

Estimates of the Price Elasticity of Demand for Casino Gaming and the Potential Effects of Casino Tax Hikes

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Study Highlights

- Estimates the demand for casino wagering.
- Employs a panel of 50 casinos in 4 states spanning 15 years.
- Generates estimates of the price elasticity of demand for wagering.
- Analyzes whether price increases are utilized to fully offset tax rate increases.

FY 2006 Gaming Taxes (millions)

State	Gaming Taxes	Share of Total Taxes
Nevada ^L	\$1,003.1	16.3%
Indiana ^R	\$803.2	5.9%
Illinois ^R	\$800.1	2.8%
Louisiana ^{L,R,H}	\$570.4	5.9%
West Virginia ^H	\$542.7	11.9%
New Jersey ^L	\$477.3	1.9%
Missouri ^R	\$421.8	4.1%
Michigan ^L	\$318.2	1.3%
Delaware ^H	\$315.0	11.0%
Mississippi ^R	\$273.6	4.6%
Iowa ^{R,H}	\$260.7	4.3%
Rhode Island ^H	\$245.7	9.0%
Remaining 6 States	\$10.2 – \$193.6	0.2% - 1.3%

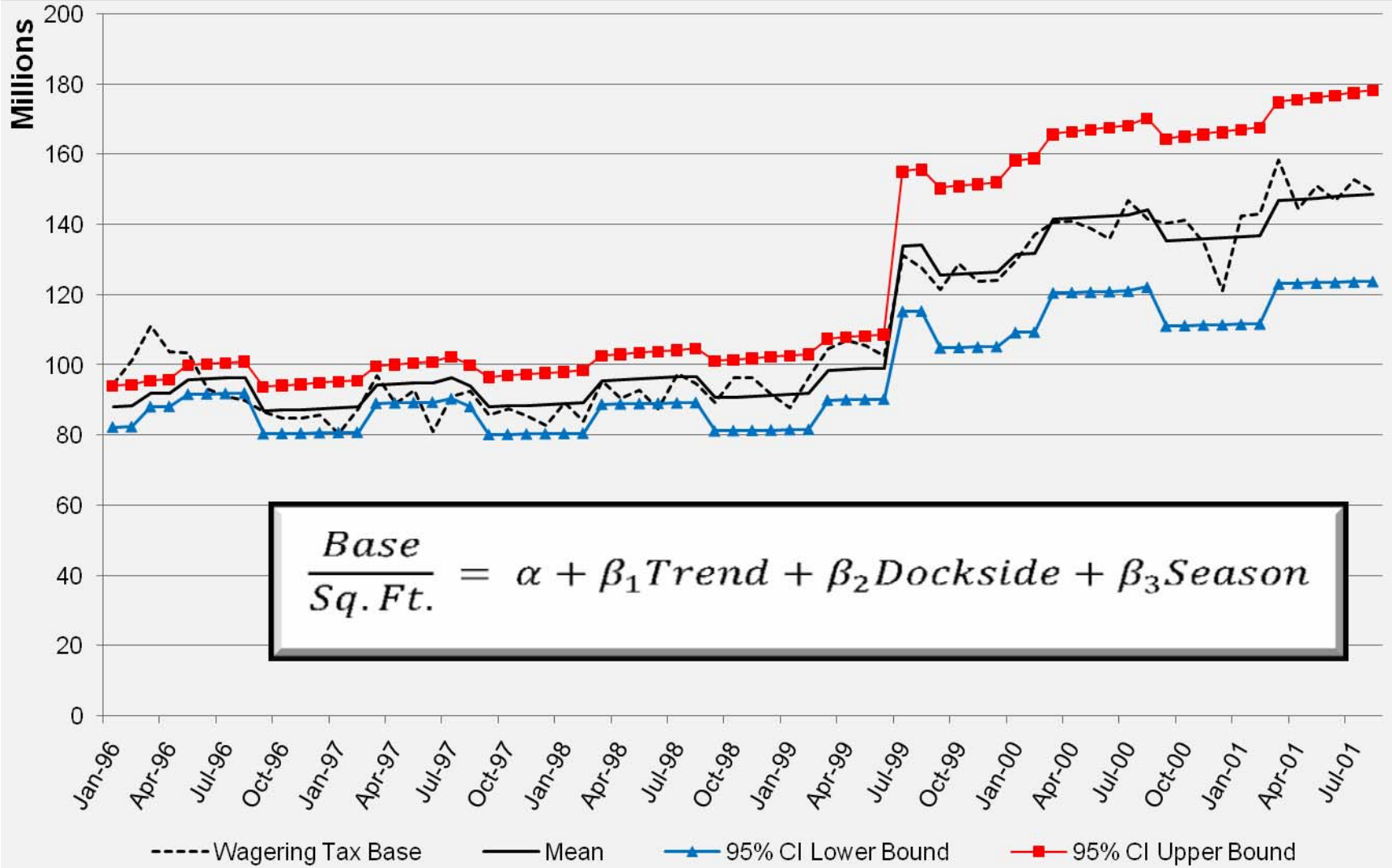
Terminology

- **Handle** = total amount wagered on games by gamblers.
 - Represents the dollar demand for gaming.
- **Win** = the portion of the handle retained by the casino after payout of winnings to gamblers.
- **Win Percentage** = $\text{Win} \div \text{Handle}$.
 - Represents the price paid by gamblers.
- **Net Win** = $\text{Win} - \text{Casino Tax}$.

