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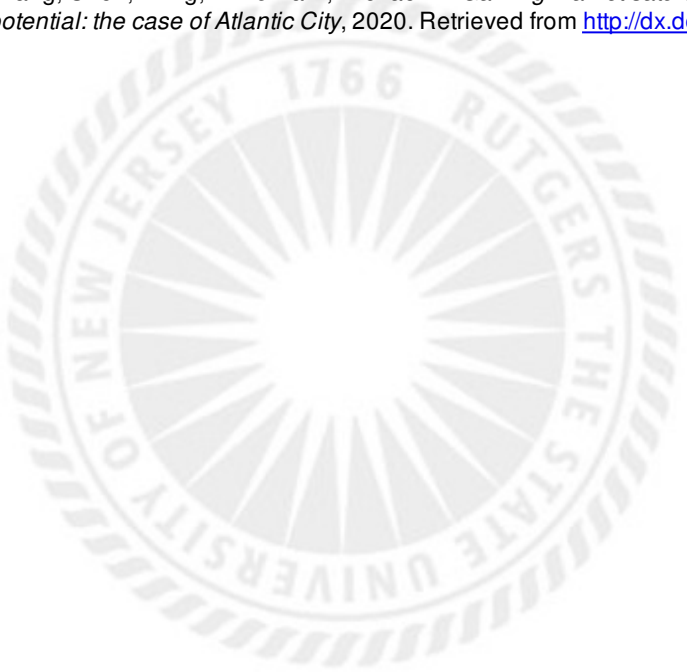

Gaming Market Saturation and Location Growth Potential: The Case of Atlantic City[1]

Chen Zhang,[2*] Will Irving,[+] and Michael L. Lahr[#]

Rutgers Economic Advisory Service (R/ECON)
Edward J. Bloustein School of Planning & Public Policy
Rutgers, the State University of New Jersey
33 Livingston Avenue
New Brunswick, NJ 08540
USA

ABSTRACT. Competing casinos in Delaware, Pennsylvania, and New York State continue to erode revenues at Atlantic City's casinos. Yet, recent evidence from nascent aspects of New Jersey gaming industry (sports betting and Internet gaming) suggest that the Atlantic City market might not be saturated. To assess whether the market is saturated or not, we first draw on the greater region's casino gaming revenue history as well as county aggregate personal income and empirically derive the spatial extent of Atlantic City's market. We then find a measure—regional gross gaming revenues (GGR) as a share of regional aggregate personal income—that suggests the market has been fairly saturated since at least 1990. We then apply two models—Huff's and a time-series regression—to estimate impact of the addition of new casinos upon those in Atlantic City. Both suggest diminishing returns to scale of additional city slot machines upon the GGR within New Jersey. They also both show that new casinos in competing states would further erode Atlantic City's share of regional GGR. This, of course, assumes that the greater economy continues apace.

Introduction

New Jersey's remain the second largest U.S. casino cluster, with Las Vegas's premier. More interestingly, since casinos were legalized in New Jersey in May 1978, they were confined to Atlantic City with the hope that they would lift the municipalities fortunes and dissipate its mounting urban problems. Indeed, by 1996 New Jersey's bold experiment surpassed revenue expectations when Atlantic City's gross gaming revenues (GGR) at $3.8 billion exceeded those of

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* Coadjutant, chen.zh@rutgers.edu.

+ Senior Policy Analyst, will.irving@gmail.com.

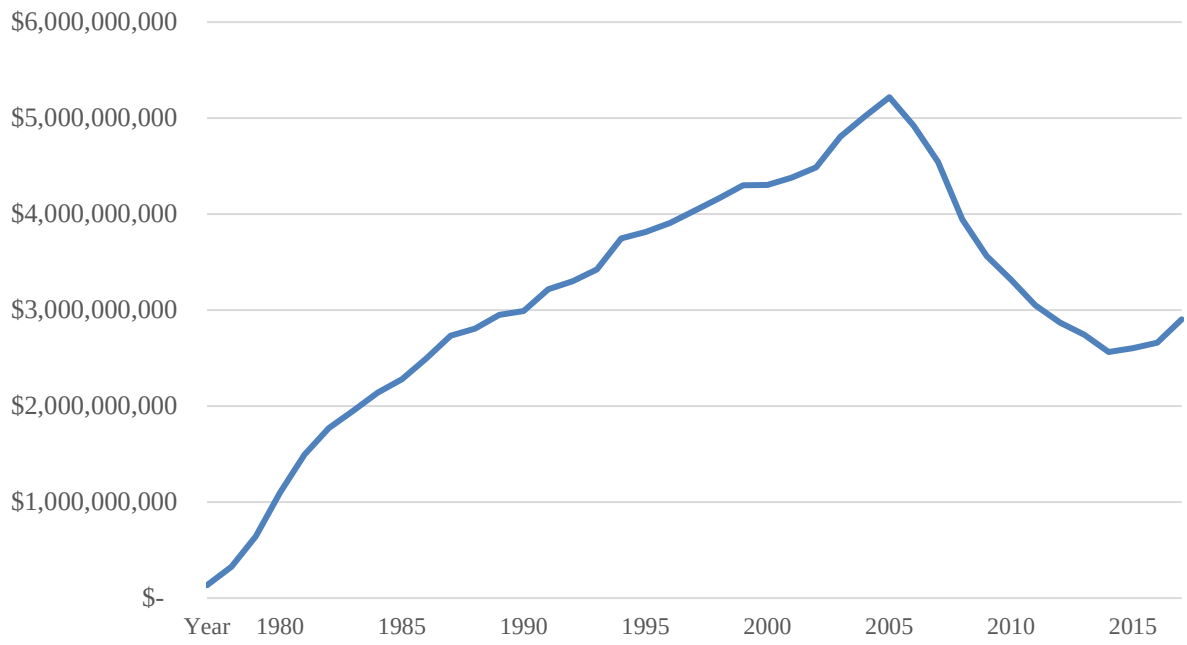
Contact author: Research Professor, lahr@rutgers.edu, +1(848)932-2372.

Las Vegas's Strip.[3] After 1996, Atlantic City's casinos continued to flourish, largely due to their proximity to New York City and Philadelphia, as well as the high opportunity cost of alternatives like Las Vegas, Monaco, and Macau. By 2006 the city's GGR cleared $5.2 billion. But, as Figure 1 shows, 2007 brought cataclysm—the onset of Great Recession and competition from newly legalized gaming in other states. New Jersey's casino gaming then remained on a downward slide through 2015. While the state bragged 12 casinos as early as 1999, only 7 existed by 2017.

