OUTLOOK FOR THE BIG GAMES IN 2018

LOOKING BACK, LOOKING FORWARD

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The relationship between jackpots and sales changed following the January 2016 record Powerball jackpot. Sales at starting and low jackpots remained much the same, but the next time a jackpot run offered a top prize of over $150 million (as happened in February 2016), sales were markedly lower than before the big event. This lack of enthusiasm as jackpots rose into the hundreds of millions persisted until May 2016, when the jackpot first exceeded $400 million. In July 2016, a Mega Millions jackpot climbed into that territory and got a similar response. It appears that in the post-billion-dollar jackpot world, $400 million is the new kindle point for excitement.

Since January 2016, six Powerball runs have provided jackpots of $400 million. Only in August of 2017 did the run last long enough to break $500 million. It delivered a top prize of $758 million on August 23, 2017. In that drawing, actual sales were about $458 million nationwide. That August event was very welcome, coming early in the fiscal year for most lotteries and making sales people feel better about reaching their goals.

Mega Millions, meanwhile, produced two notable runs, one yielding a jackpot of $536 million and another $393 million (the latter producing a sales response "like old times").

At this point in the year, I have for several years applied quantitative methods to learn something from our immediate past experience. In October 2017, I can use the past 18 months or so of history to develop a quantitative description of how people have been playing Powerball and Mega Millions. I can then use this description to drive "thousand year" models that yield some insights into what to expect in the coming months.

Since I have done this for several years, I can also readily compare current behavior to past behavior. The lack of excitement between $100 and $400 million, compared to pre-2016 behavior, has been costly to an extent of about $690 million in sales (for the jackpots that actually occurred) over 18 months of Powerball, and about $860 million in sales over 18 months of Mega Millions. However, the point of this article is not to document theoretical shortfalls, but to apply what we have seen toward understanding what we should expect in the near future.

The biggest question (just on the horizon as I write) is "what will the new $2 Mega Millions do?" I will explain how I have tried to apply what was learned in raising the price of Powerball to $2 to this question, and why the answer is not entirely "Mega Millions will be just like Powerball."

When Powerball raised the price of a wager to $2, we saw an increase in sales under low-jackpot conditions of about 22 percent. That is to say, players spent 22 percent more money than they would have for similar jackpots in the range from $40 to $250 million, in the prior period of the $1 game. Once the jackpot exceeded $300 million, they spent about twice as much as they had in the $1 game.

Put another way: with the price increase, there was a big decline in participation, though at twice the unit price the net effect was still significantly more spending and of course

faster jackpot growth. Once the jackpot reached a critical size, anyone who wanted to play paid the price without hesitation.

Applying this learning from 2012 to the situation at the end of 2017, we expect some things to be the same though others are clearly different. One thing that is different is the absence, in 2018, of another big, well-established national game priced at $1.

However, the experience of 2012 does not lead me to expect that the presence or absence of another national-scale game at a $1 price will make any difference. Mega Millions did not see a big influx of new players when Powerball raised its price.

Another thing that is different: Powerball already set the precedent of a $2 wager. Players may not feel strongly about the other national game following suit. Yet another thing: the buying power of one dollar is slightly lower than it was five years ago.

Taking all this into consideration, I have modeled several scenarios for how the current spending behavior of Mega Millions players may change with the price increase, and what the consequences of this are likely to be for jackpot development, and for the expected yield of the game. I believe a likely but conservative scenario is that spending-for-jackpot will increase 20 percent, from the start of $40 million up to around $400 million, and then, once excitement is kindled, double. I believe a scenario where the spending at low jackpots is stronger (30 percent above base) is equally likely. In what follows I refer to these as the 20 percent and 30 percent scenarios.

However, even if this happens, I do not think we will see Mega Millions becoming fully equivalent to Powerball. Powerball's sales range $23 to $28 million per drawing for its starting jackpot; Mega Millions even under the 30 percent scenario would grow only to $20 million. Although Mega Millions will match the $40 million starting jackpot of Powerball, the Mega Millions jackpot will increment by $5 million rather than by $10 million.

The size of the starting jackpot, and the way it increments on subsequent draws, is important to the long-term yield of the game. Not everyone realizes this, but when the top prize in one of the big games is won within the first few consecutive draws of a "run," the total prize liability exceeds the aggregate value of sales from the run. In other words, the run loses money.

Setting the size of the starting jackpot, and managing the way it increases, is an exercise in risk management. Higher jackpots bring higher sales in each draw. Higher sales represent more wagers. Each wager carries a risk that it will actually win the jackpot. The starting jackpot is chosen with an understanding of the volume of wagers expected, and the likelihood of progressing through several draws without having to pay the jackpot. The target prize expense (or return to players) of the big games is 50 percent, of which less than 20 percent now goes to play the lesser prizes, i.e. those below the jackpot. As the draws progress and only the lesser prizes are paid, eventually the difference between sales and prizes paid becomes great enough to pay the jackpot, should it be won. At this point the jackpot is said to be "fully funded." From this point forward, the run makes money.