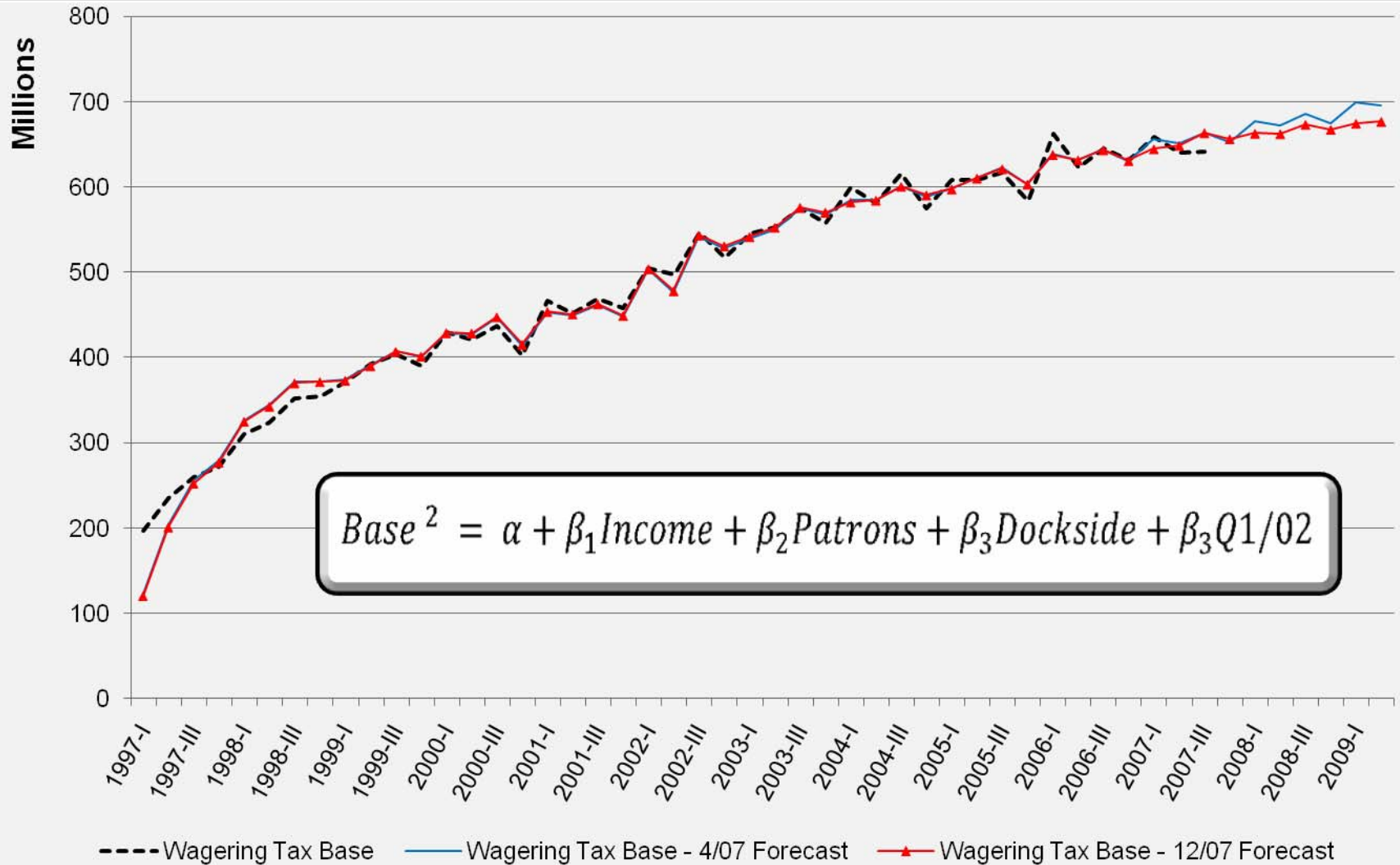
Gaming Taxes

- **Wagering Tax** = % \times Win.
 - 20% flat rate tax in Missouri.
 - Graduated tax rate structures in Illinois, Indiana, and Iowa.
 - Top rates are: 50% (IL), 35% (IN), and 22%-24% (IA).
- **Admission Tax** = \$ \times Gamblers Entering Casino.
 - \$2 small casinos, \$3 large casinos (IL).
 - \$3 generally, \$4 French Lick Casino (IN).
 - No state admission tax in Iowa.
 - \$2 (MO).

“Connections” Dockside Gaming



“Connections” Gaming Forecast



Literature – Lottery Sales

- Vrooman (1976), Vasche (1985), and Mikesell (1987).
 - Take-out rate not a determinant of lottery sales.
- DeBoer (1986).
 - Annual data for 7 state lotteries over 10 years.
 - Price elasticity = -1.19.
- Gulley and Scott (1993).
 - Weekly/biweekly data for 4 state lotto games over 10 years.
 - Price elasticities = - 0.19 to -1.92.

Literature: Pari-mutuel Wagering

- Morgan and Vasche (1979,1982).
 - Take-out rate not a determinant of pari-mutuel handle.
- Suits (1979).
 - Annual data for 24 states over 23 years.
 - Price elasticity = -1.59 to -2.73.
- Pescatrice (1980).
 - Annual data for 3 racetracks over 35 years.
 - Price elasticity = -0.50 to -0.98.
- Thalheimer and Ali (1992 & 1995).
 - Annual data for 1 racetrack over 18 years (1992).
 - Price elasticity = -1.68.
 - Annual data for 3 racetracks over 28 years (1995).
 - Price elasticity = -2.44 to -2.81.

Literature – Casino Gaming

- Thalheimer and Ali (2003).
 - Annual data for 27 casinos operating in Illinois, Iowa, and Missouri from 1991 to 1998.
 - Price elasticity = -0.99.
 - Price elasticity declined from -1.5 in 1991 to -0.9 in 1998.
- Other important determinants of casino wagering besides the win percentage.
 - Market income, patron accessibility, regulatory requirements.

