiveness

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in the short run contradicts the widespread presumption that lotteries are addictive. Third, weak economic conditions (higher rates of unemployment and economic recessions) stimulate lotto sales. Finally, the decrease in the nominal price of a lotto ticket implemented on August 8, 2004 can help explain the continued decrease in lotto sales thereafter.

Ⅰ. Introduction

Many countries and local governments consider lotteries an important means to finance public expenditures as it becomes more difficult to rely upon traditional tax collection. Although the public tend to resist tax hikes to meet the continuous demand for public goods, they are less hostile to lotteries. According to *La Fleur's 2009 World Lottery Almanac*, more than 100 countries (including 30 OECD countries) have lotteries and usually make considerable surpluses.

Economic research on lotteries is classified into five categories: (1) the effectiveness of lotteries as a means of financing public goods, (2) optimal game structures for maximizing lottery revenues, (3) the regressivity and addictiveness of lottery, (4) the social and economic effects of the expenditures of lottery proceeds, and (5) the efficient management of lottery proceeds. There have been a large number of theoretical and empirical studies on the demand for lotteries in foreign countries since a model of the demand for lotteries is a basic analytical framework that enables the above economic issues to be analyzed.

Mikesell and Zorn (1987), Clotfelter and Cook (1991), Morgan (2000), Morgan and Sefton (2000), Duncan (2002), Garrett and Marsh (2002), Hansen (2004, 2005, 2007), Landry and Price (2007), Lange et al. (2007) explore the effectiveness of lotteries as a means to increase government revenues. Especially, Morgan (2000), Morgan and Sefton (2000), Landry and Price (2007), and Lange et al. (2007) argue that lotteries are effective means of revenue generation (relative to voluntary contribution) when taxes are not feasible.

As government lottery proceeds are proportional to lottery sales, the issue of maximizing lottery proceeds is equivalent to that of maximizing lottery sales. The most important factor that determines lottery sales is the effective price of a lottery ticket (one minus the expected value of a ticket). Lottery sales are maximized where the price elasticity of demand is equal to -1. Consequently, the demand for lotteries is essential in analyzing whether lottery sales attain their maximum. If the price elasticity of the demand for lottery exceeds 1 in absolute value (elastic), lowering the effective price of a lottery ticket (increasing the proportion of sales allocated to prizes) increases government proceeds. There also have been numerous studies on the optimal prizes structure. Gulley and Scott (1993), Quiggin (1991), Scoggins (1995), Forrest et al. (2000a), and Maeda (2008) are good examples.

A common criticism against lotteries is the regressivity of the implicit taxation associated with government-run lotteries. The regressivity occurs when the implicit lottery tax paid by a household as a percentage of income is higher for low-income households than for high-income households. The regressivity of lottery arises from two sources: household expenditures on lotteries and government uses of lottery proceeds. The regressivity of lottery proceeds is related to the benefits provided by government projects on which lottery proceeds are spent (Cornwell and Mustard, 2001). Lottery proceeds are considered regressive when the projects funded by lottery proceeds favor high-income groups.

The regressivity of lottery expenditures occurs when a lower income class spends proportionally more on purchasing lottery tickets than a higher income class. When the income elasticity is less than 1, the tax is claimed to be regressive. When it exceeds 1, it is claimed to be progressive. Clotfelter (1979) and Clotfelter and Cook (1987, 1990) reveal that the income elasticity of lotteries in the United States is less than 1. Walker (1998) discovers that the income elasticity of a lottery is negative in the United Kingdom. This implies that a lottery is an inferior good, making the lottery strongly regressive. Price and Novak (1999, 2000) show that in Texas the income elasticity for lotteries is 0.50 for Lotto Texas, 0.03 for Pick 3 and -0.45 for the Instant Game, respectively, confirming that all lotteries are regressive. They also find that the Instant Game lottery is more regressive and is purchased more by low-income classes such as Blacks, Hispanics, the elderly, and lower education groups. Spry (2003) explores the effects of social and economic factors on Indiana lottery sales. His regression results show that the income elasticity ranges between 0.4 and 0.9, depending on the type of lottery. In addition, Spiro (1974), Brinner and Clotfelter (1975), Clotfelter (1979), Clotfelter and Cook (1987, 1989), Mikesell (1994), Hansen (1995), Stranahan and Borg (1998), and Farrell and Walker (1999) find that a lottery is regressive.

Other criticisms against lotteries are the addictiveness, participation by minors, and the encouragement of gambling. An analysis of the demand for lottery enables the estimation of the degree of addictiveness. Becker and Murphy (1988) and Becker, Grossman and Murphy (1994) develop a model which determines the degree of addictiveness by examining whether current consumption depends on the stock of addiction generated by past consumption. There has been significant research on the addictiveness of lotteries, including Walker (1998), and Farrell et al. (1999).

This paper develops a model for lotto demand in Korea and explores economic issues such as lottery revenue maximization, regressivity, addictiveness, and an adequate size of the lottery market. Since its first introduction on December 7, 2002, Lotto 6/45 has reached 95% of total lottery sales, playing a predominant role in the Korean lottery market. Despite its importance, however, economic research on the demand for lotto has been rare in Korea. The model for the demand for lotto developed in this paper will initiate further economic research on lotteries and will be a useful tool for designing appropriate lottery policies.

This paper is organized as follows: Section II explores the present situations of world and domestic lottery markets and derives distinguishable characteristics for the local lottery market. Specifically, we evaluate the size of domestic lottery markets as compared to those of OECD and Asian countries. Section III introduces previous research on the demand for lotteries, and discusses their regression results. Section IV proposes models for lotto demand in Korea and presents estimation results. Section V, based upon major findings of the paper, derives policy implications such as revenue maximization, regressivity, addictiveness, and an adequate size for the lottery market in Korea.

Ⅱ. World and Domestic Lottery Markets

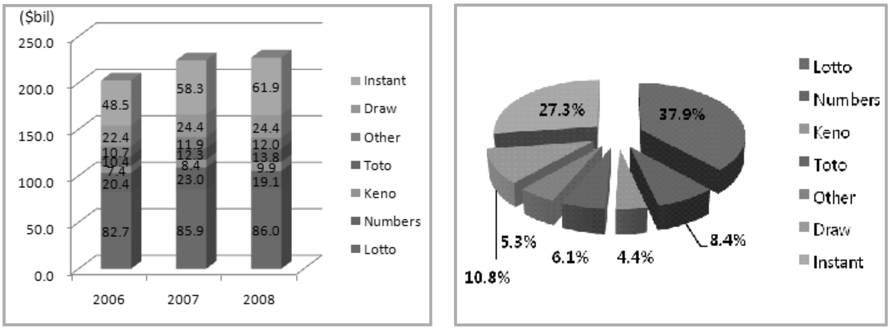
1. World Lottery Markets

According to *La Fleur's 2009 World Lottery Almanac*, worldwide lottery sales in 2008 reached $227.2 billion, increased by 1.3% relative to 2007 (Figure 1). Lotto forms the majority, explaining 37.9% of total lottery sales ($86 billion). On-line lotteries form 61.9% of total sales, including Lotto (37.9%, $86 billion), Numbers (8.4%, $19.1 billion), Toto (6.6%, $13.8 billion), Keno (4.4%, $9.9 billion), and others (5.3%). Draw game takes 10.8% of total sales ($24.4 billion), and the Instant Game 27.3% ($61.9 billion).

