# State Revenue Potential of Lottery and Racetrack Gambling

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## Introduction

In recent years many state governments have sought to enhance revenues by authorizing and taxing new forms of gambling. Most notably, thirty-four states and the District of Columbia now participate directly in the gambling industry by operating a state lottery. State regulations governing horse and dog racing have also been relaxed to permit longer racing seasons, new types of "exotic" betting and off-site wagering on satellite broadcasts. Additionally, legalization of casino gambling is increasingly being viewed as a regional development strategy outside the traditional gambling states of Nevada and New Jersey. While gambling revenues have risen sharply in response to the growing supply of wagering opportunities, state officials have expressed concern that further gains may be limited by competition between various types of gambling.

California provides a case in point. The state's Thoroughbred racing industry has long been among the nation's largest, ranking second only to New York in racetrack wagering and to Kentucky in number of foals produced. In 1989, about 10.5 million racing patrons wagered over \$2.3 billion at California's five major Thoroughbred tracks, generating \$145.5 million dollars in parimutuel taxes for state and local governments. Additionally, the industry is estimated to have employed over 10,000 people on a full-time basis (Carter, Shepard, and Whitney, 1991).

In 1985, opportunities for legal wagering expanded sharply as California authorized both a state lottery and satellite wagering on horseraces. Since its inception California's lottery has led the nation in sales, with gross receipts averaging over $2 billion per annum. Satellite wagering, an innovation that allows patrons to view and wager on races broadcast live from racetracks to designated satellite facilities, represents a significant expansion in California's racing industry. As shown in Figure 1, there are five major Thoroughbred racetracks in the state, located in three urban areas (greater San Francisco, Los Angeles, and San Diego). By 1989, satellite wagering had introduced horserace wagering to 21 new geographic markets while also extending the wagering season at the five major tracks.

Several previous studies investigating the degree of competition between racetrack wagering and state lotteries have suggested that lotteries may have a large negative impact on racetrack activity. Thalheimer and Ali (1990) estimated that the Ohio State Lottery caused declines of 14.8 percent in attendance and 21.9 percent in total handle at several racetracks in southern Ohio and northern Kentucky.[1] Examining 1982 cross-sectional data (prior to the California lottery's introduction), Simmons and Sharp (1987) noted that mean total handle in lottery states was 36 percent less than in states without lotteries. Gulley and Scott (1989) analyzed pooled data from 61 racetracks from 1976 to 1982 and concluded that each additional dollar per capita wagered on lotteries reduced racetrack wagering per attendee by $0.18 in real terms. In comparison to projections based on previous trends, Vasché (1990) noted that California wagering on live races dropped sharply following 1985, and attributed the decline to competition from the lottery and satellite wagering.

While existing studies raise concerns about competition between new forms of gambling and horseracing, some questions remain unanswered. First, the joint effects of satellite and lottery wagering on horseracing have not been estimated to date. Additionally, despite California's leadership in both lottery and racetrack wagering, interactions among its gambling markets have been little studied due to the relatively recent introduction of the state's lottery. Here we assess the impact of satellite wagering and the California state lottery on attendance and wagering at California's five major Thoroughbred racetracks and their associated satellite betting facilities over the period 1969-89. Because only the last ~~five~~ 6 years of the sample period include lottery and satellite wagering, these data have been disaggregated by region and racing season to allow a more detailed comparison with racetrack activity. An effort is made to evaluate the robustness of findings through model specification testing and by establishing confidence intervals for elasticity estimates.

## An Empirical Model

### *Background*

Although racetracks are usually privately operated, state governments maintain strict control over racing activities through a variety of statutes and regulations. For example, states determine the economic incentives ("prices") faced by bettors, horse owners, and racetracks by setting the parimutuel takeout rate and allocating takeout revenues among industry participants.[2] States also limit the number of days that racing can be offered and assign these days by track, often establishing regional monopolies. Government policies are therefore critical determinants of racing attendance and wagering.