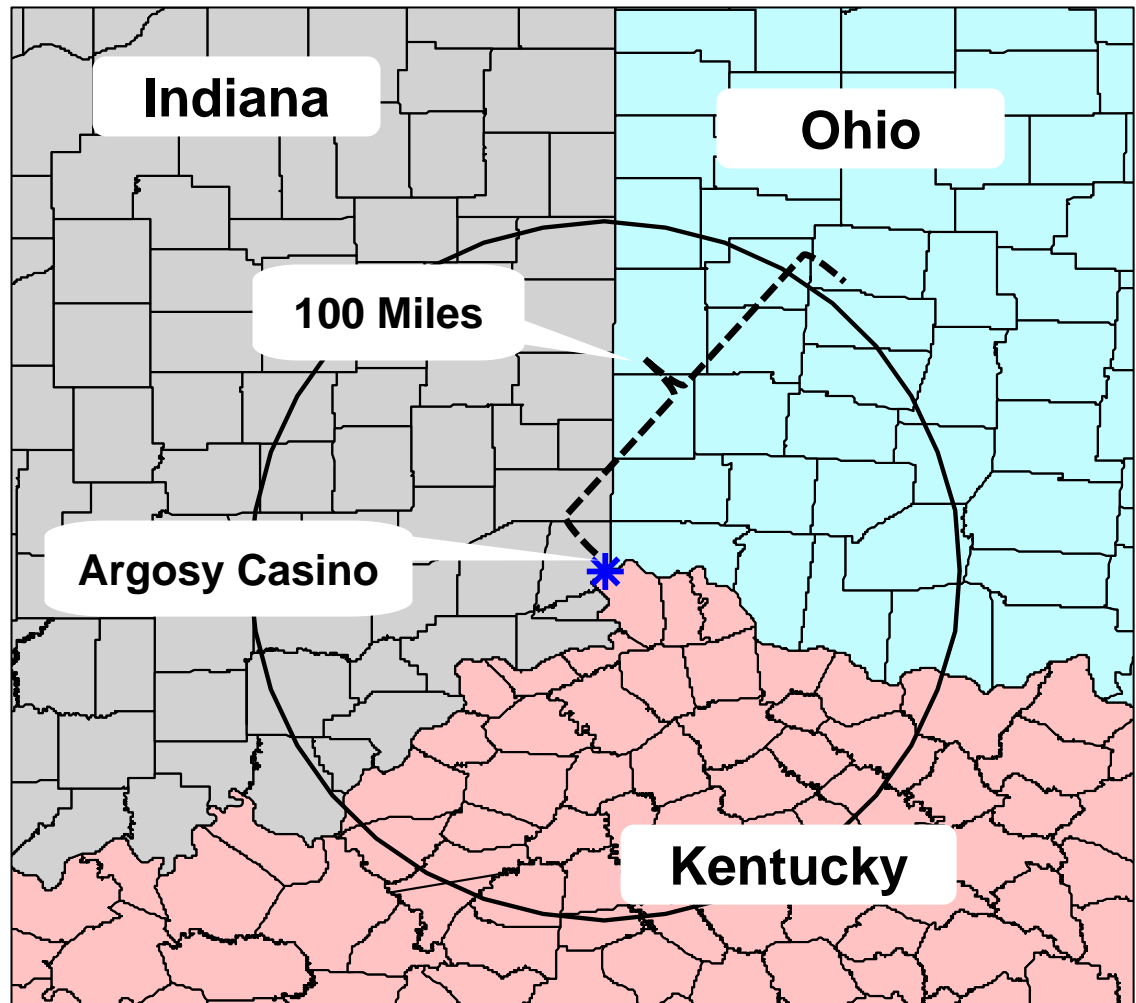
Literature – Casino Gaming

- Other estimates of casino wagering determinants.
 - Nichols (1998): Income, seasonal components, and regulatory requirements in Iowa.
 - Nichols (1998): Regulatory requirements in Atlantic City.
 - Moss, Ryan, and Wagoner (2003): Product life-cycle effects in Mississippi casino industry.
- Determinants of win percentage.
 - Navin and Sullivan (2007): Competing casinos in St. Louis casino market.

Wagering Demand Model

$$\text{Handle}_{it} = \beta_0 + \beta_1 \text{Win\%}_{it} + \beta_2 \text{Income}_{it} + \beta_3 X_{it} + \varepsilon_{it}$$

- Per Capita Handle
- Win Percentage
- Per Capita Income



Wagering Demand Model (cont.)

$$\text{Handle}_{it} = \beta_0 + \beta_1 \text{Win\%}_{it} + \beta_2 \text{Income}_{it} + \beta_3 X_{it} + \varepsilon_{it}$$

- Per Capita EGD Handle [market population].
- EGD Win Percentage ($\beta < 0$).
- Days of Operation ($\beta > 0$).
- EGDs Supplied ($\beta > 0$).
- Table Games Supplied ($\beta < 0$).
- Cruising Requirement [binary variable] ($\beta < 0$).
- Loss Limit [binary variable] ($\beta < 0$).
- Per Capita Income [market population and income] ($\beta > 0$).

Estimation Procedures

- Models are estimated using fixed effects regression procedures.
 - Model specifications include casino & year fixed effects.
 - Hausman test indicates the fixed effects model is superior.
- Correction is made for AR(1) error structure.
 - Wooldridge test conducted for first order autocorrelation in panel data models.
- Double log model specifications are estimated.
 - Ensures that predicted values for wagering handle are nonnegative.
 - Controls for potential nonlinear relationships.
 - Allows the regression coefficients to be interpreted as elasticities.

