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Abstract

This paper studies casino-style gambling from the public economics point of view in a jurisdiction populated by oligopolistically competitive legal casinos. We consider three different regimes: laissez-faire, entry regulation and tax regulation. The model highlights three important external effects from casino-style gambling: non-casino income creation, social disorder costs, and casino exporting to other jurisdictions. In the generalized case with an endogenously-determined ratio of local to total gamblers, we allow the configuration of casinos to be centralized or jurisdiction-wide dispersed. A complete comparison between equilibrium and command optimum outcomes is provided, and the welfare consequences under the three regimes and two casino configurations are examined.

Keywords: Casino gambling, externalities, oligopoly pricing, entry and tax regulation.

JEL Classification Numbers: L83, D21, D62, D43.

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1. Introduction

In less than a decade in the United States, commercial casino revenues increased 266%, from $8.7 billion in 1990 to $31.8 billion in 1999.[1] Today in the U.S., there are casinos in approximately 200 counties in 33 states, and gambling is legalized in 48 of the 50 states (see Eadington, 1999; Grinols and Mustard, 2001; and Gazel, Rickman, and Thompson, 2001). Although the growth of casino gambling has generated many important social, economic, and policy-related questions, "[i]t is surprising how little we definitely know about the social and economic impacts of this $40 billion a year industry." (Eadington, 1995, in a report to Congress on the state of knowledge regarding the casino industry). In the economics literature, there is a lack of comprehensive theoretical analysis of casino gambling, and, in particular, the relevant welfare analysis has not been formally modeled.[2] Our paper makes a first step in this direction by developing a formal theoretical model to analyze the welfare effects of casino-style gambling on the community/region where gambling is permitted.

Presently in the U.S., three types of 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. In 1998, casino revenues in these states totaled $19.9 billion, of which 40.5% was from dispersed casino markets (Nevada), 20.5% from centralized markets, and 39.0% from remote markets.

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[1] It is recently reported by Garrett (2004) that the gaming revenue has been over $40 billion in 2001.

[2] To our knowledge, Sauer (2001) is the only exception, in which Becker's (1983) model of political competition between interest groups is adapted to the problem of gambling regulation.

Casino gambling generates substantial attendant externalities including compulsive addictions, increased drug and alcohol abuse, and the committing of crimes. Because it is difficult to infer whether such undesirable behavior may still exist in the absence of casino gambling, a precise estimation of its social costs is basically impossible. Since a local government must pay to incarcerate and prosecute problem gamblers and provide restitution to the gamblers' victims, some costs may be imputed more directly, though it needs to be recognized that they only reflect at best parts of the overall social cost. Grinols and Mustard (2001) find that about 0.77% of the national sample could be classified as compulsive gamblers. Goodman (1995) estimates that each problem gambler costs the government and the private economy $13,200 a year.[3] Similarly, Thompson, Gazel, and Rickman (1995) impute the associated social costs as ranging from between $12,000 and $50,000 per problem gambler. These findings suggest that the social costs associated with casino gambling are substantial.

Because of the associated negative externalities, casino gambling is viewed by many observers as a vice with limited or tainted consumer value (see Goodman, 1995). Yet, to a local government, other considerations may come into play. In addition to casino tax revenues, casinos can make important economic contributions to the local community, including job creation, investment stimulation, tourism development, and economic growth.[4] Of greater importance, jurisdictions with legalized casinos may become exporters of gambling services if casinos can attract a high proportion of their customers from outside. A greater export effect not only creates more local net

[3] Simply increasing the incidence of problem gambling by only one-half of one percent of the adult population would cost private business and the government at least $73 million per year in a small state like Iowa and $780 million in a large state like California.

