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The Effect of Crossing the $100 Million Jackpot Threshold on Ticket Sales

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Abstract

There has been little research done on how consumers react to jackpots that first cross the $100 million threshold. Using two sets of time series data, I measure the effect on demand of being the first jackpot in a series of jackpots to cross the $100 million threshold. In both datasets, there is an additional increase in the growth of lottery ticket sales based solely on being the first jackpot to equal or surpass $100 million. These findings are not consistent with the principle of diminishing marginal utility and suggest a psychological significance of the number 100.

Keywords

$100 million jackpot, lottery irrationality, marginal utility of money, payout pricing, multi-state lotteries

1. Introduction

Multi-state lottery games have been ubiquitous in the United States since 1988, when Lotto*America became the first lottery game offered by the Multi-State Lottery Association (MUSL). Two lottery games have come to dominate multi-state lottery ticket sales: Mega Millions and Powerball. These two games are known for their huge jackpots that often reach $100 million and $200 million. This paper aims to measure demand for lottery tickets at these thresholds and observe if demand is consistent with economic theory.

The principle of diminishing marginal utility states that for each additional dollar you receive, you get a lower utility (benefit) in return. According to this principle, $5 million is worth more to someone with an income of $100,000 than it is to someone with an income of $10 million. In the context of the lottery, every time a jackpot increases by $5 million, the increase in utility decreases. A change in jackpot from $10 million to $15 million increases utility more than a change in jackpot from $15 million to $20 million does. Therefore, the smaller jackpot should have a larger increase in lottery tickets sold (a measure of utility) than the larger jackpot does when both are increased by $5 million.

In reality, however, larger jackpots sometimes sell more tickets than they should according to diminishing marginal utility. Record breaking jackpot amounts are often less than double the dollar value of the preceding jackpot, but they often sell over twice the amount of lottery tickets. On November 28th, 2012, a record jackpot of $580 million was drawn in the Powerball game[1]. 281,565,987 tickets were sold for the chance to win this jackpot. Eleven days earlier, only 34,901,405 tickets were bought for a chance at $214 million. Earlier that year, on March 30th 2012, the Mega Millions jackpot hit a multi-state lottery record high of $640 million[2]. $651,915,940 was spent on the chance to win this record jackpot. Two weeks earlier, only $66,658,484 was spent on a chance to win $200 million. The principle of diminishing marginal utility does not hold in these examples. If the principle fails in this context, it is possible that it fails in other contexts. A possible context for it to fail is for $100 million jackpots.

If there is an unexpected increase in lottery tickets sold once a jackpot surpasses $100 million, this overconsumption of lottery tickets can be inconsistent

[1] "Powerball Winning Numbers Announced in Record-high Jackpot." *CBSNews*. CBS Interactive, n.d. Web. 16 Dec. 2012.

[2] "Numbers Announced in Record Mega Millions Jackpot." *CNN U.S.* CNN, 4 Apr. 2012. Web.

with the principle of diminishing marginal utility. The number 100 holds a significant place in society; it is a commonly used threshold for dollars, cents, calories, years, etc. The number 100 is an aesthetically pleasing number. For the purpose of this paper, an aesthetically pleasing number (or focal number) will be defined as a number in which every digit except for the first one is a zero and in which the first digit is a 1, 2 or 5. This is because the major dollar bills in the U.S. are $1, $5, $10, $20, $50, $100. Jackpots that are aesthetically pleasing may lead consumers to believe that the jackpot's utility will be greater than it actually is. Overconsumption of lottery tickets when the jackpot is aesthetically pleasing is inconsistent with economic theory. Lottery ticket sales should be a function of jackpot size, odds, and the chance that a lottery is split. Overconsumption, although irrational, is not always large enough to be inconsistent with diminishing marginal utility. If overconsumption in one period is large enough that the change in tickets sold in that period is greater than the change in the previous period, this is inconsistent with diminishing marginal utility.

It is important to understand the irrationalities of aesthetically pleasing jackpots because similar irrationalities can occur in other types of markets. This research is a gateway into seeing what happens when prices surpass focal numbers, or when stock prices approach relative highs or lows. Focal numbers affect everything from the cost of gas to the cost of shoes. In terms of sales, it may be best to have prices below some focal numbers and other prices above focal numbers. Pragmatically, this information can be applied to smaller lotteries in order to increase revenue. It can be used in raffles that have the option to exchange items for monetary value. By understanding focal prices, we can gain a little more insight on the everyday consumer.

In this paper, I use time series data for both the Mega Millions game and the Powerball game. These games have large enough jackpots to test for overconsumption when jackpots reach $100 million. In both games, the jackpot increases after each drawing until the jackpot is won. The jackpot starts at $12 million for Mega Millions and $40 million for Powerball. Both games have smaller prizes that are won by predicting different combinations of correct numbers.