The decline has been and continues to be the subject study. McGowan (2009) found that when Pennsylvania legalized gaming in 2007, total GGR increased in Atlantic City's market area, although Pennsylvania casinos clearly siphoned life from those in New Jersey. While Condliffe (2012) concurred that Pennsylvania casinos lead to Atlantic City's demise, he also claimed that McGowan's findings on regional GGR were an artifact of the restricted market area that he employed and that the market area should include the State of Delaware, which legalized gaming in 1995. After including Delaware, Condliffe found that the introduction of Pennsylvania casino dampened total regional GGR.

Figure 1. Gross Gaming Revenues in Atlantic City, 1978-2018

3. The term "gross gaming revenues" used in this paper is defined as the sum of all House net revenues that are attributable to gaming. This includes the handle, less aggregate winnings, any rakes and commissions, revenues from the use or exploitation of any trademarks attributable to gaming, revenues from the use or exploitation of any of the domain names from gaming, or other revenues from other gaming operations, less any value-added tax, gaming tax or other revenue-related tax arising in connection with House operations, as determined via international financial reporting standards. Data for Las Vegas's Strip obtained from https://gaming.unlv.edu/reports/NV_1984_present.pdf. Note the Strip is Las Vegas's largest gaming district; the other main districts are Downtown and the Boulder Strip, which had net gaming revenues in 1996 of $679,033,000 and $358,464,000, respectively.



Source: Data are from: Schwartz, David G. (2019) "Atlantic City Gaming Revenue, Annual Statistics for Total Slot, table, and Internet Win, 1978-2018," unpublished memo from the University of Las Vegas, Center for Gaming Research, January, available online in January 2020 at https://gaming.unlv.edu/reports/ac_hist.pdf.

As noted, 2015 was a nadir for Atlantic City gaming. So, what has been causing the apparent renaissance? For one, New Jersey legalized internet gaming in 2013 and then sports betting in 2018. But the entry of two new casinos, Hard Rock and Ocean Resort in 2018 also appear to have enhanced the state's overall GGR since 2016, the first net gain in casino gaming revenues since 2007. But the GGR gains to the state were meager, suggesting that any success experienced by the new casinos were made by cannibalizing from the state's existing set of casinos. Indeed, all others experienced GGR declines. This more than hints at a saturated market for New Jersey's gaming casinos. But is it saturated? And how can we go about determining if it is? More basically what is the market area for New Jersey's gaming casinos? Neither McGowan (2009) nor Condliffe (2012) defensibly define their definitions of Atlantic City's market area.

Moreover, Atlantic City itself is hardly better off not than it was when New Jersey's noble experiment to uplift the city's fortunes got underway. The decline in the number of casinos is a concern since they are major employers of local populace. So the voice of lobbyist calling for more casinos licenses to be granted by the State of New Jersey have gotten louder in light of recent GGR increases in the state. That is, they advocate that the Atlantic City's market is not saturated and

that enhancing the agglomeration of casinos within the state would necessarily enhance the social situation within the city.

In this paper, we begin with a focus on measuring the saturation of a gaming center's regional gaming market area. Using this market area, we then simulate the impact of additional casinos within Atlantic City, as well as in Philadelphia and New York City, using two very different modeling approaches. After comparing results from the two models, we identify the impact of casino expansion within the regional marketplace. Finally, we extend the discussion by presenting several critical implications about the prospect of casino gambling and other emerging types of gaming, and their potential influence on New Jersey's gaming industry.

Description of Data

We use casino GGR data from the New Jersey Casino Control Commission (NJ CCC) and supplemented it with data from the websites of the casino regulating authorities for Pennsylvania, New York, and Delaware, as well as data on Delaware casinos from the University of Las Vegas, Center for Gaming Research.[4] To measure gaming demand potential, we use aggregate personal income data by county from the U.S. Bureau of Economic Analysis (BEA). We start by attempting to define the regional marketplace for Atlantic City's casinos. We apply two different perspectives to these data—the supply-side and the demand-side.

From the supply side, the marketplace is the set of casinos that compete with Atlantic City's for gross gaming revenues. A review of a timeline that shows the GGR for both Atlantic City and an extended region that includes the NJ CCC data on casinos suggests rather low impacts to Atlantic City's casinos from entrants in Monticello, New York; Harrisburg, Pennsylvania; or even Baltimore, Maryland.[5] Thus, a three-hour drive from Atlantic City appears to be the frontier of

4 Pennsylvania Gaming Control Board Monthly Revenue Reports and Annual Reports can be found at https://gamingcontrolboard.pa.gov/?p=196 and https://gamingcontrolboard.pa.gov/?p=51, respectively. Refer to https://www.gaming.ny.gov/gaming/index.php?ID=2 for New York State Gaming Commission Video Gaming Reports. Delaware Video Lottery Monthly Proceeds Reports are available at https://www.delottery.com/More/Video-Lottery/Monthly-Net-Proceeds. Data from the UNLV Center for Gaming Research are available at https://gaming.unlv.edu/abstract/de_main.html.

5. In fact, on the timeline of casino openings and closings in Figure 4, northeastern Maryland casinos such as Ocean Downs, Maryland Live, Horseshoe Baltimore and MGM National Harbor are tagged. These casinos seem to have had little impact on

the market from a supply-side perspective. Appendix Table A.1 lists the set of casinos within the marketplace as of 2018 and their sizes (numbers of slot machines). There are presently a total 17 competing casinos in the region, not including those in Atlantic City. We list the count of slot machines because they appear to be a key parameter for casinos. Interestingly, while the count of table games and the total gaming area (square footage) in Atlantic City in 2018 remain at about the same as in 1999, the number of slots has nearly halved. Atlantic City's casino win is down about 40% from 1999 and over 50% from its 2006 peak.[6]

From a demand-side perspective, we include counties whose aggregate personal incomes are perceptibly tapped by the set of all casinos that form the supply side of the Atlantic City market. We started with a broad region that constituted all of New Jersey and Delaware, Maryland's eastern shore, eastern Pennsylvania, southern New York State, and Fairfield County, Connecticut. This broad, 78-county region essentially includes all counties within 60 miles of all casinos that demonstrably compete with those in Atlantic City, a conservative radius for area casinos market areas, at least according to Gallagher (2014). Figure 2 maps the counties included.

Philadelphia and New York City have been verified by visitation studies to be within Atlantic City's market areas. Eadington (2011) notes that most Atlantic City gaming customers live within a 75-mile range of the city. Of course, Atlantic City's market area is broader than this, due to its large hospitality cluster and beach access; indeed, its market area clearly overlaps with most current casinos within the shaded area of Figure 2.