[4] For a comprehensive discussion, the reader is referred to the special issue on legalized casinos in the *Economic Development Review* (1995). In a recent case, the Niagara Falls Casino Inc. signed an agreement with the city government to guarantee, among others: (i) revenue to the city government of $2.6 million annually for the first 10 years, $3 million per year for the next 10 years, and $3 million per year, adjusted for inflation, afterward; (ii) the creation of 5,000 direct jobs in the casino complex; and, (iii) the development of over 30 major projects, including hotels, shopping malls, restaurant clusters, theme parks and recreation centers.

income, but also makes parts of the social disorder costs irrelevant to the local community. In this case, casinos may have positive net externalities in relation to the local community (see Eadington, 1998). However, to generate an export effect of casinos is a difficult challenge to a local government, particularly if legalized casinos cater predominantly to local clientele. In reality, Las Vegas is one of the very few exceptions in which most of the visitors are drawn from outside.[5]

The complexity of casino-style gambling results in a considerable variation in the patterns of legalized gambling operations found in different places. For example, Thompson (1998) identifies some significant differences between casinos in North America and in Europe. While the operations of casinos in Europe are very restrictive, the clientele of the European casino is relatively local. Moreover, European casinos are subject to much higher taxes, with 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 only from 6.25% (Nevada) to 35% (Illinois). 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, 10, 11, and 16, respectively). For those states with entry regulations, the actual number of casinos is usually at or close to the maximum. Partly as a result of different regulations, the numbers of casinos vary dramatically across states: from 230 in Nevada, to 29 in Mississippi, to 13 in New Jersey, and to 3 in Michigan.

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 casino-style gambling. Our paper provides the first attempt to fill this gap.

[5] 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.

Specifically, we construct a model of casino gambling in a jurisdiction populated by oligopolistically competitive legal casinos and an active local government that may regulate the entry of casino firms or impose a casino tax surcharge. We capture the main features of the casino market illustrated above. On the one hand, we consider three important external effects associated with casinos: (i) non-casino income creation, (ii) social disorder costs, and (iii) casino exporting to other jurisdictions. On the other hand, we highlight the importance of local versus outside visitors and even allow the ratio of local to total gamblers to be endogenously determined. Furthermore, in the case with an endogenous ratio of local to total gamblers, we 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, as well as a careful comparison between laissez-faire and command optimum regimes and between the two casino configurations.

Our main findings are summarized as follows. First, by comparing laissez-faire and entry regulation, there may be casino over-crowding or under-entry, with the former arising if the business-creation effect is weak, the social disorder cost is large, or the fraction of local gamblers is high. Second, if the business-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 to 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 either larger or smaller than that under the entry-regulation outcome. Fourth, given the same number of casino firms, tax regulation associated with a positive tax surcharge will result in lower economic welfare than will entry regulation. Finally, in response to endogenous adjustments in the fraction of local gamblers, the local government imposing entry regulation will issue a greater number of casino licenses and may achieve higher welfare if the configuration of

casinos is dispersed.

2. The Model

Consider a local economy, which may be regarded as a state of the U.S. or a casino community. There are three theaters 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.[6] 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 "casino services" y under a simple constant-marginal-cost technology.[7] 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, the imposition of a casino tax has been a common practice in America with maximum tax rates on gross gambling revenues ranging from 6.25% (Nevada) to 35% (Illinois). Of those states that permit casino-style gambling, only four (Michigan, Illinois, Indiana, and Louisiana) have entry regulations. Moreover, limits on wager and/or loss have been rare – in terms of casino revenues in 1998, only 2.6% featured wager limits (Colorado and South Dakota, with a $5 maximum) and 4.3% with loss limits (Missouri, with a cap of $500 per excursion). Thus, we may ignore wager and loss limits without loss of generality, and instead focus on entry regulation and casino tax policy.

Accordingly, we consider three different regimes of interest:

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[6] The continuum setup enables us to avoid unnecessary complications resulting from integer programming.
[7] In regard to the issues studied in this paper, it is sufficient to consider the behavior of an average representative casino firm without loss of generality.

(i) Regime I: (laissez-faire) The local government allows firms to freely enter into the casino industry under which firms choose the scale of casino services with the number of firms determined by the zero-profit condition.

(ii) Regime II: (entry regulation) The local government regulates casino activity by setting the number of licenses *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.