The Mega Millions game is drawn every Tuesday and Friday and costs $1 to buy a ticket to play. A drawing is the process of picking the winning numbers for a lottery game. Five balls are drawn from a set of balls that are numbered one through fifty-six and one additional ball is drawn from a group of balls numbered one through forty-six. You win the jackpot if you correctly predict the numbers of all six balls drawn. The odds of winning the Mega Millions game are one in 175,711,536[3].

[3] "How To Play." *Http://www.Mega Millions.com/howto/*. Mega Millions, n.d. Web.

The Powerball game is drawn on Wednesday and Saturday and costs $2 to buy a ticket to play. Five balls are drawn from a set of balls numbered from one to fifty-nine, and one additional ball is drawn from a set of balls numbered one through thirty-five. You win the jackpot if you correctly predict the numbers of all six balls drawn. The odds of winning the Powerball game are one in 175,223,510[4].

I estimate the growth rate of lottery ticket sales when a jackpot first crosses the $100 million threshold. A jackpot crosses the $100 million threshold when it is the first jackpot to be equal to or greater than $100 million in a series of jackpots. After the jackpot is won, the series starts over again.

To make my estimation, I use datasets from Lotto Report, a website that lists the sales of jackpots for the Powerball and Mega Millions games. The data includes ticket sales from each drawing from the mid-90s to the end of 2012. I use the growth in ticket sales between periods as a gauge of demand and I explore if there is an unexpected increase (overconsumption) in growth in lottery ticket sales when a jackpot first crosses the $100 million threshold. If this occurs, it is safe to assume that a psychological effect of seeing the first jackpot equal to or greater than the aesthetically pleasing number of $100 million affects demand.

I build on the research that Matheson and Grote (2004) conducted on lottery fever. They define "lottery fever" as an increase in jackpot size that leads to a decrease in expected payout. Expected payout is the expected money you receive by buying a lottery ticket. Expected payout is a function of the jackpot, the odds of winning the jackpot, and the odds of sharing the jackpot. Because the odds of winning the lottery do not change, expected payout can only decrease when the probability of sharing the jackpot increases, or when the jackpot decreases. Lottery fever occurs when the probability of sharing the jackpot increases by a greater factor than the increase in jackpot size. For example, if the probability of sharing the jackpot increases by a factor of three, while the jackpot increases by a factor of two, this is lottery fever. The principle of diminishing marginal utility does not hold in this case because the increase in tickets sold when the jackpot doubled was greater than the amount of tickets sold before it doubled. Matheson and Grote's research shows that lottery fever occurs rarely. My research differs from Matheson and Grote's research because I look at the growth in ticket sales between periods instead of the expected payout between periods. Because expected payout decreases when there is a substantial increase in lottery sales, expected payout may not decrease when there is a smaller, but still irrational, amount of overconsumption. I try to find instances where smaller amounts of overconsumption occur.

[4] "Powerball - Prizes and Odds." *Powerball*. Powerball, n.d. Web

The paper is organized as follows. Section two discusses the changes in the Mega Millions and Powerball games over time. Section three describes the data and section four explains my empirical strategy. Section five discusses the results and section six is my conclusion.

2. History of the Mega Millions and Powerball

There a few times in Mega Millions history when the game has changed or expanded to new states which has affected the nature of its data. On February 10th, 1998, the results of the Mega Millions game went from being drawn once a week to two times a week. The odds of winning the jackpot were also changed three times. The first change was on January 13th, 1999, the next on May 15th, 2002, and the last on June 22nd, 2005. The game has also expanded over time. On May 15, 2002, the game expanded to New York and Ohio. California started selling Mega Millions tickets on June 24th of 2005. States were allowed to cross sell beginning on January 31st, 2010, when Mega Millions expanded to include 23 Powerball jurisdictions. Cross selling is when the MUSL allows for states to sell both the Powerball game and the Mega Millions game[5]. On the same day, many states started offering the Megaplier. The Megaplier costs one dollar and multiplies non-jackpot prizes by 2, 3, or 4 times. There have been other times when individual states added the game. I test the new states added to the game for their effect on demand in the empirical strategy section of this paper.

The Powerball game also has significant points in its history that affects the nature of its data. On March 7th, 2001, the "Power Play" was added. The Power Play is a $1 multiplier that multiplies a non-jackpot prize up to five times. The odds of winning the jackpot have changed four times. The odds of winning were changed on October 9th 2002, on August 28th, 2005, on January 7th, 2009, and on January 15th, 2012[6]. Powerball sales also increased due to cross selling on January 31st, 2010 when tickets began being sold in ten more jurisdictions. On January 15th, 2012, the Powerball ticket went up to $2 and the minimum jackpot increased to $40 million.

3. Data

I use two sets of time series data in this paper. The first dataset is time series data on the Mega Millions game from September 6th, 1996 through November

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[5] "History Of The Game." *Mega Millions Official Home*. N.p., n.d. Web. 16 Dec. 2012.
[6] "Powerball - History." *Powerball - History*. N.p., n.d. Web. 16 Dec. 2012.

