PostScript

LETTERS

Smoke-free law *did* affect revenue from gaming in Delaware

A paper by Mandel, Alamar, and Glantz, recently published in *Tobacco Control*, purports to show that the implementation of a smoking prohibition in Delaware had no statistically significant effect on the gaming revenue from slot machine-like video lottery terminals (VLTs) located at Delaware racetracks.[1] A subsequently published correction by Glantz and Alamar corrects for a data coding error and for reported heteroskedasticity in the data, but reaches the same conclusion of no significant effect.[2]

I have carefully examined the data and methodologies used in those studies, and conclude that their finding is questionable. Using more general approaches to controlling for heteroskedasticity and seasonality in the data, I find that both total gaming revenues and revenues per VLT declined significantly after the implementation of the Delaware smoke-free law.

Table 1 reports the results of ordinary least squares (OLS) regressions that replicate the model estimated in the correction of Glantz and Alamar. The first regression uses inflation adjusted total revenues as the dependent variable; the second uses revenues per machine. The underlying data are publicly available from the Delaware Lottery.[3] The focus of the analysis is on the variable P_{law}, a dummy variable representing the implementation of the smoke-free law. The coefficient on P_{law} is negative in both equations. In the case of total revenues, the estimate is significant.

The estimates for the average revenue equation in table 1 are virtually identical to those reported by Glantz and Alamar. Accordingly, it is unlikely that data discrepancies are relevant for distinguishing my findings from those of the original studies.

With regard to the estimates for the total revenues equation, Glantz and Alamar report that the residuals from an OLS regression display heteroskedasticity. I do not find evidence that this problem is significant: White's test fails to reject the null hypothesis of homoskedasticity ($p = 0.13$). Nevertheless, a visual inspection of the residuals does suggest the presence of some mild heteroskedasticity. The authors' method of correcting for this potential problem, however, is suspect. Glantz and Alamar report estimates from a weighted least squares (WLS) regression, using the inverse of the number of video lottery machines as a weight.

In the presence of heteroskedasticity, coefficient estimates are inefficient, but unbiased. Yet in the WLS estimates reported by Glantz and Alamar, the point estimate for the P_{law} coefficient (−2.4) is considerably different from the OLS estimate in table 1. This alone should give one pause in accepting the WLS estimate. Moreover, the WLS estimation results in a substantial reduction in the R^2 of the regression.

Table 1 Ordinary least squares regression results

	Total revenues ($million)			Average revenue per machine ($/machine)		
Variable	Estimate	SE	p Value	Estimate	SE	p Value
P_{law}	−5.601	2.746	0.044	−1158.05	745.12	0.124
Time	0.555	0.133	<0.001	95.460	36.14	0.010
Time^2	−0.003	0.001	0.003	−0.312	0.277	0.262
Machines	0.002	0.002	0.334	−2.763	0.434	<0.001
Income ($trillion)	10.376	1.738	<0.001	10782.43	471.61	<0.001
Winter	−4.344	1.160	<0.001	−1353.200	314.80	<0.001
n	101			101		
R^2	0.805			0.639		

The pattern of residuals suggests that the source of heteroskedasticity is most prominent in the data for 1996—the first year of the sample. Two of the three Delaware "racinos" opened at the beginning of 1996, while the third did not open until August. Consequently, there was a sharp increase in the number of VLTs in operation during that year. This accounts for the dramatic effect of the weighting scheme employed by Glantz and Alamar. If observations from 1996 are dropped from the sample, there is clearly no evidence of heteroskedasticity ($p = 0.25$), and the coefficient estimates for both the OLS and WLS specifications are essentially the same: For P_{law}, the OLS estimate is −7.82 ($p = 0.012$) and the WLS estimate is −7.81 ($p = 0.041$).