2.1. The Casino Market

Since the behavior 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: $P(Y) = Y^{-1/\varepsilon}$, where $P' < 0$ and the price elasticity of casino demand $\varepsilon = -\frac{\partial Y}{\partial P}\frac{P}{Y} > 0$. 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 representative firm in the casino market solves the following profit maximization problem to determine its casino service scale:

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

In the case where entry is regulated (ex post) by the local government, the following participation constraint must be met: $[1-(1+\sigma)t]P(Y)y > cy$, that is, the after-tax casino revenues must exceed the variable operating cost. Equivalently, the participation constraint can be expressed

conveniently as:

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

Without entry regulation, firms continue to enter the casino market as long as $\pi(y) \geq 0$.

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 $U' > 0$, $U'' < 0$ and $U(0) = 0$. Thus, the aggregate consumer surplus of local clienteles is measured by: $U(\beta Y) - P\beta Y$.

As mentioned in the Introduction, the indirect spin-offs that occur as a by-product of casinos make important economic contributions to a local economy. These spin-offs include job creation, investment stimulation, tourism development, and other types of economic growth forces.[8] To capture such additional income generated by casinos, we assume that a multiple $\eta > 0$ of casino output Y can be generated, thereby yielding a net income of $\eta(1-t)Y$.

It is also important that we take into account attendant externalities generated by casino gambling, including compulsive addictions, increased drug and alcohol abuse, and an array of larcenies and violent crimes. As already discussed in the Introduction, these social disorder costs can be enormous. To a local economy, such disorder costs are more significant with dispersed statewide casinos than they are with destination resort casinos (cf. Eadington, 1995a). In reality, however, there are very few entertainment based destination resort casinos, such as some in Las Vegas. In the case of most casinos, visitors are drawn from local rather than other regions. In

[8] Eadington (1995a, 1995b) claims that the effect of casinos on other businesses is an important consideration in the legalization of casinos.

order to account for this, we allow the disorder costs D to depend on the ratio of local to total gamblers,[9] i.e., $D = d\beta Y$, with $d > 0$ capturing the extent to which such social costs are generated. This implies that the social disorder costs of casinos are greater if casinos draw more local visitors (i.e., β is larger).

In practice, government tax revenues may be used for consumption, investment and transfer purposes. For the sake of simplicity, we assume 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: $R = t\eta Y + (1+\sigma)tPY$. Accordingly, the local community welfare function W can be specified as:

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

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

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

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. They will 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: $\max_{n} W(n;\sigma)$, whereas in Regime III it can be specified as: $\max_{\sigma} W(n;\sigma)$.

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

[9] Our results remain qualitatively unchanged under a general setup: $D = (d_0 + d\beta)Y$, with $d_0 > 0$.

the entry regulation regime and the command optimum under the tax regulation regime.[10]

3.1. The Casino Firm's Optimization

Under the Cournot-Nash structure, the corresponding first-order necessary condition associated with the firm's profit maximization problem (1) is:

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

which is sufficient when the following second-order condition is satisfied: $\pi_{yy} = [1-(1+\sigma)t]n(1-\frac{1}{\varepsilon n})P' < 0$. The second-order condition requires that $\varepsilon n > 1$, which ensures an interior solution. Given that, we obtain:

$$y = y(n; t, \sigma)\,, \tag{5}$$

where $y_n = P[1-(1+\sigma)t][(1/\varepsilon)(1-2/n\varepsilon)]/\pi_{yy} \gtrless 0$, $y_t = P(1+\sigma)(1-1/n\varepsilon)/\pi_{yy} < 0$, and $y_\sigma = Pt(1-1/n\varepsilon)/\pi_{yy} < 0$.

Equation (5) conveys Seade's (1980) argument that the number of firms has an ambiguous effect on the equilibrium output per firm. However, the equilibrium output per firm falls as the number of firms increases, provided that $P(Y)$ is concave, or convex with a sufficiently low curvature. In this case, we obtain a result resembling the ***business-stealing*** effect (as defined in Mankiw and Whinston, 1986) – a new entrant leads the incumbent firms to have a lower volume of sales by stealing their business. In the following analysis, to simplify our analysis, we focus on the situation where the so-called business-stealing effect exists, i.e., $y_n < 0$. This requires that $\varepsilon n > 2$, under which the second-order condition is automatically satisfied. Equation (5) also indicates that imposing a higher tax (either t or σ) increases each firm's cost and hence decreases

[10] 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.

its casino services.