Given the significance of regulation in this market, it is not surprising that a number of authors have examined the effects of state policies on horseracing revenues. In addition to aforementioned studies by Simmons and Sharp, Gulley and Scott, and Thalheimer and Ali, these include Gruen (1976) in New York; Pescatrice (1980a, b) in New York and Louisiana; Ahern and Lawrence (1983) in Maryland; Suits (1979) in Nevada (based on data from off-track bookmaking); and Morgan and Vasché (1979) in California.

One policy issue addressed in each of the above studies is that of the optimal price of wagering, or takeout rate. Despite differing methodology and data, all except Pescatrice and Gulley and Scott have found that the demand for racetrack wagering is elastic with respect to the takeout rate. This implies that parimutuel revenues would increase if takeout rates were reduced. However, effective takeout rates in most horseracing states have been rising, not falling.[3] In California, for example, Morgan and Vasché estimated an elasticity of demand with respect to the effective takeout rate of -1.48, based on data from three major Thoroughbred tracks from 1958 through 1978. Yet California's takeout rate has increased steadily since the legalization of parimutuel wagering in 1933; recent levels have reached an all-time high of over 18.5 percent.[4]

Why have states generally failed to reduce takeout rates? One possibility is that governments have chosen to forego revenues in order to curtail gambling. The proliferation of state-run lotteries operated with the express purpose of generating revenues would seem to rule out this explanation. Or perhaps legislators believe that the marginal costs associated with increased wagering activity would exceed marginal revenues, as suggested by Guthrie (1980). However, there is evidence that at current levels of attendance and handle marginal costs are low for racetracks and essentially zero for state governments (Morgan and Vasché, 1980; Ahern, 1980). A more likely explanation for persistently high takeout rates is simply that legislators doubt that a rate reduction can enhance revenues.

*Variables and Data*

Following the approach of Morgan and Vasché (1979), the dependent variables considered are total attendance per thousand residents (ATTEND) and real handle wagered per attendee (HPA). Ultimately the variable of greatest interest is total dollars wagered per capita, or HANDLE (where HANDLE = ATTEND x HPA). However, separating wagering into its components yields additional information about the effects of each explanatory variable on racing activity. Explanatory variables are the effective takeout rate (ETO), real per capita income (PCY), the number of live racing days (DAYS), the number of satellite racing days (SATDAYS), and real lottery sales per capita (LOTTERY).[5]

The data are pooled cross section (by track) and annual time series observations for the years 1969 through 1989. California has two distinct racing market regions – north and south – with two major Thoroughbred racetracks operating in the northern region and three operating in the southern region. Each track's racing days are allocated by the state regulatory agency such that only one track operates at a given time within each region. Therefore, all data are observed directly by track (ATTEND, HPA, ETO, DAYS), or are matched to each track by location (SATDAYS, PCY) or by time and location (LOTTERY).

The LOTTERY variable may deserve brief elaboration. While economic theory suggests that relative prices of possible substitutes or complements are relevant in demand analysis, to include the "price" of the lottery here presents complications. First, the lottery did not exist over most of the sample period. Upon its introduction, its "price" (takeout rate) did not vary on an annual basis. Thus the lottery's price is equivalent to a dummy variable indicating the existence or non-existence of the lottery in a given year. Instead we use real per capita lottery sales – during the time each racetrack is operating and in its market region – to reflect the degree of competition presented by the lottery.

*The Model*

For both attendance (ATTEND) and handle per attendee (HPA), a linear specification was tested against the alternatives of a log-linear or semi-log functional form using the $P_E$ test proposed by Davidson and MacKinnon (1981). Test results unambiguously supported a linear functional form over either alternative for the ATTEND equation. For the HPA equation, tests supported the linear specification over the log-linear and were inconclusive when comparing linear and semi-log models. We conclude that it is appropriate to use a linear functional form for both equations.