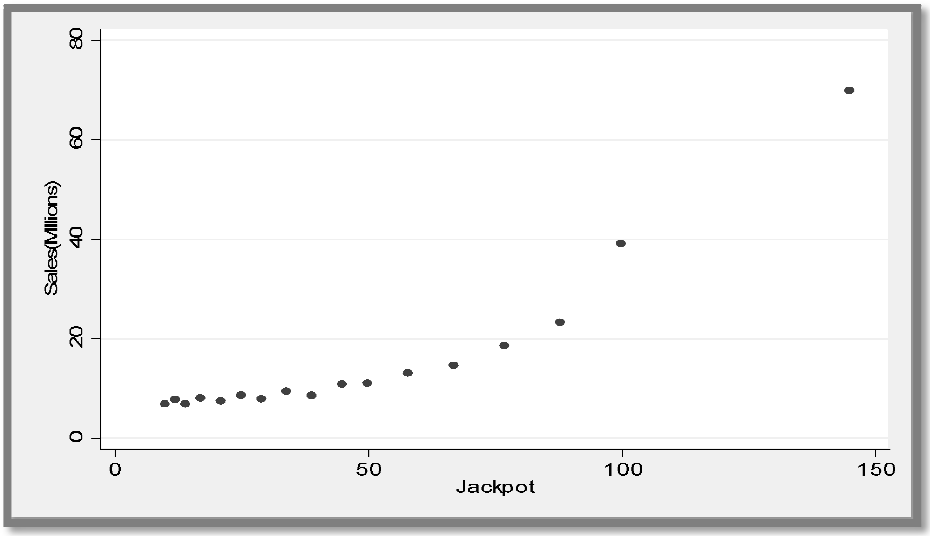
13th, 2012. It consists of the jackpot amount and total draw sales for each day a lottery was drawn. The data also provides the day of the week that the drawing was held, which is either Tuesday or Friday. Each jackpot drawing is considered a period in time. The jackpots in the data range from a low of $5 million to a high of $640 million. The jackpots increase in a periodic fashion until the jackpot is won and the jackpot starts over at a stationary amount. There are 1,616 observations in the data, which is obtained from the Lotto Report.

The second dataset is time series data on the Powerball game from November 5th, 1997 through November 24th, 2012. It consists of the jackpot amount and total draw sales (excluding the Power Play sales). The jackpot is drawn on Wednesday and Saturday. Once again, each jackpot drawing is considered a period in time. The jackpot from the data ranges from a low of $10 million to a high of $365 million. Like Mega Millions, the Powerball jackpot increases periodically until the jackpot is won and it starts over at a constant amount. There are 1,572 observations in the Powerball data, which is obtained from the Lotto Report.

I use the lottery draw sales in each period as an indicator of demand in both datasets. I use lottery draw sales as a proxy for demand because it is the amount of money being purchased on tickets in each period. In the Mega Millions dataset, I assume that the megaplier sales are independent of the jackpot because the megaplier does not multiply jackpot winnings. I also test the effect of the megaplier on growth and conclude that it has no effect on the growth of lottery draw sales. In the Powerball data set, the lottery draw sales do not include the Power Play sales, so the sales are only based on the demand for lottery tickets. I test every other variable in the dataset later to see its effect on lottery draw sales.

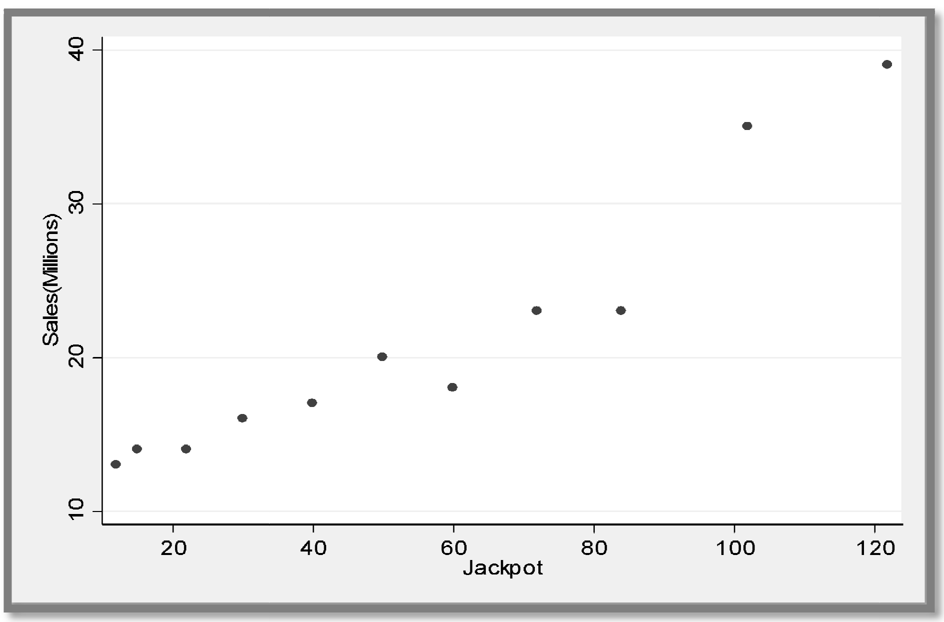
A quick mapping of the data helps to support the conjecture of an unusual increase in demand at the first jackpot over or equal to $100 million. Figure 1 and Figure 2 show how lottery ticket sales increase as the jackpot increases for both the Mega Millions game and the Powerball game. In each graph below, the jackpot starts at its floor value and increases until the jackpot is won. The jackpot increases by increasing amounts. The slopes of the graphs increase from their previous value when the jackpot is over or equal to $100 million. Due to the principle of diminishing marginal utility, you would not expect an increasing slope around $100 million. Diminishing marginal utility states that the increase in lottery sales relative to the increase in jackpot amount should have a larger value for smaller jackpots. A greater slope indicates that sales are increasing by greater amounts relative to the change in jackpot. In the two graphs provided, the slope of the first jackpot to cross the $100 million threshold is a maximum. This provides evidence that change in jackpot size is not the only factor that determines the demand for the $100 million jackpot.

