FORECASTING WAGERING TAX COLLECTIONS FROM RIVERBOAT CASINOS IN INDIANA

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In July 2003, legislation was enacted in Indiana that made significant changes to the regulatory and tax structure applying to the state's riverboat casinos. The legislation also changed the state-local distribution scheme for revenue from the wagering tax imposed by the state on casino owners. This change directed substantially more revenue from the wagering tax to the state and to the state fund that pays for local property tax relief. Consequently, state revenue forecasters, for the first time, were required to develop a formal forecasting model for the wagering tax. This paper provides a discussion and analysis of the forecasting process and model.

BACKGROUND

Gambling on riverboat casinos was legalized in Indiana in 1993. The law authorized 11 riverboat casino licenses in specified areas of the state. The first riverboat casino began operations in Evansville in December 1995, and five more began operating in 1996. Ten riverboat casinos operate from five dock sites each on the Ohio River and Lake Michigan. The tenth riverboat casino opened in October 2000.[1] Wagering receipts retained by Indiana riverboat casinos after payout of winnings (referred to as *adjusted gross wagering receipts* or *AGR*) have increased almost 90-fold since the fourth quarter of 1995, from roughly $6.5 million to about $574.9 million during the third quarter of 2003.

Through July 2002, the riverboat casinos were required to leave the dock and cruise while gambling was conducted on-board. Typically, the riverboats conducted two-hour gaming excursions. The state imposed an admissions tax of $3 per person either admitted for a gambling excursion or allowed to remain on the riverboat from one gambling excursion to another. Prior to July 2002, the state also imposed a wagering tax equal to 20 percent of AGR earned by the casino owner. The flat-rate tax increased to 22.5 percent in July 2002.

From FY 1996 to FY 2002, the admissions and wagering taxes generated approximately $2.3 billion in revenue for the state and for the communities in which the riverboats are docked.[2] In FY 1997 (the first full year of riverboat tax distributions), the admissions tax generated $28.9 million for riverboat communities and $12.4 million for the state that was earmarked for certain functions.[3] By FY 2002, these local and state distributions experienced a three-fold increase to approximately $87.9 million and $37.8 million, respectively. Similarly, wagering tax proceeds almost tripled during this period. The distributions to riverboat communities increased from about $32.9 million in FY 1997 to approximately $95.1 million in FY 2002. During the same period, the state share of the wagering tax increased from about $98.6 million to $285.1 million. The state share of the wagering tax was utilized to replace local motor vehicle taxes and to fund state and local government capital projects.

The face of regulation and taxation of riverboat gambling changed in August 2002, however, when the ten riverboats were allowed to remain dockside while conducting gambling operations. Along with the elimination of the excursion requirement, the admissions tax and wagering tax were altered. With dockside operations, the admissions tax is imposed only on the basis of patrons entering the riverboat, and the wagering tax is graduated.[4] Under the five-tier graduated wagering tax structure, rates range from 15 percent on the first $25 million in annual AGR to the top marginal rate of 35 percent on amounts exceeding $150 million during the tax year. Corresponding to the regulatory and tax changes, local distributions of wagering tax revenue have been frozen at FY 2002 levels to ensure that the revenue effects of the regulatory and tax changes accrue to the state. More importantly, state revenue from the wagering tax is, for the first time, being utilized to fund continuing state expenses relating to property tax relief. In FY 2003, $294.7 million in wagering tax revenue was distributed to property tax relief and $33.0 million was distributed to the state general fund. Another $136.2 million was used to fund replacement of local motor vehicle taxes and capital projects.

The state consensus revenue forecast comprises estimates of revenue going to Indiana's General Fund and its Property Tax Replacement Fund.[5]

Thus, beginning in FY 2003, a forecast of wagering tax revenue to the state's Property Tax Replacement Fund was required. The remainder of this paper: (1) outlines the consensus revenue forecasting process in Indiana and its impact on the modeling process; (2) reviews pertinent literature on factors that affect gaming expenditures; (3) evaluates estimation results of the first-year forecast model; and (4) evaluates estimation results from a model specification containing a variable to account for the impact of dockside gaming.