Notice that this model specification implies that real total handle per capita (ATTEND x HPA) is a restricted quadratic function of the explanatory variables. However, several authors (e.g., Gruen, Pescatrice, and Gulley and Scott) have specified total handle as a linear function. To further test the implicit quadratic functional form of this model, we compared the sum of squared residuals (SSE) from a linear regression of real total handle per capita on the explanatory variables to the SSE implied by our quadratic specification. The results provided additional support of the implicit quadratic specification for real total handle per capita.

In both equations, intercepts were allowed to vary by track to account for unique factors such as location or quality of facilities. Intercept variables SA, HP, DM, BM, and GG denote the Santa Anita, Hollywood Park, Del Mar, Bay Meadows, and Golden Gate Fields racetracks, respectively. For each equation, errors were assumed to be time-wise autoregressive (AR(1)) and cross-sectionally heteroskedastic and correlated (Kmenta 1986, pages 622-625).

## Empirical Findings

Each equation was estimated using standard generalized least squares procedures. Regression results are shown in Table 1.

TABLE 1

In addition to the elasticity point estimates presented in Table 1 (calculated from the original regression), 95% confidence intervals for each elasticity were calculated using the bootstrapping procedures recommended by Dorfman, Kling, and Sexton (1990).[6] The bootstrapping methodology for calculating confidence intervals, originally developed by Efron (1981), has been shown to have good small-sample properties (see, e.g., Dorfman, Kling, and Sexton, 1990; or Freedman and Peters, 1984). Elasticity confidence intervals, along with the elasticity means from the bootstrapping experiment, are given in Table 2.

TABLE 2

## Interpretation of Results

*Effective Takeout Rate (ETO)*

The effective takeout rate is found to be positively related to per capita attendance – a result not expected from theory. However, the t-test indicates that the coefficient is not significantly different from zero. Furthermore, the confidence interval for the elasticity of ATTEND with respect to ETO indicates that the elasticity could be zero or negative. We conclude that the effective takeout rate has little or no effect on attendance.

On the other hand, the effective takeout rate has a large negative effect on handle per attendee that is significant at the .99 confidence level. The elasticity estimate of -2.23 and its corresponding confidence interval indicate that HPA is highly responsive to changes in ETO.

It can be shown that, for any variable x,

$$\varepsilon_{\text{HANDLE, x}} = \varepsilon_{\text{ATTEND, x}} + \varepsilon_{\text{HPA, x}}$$

where $\varepsilon_{HANDLE, X}$ is the elasticity of real total handle per capita with respect to x, $\varepsilon_{ATTEND, X}$ is the elasticity of ATTEND with respect to x, and $\varepsilon_{HPA, X}$ is the elasticity of HPA with respect to x. Thus the estimated elasticity of total handle per capita with respect to the effective takeout rate is -2.04. The policy implication is obvious: parimutuel revenues can be increased by reducing the effective takeout rate. Moreover, this result holds with a high level of confidence. Only if both $\varepsilon_{ATTEND, ETO}$ and $\varepsilon_{HPA, ETO}$ fall near the upper bounds of their respective 95% confidence intervals does $\varepsilon_{HANDLE, ETO}$ fall in the inelastic range.

*Per Capita Real Income (PCY)*

Per capita real income (PCY) has a significant negative effect on attendance and a positive but insignificant effect on handle per attendee, a result consistent with earlier findings by Morgan and Vasché. The elasticity of HANDLE with respect to PCY is -0.495, indicating that horse race wagering is an inferior good. However, our confidence intervals allow for the possibility of a zero or positive net effect. Income's negative effect on attendance may reflect the scarcity of free time that is associated with high levels of employment and earnings among the population.

*Live Racing Days (DAYS)*

As expected, an expansion of live racing days is found to increase attendance (at the 99% confidence level) but decrease handle per attendee (at the 90% confidence level). Apparently an increase in racing days leads some bettors to spread their wagering activity over more days and thus bet less per visit to the track. Confidence intervals indicate that expanding the supply of racing days is almost certain to increase total dollars wagered. Nevertheless, because the current racing calendar offers little opportunity to increase live racing days without creating overlapping race meets within each market region, it is possible that additional racing days would have less impact on attendance and handle than has historically been the case.