As for 30 OECD countries, total lottery sales in 2008 were $188.8 billion and represented 83% of the world lottery sales. In 2008, the average of lottery sales in OECD countries was $6,293 million and the average ratio of lottery sales to GDP was 0.5% (Table 1). The total lottery sales of 9 Asian countries in 2008 were $41.4 billion which were 15.9% of the worldwide sales.

Figure 1. Worldwide Lottery Sales (2008)

(a) Size (b) Product Mix



Source: *La Fleur's 2009 World Lottery Almanac.*

Table 1 shows that the average of lottery sales in 9 Asian countries was $4,595 and the average lottery sales/GDP ratio was 0.67%, significantly higher than the average ratio of the OECD nations.

Table 1 exhibits the average lottery sales/GDP ratios catego-

Table 1. GDP per capita and Lottery Sales in OECD and Asia (2008 – Average)

Countries	GDP per capita ($)	Sales ($mil)	Sales/GDP (%)	Sales per capita ($)
Below $20,000 (9)[1)]	9,225	2,794	0.41	38.0
$20,000-40,000 (9)	36,501	8,130	0.57	204.2
$40,000-50,000 (9)	45,772	12,862	0.44	205.5
Above $50,000 (9)	67,005	1,188	0.37	239.6
OECD (30)	42,467	6,293	0.50	203.7
Asia (9)[2)]	17,651	4,595	0.67	151.7
Korea	**19,115**	**3,392**	**0.37**	**69.8**

Note: 1) Korea is excluded. Parenthesis indicates the number of countries included.

2) Asian countries include Korea, China, Hong Kong, Japan, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

Sources: *La Fleur's 2009 World Lottery Almanac*, World Bank (2009) and Central Bank of Taiwan.

rized into four groups based on the levels of GDP per capita. It is noteworthy that the lottery sales/GDP ratio tends to rise until GDP per capita reaches $40,000 and to fall once GDP per capita surpasses $40,000. The average ratio was 0.41% for countries with less than $20,000 of GDP per capita, 0.57% for countries with a GDP per capita between $20,000 and $40,000, 0.44% for countries with a GDP per capita between $40,000 and $50,000, and 0.37% for countries with a greater than $50,000 of GDP per capita.

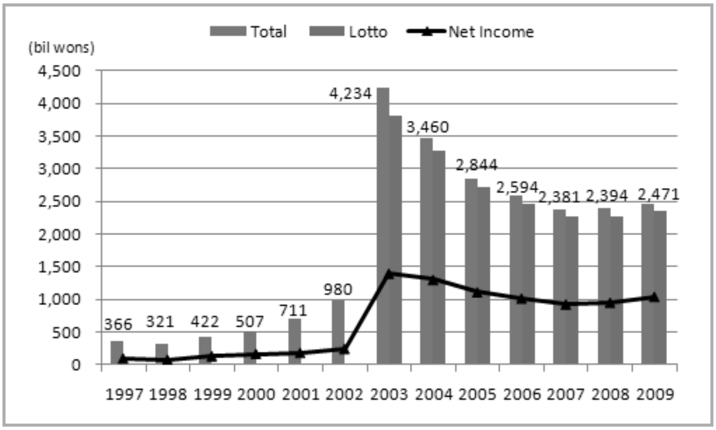
2. Domestic Lottery Market

1) Market Size

Lottery sales in Korea increased dramatically following the initial introduction of Lotto 6/45 on December 7, 2002, but they decreased after their apex in 2003 (Figure 2). Total lottery sales surged from 980 billion won in 2002 to 4,234 billion won in 2003; however, they decreased to 3,460 billion won in 2004 and to 2,471 billion won in 2009. The decrease in lotto sales has had a great impact on total lottery sales. Although lotto sales rose from 18.5 billion won in 2002 to 3,803 billion won in 2003, they fell to 3,280 billion won in 2004 and to 2,357 billion won in 2009.

Three indexes of total lottery sales, lottery sales per capita, and the lottery sales/GDP ratio in Korea are all far below the average levels of OECD nations and 9 Asian countries (Table 1). Total lottery sales in Korea in 2008 were $3,392 million and were only 54% of the average of the OECD nations ($6,293 million). Lottery sales per capita in Korea was $69.8 which was 34% of the average level of the OECD nations ($203.7), and 46% of the average level of 9 Asian countries ($151.7) The lottery sales/GDP ratio in Korea was 0.37%, lower than the averages of the OECD nations (0.50%) and 9 Asian countries (0.67%).

Figure 2. **Lottery Sales in Korea**



Source: Korea National Lottery Commission, http://www.bokgwon.go.kr/.

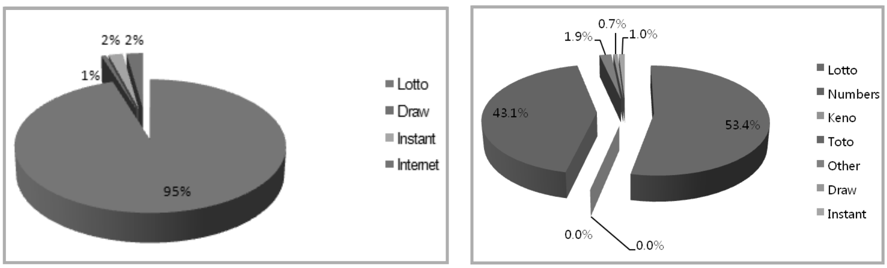
2) Product Mix

The Korean lottery market appears lop-sided and depends too much on Lotto 6/45 sales. The share of Lotto 6/45 in total lottery sales (when sports Toto is excluded) increased from 2% in 2002 to 90% in 2003. The market share of Lotto 6/45 sales has been maintained at 95% from 2004 until 2009. The market shares of other lotteries such as Draw, Instant, and Electronic lotteries are only 1%, 2%, and 2%, respectively (Figure 3a).

Even when sports Toto is taken into account as in *La Fleur's 2009 World Lottery Almanac* (Figure 3b), the market share of Lotto 6/45 sales (53.4%) in 2008 was still higher than the average of the world market (37.9%). The Korean lottery market also depends heavily on Toto. The market share of Toto in Korea was 43.1% in 2008, significantly higher than its average share of the world market (6.1%). On the other hand, the shares of the other lotteries such as Numbers, Keno, Draw, and Instant were lower than those of the world market.