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,

$$\pi(y) = [1-(1+\sigma)t]P(Y)y - cy - C_0 = 0. \tag{6}$$

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

For analytical tractability, we assume that the price elasticity of casino demand is unity, i.e., $\varepsilon = 1$. Under this assumption, aggregate casino revenues become constant ($PY = 1$), which greatly simplifies the analysis.[11] Given this, we can use (4) to derive the representative firm's casino service scale and the price of casino services as follows:

$$y = \frac{(n-1)[1-(1+\sigma)t]}{cn^2}, \tag{7}$$

$$P = \frac{cn}{(n-1)[1-(1+\sigma)t]}. \tag{8}$$

Substituting (7) and (8) into the zero-profit condition (6) yields the laissez-faire number of casinos:

$$n^E = \sqrt{\frac{1-(1+\sigma)t}{C_0}}. \tag{9}$$

This implies that both taxes and fixed entry costs lower casino firms' profitability and hence reduce their entry. Substituting (9) into (7) yields:

$$y = \frac{C_0}{c}\left[\sqrt{\frac{1-(1+\sigma)t}{C_0}} - 1\right], \tag{10}$$

which is increasing in terms of the fixed cost and decreasing in terms of the marginal cost and the

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

two tax rates.

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: $C_0 < \dfrac{1-(1+\sigma)t}{4}$.

We then establish:

Theorem 1: (Existence of a Nondegenerate Free-Entry Equilibrium) *Under Assumption 1 with* $\varepsilon = 1$, *there exists a unique nondegenerate free-entry equilibrium (y, n^E) satisfying (9) and (10).*

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).[12]

Define the tax revenue per casino as $CT = (1+\sigma)tPy$ and the net marginal external benefit as $NMEB = \eta - d\beta - (1-\beta)P/\varepsilon$. An interior optimal number of issued licenses in this regime, denoted by n^Q, must satisfy the following first-order condition:

$$\begin{aligned} \frac{\partial W}{\partial n} &= \beta U'A - C_0 - cA + \eta A - d\beta A + (1-\beta)P(1-1/\varepsilon)A \\ &= \pi(y) + (P-c)ny_n + A \cdot NMEB + CT = 0, \end{aligned} \tag{11}$$

where $A \equiv \partial(ny)/\partial n = y + ny_n$ is assumed to be positive, as in Mankiw and Whinston (1986). In deriving equation (11), the consumer's equilibrium condition $U' = P$ is used.

We must also check the participation constraint, (2), facing each casino firm. Manipulating (4)

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

gives: $0 = \pi_y y = \pi + C_0 - [1-(1+\sigma)t]\frac{Py}{\varepsilon n}$, or, $\pi + C_0 = [1-(1+\sigma)t]\frac{Py}{\varepsilon n} > 0$. That is, at the casino firm's optimal service scale, *the participation constraint under the entry regulation regime never binds*.

In the absence of casino externalities and taxes, i.e., $NMEB = CT = 0$, 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 (11) 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 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 $\pi(y) > 0$. In the case where $-C_0 \le \pi(y) \le 0$, the optimal regulation policy is to prohibit the establishment of casinos in the local economy, i.e., $n^Q = 0$.

In general, due 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. A formal analysis of these effects is relegated to Section 4 below.

Again, we assume, for analytical tractability, that $\varepsilon = 1$, under which each casino firm's service scale is given by (7) with the price of casino services given by (8), $A = \frac{1-(1+\sigma)t}{cn^2} > 0$ and $A_n = -2A/n$. Utilizing (11), we can derive the second-order condition for the command optimum under entry regulation: $\partial^2 W/\partial n^2 \equiv W_{nn} = (\beta A)^2 U'' + (\beta U' + \eta - d\beta - c)A_n + cy_n < 0$, which is guaranteed by Assumption 1 together with the following (sufficient) condition,

Assumption 2: $\eta - d\beta - c > 0$.

Substituting (7), (8) and the expression for A into (11), we must have n^Q satisfy:

$$\Gamma(n) \equiv cn\left(C_0 n - \frac{\beta}{n-1}\right) - (\eta - d\beta - c)[1-(1+\sigma)t] = 0\,, \tag{12}$$

which is monotonically increasing in n. Notice that under $\varepsilon = 1$, the presence of business-stealing effects requires that $n > 2$.