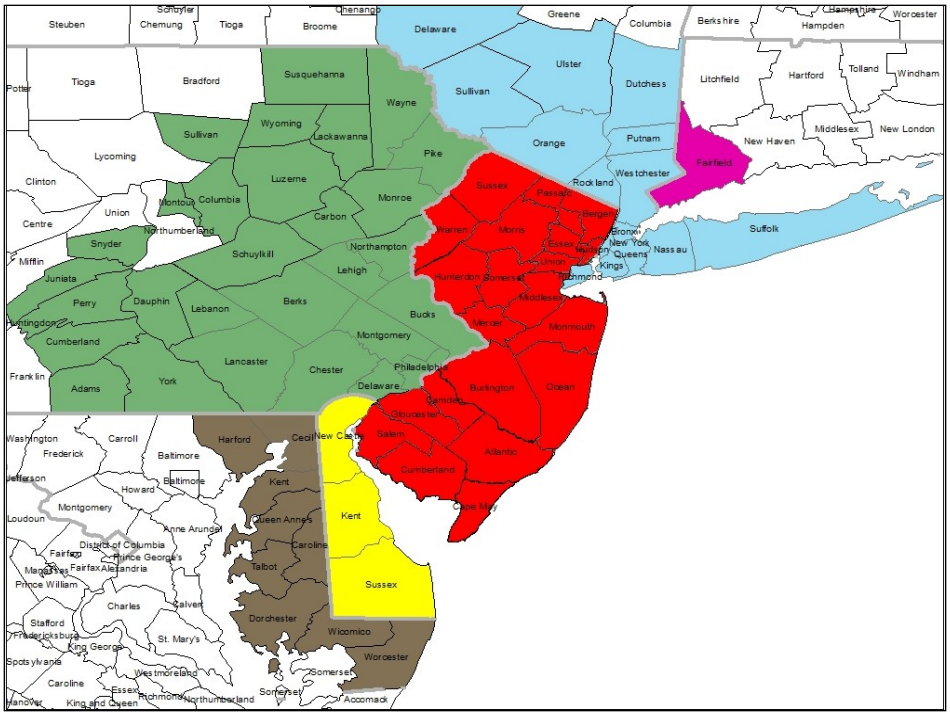
Rather than use distances to measure market areas, we opted to use travel times. To this end we used Google Maps timed for Saturday at noon from using county population centroids[7] and casino pin points. In addition, to capture monetary costs of crossing the Hudson River into New York City, we added 15 minutes to travel times to Empire City casino in Yonkers and Resorts World casino in Queens.

Atlantic City's share of regional GGR or the ratio of total GGR to regional aggregate personal income (RAPI).

6. See the 2018, 2006, and 1999 annual reports of the New Jersey Casino Control Commission.

7. The geographic information of population centroid is based on the reference files on centers of population by the Census Bureau. Records are available at https://www.census.gov/geographies/reference-files/time-series/geo/centers-population.html.

Figure 2. The 78-County Regional Marketplace



Research Approach

Modeling Market Reach

Huff's model is well-regarded for empirical modeling consumer behavior and is s founded on "social physics," in this case the gravity model. Huff essentially extended Reilly's (1931) "Law of Retail Gravitation" to enable the mapping of contours of market potential. It is therefore commonly used in planning work, particularly to evaluate the market potential for new retail developments and for identifying peak-period traffic demand. It has also been used in work regarding markets for casinos as well (Barrow & Borges, 2014).

As in the case of Sir Isaac Newton's classical gravity model, Huff's model measures the potential attraction P_{ij} between two given masses—here, the count of casino i's slot machines (gaming supply, s_i)[8] and county j's aggregate personal income (gaming demand d_j)—and

8. Casino size was measured in terms of the total number of slot machines and gaming tables. We started this out with equal weights, and later gained a best fit when each gaming table had the pull of eight slot machines. Here and elsewhere in our work with Huff's model, R^2 was used to identify the best fit.

discounts that attraction by the distance (we use travel times, t_{ij}) between i and j. A casino's GGR is estimated via Huff's model as:

$$\widehat{GGR_i} = k \cdot s_i^a \sum_j \frac{d_j^b}{t_{ij}^c} \tag{1}$$

Note that all three variables in Equation (1) has an exponent (parameter). The different exponents enable different relative influences for each mass and impedance. The summed ratio in (1) essentially apportions a county's travel-time-discounted household-spending potential to a particular casino. The relative size of the casino s_i^a matters too, of course. After being combined by multiplication, this income potential for a casino is scaled by k, the "gravitational constant," which is the same for all competing casinos.

Before applying Huff's model to estimate the impact of competition, we first had to calibrate it. To simulate the 2018 GGR for each of the casinos and using personal income for the 78 counties, we started a grid search to find a best fit using Equation (1), setting a=b=1 and c=2, with the latter being a typical value in retail studies. Ultimately, we also set

$$k = \left(\sum_i GGR_i \right) \Big/ \left(\sum_j d_j \right) \tag{2}$$

the region's total GGR as a share of its regional aggregate personal income (RAPI). In the course of the manual grid search, we first iteratively tested 10 alternatives each for a and c with separate variants for Atlantic City (over 100 total trials). A best fit was achieved with a≈1 for all casinos and c= 0.7 for non-New Jersey casinos and c= 0.5 on travel time to Atlantic City. The lower a value for Atlantic City yields the city's family of casinos a greater market reach, verifying a known attribute that was discussed earlier. We then tested a range of exponents for b, saving it for last since our choice of value for k enables ready interpretations of the distance discounted d_j when b=1. We also tested separate variants of b for Atlantic City for b. It turned out b≈1 also yielded a

best fit. Letting a=b=1 as opposed to the actual values, which were within 1.0 percent, did not appreciably alter the fit of the model.[9]

Conversely, using the same parameterization Huff's model, one can also roughly estimate a given county's contribution to regional GGR as

$$\widehat{GGR}_j = k \cdot d_j^b \sum_i \frac{S_i^a}{t_{ij}^c} \tag{3}$$

In this case, the quantity within the summation function—distance-discounted slot machines (casino size) gives a notion of the market area of casinos. Figure 3 displays the difference in market reach for Atlantic City in 2018 compared to a typical competing casino (2,000 slots) in the region, which to some extent justify our determination of the market area as broad as the 78-county region.

Market Saturation Analysis

This section is largely descriptive in that it is founded on analysis of a timeline of when casinos entered and left the market juxtaposed against an enumeration of their collective gross gaming revenues (GGR) and the region's aggregate personal income (RAPI), which in the prior subsection we denoted as the gravitational constant *k*. In this regard, Figure 4 (with supporting data in Appendix Table A.2) is the prime body of evidence we provide. It shows GGR/RAPI for Atlantic City casinos only, for competing casinos outside of New Jersey only, and for the whole region in total (*k*). It turns out that *k* (the orange dashed line) oscillates between 0.445% and 0.514% from 1993 to 2018. The unweighted average of *k* over the period is 0.477% which, coincidentally, is also the *estimated* value for the latest year shown—2018. The fact that *k* does not vary all that much suggests that the region's casino market was likely saturated before Atlantic City first received regional competition in 1996. This judgment is further resonated by the details of the changing pattern of regional competition over the years.