Figure 1: A Series of Jackpots over Time



This graph shows data for the Powerball game.

Figure 2: A Series of Jackpots over Time



This graph shows data for the Mega Millions game.

Throughout the data, marginal utility can be measured by comparing the change in sales divided by the change in jackpot. For the purpose of this section of the paper, the slope will be considered the change in sales divided by the change in jackpot. If the marginal utility is constant, the slope is constant. Every time the jackpot increases by $1 million, the change in lottery sales should increase by a constant amount. For example, if the slope is .3, for every $1 million change in jackpot size, lottery sales should increase by $300,000 under constant marginal utility. If there is diminishing marginal utility, the slope between jackpots should decrease for each subsequent jackpot.

The jackpot immediately following the winning jackpot is ignored in the consideration of the slope, in order to make the estimate of the slope consistent with the previous figures. The average value for change in sales divided by the change in jackpot (slope) is .128 for the Powerball game. This indicates that for an increase in jackpot of one million dollars, sales should increase by $128,000. The slope for the Powerball game changes to .401 when the only jackpots considered are the first jackpots to cross the $100 million threshold. Consumers are buying $401,000 worth of tickets for every million dollars the jackpot increases. The slope for the whole Mega Millions game is .161. This slope is .498 in the Mega Millions game when the only jackpots considered are the first jackpots to cross the $100 million threshold. The change in lottery ticket sales is greater for a $1 million increase in jackpot size for jackpots that first cross the $100 million threshold than for other smaller jackpots. This contradicts the principle of diminishing marginal returns.

One possible explanation is that lottery sales are exponential in terms of jackpot. This would imply that lottery sales increase at an increasing rate as jackpots increase. If the data is exponential, the average slope should be greater for jackpots that are $100 million or larger than for the jackpots that first cross the $100 million threshold. The slope has a value of .327 for the jackpots that are greater than or equal to $100 million in the Powerball game, and a value of .406 for the Mega Millions game.

Next, I remove both jackpots that first cross the $100 million threshold and the record jackpots because neither is consistent with the principle of diminishing marginal utility. When the jackpots are removed, the slope decreases to .278 for the Powerball game and to .351 for the Mega Millions game. The slopes for the jackpots that first cross the $100 million threshold are too large for diminishing marginal utility to hold. When the jackpot increases by $1 million, jackpots that are the first to cross the $1 million threshold increase lottery ticket sales the most. My empirical strategy measures how large of an effect the $100 million jackpot has on growth of ticket sales.

4. Empirical Strategy

I measure the effect that being the first jackpot to cross the \$100 million threshold has on demand. I use lottery draw sales as a proxy to measure demand. Lottery draw sales measure how much money is purchased on tickets at a certain jackpot. I also use *Day* and *Jackpot* as independent variables in my regression. I use Tuesday as the independent variable for *Day* in the Mega Millions regression and Wednesday as the independent variable for *Day* in the Powerball regression. *Jackpot* is the amount of million dollars per time period that people can win if they have the winning numbers. A variable called *Sequence* is created to measure the effect of jackpot order on demand. The first jackpot following the winning jackpot is given a *Sequence* value of one, and *Sequence* increases by one with each passing jackpot until the jackpot is won. When the jackpot is won, the *Sequence* value goes back to one. The concept is to see if consumers react to the number of lotteries in a string (for example, the difference between a 14^{th} jackpot of \$165 million and a 16^{th} jackpot of \$165 million). In other words, I examine if the number of times the jackpot has not been won (since the last jackpot was won) affects the demand for the current jackpot. The variables for both the Mega Millions lottery and Powerball lottery are the same unless otherwise noted.