A more parsimonious approach to controlling for heteroskedasticity is to employ methods for calculating a heteroskedasticity consistent covariance matrix. Using the approach of Newey and West,[4] I found that the point estimate for the coefficient on P_{law} reported in table 1 has a corrected standard error of 2.121, implying a p value of 0.010.

Heteroskedasticity is not the only problem plaguing the residuals from the regressions reported in table 1. Significant serial correlation is also present. Table 2 reports estimates of regressions including an AR(1) specification for the residuals. Newey-West HAC consistent estimates are used to calculate standard errors, adjusting for any heteroskedasticity and higher order serial correlation that might be present. The AR coefficients are highly significant in both regressions. Moreover, the coefficients on P_{law} show a highly significant negative effect associated with the implementation of the smoke-free law.

Finally, seasonal effects were estimated in Mandel *et al*[1] using quarterly dummy variables. The authors report that "only winter was found to be significant, thus only the results with winter are reported". However, the significance of a particular seasonal dummy variable depends on the specification being considered. It is generally invalid to discard specific seasonal dummy variables based on individual significance tests from a particular regression. And in fact, I find that additional seasonal effects are significant.

Table 3 shows the results of monthly model that includes a constant term plus dummy variables for *winter*, *spring*, and *summer*. The dataset used for these regressions has also been extended to include observations through December 2004.

The results reveal significant seasonal variation, clearly refuting the contention that only the seasonal effects of winter are relevant. More importantly, the regression results reported in table 3 confirm that the coefficients on the smoking ban dummy variables are negative and highly significant.

Similar results were obtained with a complete set of monthly dummy variables included in the regression. The coefficients on P_{law} were found to be –6.54 ($p < 0.001$) for

Table 2 Regression results with adjustment for AR(1) residuals

	Total revenues ($million)			Average revenue per machine ($/machine)		
Variable	Estimate	SE*	p Value	Estimate	SE*	p Value
P_{law}	−6.088	1.982	0.003	−1433.92	425.80	0.001
Time	0.540	0.094	<0.001	80.33	36.14	0.029
Time^2	−0.003	0.001	<0.001	−0.159	0.216	0.463
Machines	0.002	0.001	0.182	−2.768	0.361	<0.001
Income ($trillion)	10.546	1.404	<0.001	10957.57	264.80	<0.001
Winter	−4.215	0.765	<0.001	−1198.72	201.53	<0.001
AR(1)	−0.273	0.065	<0.001	−0.226	0.070	0.002
n	100			100		
R^2	0.807			0.678		

*Newey-West HAC standard errors.

Table 3 Regression results using a full seasonal specification (including an extended sample period)

	Total revenues ($million)			Average revenue per machine ($/machine)		
Variable	Estimate	SE*	p Value	Estimate	SE*	p Value
P_{law}	−6.487	1.663	<0.001	−1567.29	348.92	<0.001
Time	0.638	0.117	<0.001	85.36	22.28	<0.001
$Time^2$	−0.003	0.001	<0.001	−0.166	0.149	0.269
Machines	0.002	0.001	0.049	−2.728	0.284	<0.001
Income ($trillion)	−11.581	18.263	0.528	9493.88	3535.54	0.009
Constant	30.618	26.563	0.252	1506.59	5143.92	0.770
Winter	−2.549	0.947	0.008	−614.83	242.35	0.013
Spring	2.326	0.829	0.006	892.90	235.64	<0.001
Summer	3.110	0.864	<0.001	908.06	228.97	<0.001
AR(1)	−0.333	0.058	<0.001	−0.304	0.064	<0.001
n	107			107		
R^2	0.818			0.743		

*Newey-West HAC standard errors.

total revenues (R^2 = 0.846) and −1583 ($p < 0.001$) for average revenue per machine (R^2 = 0.777).

Point estimates of the P_{law} coefficient suggest losses of approximately $6.5 million per month (in inflation adjusted 2004 dollars). This figure represents a revenue loss of nearly 13% compared to the year preceding the smoking ban.