Consider the following assumption,

Assumption 3: $4cC_0 < 2\beta c + (\eta - d\beta - c)[1-(1+\sigma)t]$.

Given this, $\Gamma(2) < 0$; moreover, $\lim_{n\to\infty} \Gamma(n) > 0$. Thus, by means of the intermediate-value theorem, we can establish:

Theorem 2: (Existence of an Entry-Regulation Command Optimum) *Under Assumptions 1-3 with $\varepsilon = 1$, a unique nondegenerate entry-regulation command optimum exists in which (y, n^Q) satisfies (7) and (12).*

Furthermore, we consider,

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

From (8), Assumption 4 ensures that the marginal cost of social disorder, $\frac{\partial D}{\partial(\beta Y)}$, must exceed the price of casino services, i.e., $d > P$. We now differentiate (11) with respect to β, η, and d to establish:

Lemma 1: (Casino Externality Effects in the Entry Regulation Regime) *Under Assumptions 1-3 with $\varepsilon = 1$, the effects of casino externalities on the optimal number of firms n^Q are given by:* $\frac{\partial n^Q}{\partial \beta} = \frac{-(d-P)}{2cC_0 n + \beta c/(n-1)^2} \lessgtr 0$, $\frac{\partial n^Q}{\partial \eta} = \frac{1-(1+\sigma)t}{2cC_0 n + \beta c/(n-1)^2} > 0$ *and* $\frac{\partial n^Q}{\partial d} = \frac{-\beta[1-(1+\sigma)t]}{2cC_0 n + \beta c/(n-1)^2} < 0$.

If we further impose Assumption 4, then $\partial n^Q / \partial \beta < 0$.

While the results concerning the positive external effect of casinos from income creation (η) and the negative effect from social disorder (d) are intuitive, those to do with the ratio of local to total

visitors deserve further comment. Specifically, an increase in β raises the consumer's surplus of local visitors, but also induces social disorders stemming from gambling. Therefore, a higher β, in general, has an ambiguous effect on the optimal number of licenses 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 tainted and viewed as inessential compared with the associated social costs. Thus, in what follows, we will impose Assumption 4 and hence $\partial n^{Q} / \partial \beta < 0$.

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, and, (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:

$$\frac{\partial W}{\partial \sigma} = [(P - c) + NMEB]B - C_0 \frac{\partial n}{\partial \sigma} = 0, \tag{13}$$

with $B \equiv \partial(ny) / \partial \sigma$. It is possible for the optimal σ to be negative (i.e., a subsidy to casino firms), though the government budget balance requires that $\sigma \geq -1$.

By imposing $\varepsilon = 1$ and recalling that the presence of the business-stealing effect requires that $n > 2$, we can use (7) and (8) to derive $B = -\frac{t}{cn}\left[(n-1) + \frac{1-(1+\sigma)t}{2n^2}\right] < 0$ and rewrite the zero-profit condition as $n = \sqrt{[1-(1+\sigma)t]/C_0}$, or,

$$\sigma(n) = \min\left\{\max\left\{\frac{1}{t}\left[(1-t) - C_0 n^2\right], -1\right\}, \frac{1-t}{t}\right\}. \tag{14}$$

When $\sigma(n) = \dfrac{1-t}{t}$, the tax surcharge imposed by the local government is sufficiently large to eliminate any profitability in which case no firm would enter the casino market. Substituting these expressions into (13) implies that the optimal number of firms n^T satisfies the following necessary condition:

$$\Lambda(n) \equiv cn\left(\frac{C_0 n}{2n-1} - \frac{\beta}{n-1}\right) - (\eta - d\beta - c)[1-(1+\sigma(n))t] = 0. \tag{15}$$

where $\Lambda' = (\eta - d\beta - c)[1-(1+\sigma)t]\dfrac{2(n-1)}{n(2n-1)} + \dfrac{\beta c(2n^2-2n+1)}{(2n-1)(n-1)^2} > 0$ and $\lim_{n\to\infty}\Lambda(n) > 0.$ We impose,

Assumption 5: $\dfrac{4cC_0}{3} < 2c\beta + (\eta - d\beta - c)[1-(1+\sigma)t]$.