This paper first tests the effect of demand on the \$100 million jackpot and the \$200 million jackpot. These two jackpots are tested because they are the two least common aesthetically pleasing jackpots that have enough data points. The equation I use for both games to test these jackpots is

$$Growth_i = \alpha + B_1 Jackpot_i + B_2 Change_i + B_3 Day_i + B_4 Sequence_i + B_5 Firstover_i + B_6 Firstoverj_i + B_7 Firstoverjc_i + B_8 Firstover2_i + B_9 Firstover2j_i + B_{10} Firstover2jc_i + \mu_i \quad \textbf{(1)}$$

The variable *Firstover is* a dummy variable for being the first jackpot in a series of jackpots to cross the \$100 million threshold before the jackpot is won. *Firstover* is used to measure the additional effect, if any, of being the first jackpot over or equal to the threshold. *Firstover* has a value of one if the jackpot is the first jackpot in triple digits or zero if it is not. One caveat is that a series of jackpots often skip over the number \$100 million, so *Firstover* can have a value of one for a \$105 million or \$110 million jackpot based on the jackpots that came before it.

The dependent variable in this regression is the growth rate of lottery sales (*Growth*). It is defined in the regression as the change in lottery sales in period t from period t-1 divided by the sales in period t-1. *Growth* can also be considered the percentage change in lottery sales for the current jackpot from the previous jackpot. The growth rate is a good alternative to sales as a dependent variable. With sales as the dependent variable, there would need to be an independent variable for every change in the game because whenever a state gets added to the game, sales increase by an unknown amount. By using the growth rate, the effect of a new state selling the game is mitigated because the growth rate compares the current period to the previous period. A one-time permanent shock to sales will have far less of an effect using growth rates. The growth rate is preferable to a change in lottery sales, as a dependent variable, because a change in lottery sales is also affected by a new state selling the game. If a large state such as California starts selling the Powerball game, the change in tickets sold will increase in the following periods.

The variable *Firstover* does not account for the jackpot size and the change in jackpot size. I created two interaction variables to measure the effect of jackpot size and the change in jackpot size on this dummy variable. The variable *Firstoverj* is an interaction variable between *Firstover* and *Jackpot*. This is important because jackpots that cross the $100 million threshold are theoretically any value over or equal to $100 million. A $120 million jackpot will not have the same effect on ticket sales that a $100 million jackpot does. The variable *Firstoverjc* is an interaction variable between *Firstover* and the change in jackpot size (*Change*). The variable *Change* is an independent variable that is used in the regression equation. The variable *Change* is necessary because when a jackpot is won, it starts over at a lesser, stationary amount. This jackpot is associated with a negative growth rate because of the negative change in jackpot size. If you leave the change of jackpot out of the regression, the results are biased. *Firstoverjc* is important because some jackpots could have a disproportionate effect on the growth of lottery ticket sales. This is due to the differing amounts the jackpot changes between periods. I create a similar variable to measure the effect of being the first jackpot to cross the $200 million threshold. These variables are *Firstover2, Firstover2j, and Firstover2jc*. I use the variables mentioned in this paragraph to estimate equation 1. The resulting regression is found in table 1.

In section 2, I mention that both games had expanded into new states and had changed the odds of winning the jackpot. I made indicator variables for each time either game changed its odds to win the jackpot and for each time either game started selling in a new state. These variables were regressed with the variables in table 1. In both games, every change in odds of winning the jackpot and every expansion into a new state was not significant.

The significance of the coefficient of *Firstover* suggests that other thresholds will have a similar effect. I test the $50 million jackpot because it is aesthetically pleasing. I also test the $150 million jackpot because it is halfway in between two aesthetically pleasing jackpots. I create dummy and interaction variables for both jackpots. These variables are similar to the variables used for the $100 million and $200 million thresholds. Table 2 shows the regression of these variables for the $50 million jackpot and the $150 million jackpot. This table is leaving out all the other independent variables that were included in the regression (for example sequence, jackpot, etc.).

Table 1—The Effect of the $100 Million Jackpot on Growth of Lottery Sales

Dependent Variable:	Growth of Sales Mega Millions	Growth of Sales Powerball
Jackpot	0.0012***	0.0011***
	0.0001	0.0002
Change in Jackpot	0.0036***	0.0037***
	0.0001	0.0001
Wednesday		-.15800***
		0.0057
Tuesday	-0.1791***	
	0.0068	
First Over $100 Million	1.2736***	1.1828***
	0.3807	0.3252
First Over $100 Million * Jackpot	-0.0160***	-0.0144***
	0.0039	0.0052
First Over $100 Million * Change in Jackpot	0.0342***	0.0301***
	0.0059	0.0036
First Over $200 Million	-0.2306	0.8393*
	0.7250	0.4387
First Over $200 Million * Jackpot	-0.0001	-0.0065***
	0.0037	0.0022
First Over $200 Million * Change in Jackpot	0.0070**	0.0175***
	0.0030	0.0020
Sequence	0.0199***	0.0147***
	0.0009	0.0008
N	1615	1571
Adj. R^2	0.7249	0.7701

