Casino regulations and economic welfare

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Abstract. This paper studies the entry and tax regulation of oligopolistically competitive privately run casinos and government-run casinos in a jurisdiction. We highlight three important external effects from casino-style gambling: non-casino income creation, social disorder costs, and cross-border gambling. The laissez-faire equilibrium need not be overcrowding compared with regulated or government-run regimes. Entry regulation may lead to higher jurisdiction welfare than tax regulation. Government-run casinos always operate on a larger scale and achieve higher welfare than other regimes, given the same number of casinos. With an endogenous fraction of external gamblers, a dispersed casino configuration yields higher welfare than a centralized one. JEL classification: H2, D62, D21

Réglementations des casinos et bien-être économique. Ce texte étudie les réglementations à l'entrée et de nature fiscale dans un monde oligopolistique concurrentiel où coexistent des casinos opérés par les secteurs privé et gouvernemental. On souligne trois effets externes importants des jeux d'argent de style casino : la création de revenu de type non-casino, les coûts du désordre social engendré, et le fait que ces jeux d'argent transgressent les frontières. L'équilibre de laissez-faire n'engendre pas nécessairement sur-encombrement par rapport à des régimes réglementés ou opérés strictement par le gouvernement. Les régulations de l'entrée peuvent engendrer des effets de bien-être plus grands pour la juridiction que la réglementation fiscale. Les casinos opérés par le gouvernement opèrent

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toujours sur une plus haute échelle et engendrent des effets de bien-être plus grands que les autres régimes pour un nombre donné de casinos. Compte tenu qu'il existe une fraction endogène de joueurs externes, une configuration dispersée de casinos donnent des effets de bien-être plus grands qu'une configuration centralisée.

1. Introduction

Over the past decade or two, casino gaming in North America has grown sharply. While casino gaming revenues in the U.S. increased by 170% from \$11.2 billion in 1993 to \$30.2 billion in 2005, such revenues in Canada increased by 127% from \$6.74 billion in 1995 to \$15.3 billion in 2006. Today in the U.S., there are casinos in 33 states, among which there are 443 commercial casinos in 11 states. In Canada, there are 68 casinos in 7 of the 10 provinces. According to the 2006 American Gaming Association Survey, more than one-quarter of the U.S. adult population (52.8 million) visited a casino in 2005, making a total of 322 million trips (averaging 6.1 trips per gambler).[1] Although the growth of casino gambling has generated many important social, economic, and policy-related questions, 'it is surprising how little we definitely know about the social and economic impacts of this \$40 billion a year industry' (see Eadington's report in a special issue of the *Economic Development Review* 1995). In the economics literature, there is a lack of a comprehensive theoretical analysis of casinos, and, in particular, the relevant endogenous entry and local welfare analysis has not been formally modelled.[2] Our paper takes a first step in this direction by developing a formal theoretical model to analyze the entry and regulation of commercial casinos in a community/region where gambling is permitted.

Presently in the U.S., three types of commercial casino markets (exclusive of Indian reservations) exist: (i) centralized – usually limited to one city per state, including Atlantic City in New Jersey, Detroit in Michigan, and Deadwood in South Dakota; (ii) dispersed – anywhere in Nevada subject to local zoning restrictions; and (iii) remote – usually limited to navigable rivers and designated waterways, as in Illinois, Indiana, Iowa, Mississippi, and Missouri, and in designated mining towns, as in Colorado. Louisiana is the only state with both centralized (New Orleans in Louisiana) and remote (designated waterways) casinos. Of the \$30.2 billion commercial casino gaming revenues in 2005, 38.49% were from dispersed casino markets (Nevada), 28.49% from centralized markets, and 33.22% from remote markets (see table 1a). By contrast, most of the casinos in Canada

1 In 2003, Americans made 865 million trips to museums, 138 million trips to zoos/aquariums/wildlife parks, and 107 million trips to professional baseball games. This indicates that casino gambling is a significant part of American leisure activity. Today in Canada, over 27% of the residents are regular gamblers, participating in casino and other games at least once a week.

2 To our knowledge, the only exception is Sauer (2001), who applies Becker's (1983) political competition model to study how gambling restrictions lower the level of gambling, which is a very different problem from ours.

TABLE 1a
Casino revenues and tax regulations in the US states

States	Gross revenue (million $)	Tax revenue (million $)	Average tax rate (%)	Gross revenue tax rate (%)
Colorado	755.50	101.07	13.38	Graduated tax rate up to 20%
Illinois	1,779	749.70	42.14	Graduated tax rate from 15 to 50%
Indiana	2,414	777.78	32.22	Graduated tax rate from 15 to 35%
Iowa	1,106	265.05	23.96	Graduated tax rate up to 22%
Louisiana	2,232	531.71	23.82	Flat rate at 21.5%
Michigan	1,229	331.93	27.01	Flat rate at 24%
Mississippi	2,467	301.72	12.23	Graduated tax rate up to 8%
Missouri	1,532	413.90	27.02	Flat rate at 20%
Nevada	11,649	952.57	4.58	Graduated tax rate up to 6.75%
New Jersey	5,018	490.19	9.77	Flat rate at 8%
South Dakota	83.56	12.53	15.00	Flat rate at 8%

SOURCE: Computed from the 2006 American Gaming Association Survey of Casino Entertainment

are government run, with only a few exceptions in the border cities.[3] Moreover, Canadian casinos exhibit no such aforementioned locational differences.

Casino gambling generates various attendant externalities, including compulsive addictions, productivity losses and other social pathologies, increased drug and alcohol abuse, and the committing of crimes (see Goodman 1995). Since the local government is concerned only with negative externalities embodied in local gamblers, the *social disorder cost* arising from compulsive addictions, productivity losses, and other social pathologies are most relevant in our considerations. Because it is difficult to infer whether such undesirable behaviour may still exist in the absence of casino gambling, a precise estimation of its social costs is impossible. For illustrative purposes, we would like to provide some measures of such costs. For example, Grinols and Mustard (2001) find that about 0.77% of the U.S. sample could be classified as compulsive gamblers.[4] Goodman (1995) estimates that each problem gambler costs the government and the private economy $13,200 a year.[5] Similarly, Thompson, Gazel, and Rickman (1995) impute the associated social costs as ranging from between $12,000 and $50,000 per problem gambler.

Because of the associated negative externalities, casino gambling is viewed by the general public as a vice with limited or tainted consumer value. Yet, to a local government, other considerations may come into play. In addition to the direct value-added of the casino industry and casino tax revenues, casinos are

3 There are several European countries with government-run casions, including Austria, Finland, the Netherlands, and Sweden.

4 The comparable figure for Canada is about 0.4%.

5 Thus, increasing the incidence of problem gambling by one-half of 1% of the adult population would cost private business and the government about $73 million per year in a small state like Iowa and $780 million in a large state like California.

perceived to generate widespread economic benefits to other local businesses and industries, which can be referred to as the *income-creation effect* of casinos.[6] Of greater importance, jurisdictions with legalized casinos can capture spending by local gamblers who would otherwise travel outside to meet their demands; moreover, these casino communities can attract customers from outside. This *cross-border gambling effect* is intriguing: while it creates local net income, the local government need not be concerned with any social disorder costs embodied in external gamblers (see Goodman 1995; Eadington 1998). That is, in the presence of the cross-border gambling effect, casinos may generate larger net external benefits in relation to the local community. Of course, the magnitude of the cross-border gambling effect depends crucially on the extent to which casinos may attract non-local clientele. By this consideration, Las Vegas is perhaps the most successful casino community where most of the visitors are drawn from outside.[7] Just how large is the income-creation effect in reality? As summarized in the survey by Rose (2001), casinos are estimated to generate additional income 0.5–1.5 times as large as casino output. Based on the reports of Casino Associations of Louisiana and New Jersey, casinos are found to create additional jobs, which are 0.81 and 1.09 times as many as those of casino employees in the respective states. Interestingly, by attracting a larger fraction of external visitors than Louisiana, New Jersey casinos also deliver greater job creation.[8]

The complexity of casino-style gambling results in a considerable variation in the patterns of legalized gambling operations found in different places. Thompson (1998) identifies some significant differences between casinos in North America and in Europe. While the operations of casinos in Europe are very restricted, the clientele of the European casinos are relatively local. Moreover, European casinos are subject to much higher taxes, with (the maximum) tax rates ranging from as high as 93% of gross winnings in Germany, to 80% in France, 60% in Austria, and 54% in Spain. By contrast, the maximum tax rates on gross winnings in American casinos range from only 6.25% (Nevada) to 35% (Illinois). Even within the U.S., the maximum tax rates on gross gaming revenues vary

6 According to the 2004 American Gaming Association Survey, 66% of Americans perceive the widespread economic benefits of casinos to other local businesses and industries and 58% acknowledge the helpfulness of casino tax revenues in financing local public projects. In 2005, the commercial casino industry paid $12.6 billion in wages to its 354,000 employees and $4.93 billion in taxes to state and local governments. Garrett (2004) argues that the establishment of casinos in Illinois and Missouri has reduced the local unemployment rates significantly. For a complete discussion, the reader is referred to a special issue on legalized casinos in the *Economic Development Review* (1995).