9. In addition, we also added in some surrounding counties beyond the 78 in the basic analysis, including New Haven, Connecticut, and Northumberland, Pennsylvania, to identify the sensitivity of our findings to the model's ability to replicate GGR by casinos. The results did not change perceptibly.

Figure 3. Casino Attractiveness as a Function of Travel Time

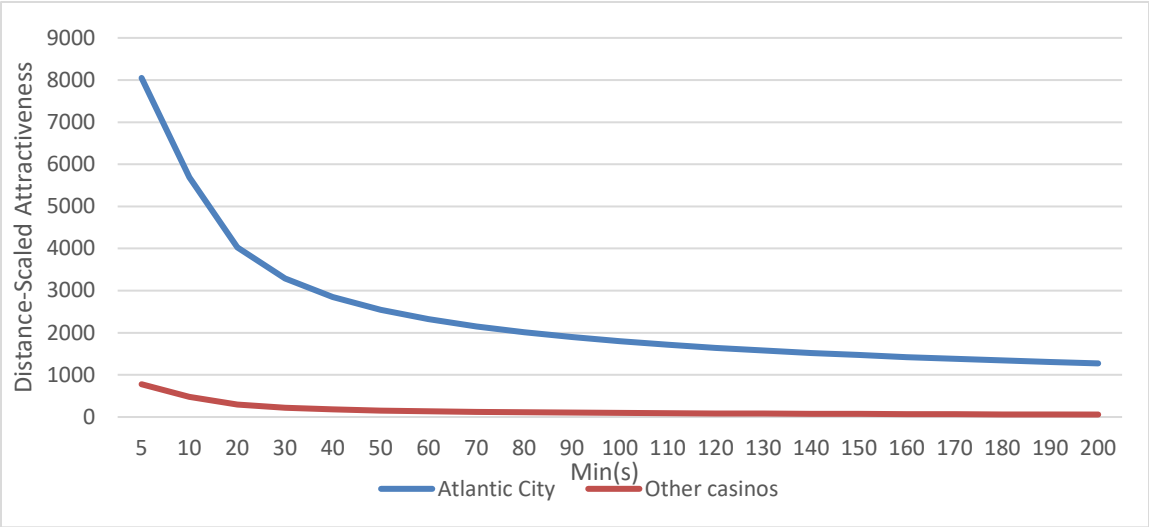
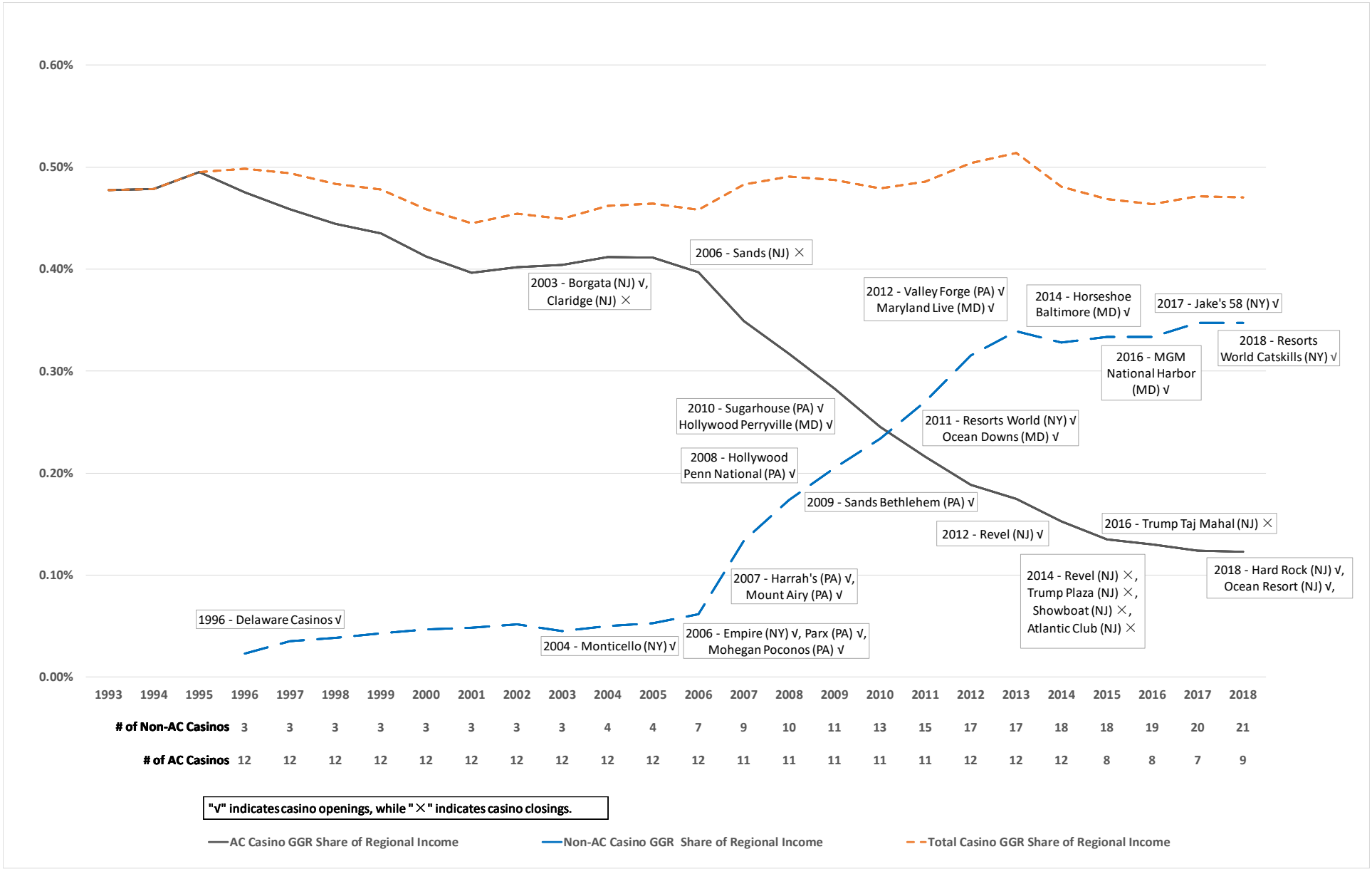


Figure 4. Casino Gross Gaming Revenues (GGR) as a Share of Regional Aggregate Personal Income (RAPI)



The regional ratio *k* attained highs in 1996 and in 2013, and fell to its nadir from 2001 to 2003. Before Delaware casinos effectively entered the regional gambling market in 1996, growth in regional GGR was strong, outpacing the rate of growth in RAPI. It, thus, rose as a share of RAPI from 0.477% in 1993 to 0.498% in 1996. Atlantic City had a particularly strong year in 1995 with 9.5% GGR growth ($325 million)—about three times the growth of the prior year. Competition then began as Delaware casinos entered the market, although the impact on Atlantic City was even weaker than when the tech bubble burst in 2001. In fact, up until 2003, Atlantic City casinos still brought in approximately 90% of the regional casino revenue. This was when Pennsylvania introduced casinos, and then Atlantic City's GGR share began to fall rather precipitously. They appear to have taken a second hit when New York State opened its doors to casinos in 2006. By 2007, New Jersey's GGR declined by nearly $300 million (-5.7%), as alternatives sprouted in nearby Philadelphia and New York City. As a consequence, Atlantic City's share of regional GGR plummeted from 86.6% to 72.3%.