***, **, *: Significant at 1%, 5%, and 10% confidence interval, respectively.
Standard errors below estimates.

Table 2.—The Effect of the $50 and $150 Million Jackpot

Dependent Variable:	Growth of Sales Mega Millions	Growth of Sales Powerball
First Over $50 Million	.0237	.0822
	.2467	.1408
First Over $50 Million * Jackpot	-.0023	-.0022
	.0051	.0030
First Over $50 Million * Change in Jackpot	.0095	.0030
	.0084	.0033
First Over $150 Million	.1224	-.1088
	.4217	.3158
First Over $150 Million * Jackpot	-.0022	-.0017
	.0026	.0021
First Over $150 Million * Change in Jackpot	.0065**	.0143***
	.0030	.0018
N	1615	1571
Adj. R^2	0.7543	0.7944

***, **, *: Significant at 1%, 5%, and 10% confidence interval, respectively.
Standard errors below estimates.

Jackpots that reach the size of $100 million are more common in the later years of the data. The psychological effect of being the first jackpot to cross the $100 million threshold should decrease as $100 million jackpots become more common. I create a variable called *Frequency* that counts the amount of times the $100 million threshold has been crossed. *Frequency* has a nonzero value when a jackpot first crosses the $100 million threshold in order to measure its effect on *Firstover*. I also create a one year moving sum (*Moving*) of the frequency variable. The variable *Moving* counts the number of jackpots that first cross the $100 million threshold in the last year. I create *Moving* because I assume consumers will only remember large jackpots that occur in the past year.

The time in between two jackpots that have *Firstover* values of one decreases as $100 million jackpots become more common. I create a variable (*Between*) that measures the amount of drawings that have passed since the last jackpot crossed the $100 million threshold. I estimate the equation

$$Growth_i = \alpha + B_1 Jackpot_i + B_2 Change_i + B_3 Day_i + B_4 Sequence + B_5 Firstover_i + B_6 Firstoverj_i + B_7 Firstoverjc_i + B_8 Frequency_i + B_9 Moving_i + B_{10} Between_i + \mu_i \quad \textbf{(2)}$$

The table below shows the estimates of equation 2. This table leaves out the other independent variables in the regression.

Table 3.—The Effect of Frequency and the Drawings in between $100 Million Jackpots on Growth

Dependent Variable:	Growth of Sales Mega Millions	Growth of Sales Powerball
Frequency	-.0017	-.0000
	.0012	.0011
Moving Yearly Sum	-.0093	-.0154**
	.0143	.0078
Drawings In Between $100 Million Jackpots	.0009	.0023***
	.0010	.0008
N	1615	1571
Adj. R^2	0.7549	0.7893

***, **, *: Significant at 1%, 5%, and 10% confidence interval, respectively.
Standard errors below estimates.

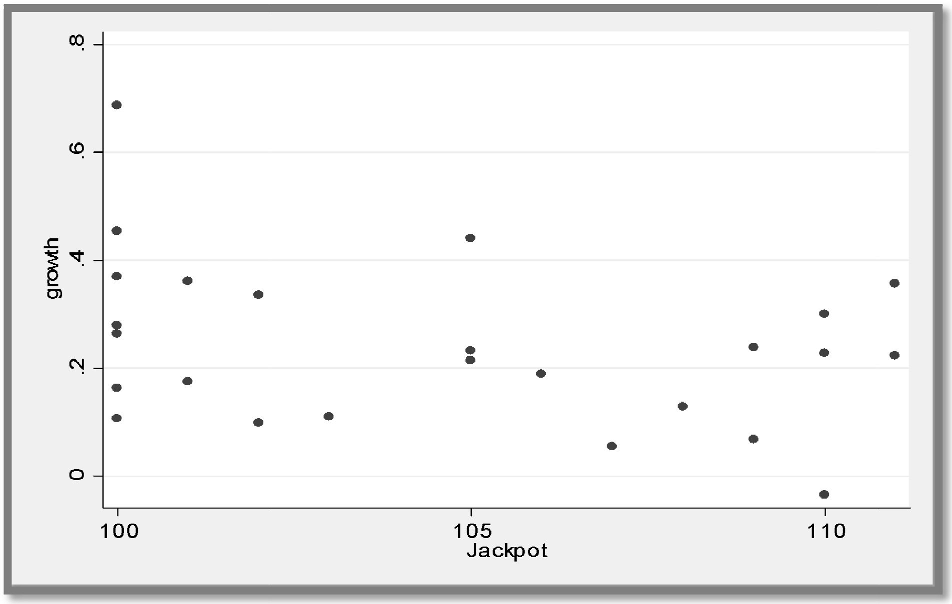
5. Results

Table 1 shows the OLS regression of the growth of lottery ticket sales on the jackpot and on other variables in the Powerball game. In the Powerball regression, the coefficient on *Jackpot* is significant. The coefficient on *Jackpot* explains that for each million dollars in a jackpot, the growth rate of lottery ticket sales increases by .11 percentage points. The growth rate of lottery ticket sales increases by .37 percentage points for every million dollar increase in the jackpot relative to the previous jackpot. The coefficients on *Jackpot* and *Change* are intuitive because the growth of lottery ticket sales will increase as the jackpot increases. The coefficient on *Day* (which is Wednesday for the Powerball game), is significant and explains that a drawing sold on Wednesday decreases the growth rate of sales by 15.8 percentage points. The reason why *Day* might be significant is because people buy more lottery tickets later in the week. The growth rate increases by 1.47 percentage points for a one position increase in *Sequence*. *Sequence* may be picking up some of the effect of the variable for time. When I tested *Sequence* and time together, time was insignificant.