*Satellite Racing Days (SATDAYS)*

Like live racing days, the effect of an increase in satellite racing days at California satellite facilities per annum (SATDAYS) is to raise attendance while reducing handle per attendee. Both coefficients are significantly non-zero at the .99 level. Although the marginal impacts of satellite days on ATTEND and HPA are very small (elasticities of 0.141 and -0.084 respectively), the overall effect of satellite wagering on total handle has been sizable since total satellite days have risen from zero to more than 5,000 between 1984 and 1989. A comparison of total 1989 handle with and without SATDAYS suggests that the presence of satellite wagering has increased total handle by 9.39 percent.[7]

Given these estimates, it would appear that substantial gains in revenues are unlikely to come from incremental expansion of satellite racing days in California. A one percent increase in SATDAYS raises total handle by only 0.057 percent. However, the effect of an additional satellite day will certainly vary depending on the market in which it is offered. Under current horseracing law, satellite wagering is restricted to locations such as fairgrounds; thus our estimates do not reflect the revenue potential of offering additional satellite days at other more conveniently located off-track betting facilities.

*The California Lottery (LOTTERY)*

An increase in real lottery sales per thousand California residents (LOTTERY) is found to reduce both attendance and handle per attendee. However, the marginal effects of LOTTERY on attendance and handle per attendee are small in magnitude and not statistically significant at the usual levels. Likewise, the bootstrapped elasticity estimates have negative means, but include the possibility of zero or positive elasticities. These results indicate that fluctuations in lottery sales have only a small effect on handle. Based on the point estimates, an additional dollar in annual per capita lottery sales is found to reduce racetrack wagering per attendee by $0.09 and total per capita handle by $0.026. Nevertheless, the implied total effect of the lottery is substantial, reflecting the growth in nominal lottery sales from $0 in 1984 to approximately $2.6 billion in 1989. A comparison of 1989 total handle with and without LOTTERY indicates the lottery has led to a 4.25 percent decline in attendance and a 3.10 percent decline in handle per attendee, for a net loss of 7.35 percent in total dollars wagered.

An alternative specification replaced LOTTERY with a dummy variable denoting the existence of the lottery. The coefficients of the lottery dummy variable were -0.528 (t=-0.17) and -6.987 (t=-1.50) for the ATTEND and HPA equations respectively; all other results remained essentially unchanged. This regression suggests that the lottery has had little effect on racing attendance while reducing real handle per attendee by approximately $7, or 3.16 percent.

*Track-specific Components of Attendance and Wagering*

The variables SA, HP, DM, GG, and BM represent the effects of factors specific to each racetrack (such as location, ease of access, general quality of racing or facilities, etc.) that are not otherwise included in the model. The estimates imply that, even if all other factors could be held equal for every track, Santa Anita and Hollywood Park (both located in the Los Angeles area) would be expected to have substantially higher attendance per capita than do the remaining tracks. Other factors held constant, handle per attendee varies little across tracks.

Apparently, track-specific factors mainly affect attendance; once at the track, patrons' gambling behavior is fairly uniform across the state.

## Summary and Conclusions

Using recent panel data from California, this study estimates the degree of competition between the state's two leading forms of legal gambling, each with annual wagers in excess of $2 billion: Thoroughbred horse racing and the state lottery. Several previous studies have suggested that lottery wagering may drastically erode racing revenues. Here lottery data are disaggregated by region and racing season to allow a more accurate comparison with racetrack activity. Our results indicate that, while the 1985 introduction of a state lottery has had a negative effect on racetrack wagering, its impact has been modest and was more than offset by the simultaneous legalization of satellite wagering on horse races. This suggests that racetrack betting and the lottery are not close substitutes, and that California's market for legal gambles had not yet reached saturation. Furthermore, our finding of a highly price elastic demand for racetrack wagering implies that both racetrack and state revenues could be enhanced by reducing the state-legislated takeout rate charged on parimutuel bets.