It is noteworthy, however, that the new casinos also appear to have tapped some previously unmet gaming demand within the region; total regional GGR grew by 13% (nearly $800 million), contrasted against strong RAPI growth of 7.3%. The ratio *k* rose from 0.458% in 2006 to 0.483% in 2007—its highest share since 1998. Unfortunately, the Great Recession soon followed. Atlantic City casinos experienced a total decline of over $600 million (-13.2%). Although the regional market appeared to find new capacity, Atlantic City's GGR continued to drop. The city's share of regional GGR dropped moderately to 37.4% in 2012 and 34% in 2013. After 2013 growth in RAPI enhanced and stabilized. But the 2013-2016 period marked a shift for the region in that RAPI growth was not accompanied by GGR growth (see Appendix Table A.3). Perhaps this shift was due to over-saturation of the market since regional GGR's share of RAPI reached its historical peak of 0.514% in 2013 as intra-state competition in New Jersey, New York, and Pennsylvania mounted.

In 2016, Atlantic City's declines in GGR share finally subsided. Indeed, they reversed, even enjoying an ever-so-slight GGR gain ($7.4 million) in 2017. Each of Atlantic City's seven

remaining casinos absorbed activity from the Trump Taj Mahal, which closed in 2016. Indeed, Atlantic City experienced further GGR gains in 2018. Its GGR rose by over $97 million vis-à-vis 2017, but it is notable that the additions of the Hard Rock and Ocean Resort casinos—effective for only the second half of the year—appear to have cannibalized potential growth from existing casinos. That is, all other casinos in the city experienced GGR declines—in aggregate, $156 million. Moreover, this trend appears to be continuing. Through June 2019, year-to-date revenues were down from a year prior for every Atlantic City casino but, again, the Hard Rock and Ocean Resort.

Simulating the Effects of Added Competition to Atlantic City's Casinos

We next simulated the impact on Atlantic City's GGR due to casino expansions in Philadelphia and/or New York City, as well in Atlantic City itself. We decided to have a duel between two approaches and compare the results from them—Huff's model and time-series regression model approaches. Both employ "gravity" type specifications.

Each model yields estimates of the impact on Atlantic City's GGR for six different scenarios in which "new casinos" are introduced to the regional gaming market. In all scenarios, the new casinos are sized at 2,000 slot machines. This is about the average size of the casinos included in the analysis in Atlantic City, Pennsylvania, and Delaware over the last several years. It is also the estimated size of the Stadium Casino slated for completion in Philadelphia in 2020.[10] The six scenarios are:

1) Adding a casino in Atlantic City.
2) Adding a casino in Philadelphia.
3) Adding a casino in New York City.
4) Adding a casino in Atlantic City and Philadelphia.

10. The average size of casinos in New York State included in the analysis is slightly over 3,000. This is skewed upward by the two casinos in New York City, each of which has over 5,000 slot machines.

5) Adding a casino in Atlantic City and New York City.

6) Adding a casino in Atlantic City, Philadelphia, and New York City.

While we required both models react to the addition of 2,000 slot machines to the market in a specific location, we could not easily design them to distinguish explicitly between the introduction of new casinos or the addition of slot machines at existing venues. This distinction is critical. It is easier and less costly to add or subtract slot machines at existing casinos than to build and license a new one. Adding more slot machines in Atlantic City presently implies some degree of cannibalization across casinos. This is clearly the case for the addition of new casinos. In recent experience, adding two new 2,000-slot casinos to the market returned net GGR yields the equivalent of one casino. For the four quarters ending in June 2018 (prior to the opening of the Hard Rock and Ocean Resort in Atlantic City at the end of that month), average total gaming revenue per casino in Atlantic City was about $336 million, with average casino size of about 2,000 slots. In the subsequent four quarters, following the addition of the two new casinos, total gaming revenues in the city grew by approximately $283.6 million (excluding the approximately $7 million in revenues earned by the two new casinos in the final days of Q2 2018). Thus, while the two new casinos generated gaming revenues of $480 million in the four quarters ending in June 2019 ($300 million at Hard Rock and $180 million at Ocean Resort), the existing casinos experienced aggregate revenue declines of nearly $200 million relative to the preceding four quarters. Consequently, total gaming revenues per slot machine city-wide dropped from about $169,000 to about $146,000.

Time-Series Regression Model

The econometric model is built on an ARIMA regression framework and estimate how changes in Atlantic City's GGR are influenced by changes in other indicators over time. Instead of the annual data used in the saturation analysis, this model uses quarterly data on GGR, county

aggregate personal income, and slot machines[11] from 2008 to 2018 to better capture the longitudinal trend and correlation. The model is mathematically described by:

$$\ln\left(GGR_t^{\mathrm{AC}}\right) = \alpha + \beta_1 \ln\left(GGR_{t-1}^{\mathrm{AC}}\right) + \beta_2 \ln\left(s_{t-3}^{\mathrm{AC}}\right) + \beta_3 \ln\left(S_{t-3}^{\mathrm{R}} - S_{t-4}^{\mathrm{R}}\right) + \beta_4 \ln\left(D_{t-1}^{\mathrm{R}}\right) + \beta_5 \ln\left(u_{t-4}^{\mathrm{NJ}}\right) + \varepsilon_t \quad (4)$$

where GGR_t^{AC} the total GGR for Atlantic City observed in quarterly period *t*, s_{t-3}^{AC} is the count of slot machines in all Atlantic City casinos three quarters prior, $S_{t-3}^{\mathrm{R}} = \left(\sum_i \frac{s_i}{tt_{i,\mathrm{AC}}^{0.5}}\right)_{t-3}$ is the travel-time discounted size (to Atlantic City) of non-New Jersey casinos three quarters prior, $D_{t-1}^{R} = \left(\sum_j \frac{d_j}{tt_{i,AC}^{0.5}}\right)_{t-1}$ is the travel-time discounted regional aggregate personal income (to Atlantic City) one quarter prior, u_{t-4}^{NJ} is the unemployment rate for the State of New Jersey a year prior, α is the regression intercept or constant, and ε_t is the error term in time *t*. The log-log functional form enables interpretation all parameters as elasticities on Atlantic City's GGR.