Being the first jackpot to cross the $100 million threshold is significant in the Powerball game. The dummy variable *Firstover is* significant and positive. The growth rate on lottery ticket sales increases by 118 percentage points (without taking into account jackpot or the change in jackpot) when *Firstover* has a value of one. The coefficient of *Firstoverj* is negative and significant, with a decrease of 1.44 percentage points for each million dollars' worth of jackpot. This implies that, holding all other variables constant, the further away from $100 million you are, the less the growth rate of lottery ticket sales increases. This suggests a psychological effect of seeing jackpots that are close to $100 million. The coefficient on *Firstoverjc* is significant and positive. The growth rate of lottery ticket sales increases by 3 percentage points for every million dollar increase in the change in jackpot.

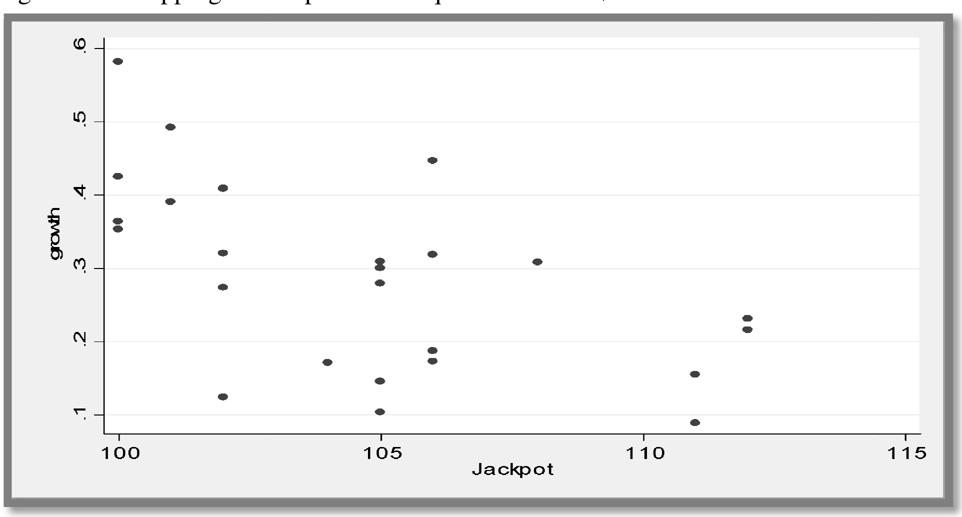
Figures 3 and 4 provide some intuition into why *Firstover is* negative. The figures only have jackpots that have *Firstover* values of one. The figures also only have jackpots that have a *Change* value of $14 million, $15 million, or $16 million. The bounds on the *Change* are to make sure that the change in jackpot is not having a large effect on the growth rate. I then graph the data with *Growth* on the y-axis and *Jackpot* on the x-axis. Both graphs show that as a jackpot gets closer to $100 million, the growth rate of lottery ticket sales increases. I also look at the growth rates of lottery ticket sales in jackpots between $90 and $100 million and see that $100 million jackpots have higher growth rates. This is unusual because larger jackpots tend to increase the growth rate of lottery tickets sold (because *Jackpot* has a significant, positive coefficient). The effect of being the first jackpot to cross $100 million is strongest near $100 million.

Figure 3: A Mapping of Jackpots First Equal or Over to $100 Million



This graph shows data from the Powerball game.

Figure 4: A Mapping of Jackpots First Equal or Over to $100 Million



This graph shows data from the Mega Millions game.

The Mega Millions regression is very similar to the Powerball regression in terms of its independent variables. *Jackpot*, *Change*, and *Day* (Tuesday) are all significant in this regression. The coefficient on *Jackpot* increases to .0012, which means that for every million dollars in the jackpot the growth rate of lottery ticket sales increases by .12 percentage points. The coefficient on *Change* decreases to .0036. The growth rate of lottery ticket sales increases by .36 percentage points for every $1 million increase in the change in jackpot. The coefficient on *Day* is negative. Drawing the lottery numbers on a Tuesday leads to a decrease in 17.91 percentage points in the growth rate of lottery ticket sales. In the Mega Millions game, the growth rate of lottery ticket sales increases by 1.99 percentage points for a one position increase in *Sequence*.

The effect of being the first jackpot over or equal to $100 million also changes in the Mega Millions game. The coefficient on *Firstover* increases to 1.274. The coefficient on *Firstoverj decreases to* -.016. The coefficient on *Firstoverjc* increases to .0342. This explains that for each million dollar increase in the change in jackpot, the growth rate of lottery ticket sales increases by 3.42 percentage points.