INDIANA'S CONSENSUS REVENUE FORECASTING PROCESS

The revenue forecast for Indiana's General Fund and Property Tax Replacement Fund is generated through a consensus process involving both the executive and legislative branches. A forecast is generated in December, immediately prior to the budget session of the legislature, and updated in April during the budget session before the legislature adjourns. The forecast covers the remainder of the fiscal year in progress and the two fiscal years immediately following for which the legislature is budgeting. Thus, in December 2002 a wagering tax forecast for the remainder of FY 2003 and for FY 2004-05 was required.

The forecast of General Fund and Property Tax Replacement revenue results from the work of two independent forecasting committees. The Revenue Technical Committee (RTC) consists of six members–two members are appointees of the governor and four members represent each party caucus in the House of Representatives and the Senate. The RTC selects the forecasting models for the various taxes that provide revenue for the General Fund and the Property Tax Replacement Fund. These taxes include income, sales, and corporate taxes and, beginning in FY 2003, the riverboat wagering tax.

The RTC's forecast models specify economic measures that are generated by a second independent committee of economists called the Economic Forecast Committee (EFC). The EFC is comprised of five economists, and it develops its economic forecast independently of the RTC. The EFC provides a forecast of only three economic measures: Non-Farm Indiana Personal Income, U. S. Gross Domestic Product (GDP), and the GDP Price Deflator. As the EFC's work product carries great weight with policymakers, the model specification work of the RTC centers on these three measures. Thus, to an extent, the work of the EFC, and the confidence it has generated over time, serves to constrain the modeling that is conducted by the RTC. The forecast model for the wagering tax is indicative of these constraints. While it was specified based on prior empirical research to be reviewed in the next section, the model also was inextricably influenced by the consensus forecasting process. In particular, by the economic measures made available by the EFC.

FACTORS AFFECTING GAMING EXPENDITURES

The forecast model follows from a variety of empirical research suggesting several potentially important determinants of wagering. Prior econometric modeling and survey research suggests that income is the overwhelming determinant of gaming expenditures and participation. Both cross-sectional and time-series analyses suggest that income has a direct and statistically significant effect on gaming expenditures, such as lottery ticket sales (Cook and Clotfelter, 1993; Mikesell, 1994; Layton and Worthington, 1999; Ashley, Liue and Chang); spending on poker machines and casino type games (Layton and Worthington, 1999); spending on video lottery machines (Potiowsky and Parker, 2000); and pari-mutuel betting (Gulley and Scott, 1989).[6] These analyses suggest that the income elasticity of spending on gambling activities can be exceptionally high both in absolute terms and relative to other factors affecting gambling expenditures. Estimated income elasticities range from 0.11 to 3.9 for lottery ticket sales and from 0.7 to 1.7 for spending on video lottery, poker machines, and casino type games.

To an extent, survey research by Gazel and Thompson (1995) and Harrah's (2002) confirms the income effects suggested by the econometric literature.[7] Harrah's estimates participation rates ranging from 22 percent for adults earning less than $35,000 annually to 35 percent for adults earning over $95,000 annually. Gazel and Thompson estimate that mean gaming losses by casino patrons increase from about $28 per visit for patrons earning $10,000 or less annually to about $54 per visit for patrons earning over $30,000 annually.

The research by Gazel and Thompson (1996) also suggests that the vast majority of casino patrons lives in close proximity to the casinos. About 83 percent of Illinois casino visitors who were interviewed resided in Illinois. In terms of distance, 50