## Endnotes

[1]The parimutuel "handle" is the total amount wagered.

[2]The takeout rate is the percentage of wagered dollars withheld from winning bettors for distribution among race tracks, horse owners (as purses), and state and local governments according to legislated formulae.

[3]In most states, a higher takeout rate applies to exotic wagers (those depending on the placement of more than one horse) than to conventional win-place-show wagers. The *effective* takeout rate is the ratio of total takeout to total handle. It depends on the legislated takeout rates on conventional and exotic wagers, plus breakage – the amount retained by the practice of rounding down winners' payoffs to the nearest dime per dollar.

[4]Although the legislated takeout rate on conventional wagers was reduced slightly in California in 1981, a corresponding increase in the exotic takeout rate resulted in a net increase in the effective takeout rate.

[5]While the effective takeout rate (ETO) is considered the marginal "price" of wagering in this analysis, racing patrons also pay an admission fee and incur miscellaneous expenses such as those for travel, parking, and racing programs. Moreover, the opportunity cost of racing attendance is substantial since it is a time-consuming activity. Unfortunately, data on admission fees and other miscellaneous costs were not available over the sample period.

[6]The procedures of Dorfman, Kling, and Sexton were modified to account for the nonspherical disturbances of our model.

[7]An important issue not addressed in this analysis is the effect of off-track wagering on on-track attendance. California's off-track wagering has been found to depress on-track attendance and handle (Carter, Shepard, and Whitney, 1991). Thus, off-track wagering may erode track revenues (e.g., by reducing track admission fees and concession sales). The long-run implications of reduced on-track activity, in the short-run primarily affecting the race tracks, must be taken into account in policy decisions.

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**Table 1. Regression Estimates**

| Explanatory Variable | ATTEND Equation | | HPA Equation | |
|---|---|---|---|---|
| | Parameter | Elasticity | Parameter | Elasticity |
| ETO | 1.286<br>(0.72) | 0.186 | –28.197<br>(-6.38) | -2.228 |
| PCY | –0.0076<br>(-3.72) | -0.881 | 0.0061<br>(1.10) | 0.386 |
| DAYS | 1.088<br>(9.58) | 0.752 | –0.273<br>(-1.83) | -0.103 |
| SATDAYS | 0.011<br>(6.35) | 0.141 | –0.012<br>(-2.75) | -0.084 |
| LOTTERY | –0.00021<br>(-1.31) | -0.037 | –0.00028<br>(-1.28) | -0.027 |
| SA | 157.18<br>(7.27) | | 654.71<br>(12.59) | |
| HP | 139.95<br>(6.21) | | 668.97<br>(12.71) | |
| DM | 84.21<br>(3.77) | | 632.02<br>(11.60) | |
| GG | 88.50<br>(4.20) | | 657.55<br>(12.36) | |
| BM | 81.49<br>(3.92) | | 665.21<br>(12.50) | |
| Buse $R^2$ | .83 | | .73 | |