Figure 3. **The Product Mix of Lotteries in Korea (2008)**

(a) Toto excluded (b) Toto included



Sources: (a) Korea National Lottery Commission, http://www.bokgwon.go.kr, (b) *La Fleur's 2009 World Lottery Almanac.*

3) Contribution to Government Revenues

The decrease in total lottery sales and the heavy dependence on Lotto 6/45 have led to the decreasing net lottery profits (proceeds) and the instability of their operation. After net profits of lottery increased from 246.8 billion won in 2002 to 1,400 billion won in 2003, they turned to decrease to 1,306 billion won in 2004 and dropped further to 966.8 billion won in 2008 (Table 2).

Table 2. **Lottery Sales, Expenses, and Profits (2008)**

(local currency in millions, %)

	Korea	US	Canada	Australia	New Zealand
Ticket Sales	2,394,003	53,318.4	7,235.28	2,271.72	777.96
(as % of GDP)	(0.37)	(0.37)	(0.59)	(0.43)	(0.74)
Total Revenues	2,422,791	53,973.06	7,244.17	2,331.97	787.63
Total Costs[1)]	1,427,226	38,032.55	5,237.27	1,645.95	548.02
Prizes	1,208,896	32,233.42	3,998.33	1,326.6	432
Commissions	151,496	3,302.8	503.63	171.44	54.41
Operating Expenses	66,834	2,496.1	735.33	147.92	61.61
Government Transfers		17,876.78	2,996.03	640.75	236.97
Net Profits	966,777	15,285.85	2,006.90	686.02	239.62
Prizes/Ticket Sales (%)	50.5	60.5	55.3	58.4	55.5
(Comm+Expenses)/Ticket Sales	9.1	10.9	17.1	14.1	14.9
Net Profits/Ticket Sales (%)	40.4	28.7	27.7	30.2	30.8

Note: 1) Sum of prizes, commissions, and operating expenses.

Sources: Korea National Lottery Commission, http://www.bokgwon.go.kr/and *La Fleur's 2009 World Lottery Almanac.*

The prizes/ticket sales ratio in Korea is 50.5%, which is lower than those of the United States and Australia as well as those of Canada and New Zealand. The net profits/ticket sales ratio in Korea is 40.4%, which is higher than those of the United States, Australia, Canada, and New Zealand. It is notable that Korea maintains a low prize/ticket sales ratio in an effort to compensate for the decrease in lottery sales, and the low prizes/sales ratio subsequently leads to decreasing lottery sales. The ratio of commissions plus operating expenses to ticket sales is 9.1% in Korea, which is lower than those of the other four countries and suggests that the lottery is efficiently operated.

Ⅲ. Literature Review of the Demand for Lotto

The early lottery games were largely numbers games: players buy numbered tickets and winners receive fixed cash prizes. Draws were infrequent and tickets highly priced. Lotto has become increasingly popular; for example, Lotto 6/45 is a pari-mutuel lottery where prizes are a share of sales revenues and players have the possibility of choosing their own numbers. When the jackpot prize pool has no winners, it is added to the jackpot pool of the following draw (rollover). A sequence of rollovers may generate extremely large jackpot pools that promote lotto sales.

Lottery games are actuarially unfair in that the expected value of a lottery ticket is far less than its price. In general, people are risk averse and hence likely to insure. Therefore, they would normally reject unfair bets. However, participating in lottery generates some additional non-pecuniary pleasure (thrill, entertainment, and dreams). Quiggin (1991) and Conlisk (1993) show that even the small pleasure from gambling can explain the simultaneous insuring and engaging in gambles where the stakes are small. Gambling can co-exist with insurance against large risks if the pleasure of gambling offsets the monetary cost implied by the unfair odds. Lotto allows players to choose their own numbers, increasing the demand by giving the illusion of control that they can improve the odds in their favor. Langer (1975) argues that conscious selection makes players take more risks in gambles where their results are stochastically determined. Therefore, lottery demand is determined by the expected value of a ticket rather than risk and the expected value largely depends on the game structure (take-out rate, jackpot, winning possibility, and game format).

1. Sprowls (1970)

Sprowls (1970) stresses three important factors to determine the demand for lotteries: the expected pecuniary value of a lottery ticket, the probability of winning prizes, and the inequality of prize distribution. The formal expression for the expected value of a lottery ticket was first derived in Sprowls (1970) and has subsequently been adopted by Vrooman (1976), Clotfelter and Cook (1987), Gulley and Scott (1993), Scoggins (1995), Walker (1998), Farell et al. (1999, 2001), Forrest et al. (2000), and Walker and Young (2001). Sprowls (1970) formulates the expected value of a lottery ticket (EV_t) as the percentage of gross ticket sales that are devoted to prizes.

$$EV_t = \frac{[R_t + \pi C_t](1 - e^{-pC_t})}{C_t} + EV_s, \tag{1}$$

where C_t is sales revenues (and tickets sold, if each costs 1 unit of local currency), R_t is the rollover from the previous drawing, π is the proportion of sales that are allocated to the jackpot fund, p is the probability of any ticket winning the jackpot, and EV_s is the expected value of smaller prizes. Note that the probability of there being a rollover is given by e^{-pC_t}.

Rollover-induced variation in the expected value of a ticket (EV_t) is an important determinant of sales. The face price of a ticket is fixed. However, the expected price of a ticket is not the face value, but the amount that is not allocated to prizes, $(1-EV_t)$. Since there is observable variation in the expected price of the ticket (due to the presence of rollovers) there is also implicitly price variation from which we can estimate the price elasticity of the demand for lotteries.

The probability of winning a prize is the ratio of the total number of prizes to the total number of tickets sold. A lottery normally has an inequal prize structure with one very large prize (jackpot) and several smaller prizes. The inequality of the prize structure is measured by Gini's ratio of concentration, $G=D/2U$, where U is the arithmetic mean and D is the average difference between all possible pairs of prize values. The formula for Gini's ratio is $1/2\sum^{k}(P_{k-1}Q_k - P_kQ_{k-1})/5{,}000$, where P_k is the percentage of the total number of prizes that those prizes constitute which have a total value less than a given amount X_k, and Q_k is the percentage of the total value of prizes distributed that those prizes constitute which have a total value less than a given amount X_k.

1) Vrooman (1976)

Vrooman (1976) adds the personal income and unemployment rate to the three explanatory variables proposed by Sprowls (1970) and estimates the demand for the New York Lottery for the period between June 1967 and March 1975.

$$SALES_t = aEV_t + bPRO_t + cGINI_t + dINC_t + e\,UNE_t + f\,WEEK_t + g\,VENDOR_t + E_t, \quad (2)$$

where EV_t is the expected value of lottery, PRO_t is the probability of winning a prize, $GINI_t$ is the inequality of the prize structure, INC_t is personal income, UNE_t is unemployment rate, $WEEK_t$ is weeks in the month, and $VENDOR_t$ is the number of lottery ticket vendors.