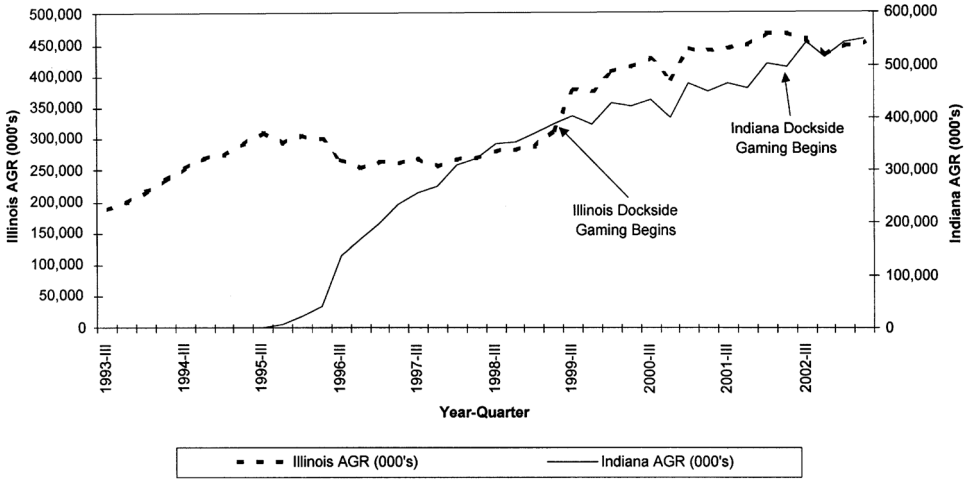
percent of the interview subjects resided within 25 miles of the casino. An additional 35.1 percent of the interview subjects resided between 25 and 50 miles of the casino. Only 4.6 percent of the interview subjects traveled more than 100 miles to visit the casino.[8] These proximity findings suggest that Indiana income likely serves as an effective proxy for income of casino patrons coming from cross-border areas of Illinois, Kentucky, Michigan, and Ohio.

Limited research also points to the efficacy of removing the cruising or excursion requirement for riverboat casinos as a means of boosting AGR. Deregulation efforts in Iowa, Illinois, and Missouri since the mid 1990s have been undertaken for this reason. Nichols (1998) and Atkinson, Nichols and Oleson (2000) suggest that removal of regulatory restrictions like betting and loss limits and cruising requirements have been advocated by the gaming industry in each of these states. In each state, regulatory changes were implemented to help local casinos compete against casinos in other states where regulation was less restrictive. This was expected to help local casinos expand market share and increase total AGR. The change to dockside gaming in Illinois in June 1999 boosted overall AGR to a substantially higher equilibrium. This increase is evidenced in Figure 1 below. Estimates indicate that Illinois post-dockside AGR was about 25 percent to 35 percent above pre-dockside levels through mid-2002. This suggests that Indiana AGR, in particular from Northwest Indiana riverboats, may have exhibited some compensating decline due to the Illinois regulatory change. This suggests, as well, that Indiana AGR may experience a boost due to dockside gaming.

Econometric research by Gulley and Scott (1989), Cook and Clotfelter (1993), Mikesell (1994), and Ashley et al. (1999) suggests that population, unemployment, and other competing forms of gambling also may be determinants of gaming expenditures. These factors are not accounted for in the forecast model, as the Economic Forecast Committee does not produce a forecast of population, unemployment, or other gaming, such as a lottery. More important, the estimated effects of these factors on gaming expenditures tend to be weak in comparison to income, and, in the case of unemployment, are unclear.

Studies of lottery spending determinants using pooled state-level lottery data (Cook and Clotfelter, 1993; Mikesell, 1994; Ashley et al., 1999) suggest that population differences explain variation in lottery sales across states. Given the relatively short time frame for which our single state forecast model is estimated, it would appear that the effect of population change would be very limited. Mikesell (1994) also explains variance in lottery sales with unemployment. The estimated relationship between unemployment and lottery sales, however, is counterintuitive (direct rather than inverse) and the elasticity on unemployment is only in the range of 0.05 to 0.17. This is extremely small compared to the estimated income elasticity, ranging from about 3.5 to 3.9.

Figure 1: **Comparison of Indiana and Illinois Quarterly AGR**



Lottery and pari-mutuel spending models estimated by Gulley and Scott (1989) and Ashley et al. (1999) reveal a potential relationship between lottery spending and pari-mutuel betting. The estimates by Gulley and Scott (1989) suggest that lottery spending substitutes for pari-mutuel betting. Thus, the substitution effects of lottery spending, pari-mutuel betting, and even charity gaming on casino gambling revenue may require further investigation. Since the late 1990s, however, expenditures on these other forms of gambling in Indiana were essentially flat, with an annual decline in percentage share of overall gaming expenditures. Thus, it is unlikely that lottery, pari-mutuel wagering, or charity gaming have had any significant long-term impact on casino wagering in Indiana.