This guarantees $\Lambda(2) < 0$.

The second-order condition for an optimal tax surcharge σ requires: $\Lambda_\sigma = \dfrac{tn}{[1-(1+\sigma)t](2n-1)}\left\{(\eta - d\beta - c)[1-(1+\sigma)t] - \beta c - \dfrac{\beta c(2n-1)}{2(n-1)^2}\right\} < 0.$ Recall that $\sigma \geq -1$; thus a sufficient condition for the second-order condition to be met is,

Assumption 6: $(c+d)\beta + c > \eta.$

We can then establish:

Theorem 3: (Existence of a Tax-Regulation Command Optimum) *Under Assumptions 1, 2, 5 and 6 with* $\varepsilon = 1$, *a unique nondegenerate tax-regulation command optimum exists in which (y,* n^T, σ*) satisfies (7), (14) and (15).*

We are ready to compare the outcomes under the three different regimes to which we now turn.

3.5. An Alternative to Direct Entry Regulation

Up to now, the entry-regulation command optimum has been modeled as direct entry control. One may inquire what happens if it is undertaken via a license fee. Specifically, we express the

license fee as a proportion of the setup fixed cost, fC_0, where $f > 0$. We can then define an ***entry fee-regulation command optimum*** as a triple (y, n, f) 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, and (iii) the local government determines the license fee f to maximize the local community welfare W. Under this regime, the number of casino firms is denoted by n^F.

Given the license fee f, the profit maximization problem can be rewritten as:

$$\max_y \quad \pi(y) = [1-(1+\sigma)t]P(Y)y - cy - C_0(1+f).$$

Since f does not enter the corresponding first-order condition, the representative firm's casino service scale and the price of casino services remain the same as in (7) and (8) (under $\varepsilon = 1$). The zero-profit condition is now modified to,

$$\pi(y) = [1-(1+\sigma)t]P(Y)y - cy - C_0(1+f) = 0,$$

which together with (7) and (8) yields the number of casinos:

$$n^F = \sqrt{\frac{1-(1+\sigma)t}{C_0(1+f)}}. \tag{9}$$

Next, we need to modify the government budget constraint to take the license fee revenue into account: $R = t\eta Y + (1+\sigma)tPY + fC_0 n$. However, since the entirety of government revenues R is redistributed to the local residents on a lump-sum basis, the community welfare remains unchanged as in (3). The first-order condition for the command optimum license fee schedule is:

$$\frac{\partial W}{\partial n} = \beta U'G - C_0\frac{\partial n}{\partial f} - cG + \eta G - d\beta G + (1-\beta)P(1-1/\varepsilon)G,$$

where $G \equiv \partial(ny)/\partial f = \dfrac{[1-(1+\sigma)t]}{cn^2}\cdot\dfrac{\partial n}{\partial f}$. Upon utilizing $U' = P$, $\varepsilon = 1$, (7) and (8), this expression can be rewritten as:

$$\left\{\frac{c[\frac{1}{n-1}+(1+\sigma)t]}{1-(1+\sigma)t}+\eta-d\beta-\frac{(1-\beta)cn}{(n-1)[1-(1+\sigma)t]}\right\}\frac{[1-(1+\sigma)t]}{cn^2}\frac{\partial n}{\partial f}=C_0\frac{\partial n}{\partial f}.$$

Eliminating $\frac{\partial n}{\partial f}$ and re-arranging, one then obtains:

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

which is exactly the same as the optimal condition in the case of entry regulation (12).

To sum up, either by setting up a license fee or by directly controlling the number of licenses for casino firms, the command optimum outcomes are identical. In practice, however, direct control by setting a quota is more common than charging a fixed license fee.

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 over-loaded 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. Finally, we can compare the entry-regulation command optimum with the tax-regulation command optimum to see whether quantity control or price control is the more effective regulatory policy in the legalization process of the casino market.