Note that both of the gravity-type variables in this model use the exponent on travel time of 0.5 that we obtained via Huff's model. To summarize in general vernacular, the model measures quarterly GGR in Atlantic City as a function of the number of slot machines in the city (with a three-quarter lag, i.e., delay), as well as two gravity-type variables: the change in the number of slot machines at competing casinos, adjusted for their travel time from Atlantic City (with a three-quarter lag); and Atlantic City's travel-time-adjusted access to each county's aggregate personal income (lagged by one year). The model also controls for Atlantic City's GGR in the preceding quarter and New Jersey's unemployment rate a year earlier.

11. We tried to include the quarterly count of tables separately but this variable was excluded for statistical reasons – it was highly collinear with the count of slot machines.

It is interesting that the state's unemployment rate is positively correlated with Atlantic City's GGR; it suggests *ceteris paribus* a propensity to gamble among unemployed workers. We included it because it alone of variables we had at our ready disposal (and we had quite a large number) was statistically related to *k*, which indicates market saturation. So we included in this equation to proxy for variations in market saturation. We also tested Internet gaming revenues to several model specifications, but that variable's influence on Atlantic City's GGR was consistently very weak. Since its introduction in 2014, the revenues of Internet gaming have grown to just under $300 million in 2018—about the size of an average casino. Data from the first two quarters of 2019 indicate that this segment continues to grow substantially and could well cut into the GGR of Atlantic City's casinos. Sports wagering data were also considered, but are too recent a phenomenon to be included in the analysis.

Notably, the regression approach differs from that with the Huff's model in that the variable for casino size employees only slot machines. Collinearity arose when we included variables for the counts both of slots and of table games. As such, in describing the results in terms of revenues per slot machine, we divide total gaming revenues, including revenues from table gaming, by the total number of slot machines. That is, we do not include a count of tables for table games—the other main source of gaming revenues, despite the finding that table games seem to have a positive effect on competing casinos (Walker & Nesbit, 2014; Levitzky, Assane, & Robinson, 2000). Slot machine revenues typically account for between two thirds and three quarters of total gaming revenues, so this paper focuses only on slots. Appendix Table A.4 presents the full regression output from EViews® software.

Huff's Model Revisited

As noted previously, Huff's model allocates market potential based on the distribution of existing facilities (casinos). To simulate the introduction of a new facility, we had to alter the model so that it could redistribute the market across all facilities, including the new one. Regardless, as we employ it here, Huff's model examines the market in a static context (with no inherent growth in regional GGR as is the case in the regression model). It therefore will necessarily yield more

conservative outcomes than would the regression model. To demonstrate the benefit of this added aspect of Huff's model, we applied the model twice for each scenario—once with no growth assumed and a second that takes on typical growth in aggregate regional GGR (i.e., real income). We used the growth rate over the four years prior to 2018 when aggregate regional GGR grew at an annual average rate of 4.3%, about $350 million.

Presentation and Analysis of Results

Table 1 displays results of the first three scenarios by modeling approach. Recall that in each case a 2,000 slot machine casino is added to the specified location. The outcomes are those expected for Atlantic City.

Table 1. Impacts on AC Gross Gaming Revenues of Adding a 2,000-Slot Casino

	Net change in AC Gross Gaming Revenues ($ millions)		
Location of New Casino	**Regression Model**	**Huff's Model (Static)**	**Huff's Model (with Regional GGR Growth)**
Atlantic City	+$68.9	+$62.6	+$150.9
Philadelphia	-$116.2	-$31.8	+$52.5
New York City (Empire)	-$72.4	-$23.9	+$60.7
New York City (Resorts World)	-$68.7	-$20.6	+$64.2

Scenario 1: Addition of 2,000 Slots in Atlantic City

Based on the regression and static Huff's model, we estimate that the addition of a 2,000-slot casino in Atlantic City most likely adds between $62.6 and $68.9 million to total annual gross gaming revenues within the city, whereas the current average annual GGR per casino is about $293 million. Therefore, these estimates reflect an increasing saturation of Atlantic City's market area, which converges upon the historical limit as explored in the previous section. Adding new casinos in Atlantic City is likely to cannibalize potential revenue growth from existing casinos. This is also the case for results from Huff's model with regional GGR growth, although the positive $150.9 million suggests a milder draw-away effect and greater potential for local market growth.

Admittedly, the static Huff's model result of a net $62.6 million net gain in Atlantic City is explicitly generated via a reallocation of a fixed amount of regional gross gaming revenues across all casinos. The reallocation is based on a readjustment from new shares of distance-weighted slot machines and tables across the casinos. In this regard, estimates from Huff's model are necessarily quite conservative. This is because historical evidence suggests that real regional gross gaming revenues tend to rise over time, recessions notwithstanding. Similarly, the $68.9 million in additional net revenues as estimated via the time-series regression also likely underestimates the true impact of an additional casino in Atlantic City. The main cause is that the model parameters are based on historical data, and most of Atlantic City's history within the time series of data used reflects a period of monotonic decrease in both slot machines available and in gross gaming revenues. As such, the important statistical history lessons provided via the introduction of Hard Rock and Ocean Resorts, while emphasized in the model through their recency, are undoubtedly cancelled somewhat in the model parameters by the years of decline and casino closures.

In summary, we deem that, for a scenario in which a new casino is added only in Atlantic City, the more sanguine estimate that emanates from the version of Huff's model that allows regional GGR growth—a net rise in city GGR of $150.9 million—may be more reasonable at the present time. This is verified somewhat by what occurred after two casinos were recently introduced there. On the other hand, should regional GGR growth falter and decline, due to a national recession that could be in the offing, the regression-based results would undoubtedly be more vital.

Scenario 2: Addition of 2,000 Slots in Philadelphia

The results of the regression and the static version of Huff's model indicate that the addition of the new Stadium Casino in Philadelphia will likely cause Atlantic City GGR losses on the order of $32 to $116 million. Here, we have more confidence in the more discouraging findings for Atlantic City from the regression model, since the historical data embody a significant number of similar competing casino starts.

The regression model gauges the impact of those competing casinos on Atlantic City gaming revenues by a metric that embodies the aggregate number of slot machines in competing markets, adjusted for their distance (travel time) from Atlantic City. The coefficient on this variable (-0.6) indicates that a 10 percent increase in the value of the metric (lagged by 3 quarters) is associated with a 6 percent decrease in the city's GGR. Using the same travel time from Atlantic City as the Sugarhouse Casino, the change in this variable when it is recalculated to reflect the addition of 2,000 slots in Philadelphia with a three quarter lag is approximately 7.4 percent, resulting in an estimated 4.4 percent decrease in Atlantic City GGR relative to the prior four quarters—a change of $116 million for the most recent four quarters. The regression model may overestimate the magnitude of this effect, however, as the addition of slots in competing markets may not capture the full potential of cannibalization within those markets. That is to say, the extent to which a new casino in Philadelphia may be more likely to draw customers away from other Philadelphia casinos than from Atlantic City.