According to his regression results, the coefficient on the expected value of a lottery has the expected positive sign, although it is not statistically significant. This is because there is significant ignorance of what the expected value of a lottery is when consumers purchase lottery tickets. The coefficient for the probability of winning a prize is negative. This implies that increasing the probability of winning a prize is not an effective policy to increase lottery sales. The coefficient for the inequality of the prize distribution is positive, indicating that a more unequal distribution generates greater lottery sales. The coefficients for personal income and the unemployment rate are -1.53 and +190.78 respectively. This means that economic recession generates greater lottery sales.

2) Gulley and Scott (1993)

Gulley and Scott (1993) estimate the demands of lottery in Massachusetts, Kentucky and Ohio states by incorporating the expected value of a lottery ticket (EV_t), as is proposed by Sprowls (1970).

$$SALES_t = \beta_0 + \beta_1 TIME + \beta_2 (1 - EV_t) + \beta_3 (1 - EV_t) + e_t, \qquad (3)$$

where *TIME* is a time trend which is included to pick up any factors that systematically affect sales over time, EV_t is the expected value of smaller prizes.

As the equation (1) shows, there is a simultaneous relationship between EV_t and $SALES_t$. Therefore equation (3) cannot be estimated directly to obtain the demand relationship. In order to solve this problem, Gulley and Scott (1993) apply the two-stage least-square (2SLS). In deciding whether to purchase a lottery ticket, the bettor estimates ex ante value, not ex post value. Ex ante value can be obtained by regressing ex post value on all relevant information at the beginning of each drawing period. In the first step, they regress the equation (4) by using ex post value. They regard the fitted value ($\widehat{EV_t}$) as ex ante value. In the second step, they apply this ex ante value ($\widehat{EV_t}$) in implementing the regression of (3).

$$(1 - EV_t) = \alpha_0 + \alpha_1 TIME + \alpha_2 R_t + \alpha_3 R_{ot} + \alpha_4 \mathrm{Pre} R_t + \alpha_5 \mathrm{Pre} R_{ot} + e_t, \quad (4)$$

where EV_t is the ex post value of a lottery ticket, R_t is the amount rolled over from the previous drawing, R_{ot} is the rollover of any competing lottery, $\mathrm{Pre} R_t$ is the predicted jackpot of a lottery, and $\mathrm{Pre} R_{ot}$ is the predicted jackpot of any competing lottery.

2. Addiction Model of Becker and Murphy (1988)

Becker and Murphy (1988) develop a theoretical model that determines the demand for a good to which consumers can become addicted to (for example, cigarettes and lotteries). We would expect increases in consumption that arises due to a fall in price to be magnified over time, given that the good is addictive. With addiction, the long run price elasticity of demand is greater than the short run price elasticity.

Addiction implies that present consumption will depend, in part, on the stock of addiction generated by past consumption. This in turn implies that this period's utility is a function of the current and past consumption of the addictive good.

$$U_t = U(y_1,\ c_t,\ c_{t-1}, e_t), \quad (5)$$

where y_t is a composite commodity, c_t is the current period consumption of the potentially addictive good, c_{t-1} is the one period lag of c_t, and e_t captures the effects of unobserved variables and current period shocks on utility. Consumers choose y_t and c_t in order to maximize the expected life-time utility that is subject to the inter-temporal budget constrain that the life-time discounted sum of consumption must equal the present value of wealth.

$$\max \sum_{t=1}^{\infty} \beta^{t-1} U(y_1,\ c_t,\ c_{t-1}, e_t) \text{ s.t. } \sum_{t=1}^{\infty} \beta^{t-1} (y_t + P_t c_t) = A_0, \qquad (6)$$

where $\beta = 1/(1+\rho)$ and ρ is the rate of subjective time preference, P_t is the current price of the good and A_0 is the present value of wealth.

For a utility function quadratic in $y_t,\ c_t, c_{t-1}, e_{t,}$ the solution to the maximization problem is such that present consumption of the addictive good is a linear function of past and future consumption, the present price and the error term. Aggregated across all individuals, the equation (7) obtains,

$$C_t = \alpha + \theta C_{t-1} + \beta\theta C_{t+1} - \theta_1 P_t + \theta_2 e_t + \theta_3 e_{t+1}, \qquad (7)$$

where C_t, C_{t-1}, C_{t+1} are the aggregate current, past and future consumption respectively, and $\alpha, \theta, \theta_1, \theta_2, \text{and}\, \theta_3$ are preference parameters from the quadratic utility function.

The greater the level of addiction of a good, then the higher θ is, with greater the effects of past and future consumption on present consumption. The model (7) states that both the lag and lead of sales will be significant determinants of current sales whose coefficients differ only by the discount factor. Becker and Murphy (1988) refer this as rational addiction. When individuals are myopic, $\rho \rightarrow \infty$ and $\beta \rightarrow \infty$. In this extreme case, only the past consumption will have a significant coefficient. Becker and Murphy call this as myopic addiction.

3. A Combined Model of Sprowls (1970) and Becker and Murphy (1988)

1) Walker (1998) and Farrell et al.(1999)

The widespread popularity of lotteries and the introduction of the U.K. National Lottery in November 1994 have generated concern over the potential addictiveness of gambling. Despite this concern there was no preliminary economic research about the extent to which lottery participation was subject to addiction.

Following Becker and Murphy (1988), Walker (1998) and Farrell et al. (1999) estimate the demand for the U.K. lottery and test the significance of past period sales by the incorporation of the lagged value of the dependent variable in a regression of current sales.

Estimating (7) requires data on $P_t = 1 - V_t$. Walker (1998) and Farrell et al. (1999) calculate the expected value of lotteries by utilizing the formula developed by Sprowls (1970). Besides the jackpot, the lottery usually awards smaller prizes for matching any three, four, five of the main numbers and a further prize pool for matching any of the five main numbers plus a seventh bonus ball, (5+b). Let π_{it} be the proportion of ticket sales going to the jth prize pool in draw t (π_{6t} is thus the proportion of ticket sales going to the jackpot prize pool in draw t). We denote R_t as the amount rolled over and C_t as the sales revenues. Then the size of jackpot in draw t is expressed as (8).

$$J_t(\pi_{6t},\ R_t;\ C_t) = R_t + \pi_{6t} C_t. \qquad (8)$$

Let p_6 be the probability that the jackpot is won. Then the probability of there being a rollover equals the probability that none of the players win the jackpot, $(1-p_6)^{C_t}$. Taking into account the smaller prizes (j = 3, 4, 5, 5+b), the expected value of buying a lottery ticket is given by (9).

$$EV_t(R_t, \pi_{6t}, \pi_{it}, p_6; C_t) = \frac{[1-(1-p_6)^{C_t}](R_t + \pi_{6t} C_t) + \sum_{j=8}^{5+b} \pi_{jt} C_t}{C_t}. \quad (9)$$

Note that $\sum_{j=8}^{5+b} \pi_{jt} + \pi_{6t} = (1-r)$, where τ is the takeout rate. The takeout rate is the proportion of sales revenue not returned in the form of prizes, which covers the costs, profits, tax, and contribution to good causes.