FIRST-YEAR FORECAST MODEL

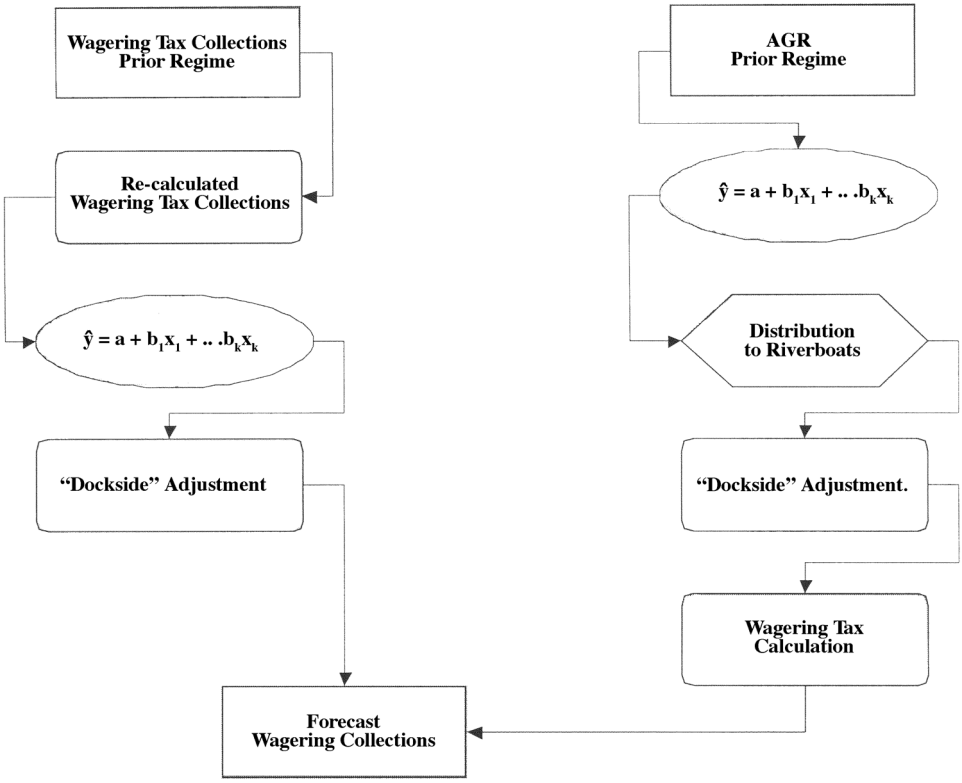
Due to the structural change in the wagering tax beginning in July 2002, subsequent wagering tax liabilities would not be consistent with the tax collection series prior to the rate change. What's more, the graduated tax rate structure beginning in August 2002 could not easily be specified in a forecast model. Thus, the wagering tax forecast is developed from a forecast model of the tax base–AGR–not from a model of wagering tax collections. A comparison of alternative forecast schemes for the wagering tax is presented in Figure 2.

Following from the forecast schemes, aggregate AGR was forecast in December 2002 and April 2003 with the following model:

$$(1) \quad AGR = f(Y, D_{IL}, D_{Q4\_00}, D_{Q1\_02})$$

where Y is quarterly Non-Farm Indiana Personal Income; D_{IL} is an intercept dummy corresponding to the period since the fourth quarter of 1999, a one-quarter lag from when Illinois began dockside gaming; and D_{Q4_00} and D_{Q1_02} are single-period

Figure 2: **Alternative Wagering Tax Forecasting Schemes**



intercept dummies that account for significant changes in wagering during the fourth quarter of 2000 and the first quarter of 2002.[9] D_{IL} is lagged, as the Indiana AGR series presented in Figure 1 suggests that a decline in Indiana AGR attributable to dockside gaming in Illinois appears to have been delayed for a 2-3 months. D_{Q4_00} essentially accounts for severe winter weather in December 2000 that caused casino patronage and wagering during the fourth quarter of 2000 to be down uncharacteristically from prior quarters. D_{Q1_02} accounts for a spike in wagering attributable in part to pent-up demand due to the winter months and the aftermath of 9/11. This spike also may have been attributable to substantial increases in patronage and wagering at one property (Caesars Indiana) that had added a new 500-room hotel in late August 2001.