Regression Estimates

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	-2.465779*** (0.3369437)	-1.788003*** (0.3415046)	-1.449593*** (0.3277336)	-20.74335*** (4.293482)	-19.41579*** (4.20456)
LN(Days)	0.9656574*** (0.0359599)	0.9285181*** (0.036484)	0.928518*** (0.036484)	0.9337485*** (0.0365292)	0.9337483*** (0.0365292)
LN(EGDs)	0.5534192*** (0.1065088)	0.5355861*** (0.1028671)	0.5355864*** (0.1028671)	0.5481851*** (0.1026696)	0.5481844*** (0.1026696)
LN(Table Games)	0.0047174 (0.0420782)	0.0107691 (0.0403974)	0.0107691 (0.0403975)	-0.0032298 (0.0409476)	-0.0032297 (0.0409476)
LN(EGD Win Percentage)	-0.7540078*** (0.1825624)	-0.8754113*** (0.17861)	-0.8754113*** (0.17861)	-0.8707295*** (0.1779422)	-0.8707306*** (0.1779422)
LN(EGD Win Percentage_{t-1})	-	-	-	-	-
LN(EGD Win Percentage_{t-2})	-	-	-	-	-
LN(EGD Win Percentage_{t-3})	-	-	-	-	-
EGD Win Percentage	-	-	-	-	-
EGD Win Percentage Squared	-	-	-	-	-
Cruising Requirement	-	-0.1839969*** (0.0566787)	-0.183997*** (0.0566787)	-0.2003658*** (0.0571207)	-0.2003658*** (0.0571208)
Loss Limit	-	-0.6179297*** (0.2125193)	-0.6179295*** (0.2125193)	-0.6216122*** (0.2115903)	-0.6216115*** (0.2115903)
Time Trend	-	-	-0.0225486** (0.010375)	-	-0.0884444*** (0.0185407)
(Time Trend)*LN(EGD Win Percentage)	-	-	-	-	-
LN(Per Capita Income)	-	-	-	1.879111** (1.024918)	1.879091* (1.024916)
LN(Per Capita Income)*LN(EGD Win Percentage)	-	-	-	-	-
Within R-Squared	0.7334***	0.7461***	0.7461***	0.7479***	0.7479***

NOTES:

Dependent Variable = LN(Per Capita EGD Handle).

Groups=50, Observations=414.

Entries are fixed-effects panel regression coefficients with standard errors in parentheses. All regression models include casino and year fixed effects.

All dollar amounts are real dollars (base year=1991) and all percentages are measured on a 0 -100 scale.

*.05<p<=.10; **.01<p<=.05; ***p<=.01.

Regression Estimates (cont.)

Variable	Model 6	Model 7	Model 8	Model 9
Constant	-17.94522*** (2.410878)	-19.08318*** (4.227141)	-5.957588 (10.37355)	-20.49137*** (4.164611)
LN(Days)	1.227875*** (0.2676029)	0.9353964*** (0.036844)	0.9354919*** (0.0370167)	0.935671*** (0.0363304)
LN(EGDs)	0.5875367*** (0.0719595)	0.5484045*** (0.1028024)	0.5513903*** (0.1027121)	0.5409275*** (0.1028185)
LN(Table Games)	-0.0164296 (0.0185584)	-0.0023103 (0.0409376)	-0.0028883 (0.0408533)	-0.0046535 (0.0410805)
LN(EGD Win Percentage)	-0.59467*** (0.1348411)	-1.068686*** (0.3626586)	-8.941377 (12.87367)	-
LN(EGD Win Percentage_{t-1})	-0.5138041*** (0.1321885)	-	-	-
LN(EGD Win Percentage_{t-2})	-0.0099853 (0.1098575)	-	-	-
LN(EGD Win Percentage_{t-3})	0.1541337 (0.0973546)	-	-	-
EGD Win Percentage	-	-	-	-0.1541213 (0.142286)
EGD Win Percentage Squared				0.0017164 (0.0097426)
Cruising Requirement	-0.2330055*** (0.0316126)	-0.200378*** (0.0570293)	-0.1971549*** (0.0572236)	-0.2017564*** (0.057338)
Loss Limit	-0.7153513** (0.2877591)	-0.6465964*** (0.2141717)	-0.6419865*** (0.2121298)	-0.6546411*** (0.2206406)
Time Trend	-0.0091707 (0.0078396)	-0.1551512* (0.0803789)	-0.0475298*** (0.0168568)	-0.0459735*** (0.0167437)
(Time Trend)*LN(EGD Win Percentage)	-	0.0232493 (0.0374455)	-	-
LN(Per Capita Income)	1.435763*** (0.5233082)	1.914514* (1.027006)	0.4626729 (2.481412)	1.859222* (1.02525)
LN(Per Capita Income)*LN(EGD Win Percentage)	-	-	0.8097809 (1.292079)	-
Within R-Squared	0.7057***	0.7466***	0.7453***	0.7515***

NOTES:

Dependent Variable = LN(Per Capita EGD Handle).