The expected value of a ticket given by (9) is endogenous since it is a function of the number of tickets sold in a given draw. In order to account for this problem, Farrell et al. (1999) estimate the model (7) using instrumental variables, instrumenting the expected value of lottery with the size of the rollover. Rollovers are exogenously determined and their sizes provide a reasonable set of instruments.

Their initial estimates of (7) indicate that the coefficient on the lead of lottery sales is small and implies an extremely implausible rate of time preference. As a result, they proceed directly to test the myopic model that includes a lag of sales. In the estimates of the myopic addiction model, the coefficient for the lagged sales is +0.33 and significant, whereas the corresponding coefficients on the lag of cigarette consumption are typically of the order of 0.45. This suggests that lottery play is less addictive than cigarette consumption. The estimated short run price elasticity of lottery sales is -1.04, while the long run elasticity is -1.55. This result suggests that the pricing of the lottery is not consistent with the objective of the regulator and the regulator could elicit greater sales if the takeout rate was reduced or the prize pool was increased.

2) Forrest et al. (2000a)

Forrest et al. (2000a) adapt a model employed by Gulley and Scott (1993) and Scoggins (1995) to explore the demand for the U.K. National Lottery. In stage one of the model, they regress ex post effective price ($P_t = 1 - EV_t$) on the time trend and its square, size of rollover and its square, and dummy variables. The rollover is included because it directly affects the size of the jackpot pool and its square is included to allow for possible non-linearity. Dummy variables control for the possible influences of Wednesday draws, Superdraws, new lottery games, and new game designs.

$$1 - EV_t = P_t = \alpha_0 + \alpha_1 TIME + \alpha_2 TIME^2 + \alpha_3 R_t + \alpha_4 R_t^2 + \alpha_5{}' Dunnies + e_t. \quad (10)$$

According to the stage one regression results, the coefficients of rollover and its square are +0.0862 and -0.00897, respectively and are significant at the 1% level, while the time trend and its square are not statistically significant. It is unlikely that the coefficient of a rollover is positive because this implies that an increase in the size of the rollover initially works to make the lottery more expensive; however, this is not the correct interpretation. From the two coefficients in the quadratic term for the size of rollover, we can calculate that the maximum contribution of rollover size occurs at ￡134. Given that any rollover is always several million pounds, this figure is effectively zero and the implication of the result is that increasing size of the rollover pushes down the price of a lottery ticket throughout the range of feasible rollover values.

Stage two of the model estimates the demand relationship by regressing the sales on the fitted values of price ($\widehat{P_t}$) generated in stage one and on other variables to influence the demand. The inclusion of a time trend and its square reflects the U.S. experience of first gaining momentum and then encountering boredom with a lottery game (Miers, 1996).

$$SALES_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i SALES_{t-1} + \alpha_5 \widehat{P}_t + \alpha_6 TIME + \alpha_7 TIME^2 \quad (11)$$
$$+ \alpha_8{}' Dummies + e_t.$$

According to the stage two regression, the short-run price elasticity is estimated to be -0.66 and statistically significant. The long-term price elasticity is estimated to be -1.03. This value is not significantly different from -1 that maximizes the net revenue of the U.K. National Lottery. The coefficients of 1, 2, and 4 period-lagged sales are all positive and statistically significant. This implies that there is an addictiveness or a halo effect where the current consumption depends on the stock of addiction generated by past consumption. The coefficients of a time trend and its square are +0.0013 and -0.00035, respectively. This result points to an increasing public support for the lottery that is sustained over time, but the public will encounter satiation with the turning point in sales found at 184^{th} draw (about 3 years).

4. Socio-Economic and Demographical Determinants of Lottery Sales

1) Kitchen and Powells (1991)

Kitchen and Powells (1991) evaluate the statistical significance of a number of socio-economic and demographical variables on lottery expenditures in the six regions of Canada. Included are income, wealth, age, sex, urban location, education, occupation, and native tongue. They employ the model that has been widely used to measure the determinants of other consumer expenditures (Kitchen and Dalton, 1990).

Kitchen and Powells (1991) find that lottery expenditures increase as income increases, lottery expenditures decline as the education level of the head of household increases and lottery expenditures are significantly lower for female heads of households than for their male counterparts. They also find that lottery expenditures are regressive: lottery expenditures (as a percentage of after-tax household income) decline in every region as household income increases. Lottery expenditures are found to be more regressive than taxes on alcohol, but less regressive than taxes on tobacco.

2) Spry (2003)

Spry (2003) examines the sales of four types of Indiana lottery games using zip code data from 1995 to 2000. He incorporates the socio-economic factors, such as age, race, gender, location, education, and income that influence lottery sales. He finds that areas with residents who are older, less college educated, part of a minority, and living in urban areas have higher lottery sales. The income elasticity of lottery demand ranges from 0.4 to 0.9, implying that lottery sales are regressive. Lotto and Powerball are less regressive than Instant and Daily Games.

Ⅳ. Regression of the Demand for Lotto

Based on the literature review of the demand for lotto discussed in the previous section, we now develop regression models of the demand for lotto in Korea and present their estimation results.

1. Regression Model

Following the combined model of Forrest et al. (2000a), we consider the equation (11) as a basic model of the demand for lotto. We incorporate the lagged values of sales ($SALES_{t-i}$) and the expected price of a lotto ticket ($\hat{P}$) as explanatory variables in the regression model of current sales. The model enables the estimation of the short and long run price elasticities of the demand along with the addictiveness of lotto. The expected price of a lotto ticket is calculated by the formula (9) as specified by Walker (1998) and Farrell et al. (1999). Besides these two explanatory variables, we consider additional explanatory variables, as is shown (12).

$$\log SALES_t = \alpha_0 + \alpha_1 DUM0408 + \alpha_2 TIME + \alpha_3 TIME^2 + \alpha_4 R_t \quad (12)$$
$$+ \alpha_5 R_t^2 + \sum_{i=1}^{4} b_i \log SALES_{t-i} + \alpha_6 \log(\hat{P})_t + \alpha_7 \log CSI_t + \alpha_8 UNEMP_t + e_t.$$

First, as in Vrooman (1976), DeBoer (1986, 1990), Gulley and Scott (1993), and Forrest et al. (2000a), we incorporate a time trend (TIME) and its square in the explanatory variables to take into account an increasing level of popularity for lotto in the early stage but any possible satiation that may occur as time goes on.

Second, as in Deboer (1990), we include the rollover (R) to examine whether the rollover affects lotto sales directly as well as indirectly through its influence on the expected price of a lotto ticket ($\hat{P}$). Its square is considered to allow for possible non-linearity in its effects on lotto sales. The period covered in this study is from the inception of the Lotto 6/45 in Korea in December 2002 through March 2010. During this period the Korean government decreased the maximum number of rollovers from 5 to 2 on February 8, 2003 (10^{th} draw) when sales peaked at 260.9 billion won. The Korean government also lowered the nominal price of a Lotto 6/45 ticket from 2,000 to 1,000 won on August 8, 2004 (88^{th} draw). In order to account for this effect, we incorporate dummy variable (DUM0408) which takes 0 for December 2002 to August 2004 and 1 after August 2004.