7 For instance, Hunsaker (2001) points out that Las Vegas casinos are more of the resort-destination type, with an average stay of 3.5 nights per tour, whereas Atlantic City casinos are day-trip destinations, with an average stay of only 6.5 hours. While Las Vegas attracts many visitors from outside, most Atlantic City gamblers live within a 150-mile radius. An alternative way to maximize the cross-border gambling effect is to establish casinos in border locations, as is frequently observed (e.g., Detroit and Lake Tahoe in the U.S. and Windsor and Niagara Falls in Canada).

8 Despite lacking a formal analysis, it is believed that the magnitude of job as well as income creation is much stronger in Nevada.

TABLE 1b
Casino revenues in Canada

Provinces	Gross revenue (million $)	Net profit (million $)	Profit rate (%)
Alberta	810.20	560.29	69.15
British Columbia	1085.35	621.64	57.28
Manitoba	177.41	30.18	17.01
Nova Scotia	85.38	27.84	32.61
Ontario	2159.98	438.73	20.31
Quebec	758.46	120.65	15.91
Saskatchewan	202.60	63.10	31.15

SOURCE: Computed from the Canadian Gambling Digest, 2005–2006

dramatically across states (see table 1a): from as low as 6.75% (Nevada) to as high as 50% (Illinois). We also compute the average casino tax rates prevailing in the 11 states: from 4.58% in Nevada (dispersed), to 9.77% in New Jersey (centralized), to 12.23% in Mississippi (remote), to 27.01% in Michigan (centralized), to 40.47% in Illinois (remote). Since Canadian casinos are mostly government run, we can measure the casino tax rate by the net profit rate incurred by each provincial government (see table 1b), which ranges from 15.9% (Quebec) to 57.3% (British Columbia) and 69.2% (Alberta).

Furthermore, while European countries usually set limits on the numbers of casino establishments, only some states in the U.S. regulate the entry of casinos (Michigan, Illinois, Indiana, and Louisiana, which limit them to 3, 9, 10, and 16, respectively) and one imposes entry development fees (Indiana). Partly as a result of different regulations, the numbers of casinos vary dramatically across states: from 268 in Nevada, to 29 in Mississippi, to 12 in New Jersey, and to 3 in Michigan. In Canada, the numbers (as well as the size) of government-run casinos also vary dramatically across provinces, from 27 in Ontario (with an average size of $80 million in gross revenue), to 11 in Alberta (average size of $74 million), to 3 in Quebec (average size of $253 million), to 2 in Nova Scotia (average size of $43 million).[9]

While the observations and comparisons mentioned above raise interesting issues that need to be addressed, to our knowledge there is an absence of an integrated framework to study the economics of casinos. To fill this gap, we construct a model focusing on a jurisdiction populated by oligopolistically competitive legal casinos and an active local government, which may regulate the entry of casino firms or impose a casino tax surcharge. We also study the case of government-run casinos. We capture the main features of the casino market

9 Only two American states have wager limits (Colorado and South Dakota, with a $5 maximum) and one sets loss limits (Missouri, with a cap of $500 per excursion). Given that limits on wager and/or loss have been rare, we may ignore such a regulation and instead focus on entry- and tax-regulation as well as government-run casinos.

illustrated above that are very different from other manufacturing and service industries. Specifically, we consider three important external effects associated with casinos: (i) non-casino income creation, (ii) social disorder costs, and (iii) cross-border gambling. The latter is most intriguing, because the local community may enjoy the benefit of the industry without bearing the accompanying cost. To highlight the importance of local versus outside visitors, we even allow the ratio of local to total gamblers to be endogenously determined. In the case of an endogenous ratio of local to total gamblers, we also examine two different configurations of casinos: centralized and jurisdiction-wide dispersed. We provide a complete characterization of the equilibrium and the command optima under entry or tax regulation or with government-run casinos. We also provide a careful comparison between laissez-faire, the two regulated command optima, and the government-run casino regimes.

Our main findings are summarized as follows. First, when we compare laissez-faire and entry regulation, we find there may be casino overcrowding or under-entry, the former arising if the income-creation effect is weak, the social disorder cost is large, or the fraction of local gamblers is high. Second, if the income-creation effect is weak, the social disorder cost is large, or the fraction of local gamblers is high, the tax-regulation command optimum features a positive tax surcharge with less entry compared with the laissez-faire outcome. Third, the number of casino firms under a subsidy is always greater than that under entry regulation, while that under a positive tax surcharge could be larger or smaller than that under the entry-regulation outcome. Given the same number of casino firms, entry regulation will result in higher economic welfare than tax regulation associated with a positive tax surcharge. Fourth, although the number of casinos under the government-run regime could be larger or smaller than that under laissez-faire and entry/tax regulation, government-run casinos always operate on a larger scale than those under other regimes and achieve higher welfare than others, given the same number of casinos. Finally, in response to endogenous adjustments in the fraction of local gamblers, the local government will allow for a greater number of casinos and can achieve higher welfare if the configuration of casinos is dispersed.

2. The model

Consider a local economy, which may be regarded as a province of Canada or a state of the U.S. There are three theatres of economic activities in the local economy: a continuum of consumers of unit mass, a continuum of casino firms of mass $n > 0$, and a local (jurisdiction) benevolent government, where the continuum setup enables us to avoid unnecessary complications resulting from integer programming and is innocuous as long as the equilibrium solution of n is not too small. Implicitly, there are local non-casino firms and non-local casino consumers, which are exogenous in the benchmark model. In this case, consumers are entirely passive, with fixed local consumption in terms of casino gambling, which provides a utility of a simple linear form. Each casino firm faces a given demand schedule that exhibits constant elasticity, producing y units of 'casino services' of a given quality (normalized to one) under a simple constant-marginal-cost technology.[10] Because in reality casino firms mostly compete in quantity (scale, quality, and variety of services) rather than in prices, we assume Cournot competition throughout the paper.[11] In the absence of government regulation of entry, a casino firm decides whether to operate, given a fixed entry cost, and unrestricted entry implies that zero profit must be achieved in equilibrium.

With respect to local government regulations, we consider four different regimes of interest:

(i) Regime I (laissez-faire): The local government allows firms to freely enter the casino industry under which firms choose the scale of casino services (i.e., output); the number of firms is determined by the zero-profit condition.
(ii) Regime II (entry regulation): The local government regulates casino activity by setting the number of licences n under which firms decide whether to enter according to the participation constraint.
(iii) Regime III (tax regulation): The local government regulates casino activity by setting a tax surcharge σ (negative if it is a subsidy) under which firms choose to enter until the zero-profit condition is met.
(iv) Regime IV (government-run casinos): The number and scale of casinos are determined by the local government (as in Canada).

2.1. The casino market

Since the behaviour of consumers is entirely passive in the benchmark case, our main focus will be on the activity of casino firms. By denoting the total output of casino services in the local market by Y (i.e., $Y = ny$), we assume that the inverse demand function takes the constant-elasticity form, abstracting from the consumer's income effect: $P(Y) = Y^{-1/\varepsilon}$, where $P' < 0$ and the price elasticity of casino demand $\varepsilon = -(\partial Y/\partial P)/(P/Y) > 0$. When casinos are privately run, casino firms are assumed to be oligopolistically competitive. Upon paying a fixed setup cost C_0, each firm can produce casino services y with a variable cost $C(y) = cy$, where the marginal cost $c > 0$ is a constant.

Under a flat business tax rate t and a casino tax surcharge σ, a privately run casino firm solves the following profit maximization problem to determine its casino service scale:

$$\max_{y} \ \pi(y) = [1 - (1 + \sigma)t]P(Y)y - cy - C_0. \tag{1}$$

10 In regard to the issues studied in this paper, it is sufficient to consider the behaviour of an average representative casino firm, without loss of generality.

11 Notably, as established in Kreps and Scheinkman (1983), Bertrand competition would yield Cournot outcomes if firms face capacity constraints (as most casinos do). Moreover, although we focus on competition in the quality-normalized scale of casino services, we have examined the implications of the presence of a variety effect and found no new results.