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Impact of Tax Rate Increases

- The price elasticity estimates suggest that casinos could pass tax rate increases forward to players by increasing the win percentage.
- Unanswered questions.
 - Do price increases follow tax rate increases?
 - Do the price increases offset fully the tax rate increases?
 - Does handle respond accordingly to price increases?
 - What occurred in Illinois after tax rate changes in FY 2003, FY 2004, and FY 2006?

Illinois Experience

- Increased the top wagering tax rate from:
 - 35% to 50% in FY 2003.
 - 50% to 70% in FY 2004.
 - Back to the FY 2003 Rates in FY 2006, with “hold harmless” provision.
- Increased the admission tax rate from:
 - \$2 to \$3 in FY 2003.
 - \$3 to \$4 for small casinos and \$3 to \$5 for large casinos in FY 2004.
 - Back to the FY 2003 Rates in FY 2006.

What Happened to Price?

Fiscal Year	Handle ¹	Win ¹	Win %	Tax ¹	Tax Rate	Net Win ¹	Net Win %
2002	\$24,453.4	\$1,540.6	6.30%	\$479.8	31.15%	\$1,060.7	4.34%
2003	\$23,801.7	\$1,525.3	6.41%	\$579.7	38.00%	\$945.6	3.97%
2004	\$21,765.8	\$1,423.2	6.54%	\$659.2	46.32%	\$764.0	3.51%
2005	\$22,863.4	\$1,519.4	6.65%	\$708.5	46.63%	\$810.9	3.55%
2006	\$23,985.4	\$1,653.0	6.89%	\$627.1	37.94%	\$1,025.9	4.28%

- FY 2002-04 tax rate increase = 49%.
 - Win % increase = 3.8%.
 - Net Win % decline = 18.6%.
 - Handle decline = 11%
- FY 2004-06 tax rate decrease = 18.1%.
 - Win % continued to increase = 5.4%
 - Net win % returned to pre-tax hike level.
 - Handle increase = 10.2%.

Did Prices Hikes Offset Tax Hikes?

Measure	Fiscal Year			
	2003	2004	2005	2006
Actual Tax Rate Increase	22.01%	21.88%	0.67%	-18.64%
Win % Required to Obtain Prior Year Net Win %	7.00%	7.40%	6.58%	5.71%
Win % Shortfall	-0.59%	-0.86%	0.07%	1.18%

- FY 2003 & FY 2004:
 - Win % < level required to maintain the prior year's Net Win%.
 - 0.6 percentage points or 8.4% off in FY 2003.
 - 0.9 percentage points or 11.6% off in FY 2004.
- FY 2005 & FY 2006:
 - Win % > level required to maintain the prior year's Net Win%.

What Happened to Handle?

Measure	Fiscal Year			
	2003	2004	2005	2006
Estimated Price Elasticity	-0.8700	-0.8700	-0.8700	-0.8700
Actual Change in Win %	1.72%	2.03%	1.64%	3.71%
Expected Change in Handle	-1.50%	-1.77%	-1.42%	-3.23%
Expected Handle ¹	\$24,087.4	\$23,381.0	\$21,455.9	\$22,126.0
Actual Change in Handle	-2.67%	-8.55%	5.04%	4.91%
Handle Change Due to Win % Increase	-1.50%	-1.77%	-1.42%	-3.23%
Handle Change Due to Other Factors	-1.17%	-6.79%	6.47%	8.13%

- FY 2003: ½ of the reduction in handle attributable to other factors.
- FY 2004: ¾ of the reduction in handle attributable to other factors.
- FY 2005 & FY 2006: Handle grew despite Win% increases.

Study Highlights

- Generated multiple estimates of the price elasticity of demand for casino gaming.
 - On average: Between -0.8 and -1.0.
 - Change over time not discernable.
 - Short
- Examined the aftermath of tax rate changes in Illinois.
 - Overall gaming price increases did not offset tax rate increases.
 - Overall gaming handle declined more than can be explained by the estimated impact of price increases on handle.
- Illinois casinos implemented price changes and cost cutting strategies to maintain profit margins.

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