The forecast model was estimated using a quarterly series spanning the first quarter of 1997 to the second quarter of 2002, before dockside gaming and the tax changes were implemented in August 2002. Quarterly AGR was selected as the dependent variable to smooth the volatility present in the monthly AGR series. To maximize model fit and minimize prediction error, the first five quarters of the complete series (fourth quarter 1995 to fourth quarter 1996) were excluded. This eliminates from the series a significant portion of the initial ramping-up of riverboat gaming in Indiana that could potentially bias parameter estimates. Summary statistics for the series utilized for initial and subsequent model estimates are reported in Table 1.

The forecast requires predicted AGR to be distributed among the ten casinos based on quarterly distribution shares experienced in 2001 and 2002. This process renders a *base* AGR forecast for each riverboat casino. The forecast of *base* AGR did not account for the expected increase in wagering on the riverboats due to the shift to dockside gaming. Since the forecast was conducted in December 2002, data on the impact of this regulatory change was available for the initial four months. A post hoc adjustment factor was derived for each casino based on year-over-year change for the September-November period. Estimates of the underlying growth in wagering for each riverboat casino were netted off the adjustment factors. In addition, August activity (the first month of dockside gaming) was excluded to avoid potentially serious novelty effects. The result is a *dockside-adjusted* AGR forecast for each riverboat casino. The forecast amount distributed to each riverboat casino is utilized to compute a forecast wagering tax with the graduated tax structure.

Different functional forms were estimated for the model specification in (1) based on Mosteller and Tukey's (1977) *bulging rule*. The linear model (Model 1) performed moderately well, but forecast above actual AGR at the end of the series. *Mixed* functional forms in which the dependent variable AGR is squared and the independent variable is either income (Model 2), the natural log of income

Table 1
Summary Statistics
Q1-1997 through Q2-2002 (n=22)

	Summary Statistics (n=22)			
	Mean	*Std. Dev.*	*Min.*	*Max.*
AGR (000's)	381,277.63	85,672.78	196,663.76	503,888.89
Income (000's)	156,238,318.18	11,649,412.26	135,891,000.00	173,250,000.00
Illinois Dockside*	0.50	0.51	0.00	1.00

*Binary variable. The mean indicates the proportion of series quarters that dockside gaming operations has been conducted in Illinois and Indiana.

Q1-1997 through Q2-2003 (n=26)

	Summary Statistics (n=26)			
	Mean	*Std. Dev.*	*Min.*	*Max.*
AGR (000's)	405,693.11	98,005.89	196,663.76	552,110.77
Income (000's)	159,335,153.85	13,001,662.31	135,891,000.00	177,761,000.00
Illinois Dockside*	0.58	0.50	0.00	1.00
Indiana Dockside*	0.15	0.37	0.00	1.00

*Binary variable. The mean indicates the proportion of series quarters that dockside gaming operations has been conducted in Illinois and Indiana.

(Model 3), or the square root of income (Model 4) performed best. The parameter estimates for the four models are reported below in Table 2.

Model 2 exhibited the maximum R^2 (=.985) and Model 4 exhibited the minimum mean absolute prediction error (MAE) (=7,604) with an R^2 just below Model 2 (=.984). Model 3 exhibited a similar fit (R^2=.983) and somewhat higher prediction error (MAE=7,640) than either Model 2 or Model 4. Model 3 was selected, however, because it provided slightly lower predictions at the end of the series and a more conservative forecast than either Model 2 or Model 4.