The after-tax casino revenues must exceed the variable operating cost; that is, the following participation constraint must hold true:

$$\pi(y) \geq -C_0. \tag{2}$$

Without entry regulation, firms will continue to enter the casino market as long as $\pi(y) \geq 0$. In this case, the participation constraint holds automatically. With entry regulation, the government may subsidize casino firms' setup costs when $\pi(y)$ falls in $[-C_0, 0)$. While the above profit maximization problem will be omitted with government-run casinos, the participation constraint will continue to hold true.

2.2. Local community welfare

Given a mass of n casino firms, the aggregate producer surplus is measured by $n\pi(y) = n\{[1-(1+\sigma)t]Py - cy - C_0\}$. In the benchmark case, the ratio of local to total casino gamblers, denoted by β, is exogenously given. Under a utilitarian social welfare setup, the aggregate utility stemming from casino services in the local economy is given by $U(\beta Y)$, where $U' > 0$, $U'' \leq 0$ and $U(0) = 0$. Thus, the aggregate consumer surplus of local clientele is measured by $U(\beta Y) - P\beta Y$.

To measure local community welfare, we need to consider two crucial externalities. As mentioned in the introduction, by keeping local gamblers and attracting non-local visitors, casinos contribute to a local economy with additional income creation. We assume that a multiple $\eta > 0$ of casino output Y can be created, thereby yielding a net income of $\eta(1-t)Y$. Another consideration is the negative attendant externalities generated by casino gambling, particularly disorder costs due to compulsive addictions, productivity losses, and other social pathologies. Since the local government is concerned only with disorder costs associated with local gamblers, the disorder costs are measured by $D = d\beta Y$, where $d > 0$ captures the extent to which such social costs are generated.[12] This implies that the social disorder costs of casinos are less if casinos draw more non-local visitors (i.e., β is smaller).

In practice, government tax revenues may be used for consumption, investment, and transfer purposes. For the sake of simplicity, we assume that the utility is linear in a numeraire composite consumption good and that the entirety of government tax revenues R will be redistributed to the local residents on a lump-sum basis. Under flat business taxes and casino tax surcharges, we have $R = t\eta Y + (1+\sigma)tPY$, which enters the community welfare function linearly. Thus, we can specify the local community welfare function W as

12 Of course, casinos may also create other types of negative externalities generated by all gamblers, including alcohol and drug abuse, crimes, and other social disturbances. We may easily capture these by including $d_0 > 0$ in the social disorder cost function: $D = (d_0 + d\beta)Y$. Our results remain qualitatively unchanged under this general setup.

$$W = n\{[1-(1+\sigma)t]Py - cy - C_0\} + [U(\beta Y) - \beta PY] + \eta(1-t)Y - D + R,$$

or, upon substituting in the expressions of Y, D, and R,

$$W = U(\beta ny) - n(C_0 + cy) + [\eta + (1-\beta)P]ny - d\beta ny. \tag{3}$$

In equation (3), the terms $[\eta + (1-\beta)P]ny$ and $d\beta ny$ respectively correspond to the positive and negative externalities stemming from casino gambling in the local economy, which play prominent roles in our analysis.

In Regime I, the only use of the local community welfare function is to evaluate the social welfare in the local economy. In Regime II, the local government's welfare maximization problem is given by $\max_n W$ such that y solves the profit maximization problem (1). In Regime III it can be specified as $\max_\sigma W$ such that y solves the profit maximization problem (1) and n satisfies the zero profit condition. Finally, when casinos are government run, the welfare maximization problem is given by $\max_{y,n} W$. In all regimes, the participation constraint must hold.

3. Optimization, equilibrium, and command optimum

In this section, we begin by solving the representative casino firm's profit maximization problem. We then define and establish the free-entry equilibrium, the command optimum under either entry or tax regulation, and the government-run casinos.[13]

3.1. The casino firm's optimization

The first-order necessary condition associated with the firm's profit maximization problem (1) is

$$\pi_y = [1-(1+\sigma)t]P\left(1 - \frac{1}{\varepsilon n}\right) - c = 0. \tag{4}$$

For analytical tractability, we consider in most circumstances that the price elasticity of casino demand is unity; that is, $\varepsilon = 1$ (in this case, aggregate casino revenues become constant, $PY = 1$).[14] While in general entries have an ambiguous effect on the equilibrium output per firm (see Seade 1980), we focus on the situation where the model features a *business-stealing effect* (as defined in Mankiw and Whinston 1986): a new entrant leads the incumbent firms to have

13 We refer to the 'command optimum' as a social optimum, based exclusively on the community's welfare and constrained to a particular set of policy instruments (entry and casino tax) without direct control over the scale of casino services.

14 It should be noted that, with a general constant elasticity, our main findings remain qualitatively unchanged.

a lower volume of sales by stealing their business. That is, we assume $y_n < 0$, which requires that $n > 2$, under which the second-order condition ($\pi_{yy} < 0$) is automatically satisfied. Given this, we can use (4) to derive the interior solution of the representative casino firm's service scale and the associated price:

$$y = \frac{(n-1)[1-(1+\sigma)t]}{cn^2} \tag{5}$$

$$P = \frac{cn}{(n-1)[1-(1+\sigma)t]}. \tag{6}$$

Thus, a casino tax surcharge creates a negative distortionary effect on casino output and a positive effect on its price.

3.2. The laissez-faire regime

A free-entry equilibrium is a pair of casino services and a mass of firms (y, n), such that each casino firm maximizes its profit, subject to a given service production technology and a given cost schedule under which the zero-profit condition is satisfied. Under unrestricted entry, the number of firms in the casino market, n^E, is therefore determined by the zero-profit condition given by

$$\pi(y) = [1-(1+\sigma)t]P(Y)y - cy - C_0 = 0. \tag{7}$$

A free-entry equilibrium is called *non-degenerate* if $n^E > 0$.

Substituting (5) and (6) into the zero-profit condition (7) yields the laissez-faire number of casinos:

$$n^E = \sqrt{\frac{1-(1+\sigma)t}{C_0}}. \tag{8}$$

This implies that both the tax surcharge and the fixed entry cost lower the casino firms' profitability and hence reduce their entry. Substituting (8) into (5) yields

$$y = \frac{C_0}{c}\left[\sqrt{\frac{1-(1+\sigma)t}{C_0}} - 1\right], \tag{9}$$

which is increasing in the fixed cost and decreasing in the marginal cost and the tax surcharge. Consider the following assumption that ensures the presence of the business-stealing effect (i.e., $n > 2$) and also the validity of the second-order condition.

ASSUMPTION 1. $C_0 < [1-(1+\sigma)t]/4$.

Intuitively, assumption 1 requires that the entry cost (C_0) be not too large, to ensure that $n > 2$. We then establish the existence of a non-degenerate free-entry equilibrium.[15]

3.3. *Command optimum in the entry-regulation regime*

An *entry-regulation command optimum* is a pair of casino services and a mass of firms (y, n) such that each casino firm chooses y to maximize its profit, subject to a given service production technology and a given cost schedule, while the local government determines the entry n to maximize the local community welfare W specified in (3).[16] It can be shown that this entry-regulation command optimum is equivalent to one with the local government imposing a development or licence fee.[17]

Define the tax revenue per casino as $CT = (1 + \sigma)tPy$. Further define the net marginal external benefit as $NMEB = \eta - d\beta - (1 - \beta)P/\varepsilon$, which consists of three components: (i) income creation (η), (ii) local social disorder ($d\beta$), and (iii) discouragement of cross-border gambling due to imperfect competition ($(1 - \beta)P/\varepsilon$). An interior optimal number of issued licences in this regime, denoted by n^Q, must satisfy the following first-order condition:[18]

$$\begin{aligned}\frac{\partial W}{\partial n} &= [\beta U' - c + \eta - d\beta + (1 - \beta)P(1 - 1/\varepsilon)]A - C_0 \\ &= \pi(y) + (P - c)ny_n + A \cdot NMEB + CT = 0,\end{aligned} \tag{10}$$

where $A \equiv \partial(ny)/\partial n = y + ny_n$ is assumed to be positive, as in Mankiw and Whinston (1986).

We must also check the participation constraint, (2), facing each casino firm. Manipulating (4) gives $\pi + C_0 = [1 - (1 + \sigma)t](Py/\varepsilon n) > 0$. That is, at the casino firm's optimal service scale, the participation constraint under the entry regulation regime never binds. In the case where $\pi(y) \in [-C_0, 0)$, the government may use the tax revenue collected from casino-related economic activities $(n \cdot CT)$ to subsidize casino firms' setup costs, where we assume $CT \geq C_0$ to ensure that such a subsidy is always feasible.