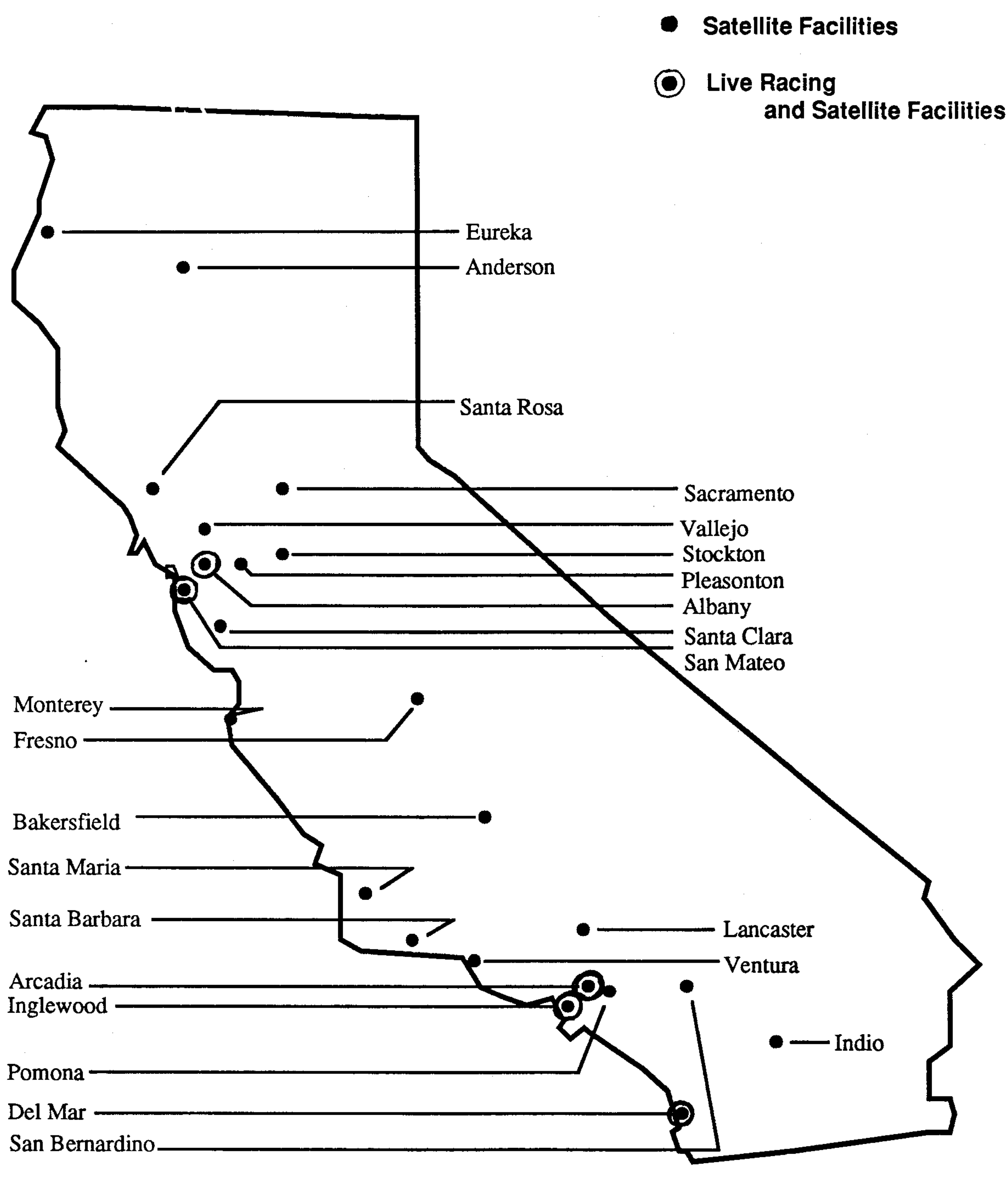
Numbers in parenthesis are t-ratios. Elasticities are point estimates from the original regression, evaluated at sample means.

**Table 2. Bootstrapped Elasticity Estimates, Means and 95% Confidence Intervals**

| | ATTEND | | | HPA | | |
|---|---|---|---|---|---|---|
| | | Confidence Interval | | | Confidence Interval | |
| | Mean | Lower | Upper | Mean | Lower | Upper |
| ETO | 0.191 | -0.261 | 0.684 | -2.255 | -2.904 | -1.569 |
| PCY | -0.878 | -1.304 | -0.462 | 0.408 | -0.291 | 1.100 |
| DAYS | 0.756 | 0.600 | 0.901 | -0.103 | -0.214 | 0.008 |
| SATDAYS | 0.145 | 0.100 | 0.188 | -0.087 | -0.144 | -0.020 |
| LOTTERY | -0.036 | -0.096 | 0.017 | -0.027 | -0.066 | 0.017 |

Elasticities evaluated at sample means

**Figure 1. Location of Racetracks and Satellite Wagering Facilities in California, 1989**

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