Mega Millions, starting at $40 million and incrementing by $5 million, will fully fund its jackpot on the fifth draw, at $60 million, under the 30 percent scenario. Under the more conservative 20 percent scenario, full funding would happen one draw later. Powerball, starting at $40 million and incrementing by $10 million, will be fully funded at $90 million, on the sixth draw. Powerball, with higher sales, more wagers, and perhaps one more draw to reach full funding, has a greater probability of ending any particular run at a financial loss.

My analysis suggest that these two games will differ in several respects, with Powerball producing higher sales and more jackpots won in a typical year. However, this same analysis suggests that the two games will produce similar profit. Simulations of both games produce net win of between $1.75 and $2.75 billion about 2/3 of the time.

My intent is not to judge one game as superior to the other: after all, they have similar expectations of profit. Powerball will probably be the faster-moving game, and this may be advantageous in that its likelihood of producing a newsworthy jackpot in any given year is greater. Both games have approached risk management in a similar way, and chosen actions consistent with their different starting conditions.

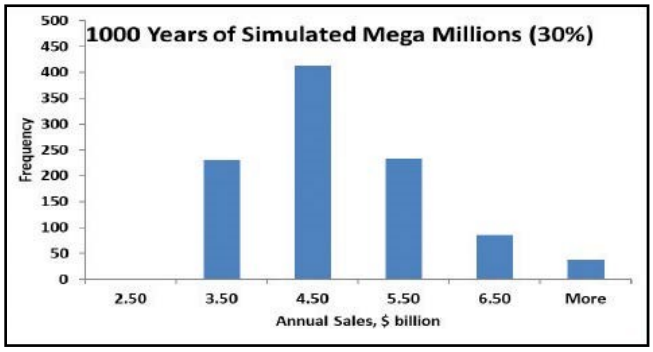
The table below summarizes some comparisons made on the basis of simulating one year's experience in the games several thousand times. The values shown represent averages or central tendency.

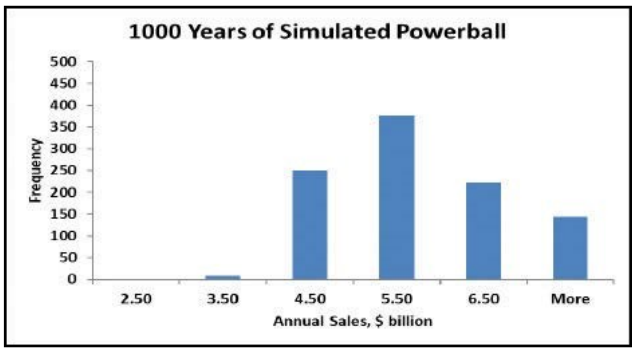
Projected characteristics of Mega Millions and Powerball for 2018

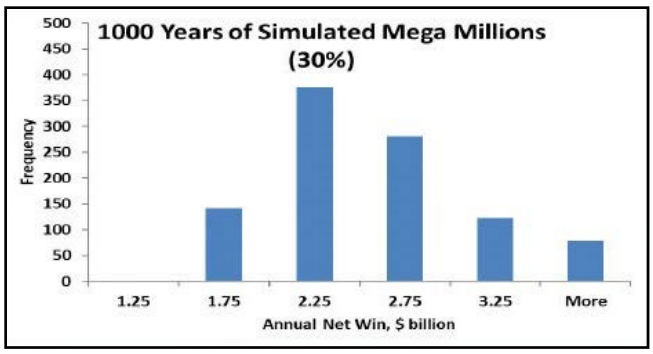
Based on several thousand years' simulated activity
Bond Factor 1.6 throughout

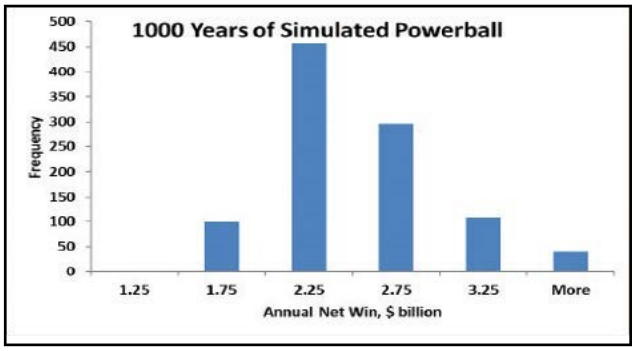
		Mega Millions 120%	Mega Millions 130%	Powerball
Average sales	$ bn	4.0	4.3	5.3
Median run length	draws	16	15	12
Jackpot at median run length	$ million	220	220	260
Jackpot wins per year	count	6.0	6.3	8.1

Massive simulations of this sort also provide some insight into the year-to-year variability of results, or the uncertainty around a prediction for any particular year. As always with the big games, this uncertainty is significant. Given this level of uncertainty, the figures below are perhaps even more meaningful than the averages on the previous page.









What I learn from these charts is: each game is very likely produce more than $3.5 billion in sales in the year (the axis values represent the upper limit of the corresponding category, i.e. the third columns represent just over $3.5 billion up to $4.5 billion in sales). Powerball sales will more likely than not exceed $4.5 billion. Also, each game is very likely to produce net win between $1.75 and $2.75 billion. If this seems like an awfully broad range of outcomes, you have taken from this graphic presentation exactly what I intended: these games remain very volatile. ■