In the absence of casino externalities and taxes, that is, $NMEB = CT = 0$, our condition reduces to the optimum entry condition in Mankiw and Whinston (1986). In this case, the first term $\pi(y)$ on the right-hand side of (10) reflects the fact that a new entrant contributes to community welfare through the profit it generates, whereas the second term $(P - c)ny_n$ measures how the new entrant crowds out the incumbents by lowering their services provided to the local casino

15 See our working paper for the proofs of all the existence results (http://pingwang.wustl.edu/).

16 More precisely, we suppose hypothetically that the community not only restricts entry but can also induce entry. This is assumed because, a priori, we want to allow for the possibility of under-entry in laissez-faire equilibrium.

17 We refer the reader to our working paper for a formal proof of this assertion (see fn 15).

18 In deriving this equation, the consumer's equilibrium condition $U' = P$ is used.

industry. In the presence of the business-stealing effect the second term is negative, and hence an interior number of casinos is determined as long as $\pi(y) > 0$. The greater the oligopolist mark-up $(P - c)$ is, the larger the business-stealing effect will be.

In general, owing to the distinctive features of casinos, there are two additional welfare effects associated with changes in the number of casino firms n: the casino externality effect (via $NMEB$) and the casino tax effect (via CT). These two effects not only contribute to the study by Mankiw and Whinston (1986) on firm entry, but also provide additional insights toward evaluating the welfare consequences of legalizing casinos.

With $\varepsilon = 1$ and from (5) and (6), $A = [1 - (1 + \sigma)t]/cn^2 > 0$ and $A_n = -2A/n$. We can then show that the second-order condition $(\partial^2 W/\partial n^2 < 0)$ holds under assumption 1 together with the following (sufficient) condition:

ASSUMPTION 2. $\eta - d\beta > c$.

By substituting (5), (6), and the expression for A into (10), the interior solution n^Q must satisfy

$$\Gamma(n) \equiv cn\left(C_0 n - \frac{\beta}{n-1}\right) - (\eta - d\beta - c)[1 - (1 + \sigma)t] = 0, \tag{11}$$

which is monotonically increasing in n. Since $\lim_{n\to\infty} \Gamma(n) > 0$, the existence of a non-degenerate entry-regulation command optimum is ensured if $\Gamma(2) < 0$, or,

ASSUMPTION 3

$$\eta - d\beta > \left[1 + \frac{4C_0 - 2\beta}{[1 - (1 + \sigma)t]}\right] c.$$

Notably, assumptions 2 and 3 require that the income-creation effect net of the local social disorder cost $(\eta - d\beta)$ be sufficiently large relative to the production cost (c) and the entry cost that the optimal regulated entry features $n > 2$.

It can be easily shown that a larger income-creation effect (higher η) or a smaller social disorder cost (lower d) raises optimal casino entries. Furthermore, an increase in the ratio of local to total gamblers (β) raises the consumer's surplus of local visitors, but also induces social disorders stemming from gambling. It therefore has an ambiguous effect on the optimal number of licences issued by the local government. However, as established by many empirical studies, including Goodman (1995) and Thompson, Gazel, and Rickman (1995), the consumer surplus of the casinos is usually viewed as far less important than the associated social costs. Thus, in what follows, we will impose $\partial n^Q/\partial\beta < 0$, which requires that the marginal cost of social disorder $([\partial D/\partial(\beta Y)])$ exceed the price of casino services (i.e., $d > P$), or,

ASSUMPTION 4. $d[1-(1+\sigma)t] > 2c$.

Assumption 4 requires that the social disorder cost (d) be large compared with the production cost (which determines prices).

3.4. *Command optimum in the tax-regulation regime*

A *tax-regulation command optimum* is a pair of casino services and a mass of firms (y, n) such that (i) each casino firm chooses y to maximize its profit, subject to a given service production technology and a given cost schedule; (ii) the entry of casino firms n is pinned down by the zero-profit condition; (iii) the local government determines the casino tax surcharge σ to maximize the local community welfare W specified in (3). Under this regime, the number of casino firms is denoted by n^T, whereas the casino tax surcharge satisfies the following first-order condition:

$$\frac{\partial W}{\partial \sigma} = [(P-c) + NMEB]B - C_0 \frac{\partial n}{\partial \sigma} = 0, \tag{12}$$

where $B \equiv \partial(ny)/\partial\sigma$. It is possible for the optimal σ to be negative (i.e., a subsidy to casino firms), although the government budget balance requires that $\sigma \geq -1$. Moreover, we expect $\sigma < (1-t)/t$, otherwise, the tax surcharge imposed by the local government is too large to permit any casino entry. By imposing $\varepsilon = 1$ and using (5) and (6), we can derive

$$B = -\frac{t}{cn}\left[(n-1) + \frac{1-(1+\sigma)t}{2n^2}\right] < 0.$$

Substituting this expression and (8) into (12) implies that the interior solution of the optimal number of casinos n^T must satisfy

$$\Lambda(n) \equiv cn\left(\frac{C_0 n}{2n-1} - \frac{\beta}{n-1}\right) - (\eta - d\beta - c)[1-(1+\sigma(n))t] = 0 \tag{13}$$

where $\sigma(n) = (1/t)[(1-t) - C_0 n^2]$. It is easily seen that $\Lambda(n)$ is monotone increasing in n and $\lim_{n\to\infty}\Lambda(n) > 0$. Thus, an interior solution n^T exists if $\Lambda(2) < 0$ or,

ASSUMPTION 5. $\eta - d\beta > [(4/3 - \beta/2C_0)]c$.

By using (8), we can see that the second-order condition for an optimal tax surcharge σ requires

$$\tilde{\Lambda}(n) = (\eta - d\beta - c)C_0 n^2 - \beta c - \frac{\beta c(2n-1)}{2(n-1)^2} < 0.$$

Recall that $\sigma \geq -1$, so that the maximum number of casinos is given by $n_{\max} = \sqrt{1/C_0}$. Since $\tilde{\Lambda}(n)$ is increasing in n, a sufficient condition for the second-order condition to be met is

ASSUMPTION 6

$$\eta - d\beta < \left\{1 + \beta\left[1 + \frac{2n_{\max} - 1}{2\,(n_{\max} - 1)^2}\right]\right\} c.$$

Intuitively, assumptions 5 and 6 require that the income creation effect net of the local social disorder cost be not too large or too small compared with the production cost and the entry cost. On the one hand, it is not too small, so to ensure that the optimal entry under tax regulation is associated with $n > 2$. On the other hand, it is not too large, so as to yield an optimal subsidy strictly above the lower bound $\sigma = -1$. Assumptions 5 and 6, together with assumptions 1 and 2, are sufficient to ensure the existence of a non-degenerate entry-regulation command optimum.

3.5. Government-run casinos

A *social optimum with government-run casinos* is a pair of casino services and a mass of firms (y, n) determined by the local government to maximize the local community welfare W specified in (3), subject to the participation constraint, $P(Y)y \geq cy$. Although the government chooses the optimal number of casinos in this regime, it differs from the entry-regulation regime in that it has a direct control over the scale of the casinos, thereby abstracting from the business-stealing effect.

An interior optimal number of issued licences (n^G) must satisfy the following first-order condition:

$$\frac{\partial W}{\partial n} = [\beta U' - c + \eta - d\beta + (1 - \beta)P(1 - 1/\varepsilon)]y - C_0 = 0, \tag{14}$$

under which

$$\frac{\partial W}{\partial y} = [\beta U' - c + \eta - d\beta + (1 - \beta)P(1 - 1/\varepsilon)]n > 0.$$

That is, once it is optimal to operate casinos ($n^G > 0$), the optimal scale of each casino (y^G) must be set as high as possible, which is indeed at the corner,

$$P(Y)y = cy, \tag{15}$$

yielding $y = c^{-\varepsilon}/n$. Substituting this expression into (14) and imposing $\varepsilon = 1$, we obtain

$$n^G = [\eta - d\beta - (1 - \beta)c]\,/\,(cC_0)\,,$$

which is positive under assumption 2, ensuring the existence of a non-degenerate social optimum with government-run casinos.[19]

We are ready to compare the outcomes under the four different regimes.

4. Comparisons between various regimes

The main purpose in comparing the entry-regulation command optimum with the free-entry equilibrium is to understand whether or not the local economy is overloaded with casinos under laissez-faire. By contrasting the tax-regulation command optimum with the free-entry equilibrium, we can learn whether a casino tax surcharge or subsidy is needed in order to correct the externality problems associated with casinos. We can further compare the entry-regulation command optimum with the tax-regulation command optimum to see which is the more effective regulatory policy in the legalization process of the casino market. Finally, we can compare the scale and the number of casinos as well as economic welfare under the government-run regime with those of other regimes to complete the analysis.