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 (9), while under entry regulation, the optimal number of casino firms n^Q satisfies the entry-regulation (*ER*) locus (12). 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 $\overline{n} = \sqrt{[1-(1+\sigma)t](\eta - c)/C_0 c}$. Under Assumption 4, $d > P$ and it follows from (12) that *ER* is downward sloping. In general, $\overline{n}$ (the vertical intercept of the *ER*) could be greater or less than $n^E = \sqrt{[1-(1+\sigma)t]/C_0}$. When $\eta - 2c \le 0$, $\overline{n} \le n^E$ and hence the casinos must over-crowd the local economy under laissez-faire, i.e., $n^E > n^Q$, for any $\beta > 0$. This resembles the conclusion obtained by Mankiw and Whinston (1986).[13] Intuitively, since $\eta - 2c \le 0$, the business-creation effect is not too strong; the presence of the business-stealing effect (Assumption 1) is therefore sufficient to ensure casino over-crowding in the absence of government regulation.

We next turn to the case of $\eta - 2c > 0$, i.e., the positive externality of the casinos through business creation is substantial. In this case, $\overline{n} > n^E$ and thus it is possible to have $n^E < n^Q$, particularly if the business-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), because under these circumstances the net marginal external benefit (*NMEB*) is large.[14] 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,

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[13] In our terminology, the Mankiw-Whinston framework ignores the external effects ($\eta = d = 0$ and $\beta = 1$) and taxes ($t = 0$), under which (9) and (12) reduce to $n^E = \sqrt{1/C_0}$ and $n^Q = \sqrt{1/[C_0(n^Q - 1)]}$, respectively. So, the result $n^E \ge n^Q$ always holds as long as the business-stealing effect is present (so that $n > 2$).

[14] Equation (12) implies that, given β, as η increases (*d* increases), *ER* shifts rightwards (leftwards) to $ER(\eta \uparrow)$ ($ER(d \uparrow)$).

Proposition 1: (Laissez-Faire versus Entry Regulation) *Under Assumptions 1-3, with* $\varepsilon = 1$,

(i) *casinos always over-crowd the local economy in laissez-faire if* $\eta - 2c \leq 0$;

(ii) *given* $\eta - 2c > 0$, *there may be under-entry of casinos in laissez-faire if the business-creation effect is strong, the social disorder cost is nil, or the fraction of local gamblers is small.*

4.2. Laissez-Faire versus Tax Regulation

Recall that the zero-profit (*ZP*) locus (9) determines the free-entry equilibrium number of casinos n^E. Under tax regulation, the optimal tax surcharge σ^T and the number of casinos n^T are pinned down by the tax-regulation (*TR*) locus (15) and the zero-profit locus (14). It is easily seen from these two expressions that both loci must be downward sloping. Under Assumption 6, the second-order condition is met under which the *ZP* locus is steeper than the *TR* locus.

From Figure 2, we learn that, based on Assumption 4, a casino tax surcharge must be imposed (i.e., $\sigma > 0$) if the business-creation effect is weak (η is small), the social disorder cost is enormous (*d* is large), or the fraction of local gamblers is large (β is large); otherwise, a subsidy is needed to achieve the tax-regulation command optimum. Accordingly, with a positive tax surcharge (a subsidy on casino services), the command optimum must feature less (more) entry compared to the zero-tax 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 business-creation effect is weak, the social disorder cost is large, 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 to the zero-tax 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 (15) and the zero-profit (*ZP*) locus (14), while under entry regulation, the optimal number of casino firms satisfies the entry-regulation (*ER*) locus (12). By examining (12), it is clear that the *ER* locus is downward sloping in (n,σ) space. Moreover, we learn from (12) and (15) that $\Gamma(n)-\Lambda(n)=\dfrac{2cC_0n^2(n-1)}{2n-1}>0$. 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 3a and 3b the *TR* locus is uniformly above the *ER* locus.

Given $\sigma=0$ under the entry regulation regime, Figure 3a provides a graphical illustration for the case associated with a casino subsidy. Proposition 2 has pointed out that if the business-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), 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, i.e., $n^Q<n^T$.