The coefficient on the variable *Firstover2* is not significant at the five percent level in the Powerball game. The variables *Firstover2j* and *Firstover2jc* are both significant at the five percent level in the Powerball game. The variables for the $200 million threshold all become less significant in the Mega Millions game.

The full effect of being the first jackpot over or equal to $100 million is measured by holding constant all terms that are not interacted with *Firstover*. This effect is measured by the equation

$$Overconsumption_i = (B_1 * Firstover_i) + (B_2 * Firstoverj_i) + (B_3 * Firstoverjc_i) \quad \textbf{(3)}$$

Overconsumption is defined (by equation 3) as the increase in the growth rate of sales for having a *Firstover* value of one. The average change in jackpot for jackpots between 80 and 120 million is about $14 million. I use $120 million as an upper bound because the vast majority of jackpots that first cross the $100 million threshold are less than or equal to $120 million. For symmetry, I use $80 million as a lower bound. Arbitrarily, I use $103 million as my jackpot in period t and $89 million as my jackpot in period t-1. Using equation 3, solely being the first jackpot to cross the $100 million threshold adds 12.1 percentage points (of *Overconsumption*) to the growth of lottery ticket sales in the Powerball game. This equation states that having a *Firstover* value of one adds 10.44 percentage points (of *Overconsumption*) to the growth of lottery ticket sales in the Mega Millions game.

The regressions in table 2 show the effect of being the first jackpot over or equal to $50 million and the effect of being the first jackpot over or equal to $150 million. In the Mega Millions game, there is no significance in being the first jackpot over or equal to $50 million. There is also no significance of being the first jackpot over or equal to $150 million in the Mega Millions game. These two dummy variables are also not significant in the Powerball game.

The regressions in table 3 show the effect of *Frequency*, *Moving*, and *Between* on the growth rate of lottery ticket sales. None of these variables were significant in the Mega Millions game. The coefficient on Frequency is not significant in the Powerball game. The coefficient on *Moving* is significant at the five percent level in the Powerball game. The growth rate of ticket sales for a jackpot that has a *Firstover* value of one decreases by 1.54 percentage points every time a jackpot had a *Firstover* value of one in the last year. The coefficient on *Between* is significant at the one percent level in the Powerball game. The growth rate increases by .23 percentage points for each drawing that has passed since the last $100 million jackpot. There seems to be no reason why these variables are significant in the Powerball game and not the Mega Millions game.

6. Conclusion

This paper tests the effect of aesthetically pleasing jackpots on the growth rate of lottery ticket sales. The $50 million, $100 million, $150 million and $200 million jackpot were all tested for their significance on the growth rate of lottery ticket sales. The $100 million jackpot was the only jackpot to have a significant effect on demand for lottery tickets. The $100 million jackpot did not follow the principle of diminishing marginal utility. There was also an increase in the growth rate of lottery ticket sales based solely on the aesthetics of the number $100 million. According to economic theory, there should not be an increase in lottery ticket sales based on the aesthetics of a number.

I have shown that there is something inherently special about the $100 million jackpot. A possible explanation is that consumers have a history of misinterpreting certain numbers. Research has shown that consumers misinterpret the price of zero[7]. In this study, consumers frequently changed their preferences between a set of goods once one of the goods became free. Consumers may overreact to the number 100 the same way that consumers overreact to the price of zero.

A possible reason for the misinterpretation of the $100 million jackpot is the significance of the number 100 in society. One hundred is the largest commonly used bill in the United States. When consumers think in terms of money, any

[7] Kristina Shampanier, Nina Mazar, and Dan Ariely (2007), “Zero as a Special Price: The True Value of Free Products.” Marketing Science. Vol. 26, No. 6: 742-757.

number that starts with the number 100 ($100, $100,000, $100 million, etc.) may be overvalued for this reason. Other examples of the number 100's significance in society are the "100 calorie pack", the "top 100" lists, the 100 cents in a dollar, etc.

Another possible explanation is that consumers do not understand how much money $100 million is. Most consumers will never make a purchase of $100 million. Consumers make frequent purchases of $10, $20 and $50 and understand how much those bills are worth. Most consumers will never have a true understanding of the value of $100 million. Consumers may have to use heuristics in order to estimate the value of $100 million. These heuristics, like the "top 100 lists" mentioned above, may cause consumers to overreact to $100 million.

This additional increase in demand in lottery tickets from being first or equal to $100 million is not consistent with economic theory. There is a psychological effect of winning $100 million that is not explained by economic theory. This effect contradicts the principle of diminishing marginal utility because consumers should understand that there is no extra marginal utility of money from winning that jackpot. The results show that when dealing with focal numbers, the principle of diminishing marginal utility does not always hold.

This research can also be applied to small lotteries, raffles and the stock market. For example, if you have a lottery or raffle, you may want to get your prize to equal or surpass $100 in order to attract more buyers. Future research should examine how other goods, like stocks, react to surpassing the $100 threshold.

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