The stated purpose of Mandel *et al*[1] was to refute the contention of the gaming industry that smoking bans pose a threat to their business: ''These results reject the argument that smoke-free laws hurt revenues from gaming''. I find, however, that the smoke-free law in Delaware *did* affect revenue from gaming. This finding is statistically significant and quite robust. The public health benefits of smoke-free laws should be weighed against these (and other, similar) economic costs.

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Authors' response to M R Pakko

Pakko[1] takes issue with our paper ''Smoke-free law did not affect revenue from gaming in Delaware,''[2 3] arguing that our methods were not sufficient because we failed to control for serial correlation and used a method of controlling for heteroskedasticity that did not meet his approval. We found these concerns odd, since in his original analysis claiming that there were negative effects of the Delaware law (published on the internet as a working paper[4]) he did not correct for either serial correlation or heteroskedasticity. Indeed, correcting Pakko's original model for heteroskedacity led to the conclusion that the Delaware smoke-free law was *not* associated with a significant change in revenues.

Now, Pakko has produced yet another, more complex statistical model, which he uses to repeat his argument that the Delaware law had an adverse economic impact. Pakko does not present any statistical evidence that his new model is correctly specified, nor has he retracted his earlier model.

Pakko also ignores the explanation given by the Delaware racinos in official filings with the US Securities and Exchange Commission, which did not even suggest that the smoke-free law had any effect on its revenues. As we noted in our paper,[2] the 7% decrease in revenue for its three casinos in Atlantic City and the management fees from Dover Downs was mainly due to inclement weather.[5] The online summary of the filing[5] did not mention the smoking restrictions as a reason revenue was down from the first quarter of the previous year.[2] In any event, as we showed in our paper,[2 3] this reduction was not significantly significant—that is, it is within the usual random fluctuation in the revenue stream.

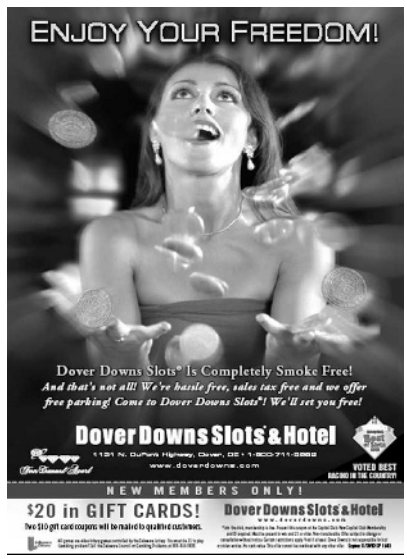

Figure 1 Advert highlighting a racino's smoke-free environment.

Finally, Pakko does not address the current reaction of the racinos to the smoke-free law. The racinos are not looking for ways to circumvent the law, as would be expected if the revenues were in fact suffering as badly as he suggests. Instead, Dover Downs is featuring their smoke-free environment in its advertising (fig 1). If the smoke-free environment were a drain on revenues, it seems odd that Dover Downs would advertise it.

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Health meetings do not belong in smoky cities

Each year thousands of tobacco control workers meet at the US National Conference on Tobacco or Health. Eleven years ago, in Boston, the opening plenary of the first meeting was held in the Roxy Hotel. Participants at the session complained of the stench of stale tobacco smoke which lingered in the air from an event on the previous evening.

The most recent meeting, held in May 2005, took place in Chicago, where smoking is still allowed in the lobbies of convention hotels and adjacent bars and clubs. The same complaints heard years ago about Boston were expressed by this year's attendees. A group of delegates conducted research on the air quality of Chicago bars and restaurants in an effort to urge conference organisers and city leaders to adopt a smoke-free policy. Fifty people were trained in a conference session on conducting indoor air quality studies.

The training session taught participants to learn how to measure indoor air pollution levels in smoke contaminated and smoke-free settings using a TSI SidePak AM510