As expected, the parameter estimates suggest that personal income has an overwhelming impact on wagering levels. The models suggest that the income elasticity of wagering is between 2.8 and 3.6 on average. Thus, a 1 percent increase in personal income is estimated to result in a 2.8 percent to 3.6 percent average increase in wagering. The forecast model also suggests that the shift to dockside gaming in Illinois at the end of June 1999 has had, on average, a negative effect on wagering in Indiana. Thus, it appears that this regulatory change may have enabled casinos in Illinois to capture market share from Indiana casinos. The estimated parameters suggest that the average percentage impact on Indiana AGR due to the change to dockside gaming in Illinois ranges from –6 percent to about –11 percent. Based on the series average, this is an impact on the scale of about $23 million to $42 million in AGR per quarter. The parameter estimate also confirms the conjecture that the impact of Illinois dockside gaming on Indiana AGR lagged somewhat behind its actual implementation.

Reestimation of the model specification in (1) using the linear and mixed functional forms and four additional quarters of data (third quarter 2002 to second quarter 2003) produces changes in model fit and prediction error. The parameter estimates utilizing the extended series are reported below in Table 3.

Model 3 performs comparatively well, again. In fact, with the longer series, Model 3, by far, generates the maximum R^2 (=.983) and the minimum MAE (=8,169). While the R^2 for Model 3 is unchanged, MAE increased by almost 7 percent from the previous level of 7,640. As for prediction levels, Model 2 and Model 4 generate lower predicted values at the end of the series, with Model 4 generating the most conservative forecast. Model 2 (R^2 = .972) and Model 4 (R^2 = .968) exhibited

Table 2
First-Year AGR Forecast Model—Series through Q2-2002

	Model 1^*			*Model 2**^*		
	B	*ε*	*p-value*	*B*	*ε*	*p-value*
Constant	–977,426.79		0.00	–7.51E+11		0.00
Income	0.01	3.63	0.00	5,837.68	3.00	0.00
Illinois Dockside	–51,269.61	–0.13	0.00	–2.39E+10	–0.08	0.00
4th Quarter 2000	–38,394.20	–0.10	0.01	–3.45E+10	–0.11	0.00
1st Quarter 2002	19,490.63	0.05	0.17	2.87E+10	0.09	0.00
R^2	0.977		0.00	0.985		0.00
MAE	8,412.35			7,631.41		
	*Model 3**^*			*Model 4**^*		
	B	*ε*	*p-value*	*B*	*ε*	*p-value*
Constant	–1.63E+13		0.00	–1.62E+12		0.00
SQRT(Income)				1.43E+08	2.93	0.00
LN(Income)	8.72E+11	2.86	0.00			
Illinois Dockside	–1.90E+10	–0.06	0.02	–2.16E+10	–0.07	0.01
4th Quarter 2000	–3.52E+10	–0.12	0.00	–3.49E+10	–0.11	0.00
1st Quarter 2002	3.13E+10	0.10	0.00	3.00E+10	0.10	0.00
R^2	0.983		0.00	0.984		0.00
MAE	7,640.13			7,604.36		

*Dependent variable = AGR
**Dependent variable = AGR^2
^$100*\varepsilon$ = the percent impact of the dummy variable.

Table 3
Re-estimate of First-Year AGR Forecast Model—Series through Q2-2003

	Model 1^*			*Model 2**^*		
	B	*ε*	*p-value*	*B*	*ε*	*p-value*
Constant	–9.97E+05		0.00	–9.03E+11		0.00
Income	0.01	3.52	0.00	6.88E+03	3.15	0.00
Illinois Dockside	–4.61E+04	–0.11	0.00	–3.32E+10	–0.10	0.01
4th Quarter 2000	–3.40E+04	–0.08	0.02	–3.67E+10	–0.11	0.01
1st Quarter 2002	1.73E+04	0.04	0.22	1.68E+10	0.05	0.22
R^2	0.982		0.00	0.972		0.00
MAE	8,917.24			11,530.42		
	*Model 3**^*			*Model 4**^*		
	B	*ε*	*p-value*	*B*	*ε*	*p-value*
Constant	–1.65E+13		0.00	–2.00E+12		0.00
SQRT(Income)				1.71E+08	3.07	0.00
LN(Income)	8.83E+11	2.54	0.00			
Illinois Dockside	–1.96E+10	–0.06	0.02	–3.20E+10	–0.09	0.01
4th Quarter 2000	–3.61E+10	–0.10	0.00	–3.80E+10	–0.11	0.02
1st Quarter 2002	3.02E+10	0.09	0.01	1.69E+10	0.05	0.25
R^2	0.983		0.00	0.968		0.00
MAE	8,169.10			12,514.21		