Third, as in Vrooman (1976) and Mikesell (1994), we consider personal income and unemployment rate (UNEMP) in order to account for the possible effects of short-term business cycle fluctuations on lotto sales.

The expected price of a lotto ticket ($\hat{P}$) is endogenous since it is itself a function of the tickets sold in a given draw. In order to account for this endogeneity, we regress the model (12) by the two-stage least-square (2SLS), instrumenting the expected value of a lotto ticket with the size of the rollover and its square, as in Gulley and Scott (1993), Farrell et al. (1999), and Forrest et al. (2000a).

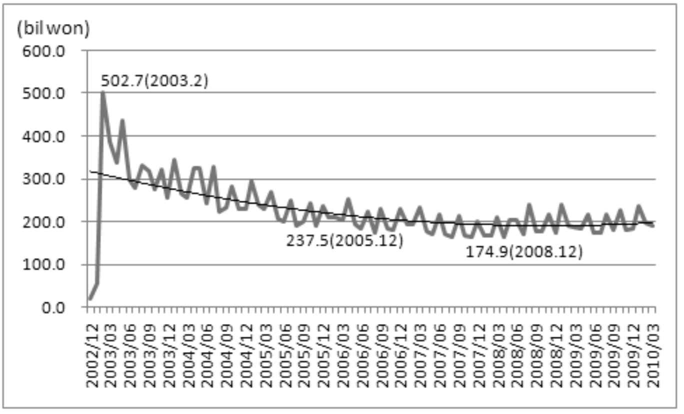
$$1 - EV_t = P_t = \beta_0 + \beta_1 TIME + \beta_2 TIME^2 + \beta_3 R_t + \beta_4 R_t^2 + e_t. \quad (13)$$

2. Data Description

The data on Lotto 6/45 are collected from Korea National Lottery Commission and Nanum Lotto. Lotto sales, prizes, rollovers have been collected weekly from the homepage of Nanum Lotto (http://www.645lotto.net) and converted into monthly data. Such a conversion is made because the unemployment rate and personal income are not published weekly. Figure 4 displays the monthly lotto sales. Sales vary from 18.6 billion won (Dec. 2002) to 502.7 billion won (Feb. 2003); the mean and standard deviation of sales are 225.4 and 68.6 billion, respectively. It is noteworthy that lotto sales rapidly decreased over the period 2003-2005 after they peaked in February 2003.

The Lotto in Korea has been 6/45 for the entire sample period. The probability of any ticket matching all six balls (p_6), which measures how hard it is to win the jackpot, is 1 in 8,145,060. A total of 50% of Lotto 6/45 sales is returned as prizes: all three-ball matches pay 5,000 won; 60% of the remainder is reserved for the jackpot, and the rest is split into prize pools offering smaller prizes for matching four balls (20%), five balls (10%), and five

Figure 4. **Monthly Lotto Sales**



Source: Nanum Lotto, http://www.645lotto.net.

balls plus the seventh 'bonus' ball (10%). Although exactly 50% of sales are always devoted to prizes, there is an observable variation in the effective price of a ticket due to the presence of rollovers. We calculate the effective price of Lotto 6/45, (1-EV_t) by the equation (9). The effective price ranges from 0.3977 (Jan. 2003) to 0.50 during December 2002-March 2010. Its mean and standard deviation are 0.4942 and 0.0171, respectively.

The unemployment rate is published monthly; however, monthly data on personal income are not available. The consumer sentiment index for the current period (CSI), the consumer sentiment index for future prospects collected by the Bank of Korea, and the composite business index published by the Korea National Statistical Office are used as a proxy variable for personal income.

3. Regression Results

The first stage estimates the expected price of a Lotto 6/45 ticket by the equation (13) for the period between December 2002 and March 2010. According to the first stage estimation results in Table 3, the coefficients of rollover and its square are significant at the 1% level. The coefficient of the rollover is negative and implies that an increase in the size of the rollover lowers the expected price of a Lotto 6/45 ticket by making it more valuable. From the two coefficients in the quadratic term, we can calculate that the maximum contribution of rollover size occurs at 21.9 billion won. The largest rollover has always been less than 19 billion won (25^{th} draw, May 24, 2003) and implies that increasing the size of rollover pushes down the price of a Lotto 6/45 ticket throughout the range of feasible rollover values. The time trend and its square are also statistically significant at the 1% and 5% levels, respectively. The positive and negative values of the time trend and its square indicate that the expected price tends to rise at a decreasing rate over the initial 8 years, but begins to fall at an increasing rate thereafter.

Table 3. Estimation of PHAT (2002.12 - 2010.3)

C	TIME	$TIME^2$	ROLL	$ROLL^2$	$\overline{R}^2$	DW
0.4903*** (161.9)	0.0004*** (2.94)	-4.13E-06** (-2.54)	-9.09E-12*** (-9.63)	4.15E-22*** (6.74)	0.7580	1.6991

Notes: The values of the t statistics are shown in parentheses. *** and ** denote significance at 1% and 5%, respectively.

The second stage estimates the demand relationship (12) by regressing sales on the fitted values of price ($\widehat{P}_t$) generated in the first stage and on other variables that influence lotto sales. Table 4 displays estimation results for the regression model (12) and its variants for the period between December 2002 and March 2010. Four lags of lotto sales are selected, based on the Schwarz information criterion. Model 1 includes all variables specified in the equation (12). The regression results of Model 1 show that the rollover and its square as well as the time trend and its square