Results from Huff's model with regional GGR growth produces a somewhat different result, with a positive $52.5 million of regional GGR growth allocated to Atlantic City. This indicates that Atlantic City casinos are likely to share about one seventh of total regional GGR growth of $350 million when a new casino in Philadelphia is added to the mix, which implies that Atlantic City would receive about $100 million less of regional growth than it would if no new competitors entered the market.

Scenario 3: Addition of 2,000 Slots in New York City

As with Philadelphia, we simulated the addition of a 2,000-slot casino in New York City, using the Empire City Casino in Yonkers and the Resorts World Casino in Queens as the proxies for travel time from Atlantic City. Because of its distance from Atlantic City, the effect of an additional casino in New York City yields a more muted effect on Atlantic City gaming revenues than is obtained from one casino added in Philadelphia. This is as expected given the greater amount of time it takes to get to Atlantic City from New York City, let alone the other side of the East River. The simulations using the two casino locations produce similar results, with a range of

$21 to $24 million in reduced Atlantic City gaming revenues from Huff's model without growth, and a range of $69 to $72 million in reduced Atlantic City revenues according to the regression model.

In the meantime, Huff's model with GGR growth produces a positive range of $61 to $64 million in increased Atlantic City gaming revenues. Due primarily to the longer travel time from Atlantic City, the effect of adding casinos in New York City seems to be slightly weaker on Atlantic City casinos, though Atlantic City's gain is still a rather small portion of regional growth relative to the aggregate size of its casinos.

Scenario 4: Addition of 2,000 Slots in Atlantic City and Philadelphia

In Scenarios 4 through 6, we estimate the results of adding a new casino in Atlantic City concurrent with the opening of a new casino in Philadelphia, New York City, or both. The results of this analysis are provided in Table 2.

Table 2. Impacts on AC Gross Gaming Revenues of Adding 2,000-Slot Casinos in Multiple Locations

	Net change in AC Gross Gaming Revenues ($ millions)		
Location of New Casino(s)	**Regression Model**	**Huff's Model (Static)**	**Huff's Model (with Regional GGR Growth)**
Atlantic City alone	+$68.9	+$62.6	+$150.9
AC + Philadelphia	-$47.3	+$30.2	+$117.1
AC + NYC	-$3.5	+$39.9	+$127.2
AC + Philadelphia + NYC	-$117.9	+$8.1	+$94.1

For the regression model, the results in these scenarios are simply the sum of the results of the individual scenarios. Thus, in Scenario 4, the addition of new casinos in both Atlantic City and Philadelphia results in a $47.3 million decrease in Atlantic City's gaming revenues. By contrast, the static version of Huff's model estimates that adding the two 2,000-slot casinos at the same time would likely result in a net increase of $30.2 million in Atlantic City's GGR, though this still points to a decay in the city's potential to draw customers away from other casinos due to increased

competition in Philadelphia. In the version of Huff's model with revenue growth, while the net increase in GGR for Atlantic City is larger, it nevertheless reflects the off-setting draw of the new Philadelphia casino, which reduces Atlantic City GGR by about the same amount as in the static model relative to a casino being added in Atlantic City alone.

Scenario 5: Addition of 2,000 Slots in Atlantic City and New York City

In this scenario, we estimate the impacts on Atlantic City's GGR of adding new casinos in Atlantic City and New York City. Here we use the average impact of the addition of a casino in Yonkers (using Empire City Casino as a proxy) and Queens (using the Resorts World Casino as a proxy) to represent the casino in New York City. Results indicate impacts on Atlantic City GGR ranging from a loss of $3.5 million in regression model to a gain of $127.2 million in Huff's model with regional GGR growth. The static version of Huff's model predicts an increase of $39.9 million in Atlantic City GGR. As with Philadelphia, the results suggest that the addition of a new casino in New York City will undermine Atlantic City's ability to draw revenues, though with a somewhat weaker effect than that of a new casino in Philadelphia.

Scenario 6: Addition of 2,000 Slots in Atlantic City, Philadelphia, and New York City

Based on the modeling results, we estimate that the impact of adding a 2,000-slot casino in all three locations on Atlantic City GGR will most likely range from a loss of $118 million in regression model to a gain of $94 million in Huff's model with regional growth. As one would expect, the addition of new casinos in multiple competing jurisdictions significantly offsets any GGR gains that Atlantic City might realize from the addition of a new casino. While this offsetting effect is curtailed in Huff's model, either with or without growth, it nonetheless results in negligible GGR gains relative to the average GGR of existing casinos.

Implications and Conclusion

We examined the extent of market saturation for casinos in Atlantic City, as well as the potential impacts of the addition of one or multiple new casinos on the total gross gaming revenues

of the city's casino industry. In addition to a retrospective story of market fluctuations and regional competitors, we used two modeling approaches to obtain a range of impact estimates for each of the six scenarios. The range is wide in selected scenarios. Both approaches consistently found that the addition of new casinos in Atlantic City should reap increasingly diminishing returns, and the vitality of a new market entrant depends, in part, on its ability to draw revenues away from the existing set of casinos in the city. The analysis also shows that a new casino in the competing markets of Philadelphia and New York City would draw gaming revenues away from Atlantic City, the observed experience of its casinos since 2005. Gross gaming revenues in Atlantic City declined by over 50% from its 2006 peak of over $5.2 billion to just over $2.5 billion in 2018. This effect further diminishes any growth-inducing capacity of new casinos in Atlantic City.

Beyond the historical trend, the near-term trajectory of gaming revenues in Atlantic City presents instructive implications. For one, we should be able to observe how the recently opened Hard Rock and Ocean Resort casinos affects citywide gaming revenues. Through the end of the second quarter of 2019 the two new casinos enabled Atlantic City to gain only the equivalent of a single, average-sized casino because their revenue gains have been at least partly at the expense of existing casinos within the city. Our analysis suggests that such cannibalization should become more pronounced with the addition of more casinos—indeed, even more slot machines—in Atlantic City since new entrants are unlikely to invigorate the relatively settled share that area casino gross gaming revenues retain of the region's aggregate personal income.

Nevertheless, the greater 78-county Atlantic City gambling market may not be fully saturated. Sports betting and internet gaming are still somewhat nascent, and costs associated with their operation are substantially lower than they are for brick-and-mortar competition. So they are unlikely to fade away any time soon. Still, their markets are presently limited to customers physically within New Jersey, so any substantial growth on their part could make considerable inroads into Atlantic City's gaming action. To be sure, this could change as other states ride this new tide.