*Dependent variable = AGR
**Dependent variable = AGR^2
^$100*\varepsilon$ = the percent impact of the dummy variable.

declines in fit from the first-year model estimates. As with the initial parameter estimates, the models again suggest that income is the overwhelming determinant of wagering levels. With the additional data, the models suggest that the income elasticity of wagering ranges between 2.5 and about 3.5. In addition, the new estimates of the impact of dockside gaming in Illinois are consistent with initial estimates–ranging from about –6 percent to –11 percent. It is noteworthy that the additional four quarters of data coincide almost perfectly with the commencement of dockside gaming in Indiana. As the decline in model fit and increase in prediction error coincide with the addition of this data, an alternative model specification accounting for the impact of dockside gaming is estimated.

ALTERNATIVE MODEL SPECIFICATION

The alternative model specification is as follows:

(2) $AGR = f(Y, D_{IL}, D_{Q4\_00}, D_{Q1\_02}, D_{IN})$

where D_{IN} is an intercept dummy corresponding to the period since the third quarter of 2002 when Indiana riverboat casinos started dockside gaming. The intercept dummy is expected to provide a more precise measure of any upward shift in AGR generated by the regulatory change. If the coefficient on D_{IN} is not statistically significant, it suggests that dockside gaming has so far not resulted in a permanent upward shift in wagering at Indiana casinos. It also suggests that the post hoc adjustment to the *base* AGR forecast to account for dockside gaming impacts may be unnecessary, and could potentially result in an excessively optimistic forecast of the wagering tax base. The current adjustment for FY 2004 and FY 2005 averaged 8.36 percent for the 10 casinos. The results of the new model specification are reported below in Table 4.

Again, the parameter estimates suggest that income is the most significant determinant of wagering activity. The income elasticity of wagering is estimated to range from about 2.46 to 3.5. The parameter estimate for Illinois dockside gaming is, once again, statistically significant, with an average percentage impact ranging from –5 percent to –11 percent. The parameter estimates for Indiana dockside gaming are intuitive, but are statistically significant only in Model 2 and Model 4. It is noteworthy that Model 2 and Model 4 exhibit better fit

Table 4
Dockside Gaming Model Specification—Series through Q2-2003

	Model 1^*			*Model 2**^*		
	B	*ε*	*p-value*	*B*	*ε*	*p-value*
Constant	–9.94E+05		0.00	–7.65E+11		0.00
Income	8.96E-03	3.52	0.00	5.94E+03	2.72	0.00
Illinois Dockside	–4.59E+04	–0.11	0.00	–2.07E+10	–0.06	0.02
Indiana Dockside	6.31E+02	1.55E-03	0.95	3.00E+10	0.09	0.00
4th Quarter 2000	–3.39E+04	–0.08	0.03	–3.15E+10	–0.09	0.00
1st Quarter 2002	1.75E+04	0.04	0.24	2.73E+10	0.08	0.01
R^2	0.981		0.00	0.985		0.00
MAE	8,908.95			7,860.76		
	*Model 3**^*			*Model 4**^*		
	B	*ε*	*p-value*	*B*	*ε*	*p-value*
Constant	–1.60E+13		0.00	–1.65E+12		0.00
SQRT(Income)				1.45E+08	2.64	0.00
LN(Income)	8.56E+11	2.46	0.00			
Illinois Dockside	–1.69E+10	–0.05	0.08	–1.87E+10	–0.05	0.04
Indiana Dockside	5.60E+09	0.02	0.52	3.38E+10	0.10	0.00
4th Quarter 2000	–3.53E+10	–0.10	0.00	–3.20E+10	–0.09	0.00
1st Quarter 2002	3.17E+10	0.09	0.01	2.86E+10	0.08	0.01
R^2	0.983		0.00	0.985		0.00
MAE	8,144.92			7,930.72		

*Dependent variable = AGR
**Dependent variable = AGR^2
^$100*\varepsilon$ = the percent impact of the dummy variable.

and much lower prediction errors than either Model 1 or Model 3. The significant parameter estimates suggest that the regulatory change in Indiana has produced an upward shift in AGR average between 9 percent and 11 percent. Based on these parameter estimates, the post hoc adjustment averaging 8.36 percent appears to be valid.