Table 4. Estimation of Lotto Demand, LOG (SALES) (2002.12 - 2010.3)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
C	34.3358 (0.53)	43.4730*** (7.53)	13.4102*** (3.35)	24.9027*** (5.60)	25.8648*** (5.95)	15.6331*** (4.47)
DUM0408	-0.1007* (-1.89)	-0.1016* (-1.94)	-0.1427** (-2.30)	-0.1915*** (-3.66)	-0.1963*** (-3.76)	-0.1701*** (-3.06)
TIME	-0.0157 (-0.20)	-0.0265*** (-4.67)	-	-0.0031*** (-3.61)	-0.0031*** (-3.56)	-
$TIME^2$	0.0001 (0.13)	0.0002*** (4.17)	-	-	-	-
ROLL	-2.21E-10 (-0.13)	-	-9.89E-11 (-0.95)	-1.06E-11 (-1.03)	-	-
$ROLL^2$	9.87E-21 (0.13)	-	4.19E-21 (0.88)	-	-	-
LOG (SALES(-1))	-0.4190*** (-3.96)	-0.4329*** (-4.39)	-0.0553 (-0.61)	-0.1597* (-1.87)	-0.1733** (-2.05)	-0.0345 (-0.43)
LOG (SALES(-2))	-0.2326** (-2.07)	-0.2434** (-2.37)	0.1762** (2.06)	0.0389 (0.45)	0.0377 (0.44)	0.2043*** (2.64)
LOG (SALES(-3))	0.1998** (2.46)	0.1805*** (3.20)	0.3710*** (5.80)	0.3148*** (5.18)	0.2891*** (5.22)	0.3618*** (6.54)
LOG (SALES(-4))	-0.1518*** (-2.99)	-0.1338*** (-4.12)	-0.1644*** (-2.96)	-0.1893*** (-3.74)	-0.1524*** (-4.28)	-0.1442*** (-3.78)
LOG (PHAT)	-12.7571 (-0.15)	-0.9403** (-2.19)	-6.9096 (-1.29)	-2.5508** (-2.04)	-1.3567*** (-2.95)	-1.3968*** (-2.82)
LOG (CSI)	-0.2358* (-1.70)	-0.2433* (-1.79)	-0.1743 (-1.08)	-0.1733 (-1.16)	-0.1863 (-1.25)	-0.1736 (-1.08)
UNEMP	0.0743** (2.51)	0.0760*** (2.62)	0.0639* (1.84)	0.1040*** (3.33)	0.1096*** (3.56)	0.0795** (2.50)
$\overline{R}^2$	0.8284	0.8326	0.7618	0.7957	0.7955	0.7638
DW	2.2412	2.2260	2.3691	2.4269	2.4139	2.4432

Notes: The values of the t statistics are shown in parentheses. ***, ** and * denote significance at 1%, 5% and 10%, respectively.

are not statistically significant even at the 10% level. In particular, the expected price of a Lotto 6/45 ticket is not statistically significant and has an extremely implausible price elasticity of demand, -12.76. This result can be due to the effects of the rollover and its square are already reflected in the estimation of the expected price of Lotto 6/45 in the first stage regression.

Thus we proceed to estimate Model 2, excluding the rollover and its square from the explanatory variables in Model 1. In Model 2, all explanatory variables are statistically significant at the conventional significance levels. The expected price of a Lotto 6/45 ticket gains statistical significance at the 5% level and has a moderate value of -0.94. The time trend and its square also turn to be statistically significant at the 1% level. These results suggest that the rollover mainly influences lotto sales indirectly through the effect on the expected price of a lotto ticket. In addition to Model 2, we consider various models with different specifications of the time trend and rollover. Model 3 excludes the time trend and its square and Model 4 excludes the quadratic terms of the time trend and rollover from Model 1. Model 5 rules out the quadratic time trend, the rollover and its square; and Model 6 excludes the time trend, the rollover, and their squares.

The estimation results in Table 4 indicate that Model 2 appears the best fit to lotto sales in Korea among the six models. Model 2 explains the largest portion of the variations in lotto sales per month with the adjusted coefficient of determination of 0.83. With regard to the estimate of the individual coefficients, all of the explanatory variables in Model 2 are significant at the 10% level or below, while some of the explanatory variables lose statistical significance in Models 3-6.

Proceeding to the discussion of individual variables in Model 2, the coefficient on DUM0408 is -0.1016 and is statistically significant at the 10% level. This result suggests that reducing the nominal price of a Lotto 6/45 ticket from 2,000 to 1,000 won may explain the decrease in lotto sales after August 2004. In fact, the average of monthly Lotto 6/45 sales decreased from 291.8 billion won before the reduction in the nominal price to 204.5 billion won after the price reduction.

The coefficients on time trend and its square are -0.0265 and +0.0002, respectively, both being statistically significant at the

1% level. These two coefficients in the quadratic term for the time trend imply that the rate of decrease in lotto sales slows down until the turning point occurs (132 months). Lotto 6/45 sales peaked at 502.7 billion won in February 2003 and then rapidly decreased from 2003 to 2005, recording 237.5 billion won at the end of 2005. Beginning in 2006; however, the decreasing rate of Lotto 6/45 sales significantly slowed down (Figure 4).

Two measures of general economic activity indicate that weak economic conditions enhance the sale of Lotto 6/45 tickets. The coefficient on CSI is -0.2434 and statistically significant at the 10% level, suggesting that consumers purchase fewer lottery tickets when incomes increase. The coefficient on the unemployment rate is +0.0760 and is statistically significant at the 1% level. Higher rates of unemployment during economic recession increase lottery sales.

The coefficients on 1, 2, and 4 period-lagged sales are negative and are highly significant, while the coefficient on 3 period-lagged sales is significantly positive. The negative coefficients on 1, 2, and 4 periods-lagged sales imply that consumers who have spent large amount of money on lotteries during past several months (being disappointed of their past winning expectations) eventually reduce lotto purchases.

We now examine the price elasticity of the demand for lotto. The coefficient on the expected price of lotto (PHAT) is -0.9403 and significant at the 5% level. The null hypothesis of unity price elasticity is not rejected at the 1% significance level and implies that in the short run lottery sales come close to the optimal level where sales are being maximized. In the long run the price elasticity of the demand is found to be inelastic, -0.5770. Consequently, any measure which increases the expected price of a lotto ticket (equivalently, decreases the expected value of a lotto ticket), for instance, lowering the ratio of sales distributed to jackpot or smaller prizes, may cause a lotto sales to increase in the long run. Finally, it is notable that the long-run price elasticity of the demand for lotto is smaller in absolute value than the short-run price elasticity, contradicting the widespread presumption that lotteries are addictive.

Ⅴ. Conclusion: Policy Implications

The regression results of this study provide important implications about lottery policies in Korea. First, the size of the lottery market in Korea is quite small when compared with the average sizes of OECD nations, Asian countries, and countries whose GDP per capita is between $20,000 and $40,000. In 2008, the ratio of lottery sales to the GDP in Korea was 0.37% which was lower than the average ratio of 30 OECD nations (0.50%), that of 9 Asian countries (0.67%), and that of countries with a GDP per capita between $20,000 and $40,000 (0.57%). The total lottery sales and sales per capita in Korea were also lower than the averages of OECD and Asian countries and countries with a GDP per capita between $20,000 and $40,000, respectively. This fact shows that there is room for enhancing the efficiency of lotteries as a way to finance public goods.

As argued by Morgan (2000), Morgan and Sefton (2000), Landry and Price (2007), Lange et al. (2007), per capita lottery expenditures are greater when lottery proceeds are earmarked for public goods. Therefore, it may be a good strategy to develop various lotteries and earmark these lotteries proceeds to ‘good causes’ such as financial support for low-income classes and neglected classes, and public education. Second, the demand for lotteries is found to be unit elastic in the short run, but it is inelastic in the long run. Consequently, any measure that increases the expected price of a lottery ticket (for instance lowering the ratio of sales distributed to jackpot or smaller prizes) may increase lotto sales in the long run. The finding that the price elasticity is greater in the long run than in the short run contradicts the widespread presumption that lotteries are addictive. Third, a proxy variable of personal income (CSI) is found to be negative and statistically significant at the 1% level. This finding suggests that consumers purchase less lotto tickets when income increases. The coefficient on unemployment rate is positive and statistically significant at the 5% level and implies that higher rates of unemployment stimulate lotto sales. Fourth, the regression result suggests that the decrease in the nominal price of a lotto ticket can explain the continued decrease in Lotto 6/45 sales after August 2004.