4.1. Laissez-faire versus entry regulation

In the laissez-faire regime, the free-entry equilibrium number of casinos, n^E, is pinned down by the zero-profit (ZP) locus (8), whereas under entry regulation, the optimal number of casino firms n^Q satisfies the entry-regulation (ER) locus (11). We depict these loci in figure 1 to illustrate that the outcomes depend crucially on the degree to which gamblers are locally based (β).

Since individual firms ignore the external effects, the entry decision is independent of β, implying a horizontal ZP locus. The vertical intercept of the ER locus is $\bar{n} = \sqrt{[1-(1+\sigma)t](\eta - c)/C_0 c}$. Under assumption 4, $d > P$ and it follows from (11) that ER is downward sloping. In general, $\bar{n}$ (the vertical intercept of the ER) could be greater or less than $n^E = \sqrt{[1-(1+\sigma)t]/C_0}$. When $\eta - 2c \leq 0, \bar{n} \leq n^E$ and hence the casinos must overcrowd the local economy under laissez-faire; that is, $n^E > n^Q$ for any $\beta > 0$. This resembles the conclusion obtained by Mankiw and Whinston (1986).[20] Intuitively, since $\eta - 2c \leq 0$, the income-creation effect is not too strong; the presence of the business-stealing effect (assumption 1) is therefore sufficient to ensure casino overcrowding in the absence of government regulation.

19 Alternatively, one may assume that the local government set the scale of each casino at the corner under which the profit incurred is zero (i.e., $P(Y)y = cy + C_0$). While this alternative setup leads to a smaller output and a larger number of casinos $n^{G'} = [\eta - d\beta - (1-\beta)c]/[(\eta - d\beta)\,C_0]$, it does not change any of our findings qualitatively.

20 In our terminology, the Mankiw-Whinston framework ignores the external effects ($\eta = d = 0$ and $\beta = 1$) and taxes ($t = 0$), under which (8) and (11) reduce to $n^E = \sqrt{1/C_0}$ and $n^Q = \sqrt{1/[C_0(n^Q - 1)]}$, respectively. So, the result $n^E \geq n^Q$ always holds as long as the business-stealing effect is present (so that $n > 2$).

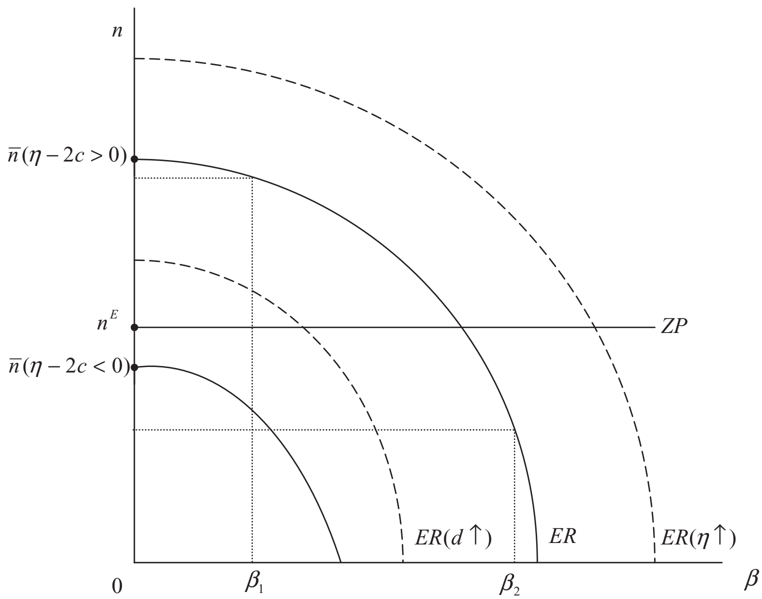


FIGURE 1 Laissez-faire versus entry regulation

We next turn to the case where $\eta - 2c > 0$; that is, the positive externality of the casinos through income creation is substantial. In this case, $\bar{n} > n^E$, and thus it is possible to have $n^E < n^Q$, particularly if the income-creation effect is strong (η is large), the social disorder cost is nil (d is small), or the fraction of local gamblers is small (β is small, e.g., at β_1 in figure 1), because under these circumstances the net marginal external benefit ($NMEB$) is large.[21] This result contrasts with the Mankiw-Whinston proposition – even when the business-stealing effect is present, entry need not be more desirable to the entrant than it is to the society.

Summarizing:

PROPOSITION 1 (Laissez-faire versus entry regulation). *Under assumptions 1–3, with* $\varepsilon = 1$,

i) if the income-creation effect is sufficiently weak that $\eta - 2c \leq 0$, *casinos always overcrowd the local economy in laissez-faire;*
ii) if the income-creation effect is sufficiently strong that $\eta - 2c > 0$, *there may be under-entry of casinos in laissez-faire when the social disorder cost or the fraction of local gamblers is small.*

21 Equation (11) implies that, given β, as η increases (resp. d increases), ER shifts rightwards (resp. leftwards) to $ER(\eta\uparrow)$ (resp. $ER(d\uparrow)$).

4.2. *Laissez-faire versus tax regulation*

Recall that the zero-profit (ZP) locus (8) determines the free-entry equilibrium number of casinos n^E. Under tax regulation, the number of casinos n^T and the optimal tax surcharge σ^T are pinned down by the zero-profit locus (8) and the tax-regulation (TR) locus (13), where the TR locus is downward sloping and, under assumption 6, flatter than the ZP locus (also downward sloping). When the income-creation effect is sufficiently weak (η low) or the social disorder cost or the fraction of local gamblers is sufficiently large (d, β high), the net marginal social benefit from σ^T is high and hence a casino tax surcharge is imposed (i.e., $\sigma^T > 0$). Otherwise, a subsidy ($\sigma^T < 0$) is needed to achieve the tax-regulation command optimum. From (8), it is obvious that the command optimum with a tax surcharge (a subsidy) must feature less (more) entry than the zero-tax surcharge free-entry equilibrium. These results can be summarized in the following proposition:

PROPOSITION 2 (Laissez-faire versus tax regulation). *Consider assumptions 1, 2, and 4–6 and set* $\varepsilon = 1$ *. If the income-creation effect is weak, or the social disorder cost or the fraction of local gamblers is large, then the tax-regulation command optimum is associated with a positive tax surcharge and less entry compared with the zero-tax surcharge free-entry equilibrium; otherwise, it is associated with a subsidy on casino services and more entry.*

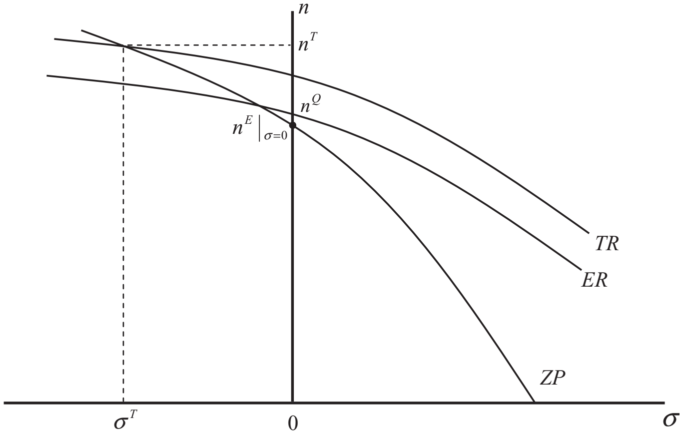
4.3. *Entry versus tax regulation*

Recall that, under tax regulation, the optimal tax surcharge and the number of casinos are pinned down by the tax-regulation (TR) locus (13) and the zero-profit (ZP) locus (8), while under entry regulation, the optimal number of casino firms satisfies the entry-regulation (ER) locus (11). By examining (11), it is clear that the ER locus is downward sloping in (n, σ) space. Moreover, we learn from (11) and (13) that $\Gamma(n) - \Lambda(n) = [2cC_0 n^2(n-1)]/(2n-1)] > 0$. Since both $\Gamma(n)$ and $\Lambda(n)$ are increasing in n, given the same σ, the level of n under the tax regulation regime should be higher than under the entry regulation regime. Thus, in figures 2a and 2b the TR locus is uniformly above the ER locus.

Given $\sigma = 0$ under the entry regulation regime, figure 2a provides a graphical illustration for the case associated with a casino subsidy. Proposition 2 has pointed out that if the income-creation effect is strong (η large), or the social disorder cost or the fraction of local gamblers is small (d or β small), casino services are subsidized (i.e., $\sigma < 0$). In this scenario, the number of casino firms under tax regulation must be greater than under entry regulation; that is, $n^Q < n^T$.