Finally, the current pace of growth in Atlantic City's GGR, while positive, is also rather slow. Yet, the regional and national economies are growing fairly strongly—as well as they have over the past decade. If general economic growth falters, it is likely to have a deleterious effect on all casinos' GGRs, let alone those for Atlantic City. At this stage, given the saturated market and forceful competitors, New Jersey's casinos will have a tough time sustaining their position. The degree to which casinos in Atlantic City, which have experienced recent GGR losses, are able to recover will be worth watching.

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APPENDIX

Table A.1. Number of Slots by Casino, 2018

Casino	Slots	Year of Entry
New Jersey		
Bally's	1,776	
Borgata	2,994	2003
Caesars	1,889	
Golden Nugget	1,444	
Hard Rock	2,103	2018
Harrah's	2,129	
Ocean Resort	1,937	2018
Resorts	1,475	
Tropicana	2,476	
Delaware		
Delaware Park	2,254	1996
Dover Downs	2,179	1996
Harrington	1,787	1996
Pennsylvania		
Mohegan	2,325	2006
Parx	3,331	2006
Harrah's	2,450	2007
Mount Airy	1,863	2007
Hollywood/Penn National	2,171	2008
Sands Bethlehem	3,073	2009
Sugarhouse	1,809	2010
Valley Forge	600	2012
New York		
Monticello	1,110	2004
Empire	5,220	2006
Resorts NYC	5,545	2011
Jake's 58	1,000	2017
Resorts Catskills	2,156	2018
Maryland		
Hollywood Perryville	822	2010

Table A.2. Change in Gross Gaming Revenues: AC and Non-AC with AC Share of Total Win

	AC GGR (Win)			Non-AC GGR (Win)			
Year	Total	Absolute Change	Pct. Change	Total	Absolute Change	Pct. Change	AC / Total Win%
1993	3,301,360,000						
1994	3,422,534,000	121,174,000	3.7%				
1995	3,747,578,000	325,044,000	9.5%				
1996	3,813,598,000	66,020,000	1.8%	184,378,411	184,378,411	-	95.4%
1997	3,906,140,000	92,542,000	2.4%	298,905,100	114,526,689	62.1%	92.9%
1998	4,032,998,000	126,858,000	3.2%	350,821,200	51,916,100	17.4%	92.0%
1999	4,164,199,000	131,201,000	3.3%	412,493,300	61,672,100	17.6%	91.0%
2000	4,300,734,397	136,535,397	3.3%	485,104,300	72,611,000	17.6%	89.9%
2001	4,303,078,299	2,343,902	0.1%	526,639,900	41,535,600	8.6%	89.1%
2002	4,381,579,187	78,500,888	1.8%	565,909,900	39,270,000	7.5%	88.6%
2003	4,488,334,419	106,755,232	2.4%	501,999,700	-63,910,200	-11.3%	89.9%
2004	4,806,800,604	318,466,185	7.1%	585,603,466	83,603,766	16.7%	89.1%
2005	5,018,276,523	211,475,919	4.4%	647,504,990	61,901,524	10.6%	88.6%
2006	5,217,713,795	199,437,272	4.0%	809,745,207	162,240,217	25.1%	86.6%
2007	4,920,786,970	(296,926,825)	-5.7%	1,888,311,745	1,078,566,538	133.2%	72.3%
2008	4,544,960,791	(375,826,179)	-7.6%	2,487,367,942	599,056,197	31.7%	64.6%
2009	3,943,171,237	(601,789,554)	-13.2%	2,861,716,669	374,348,727	15.0%	57.9%
2010	3,564,330,358	(378,840,879)	-9.6%	3,390,790,354	529,073,685	18.5%	51.2%
2011	3,315,939,476	(248,390,882)	-7.0%	4,146,019,549	755,229,195	22.3%	44.4%
2012	3,050,700,679	(265,238,797)	-8.0%	5,102,264,255	956,244,706	23.1%	37.4%
2013	2,862,068,918	(188,631,761)	-6.2%	5,556,623,181	454,358,926	8.9%	34.0%
2014	2,619,250,906	(242,818,012)	-8.5%	5,624,342,717	67,719,536	1.2%	31.8%
2015	2,414,237,376	(205,013,530)	-7.8%	5,974,416,692	350,073,975	6.2%	28.8%
2016	2,406,012,101	(8,225,275)	-0.3%	6,156,928,065	182,511,373	3.1%	28.1%
2017	2,413,407,612	7,395,511	0.3%	6,742,576,235	585,648,170	9.5%	26.4%
2018	2,510,754,211	97,346,599	4.0%	7,099,901,254	357,325,019	5.3%	26.1%

Table A.3. Regional Gross Gaming Revenues and Personal Income Growth Rates, 1994-2018

Year	GGR	Personal Income
1994	3.7%	3.4%
1995	9.5%	5.9%
1996	6.7%	5.9%
1997	5.2%	6.1%
1998	4.3%	6.6%
1999	4.4%	5.6%
2000	4.6%	8.9%
2001	0.9%	4.0%
2002	2.4%	0.4%
2003	0.9%	2.0%
2004	8.1%	5.1%
2005	5.1%	4.5%
2006	6.4%	7.7%
2007	13.0%	7.3%
2008	3.3%	1.6%
2009	-3.2%	-2.6%
2010	2.2%	4.1%
2011	7.3%	5.8%
2012	9.3%	5.3%
2013	3.3%	1.3%
2014	-2.1%	4.7%
2015	1.8%	4.4%
2016	2.1%	3.2%
2017	6.9%	5.3%
2018	5.0%	5.2%

Table A.4. Times Series Regression Model Output

Dependent variable: log(ACGGR)
Method: ARMA Maximum Likelihood (OPG-BHHH)
Sample: 2009 Q1 – 2018 Q4
Included observations: 40
Convergence achieved after 10 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.691056	5.825862	0.461915	0.6473
log(ACGGR(-1))	0.520802	0.165782	3.141481	0.0036
log(ACSlots(-3))	0.194489	0.111923	1.737698	0.0919
log(DS_Slots(-3))	-0.596524	0.193166	-3.088135	0.0041
log(income(-4))	1.464683	0.675732	2.167549	0.0377
log(NJUrate(-4))	0.117957	0.077160	1.528738	0.1362
AR(4)	0.926544	0.083205	11.13565	0.0000
SigmaSQ	0.002355	0.000697	3.380828	0.0019

R-squared	0.941100	Mean dependent var	20.38479
Adjusted R-squared	0.928216	S.D. dependent var	0.202505
S.E. of regression	0.054256	Akaike info criterion	-2.617805
Sum squared residue	0.094200	Schwartz criterion	-2.280029
Log likelihood	60.35610	Hannan-Quinn criterion	-2.495676
F-statistic	73.04236	Durbin-Watson stat	2.291111
Prob (F-statistic)	0.000000		

Inverted AR Roots	.98	.00+.98i	-.00-.98i	-.98