The parameter estimates for Indiana dockside gaming are fairly consistent with year-over-year growth figures showing average quarterly growth of 12.2 percent from third quarter 2002 to third quarter 2003. It is important to note that year-over-year growth during the preceding four quarters averaged 9.9 percent. The 2002-03 AGR growth in Indiana is fairly robust given the behavior in consumption expenditures nationally, employment in Indiana, and AGR of Illinois riverboat casinos during the same period. From first quarter 2002 to third quarter 2003, personal consumption expenditures grew by only about 0.8 percent per quarter nationally; and consumption expenditures on recreation services were even more anemic, growing at about only 0.4 percent per quarter nationally. During the same period, employment in Indiana increased by only about 0.3 percent per quarter, and the unemployment rate remained well within the range of 4.9 percent to 5.2 percent.

More telling may be the decline in AGR experienced by the Illinois riverboat casinos from the beginning in third quarter 2002. Illinois casinos experienced decreasing year-over-year growth in AGR from July 2002 to September 2002. Then, from October 2002 to October 2003, Illinois casinos experienced year-over-year decline in AGR for 13 consecutive months. On average, monthly AGR in Illinois has been down 5.0 percent per month during this period. Recent experience in Illinois is problematic because it is unclear the extent to which this decline is related to macro-economic factors as opposed to micro-economic behavior by riverboat owners responding to significant increases in Illinois gaming taxes since July 2002. Still, one could argue that if not for the shift to dockside gaming, Indiana AGR could potentially have declined, or grown at a much lower rate than 12.2 percent per quarter over the last year.

CONCLUSIONS

The current and proposed alternative forecasting models presented in this paper are the product, in part, of prior empirical analysis and constraints placed on model specifications due to the forecasting process. The scope of the economic measures forecast under Indiana's consensus revenue forecast process limits the amount of information that can be specified in the AGR forecasting model. Consistent with the prior empirical literature, the forecasting models of AGR earned by Indiana's riverboat casinos suggest that income is the dominant factor affecting wagering levels on an ongoing basis. Alternative models specifying intercept dummies to reflect dockside gaming in Indiana suggest that the current post hoc adjustments to forecast AGR appear to be valid.

Notes

[1] The riverboat gambling law authorized an eleventh riverboat license for Patoka Lake in southern Indiana. This license was not issued, however, and was eliminated by legislation enacted in 2003.

[2] The state fiscal year Indiana runs from July 1 to June 30.

[3] Approximately 72.2 percent of the state admissions tax revenue goes to assist the horse racing industry; about 16.6 percent goes to the State Fair; and 11.2 percent goes to fund addiction services.

[4] The admissions tax based on a head count for each excursion and a 22.5 percent flat-rate wagering tax would be imposed in the future on riverboats that choose to discontinue dockside gaming operations and operate under the excursion regime.

[5] The state gives local governments property tax replacement credits (PTRC) equal to 20 percent of taxes levied on real and personal property, except that PTRC is equal to 60 percent for all property taxes levied for school general funds. These credits are paid out of the state's Property Tax Replacement Fund.

[6] Casino type games, such as blackjack and roulette.

[7] Harrah's (2002) survey is conducted with a nationwide random sample (n=2000). Gazel and Thompson (1995) conducted random interviews of patrons (n=785) visiting five Illinois riverboat casinos.

[8] Non-random interviews conducted by Klasick et al. (2001a-2001e) tend to confirm the link between proximity and casino patronage with respect to several of Indiana's riverboats.

[9] Attempts were made to estimate separate forecast models for each riverboat casino. This modeling process was scrapped due to the volatility and imprecision exhibited by these separate forecast models.

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