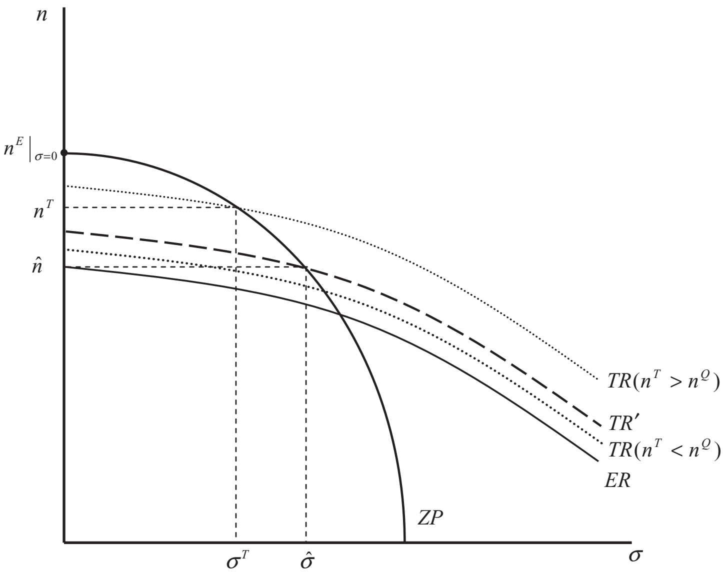
We next turn to the case where there is a positive tax surcharge and illustrate it in figure 2b. Specifically, we can derive the following relationship from (11) and (13):

$$\Lambda(n) = \Gamma(n)|_{\sigma=0} + (\eta - d\beta - c)t\sigma - \frac{2cC_0 n^2(n-1)}{2n-1} = 0.$$



(a)

FIGURE 2a Entry versus tax regulation: subsidizing casinos ($\sigma_r < 0$)



(b)

FIGURE 2b Entry versus tax regulation: taxing casinos ($\sigma_r > 0$)

Accordingly, we can find a critical level $\widehat{\sigma}$ such that $\Lambda(n)|_{\sigma=\widehat{\sigma}} - \Gamma(n)|_{\sigma=0} = 0$, or

$$\widehat{\sigma} = \frac{2cC_0[n(\widehat{\sigma})]^2[n(\widehat{\sigma}) - 1]}{[2n(\widehat{\sigma}) - 1]t(\eta - d\beta - c)}, \tag{16}$$

where $n(\widehat{\sigma})$ is given by (8). Thus, $n^Q = n^T = \widehat{n} = n(\widehat{\sigma})$ and, from (16), the critical value $\widehat{\sigma}$ must be positive to achieve $n^Q = n^T = \widehat{n}$ (see TR' in figure 2b). That is, in order for the entry-regulation and tax-regulation outcomes to coincide, a casino tax surcharge must be imposed. Moreover, when casino firms are subject to a positive tax surcharge, the number of casino firms under tax regulation could be either greater or smaller than that under entry regulation (see figure 2b). The number of casino firms under tax regulation is smaller if the income-creation effect is sufficiently weak or the social disorder cost or the fraction of local gamblers is sufficiently large.

It is also interesting to compare the levels of welfare between the entry-regulation and tax-regulation regimes, provided that the number of casinos is the same, $n^Q = n^T = \widehat{n}$. Let us denote W^T as the welfare in the tax-regulation command optimum and W^Q as the welfare in the entry-regulation command optimum. Given $n^Q = n^T = \widehat{n}$, we can utilize the welfare specification (3) to derive

$$W^T\big|_{(n,\sigma)=(\widehat{n},\widehat{\sigma})} - W^Q\big|_{(n,\sigma)=(\widehat{n},0)} = U(\beta\widehat{n}y^T) - U(\beta\widehat{n}y^Q) + (\eta - d\beta - c)\widehat{n}(y^T - y^Q).$$

Based on assumption 2 and on U being strictly increasing, it follows immediately that $W^T \lesseqgtr W^Q$ iff $y^T \lesseqgtr y^Q$.

Given $\sigma = 0$, from (4) we have: $y^Q = [(\widehat{n} - 1)(1 - t)]/c\widehat{n}^2$. Furthermore, it follows from (5) and (8) with $\sigma = \widehat{\sigma}$ that: $y^T = [C_0(\widehat{n} - 1)]/c$. Thus, it is easily seen from figure 2b that, under $n^Q = n^T = \widehat{n}$, the necessary and sufficient condition for the welfare under entry regulation to be higher than under tax regulation is $\widehat{n} < \sqrt{(1 - t)/C_0}$, where the right-hand side is the vertical intercept of the ZP locus. This inequality holds only if casinos are subject to a positive tax surcharge (i.e., $\sigma > 0$). Thus, a quantity control (entry regulation) leads to higher welfare than a price control (tax regulation) when casinos face a positive surcharge in the tax-regulation command optimum (which holds if the income-creation effect is weak or the social disorder cost or the fraction of local gamblers is large). This is because, by imposing a tax surcharge to correct for negative externalities under the tax-regulation regime, the government discourages casinos from operating on a larger scale, despite a larger scale being welfare improving. The intuition becomes clearer if we regard the entry-regulation regime as one imposing a development or licence fee (which is equivalent, as argued in section 3.3 above). Based on general principles in public finance, a development or licence fee is less distortionary than a revenue tax (our casino tax surcharge). It is therefore plausible that the entry-regulation regime can lead to higher economic welfare than the tax-regulation regime.

We summarize these results as follows:

PROPOSITION 3 (Entry versus tax regulation). *Under assumptions 1–3, 5, and 6 with* $\varepsilon = 1$, *if casino firms are subsidized in a tax-regulation command optimum, the number of casino firms under tax regulation is always greater than under entry regulation (i.e.,* $n^Q < n^T$*); if casino firms are subject to a positive tax surcharge, then*

i) the number of casino firms under tax regulation is smaller than that under entry regulation if the income-creation effect is sufficiently weak or the social disorder cost or the fraction of local gamblers is sufficiently large;
ii) given the same number of casino firms (i.e., $n^Q = n^T = \widehat{n}$), the associated economic welfare under tax regulation is always lower.

4.4. Government-run casinos versus other regimes

To compare the regime of government-run casinos with other regimes (laissez-faire as well as entry and tax regulation), we first plot (15) and $\pi(y)$ over y, where, from (4), the former locus is above the latter with a zero or positive casino surcharge (i.e., $\sigma \geq 0$). These loci are depicted in the top panel of figure 3, where points S^G and $S^{G'}$ give the optimal scale of government-run casinos under a binding participation constraint and under the zero-profit condition, respectively, and point S^M gives the profit-maximizing solution of y under the other three regimes. It is obvious that the optimal scale of government-run casinos in either case is always greater than that under other regimes as long as casino firms are not subsidized.

To facilitate a fair comparison of the number of casinos, we restrict our attention to the optimal scale of government-run casinos under zero profit with $n^{G'} = [\eta - d\beta - (1-\beta)c] / [(\eta - d\beta)\, C_0]$. From (8), the optimal number of government-run casinos under zero profit ($n^{G'}$) is larger than that under laissez-faire (n^E) or under tax regulation (n^T) as long as $\sigma \geq 0$ and $[(1-\beta)\, c/(\eta - d\beta)] < 1 - \sqrt{(1-t)\, C_0}$. Under assumption 4, the latter inequality is met if the income-creation effect is strong (η large) or the social disorder cost or the fraction of local gamblers is small (d, β small). In this case, the net marginal external benefit from the casino industry is higher, and, by accounting for this, the government operates a larger number of casinos than under laissez-faire and tax regulation, where the government has no direct control over the number of casino firms.

The comparison between $n^{G'}$ and n^Q (entry regulation) is less obvious. To undertake this task, we plot (10) and (14) in (y, n) space in the bottom panel of figure 3. As long as C_0 is not too large, both (10) and (14) are downward sloping, where the former locus is lower than the latter in the presence of the business-stealing effect (implying $A < y$). That is, the government-run casino regime differs from the entry-regulation regime because the government can directly control the scale of the casinos and is hence abstracting from the business-stealing effect. When the business-stealing effect is sufficiently strong, the locus (10) is far below (14) and the optimal number of government-run casinos under zero profit ($n^{G'}$) is larger than that under entry regulation (n_1^Q). When the business-stealing effect is negligible, the optimal number of government-run casinos is smaller than that under entry regulation (n_1^Q).