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Appendix. Lottery Sales in OECD and Asia

In OECD, the average ratio of lottery sales to GDP was 0.5% in 2008. Among them, Greece had the highest ratio at 2.19%, the rest were — Italy 1.19%, Spain 1.09%, Austria 0.81%, Finland 0.77%, and Portugal 0.75%. In 11 countries including New Zealand (0.65%), Canada and Denmark (0.52%), and France (0.5%), the ratios were above 0.5% (Appendix Table 1).

Lottery sales/GDP ratio tends to rise until GDP per capita reaches $40,000 and fall once GDP per capita surpasses $40,000

Appendix Table 1. Lottery Sales in OECD (2008)

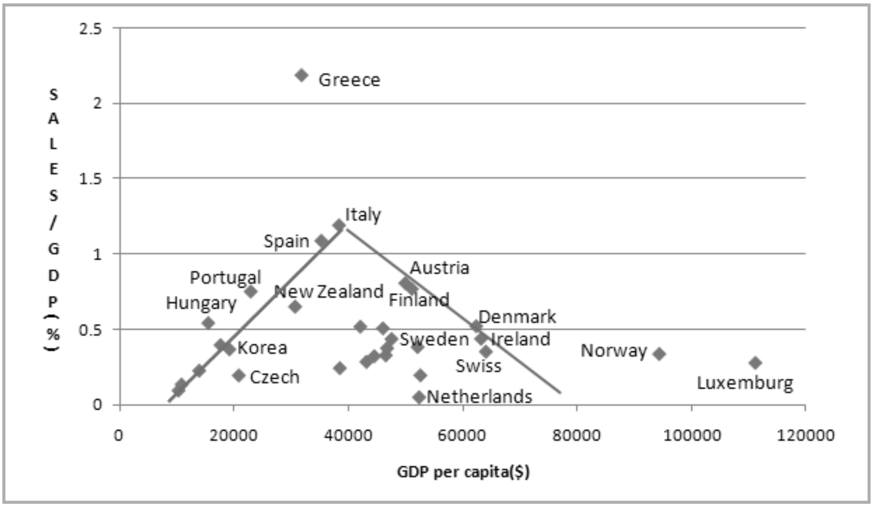
	Country	Sales ($mil)	Sales per capita($)	Sales/GDP (%)	GDP per capita ($)
1	**Korea**	**3,391.9**	**69.8**	**0.37**	**19,115**
2	Australia	4,398.9	205.8	0.43	47,498
3	Austria	3,352.4	401.8	0.81	49,902
4	Belgium	1,618.4	151.2	0.33	46,486
5	Canada	7,215.3	216.6	0.52	42,031
6	Czech	413.2	39.6	0.19	20,760
7	Denmark	1,778.2	323.4	0.52	62,327
8	Finland	2,079.0	391.3	0.77	51,060
9	France	14,383.3	231.8	0.50	45,982
10	Germany	11,642.3	141.7	0.32	44,471
11	Greece	7,811.9	695.1	2.19	31,749
12	Hungary	834.6	83.1	0.54	15,408
13	Iceland	31.9	100.6	0.19	52,549
14	Ireland	1,226.3	275.0	0.44	63,178
15	Italy	27,297.5	456.1	1.19	38,309
16	Japan	11,762.8	92.1	0.24	38,443
17	Luxemburg	149.0	305.3	0.27	111,182
18	Mexico	985.7	9.3	0.09	10,211
19	Netherlands	392.5	23.9	0.05	52,322
20	New Zealand	848.2	198.7	0.65	30,614
21	Norway	1,502.8	315.1	0.33	94,359
22	Poland	1,172.3	30.8	0.22	13,823
23	Portugal	1,819.8	171.3	0.75	22,841
24	Slovakia	373.0	69.0	0.39	17,565
25	Spain	17,448.9	382.9	1.09	35,204
26	Sweden	1,824.9	197.9	0.38	52,057
27	Swiss	1,707.3	223.7	0.35	64,011
28	Turkey	1,037.2	14.0	0.13	10,745
29	UK	7,440.0	121.2	0.28	43,089
30	US	52,843.5	173.8	0.37	46,716
	Average	**6,292.8**	**203.7**	**0.50**	**42,467**

Note: Toto included.

Sources: *La Fleur's 2009 World Lottery Almanac* & World Bank (2009).

(Appendix Figure 1). For instance, the lottery sales/GDP ratio of New Zealand with $30,614 of GDP per capita was 0.65%, Spain with $35,204 of GDP per capita was 1.09%, and Italy with $38,309 of GDP per capita was 1.19%. In Luxembourg (whose

Appendix Figure 1. GDP per capita and Lottery Sales/GDP in OECD (2008)



Note: Toto included.
Sources: *La Fleur's 2009 World Lottery Almanac* & World Bank (2009).

GDP per capita is the highest in the world), the lottery sales/GDP ratio was only 0.27%, far below the average ratio of OECD nations. The lottery sales/GDP ratio of Norway with the second highest GDP per capita and Switzerland with the third highest GDP per capita was 0.33% and 0.35%, respectively.

In 2008, the total lottery sales of 9 Asian countries in 2008 was $41.4 billion which was 15.9% of the worldwide sales (Appendix Table 2). The average lottery sales/GDP ratio of 9 Asian countries was 0.67% which was higher than the average ratio of OECD nations. The lottery sales/GDP ratio of Singapore was 2.35% (the highest in the world) and 1.01% in Malaysia (fifth in the world). The lottery sales/GDP ratio of Taiwan, Thailand, and China was 0.57%, 0.49%, and 0.39% respectively. Only Japan and the Philippines (0.24%) had lower lottery sales/GDP ratio than Korea (0.37%).

Appendix Table 2. Lottery sales in Asia (2008)

	Country	Sales ($mil)	Sale per capita ($)	Sales/GDP (%)	GDP per capita ($)
1	**Korea**	**3,391.9**	**69.8**	**0.37**	**19,115**
2	China	15,225.2	11.5	0.39	2,912
2	Hong Kong	806.2	115.5	0.37	30,862
4	Japan	11,762.8	92.1	0.24	38,443
5	Malaysia	1,973.0	73.1	1.01	7,221
6	Philippines	401.6	4.5	0.24	1,847
7	Singapore	4,274.4	883.3	2.35	37,600
8	Taiwan	2,231.1	96.8	0.57	16,986
9	Thailand	1,286.8	19.1	0.49	3,869
Average		**4,594.8**	**151.7**	**0.67**	**17,651**

Note: Toto included.

Sources: *La Fleur's 2009 World Lottery Almanac*, World Bank (2009), and the Central Bank of Taiwan.