PROPOSITION 4 (government-run casinos versus other regimes – positive analysis). *Under assumptions 1–3, 5, and 6 with $\varepsilon = 1$, the optimal scale of*

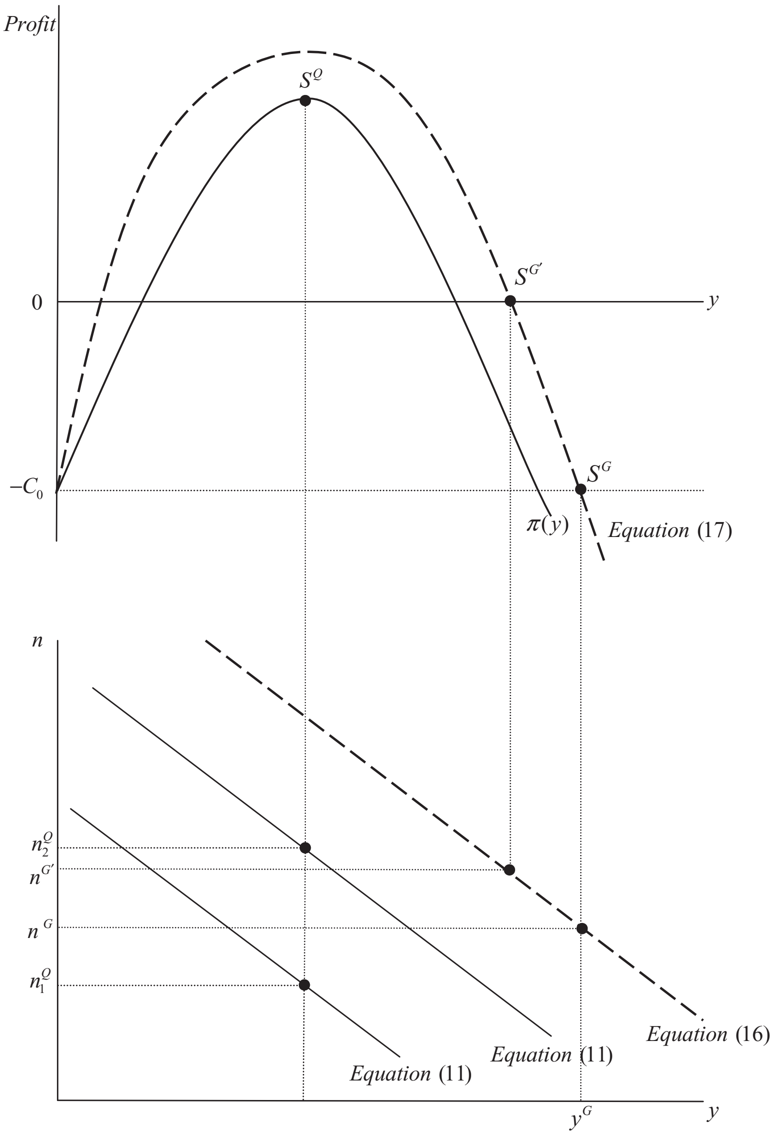


FIGURE 3 Entry regulation versus government-run casinos

government-run casinos is always larger than that under laissez-faire and entry and tax regulation with a zero or positive casino surcharge. Moreover, under assumptions 1–6, with $\varepsilon = 1$,

i) if the income-creation effect is strong, or the social disorder cost or the fraction of local gamblers is small such that $[(1-\beta)\,c/(\eta - d\beta)] < 1 - \sqrt{(1-t)\,C_0}$, *then the optimal number of government-run casinos under zero profit is larger than that under laissez-faire and tax regulation;*

ii) if the business-stealing effect is sufficiently strong, then the optimal number of government-run casinos under zero profit is larger than that under entry regulation.

We turn next to a comparison of the levels of welfare between the government-run casino regime and other regimes, provided that the number of casinos is the same, $n^{G'} = n^E = n^Q = n^T = \widehat{n}$. Denote $W^{G'}$ and W^E as the welfare under government-run casino (with zero profit) and laissez-faire regimes, respectively. From (3), we have

$$W^{G'}|_{n=\widehat{n}} - W^E|_{(n,\sigma)=(\widehat{n},\sigma)} = U(\beta\widehat{n}y^{G'}) - U(\beta\widehat{n}y^E) + (\eta - d\beta - c)\widehat{n}(y^{G'} - y^E)$$
$$W^{G'}|_{n=\widehat{n}} - W^Q|_{(n,\sigma)=(\widehat{n},\sigma)} = U(\beta\widehat{n}y^{G'}) - U(\beta\widehat{n}y^Q) + (\eta - d\beta - c)\widehat{n}(y^{G'} - y^Q)$$
$$W^{G'}|_{n=\widehat{n}} - W^T|_{(n,\sigma)=(\widehat{n},\widehat{\sigma})} = U(\beta\widehat{n}y^{G'}) - U(\beta\widehat{n}y^T) + (\eta - d\beta - c)\widehat{n}(y^{G'} - y^T).$$

Again, as long as casino firms are not subsidized ($\sigma, \widehat{\sigma} \geq 0$), the optimal scale of government-run casinos is always greater than that under other regimes. Thus, assumption 2 and the monotone increasing property of U guarantee that the welfare under the government-run casino regime is the highest compared with other regimes. Intuitively, under the government-run casino regime the government internalizes all externalities and disposes of all instruments. Therefore, government-run casinos can reach the highest welfare among all regimes.

PROPOSITION 5 (government-run casinos versus other regimes – welfare analysis). *Under Assumptions 1–3, 5, and 6, with $\varepsilon = 1$, if casino firms are not subsidized under laissez-faire and entry and tax regulation, then, given the same number of casino firms (i.e., $n^{G'} = n^E = n^Q = n^T = \widehat{n}$), the associated economic welfare under the government-run casino regime is the highest.*

5. Endogenous ratio of local to total casino gamblers

We now consider the behaviour of consumers engaged in casino gambling to allow for an endogenous determination of the fraction of local to total gamblers (β). This generalization is important, particularly because of the cross-border gambling effect. As discussed above, by attracting a larger fraction of non-local gamblers, casinos can generate greater net external benefits in relation to the local community. To evaluate a casino regulation policy, one must therefore take into account how the composition of local and external customers responds to the policy and subsequently how large the cross-border gambling effect is.

Specifically, we modify the previously assumed identical preferences of potential consumers to differentiate their demand for casino services depending on their residential location z, which is uniformly distributed with a well-defined p.d.f., $g(z)$, over a compact support, [0, 1]. This is a natural setup that permits an endogenous determination of non-local gamblers. The basic idea is quite intuitive: customers must travel to casinos in order to enjoy the services. Other things being equal, a consumer is more likely to engage in cross-border gambling when casinos are closer in terms of travel distance.[22] Thus, the extent to which casinos can attract external gamblers depends on whether the gaming locations are convenient to outside visitors. To discuss this issue, we consider two types of casino market: centralized and jurisdiction-wide-dispersed casinos. The remote-type casinos can be thought of as an intermediate case of centralized and jurisdiction-wide-dispersed casinos. In the case of centralized casinos, we assume that the legal casinos are restrictively located at $z = 0$, while in the case with jurisdiction-wide-dispersed casinos the legal casinos are located between 0 and the state border, $\bar{z}$.

Assume that casino visitors incur a transportation cost that is linear in the distance from their residential locations to the casino sites. An individual follows a two-step decision process: he first decides whether or not to visit the casinos and afterwards chooses the level of demand for the casinos, denoted by x. The utility derived by consuming x is specified by $u(\cdot)$, with $u' > 0$ and $u'' \leq 0$.[23] By backward induction, we first solve the individual's demand for casino-style gambling $x^*(P)$, where $x^*_P < 0$ satisfies the standard Law of Demand.

5.1. *Centralized casinos*

Under the centralized configuration, where all casinos are located at $z = 0$, the indirect utility function of the individual is given by

$$u(x^*(P)) - \delta z, \tag{17}$$

where $\delta > 0$ and δz measures the disutility stemming from commuting to the casino sites. The active participation constraint for an individual who visits casinos is $u(x^*(P)) - \delta z \geq 0$. Thus, we denote z^C as the critical value of z at which $u(x^*(P)) - \delta z^C = 0$ and solve

$$z^C = \frac{u(x^*(P))}{\delta}, \tag{18}$$

which is decreasing in P.

22 For example, based on the reports of the Casino Association of Kansas, annual spending incurred by each gambler from 50–100 miles is about eight times as high as that from 150–200 miles.

23 In the baseline case considered below, we assume linear utility (with $u'' = 0$), which permits a full analytic characterization of the endogenous fraction of local casino gamblers (β) under different regimes.

Given that z is uniformly distributed between 0 and 1, the market demand for casinos is $\Psi = \int_0^{z^C} g(z)dz \cdot x^* = z^C x^* = \bar{z}x^* + (z^C - \bar{z})x^*$, where $\bar{z}x^*$ and $(z^C - \bar{z})x^*$ are the local and non-local demands, respectively. Accordingly, the endogenous ratio of local to total casino gamblers under a centralized casino configuration is

$$\beta^C = \frac{\bar{z}}{z^C(P)} = \frac{\bar{z}}{u(x^*(P))/\delta} = \beta^C(P), \tag{19}$$

where $\beta_P^C = -\bar{z}u'x_P^*/\delta(z^C)^2 > 0$ and $(1 - \beta^C) = 1 - \bar{z}/z^C$. To be meaningful, we assume that cross-border gambling exists; that is, $(1 - \beta^C) > 0$, which implies that $z^C \geq \bar{z}$.

We next turn to the optimization problem facing the casino firms. In facing the market demand given by Ψ, a casino firm chooses y so as to maximize the π reported in (1). The corresponding first-order condition is

$$\pi_y = [1 - (1 + \sigma)t]P(1 - \frac{1}{\varepsilon^* n}) - c = 0, \tag{20}$$

where $\varepsilon^* = -(\partial\Psi/\partial P)(P/\Psi)$ is the price elasticity for casinos with an endogenous β. In equilibrium, the market demand, $\Psi(= z^C x^*)$, must equal the supply, $Y = ny$.

Given that the local government is concerned only with the local consumer surplus and that the demand on the part of the local visitors is $\bar{z}x^* = \beta^C Y$, the local consumer surplus in equilibrium can be expressed as $\bar{z}u(x^*(P)) - \beta^C PY - \delta\bar{z}$. Under linear utility, $\bar{z}u(x^*) = U(\bar{z}x^*) = U(\beta^C Y)$. Accordingly, the welfare achieved by the local economy is modified as

$$W = U(\beta^C ny) - n(cy + C_0) + \eta ny + (1 - \beta^C)Pny - d\beta^C ny - \delta\bar{z}, \tag{21}$$

where β^C and y solve (19) and (20).

With an endogenous β^C, the optimal number of casinos under entry-regulation, tax-regulation, and government-run casino regimes satisfies, respectively,

$$\frac{\partial W}{\partial n} = \pi(y) + (P - c)ny_n + A \cdot NMEB + CT + \frac{d\beta^C}{\varepsilon}\left(\frac{P\beta_P^C}{\beta^C}\right)A = 0$$

$$\frac{\partial W}{\partial \sigma} = [(P - c) + NMEB]B - C_0\frac{\partial n}{\partial \sigma} + \frac{d\beta^C}{\varepsilon}\left(\frac{P\beta_P^C}{\beta^C}\right)B = 0$$

$$\frac{\partial W}{\partial n} = \left[\beta^C U' - c + \eta - d\beta^C + (1 - \beta^C)P\left(1 - \frac{1}{\varepsilon}\right)\right]y - C_0 + \frac{d\beta^C}{\varepsilon}\left(\frac{P\beta_P^C}{\beta^C}\right)y = 0,$$

which differ from (10), (12), and (14) in the respective regimes by only an additional term. Since $[(d\beta^C/\varepsilon)(P\beta_P^C/\beta^C)] > 0$, $A > 0$ and $y > 0$, we can easily conclude that the optimal number of casinos with an endogenous fraction of local gamblers under entry-regulation and government-run regimes is always greater than the respective number with an exogenously fixed fraction of local gamblers. Moreover, as $B < 0$, the optimal tax surcharge with an endogenous fraction of local gamblers under tax regulation is lower than that with an exogenously fixed fraction of local gamblers. Because a lower tax surcharge encourages casino entry, the optimal number of casinos with endogenous β is also higher than its counterpart with exogenous β.

The extent to which the optimal number of casinos is larger when the local government takes the endogenous ratio of local gamblers into account depends crucially on two elasticities: the inverse demand elasticity (measured by $1/\varepsilon$) and the price elasticity of cross-border gambling (captured by $P\beta_P^C/\beta^C$). With a higher inverse demand elasticity, an increase in the number of casinos leads to a larger drop in the price of casino service. With a higher price elasticity of cross-border gambling, a reduction in the price of casino services stimulates a greater number of external visitors and hence a larger drop in the fraction of local gamblers. Thus, the higher these two elasticities are, the more the government will raise the optimal number of casinos in entry-regulation and government-run regimes when internalizing the endogenous ratio of local gamblers. The underlying intuition is even clearer in the case of tax regulation. By the standard Pigovian tax argument, when the proportion of external visitors is endogenously determined, the demand for casino services is more elastic and hence one must tax such services less (lower σ), thus inducing a greater number of entries. To summarize:

PROPOSITION 6 (endogenous ratio of local gamblers). *Under assumptions 1–3, 5, and 6, with an endogenous fraction of local casino gamblers, the optimal number of casinos under each of the entry-regulation, tax-regulation, and government-run casino regimes is larger than that with an exogenously fixed fraction of local gamblers. The more elastic the inverse demand and cross-border demand are, the more the government will raise the optimal number of casinos above the case with an exogenous ratio of local gamblers.*

This result reflects Gazel's (1998) argument that 'with a few exceptions, many state and local economies in the United States have, most likely, experienced net losses due to casino gambling in their jurisdictions ... one of the major reasons for such negative impacts is the strategy of the monopolistic and oligopolistic market structure chosen by the new jurisdictions ... [which] resulted in low ratios of non-local to total visitors,' or, in our language, a high β. This also has an important implication for assessing the consequences of casino market structures, particularly for those with imperfect market structures or that impose restrictions on the operations of casinos.

As observed by Eadington (2007), in European countries casino taxes are higher, casino industries are smaller, and casino visitors are mostly local. These phenomena can also be easily explained within our framework. In particular, a higher tax imposed on casinos lowers casino entries and discourages external visitors. Such a strong tax regulation may overcorrect the negative externalities associated with the casino industry, leading to lower economic welfare.

5.2. Jurisdiction-wide-dispersed casinos

If the legal casinos are dispersed within a jurisdiction (a province or a state), the casinos are scattered over $[0, \bar{z}]$. Analogous to section 5.1, the active participation constraint facing each individual is given by

$$u(x^*(P)) - \delta(z - \bar{z}) \geq 0. \tag{22}$$

where the only difference between (17) and (22) is the disutility term.

By repeating the same procedure, we can solve for the critical value z^D that satisfies equation (22) with equality, $z^D = [u(x^*(P))/\delta] + \bar{z}$, as well as the equilibrium ratio of local to total casino gamblers,

$$\beta^D = \frac{\bar{z}}{z^D} = \frac{\bar{z}}{[u(x^*(P))/\delta] + \bar{z}}. \tag{23}$$

By comparing (23) with (19), it can be established that $\beta^D < \beta^C$, regardless of the underlying regimes:

PROPOSITION 7 (centralized versus jurisdiction-wide-dispersed casinos). *Under assumptions 1–3, 5, and 6, with an endogenous fraction of local casino gamblers, the optimum in the dispersed configuration under each of the entry-regulation, tax-regulation, and government-run casino regimes stimulates greater cross-border gambling and leads to higher welfare than in the centralized configuration.*

This result suggests that legal casinos that are dispersed may be a better 'institutional design' for the local community, which also provides a plausible explanation for the success of the Nevada casino industry over that of Atlantic City.

6. Concluding remarks

We have constructed an oligopolistically competitive model of legal casinos under laissez-faire, entry- or tax-regulation, and government-run casino regimes in which a number of external effects from casino-style gambling are explicitly taken into account. We have shown that, owing to the presence of positive and negative externalities and the business-stealing effect, private casino firms need not overcrowd under laissez-faire, whereas the government-run casino market need not be thinner. We have also shown that, owing to its additional distortion to the casino scale, tax regulation is in general less effective in the welfare sense than entry regulation. The disadvantage of tax regulation is magnified when the demand of non-local gamblers is elastic. The result suggests that the high casino tax policy adopted by European countries may very likely be harmful to their local communities. Finally, we have shown that it is beneficial to local jurisdictions if the casino industry is set in such a way that it can take advantage of cross-border gambling. One such approach is to have a jurisdiction-wide-dispersed casino configuration, such as exists in Nevada, which yields higher welfare than a centralized configuration, such as exists in New Jersey. Another approach is to develop casinos in border cities, such as exists in Detroit and Windsor, to maximize the net external benefit from cross-border gambling.

For future work, one may consider whether a certain policy mix, say, a combination of a tax surcharge and a licence fee, may be a better program to achieve higher community welfare. Moreover, it may be interesting to extend the model to allow for product differentiation in casino services. Should gamblers have a strong preference for a certain variety of casino products, the local government could consider issuing more casino licences in order to enhance community welfare. Another concern is related to social norms. Suppose that, if an individual's decision regarding whether to gamble depends on others (or the social norm), a reinforcing effect may be present. As a consequence, if the net external marginal benefit from casino-style gambling is negative, a stingy casino regulation may be required so as to minimize the negative reinforcing external effect.

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