We next turn to the case where there is a positive tax surcharge and illustrate it in Figure 3b. Specifically, we can derive the following relationship from (12) and (15):

$$\Lambda(n,\sigma)=\Gamma(n,\sigma=0)+(\eta-d\beta-c)t\sigma-\frac{2cC_0n^2(n-1)}{2n-1}=0.$$

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

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

where $n(\hat{\sigma})$ is given by (14). Thus, $n^Q=n^T=\hat{n}=n(\hat{\sigma})$ and from (16), the critical value $\hat{\sigma}$ must be positive to achieve $n^Q=n^T=\hat{n}$. That is, in order for the entry-regulation and

tax-regulation outcomes to coincide, a casino tax surcharge must be imposed. In other words, if casino firms are subject to a positive tax surcharge, then the number of casino firms under tax regulation could be either greater or smaller than that under entry regulation.

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 $n^Q = n^T = \hat{n}$. 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 $n^Q = n^T = \hat{n}$, we can utilize the welfare specification (3) to derive:

$$W^T(\hat{n};\hat{\sigma}) - W^Q(\hat{n};\sigma = 0) = U(\beta \hat{n} y^T) - U(\beta \hat{n} y^Q) + (\eta - d\beta - c)\hat{n}(y^T - y^Q).$$

Based on Assumption 2 and on *U* being monotone, it follows immediately that $W^T > W^Q$ as long as $y^T > y^Q$.

Given $\sigma = 0$, from (4) we have: $y^Q = \dfrac{(\hat{n}-1)(1-t)}{c\hat{n}^2}$. Furthermore, it follows from (7) and (9) with $\sigma = \hat{\sigma}$ that: $y^T = \dfrac{C_0(\hat{n}-1)}{c}$. Thus, it is easily seen from Figure 3b that, under $n^Q = n^T = \hat{n}$, the necessary and sufficient condition for the welfare under entry regulation to be higher than under tax regulation is $\hat{n} < \sqrt{(1-t)/C_0}$, where the right-hand side is $n(0)$ solved from (14) (i.e., the vertical intercept of the *ZP* locus). This inequality holds only if casinos face a positive tax surcharge (i.e., $\sigma > 0$). In the context of international trade, a general conclusion is that a quantity control (quota) is inferior to a price control (tariff).[15] In the context of casino gambling, however, we can establish that a quantity control (entry regulation) leads to higher welfare than a price control (tax regulation) when casinos are taxed with a positive surcharge in the tax-regulation command optimum (which holds if the business-creation effect is weak, the social disorder cost is enormous, or the fraction of local gamblers is large).

[15] See, for example, a comprehensive discussion in Bhagwati and Srinivasan (1983, chapter 10).

We summarize these results as follows:

Proposition 3: (Entry Regulation 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 could be either larger or smaller than under entry regulation;

(ii) given the same number of casino firms (i.e., $n^Q = n^T = \hat{n}$*), the associated economic welfare under tax regulation is always lower.*

5. Endogenous Ratio of Local to Total Casino Gamblers

We have assumed the fraction of local to total gamblers (β) to be exogenous. We now consider the behavior of consumers engaged in casino gambling to allow for an endogenous determination of β. 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].

There is a growing interest in the discussion on the geographical structure of legal casinos. To discuss this issue, this section extends the model above and considers two types of casino market: centralized and dispersed statewide casinos. The remote-type casinos can be thought of as an intermediate case of centralized and dispersed statewide casinos. In the case with centralized casinos, we assume that the legal casinos are restrictively located at $z = 0$ (see Figure 4a), while in the case with dispersed statewide casinos the legal casinos are located between 0 and the state border,

$\bar{z}$ (see Figure 4b).

We assume for simplicity that casino visitors incur a transportation cost that is linear in terms of 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 afterward 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 $u'' < 0$. 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 with all casinos 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*.

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 $\beta_P^C = -\frac{\bar{z}u'x_P^*}{\delta(z^C)^2} > 0$ and hence $(1 - \beta^C) = 1 - \bar{z}/z^C$. To be meaningful, we assume that

the export effect of casinos exists, i.e., $(1-\beta^C)>0$, which implies that $\bar{z} \le z^C$. Under this assumption, Figure 5a illustrates the relationship between z^C and β^C.

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 only concerned 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:

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

where β^C and *y* solve (19) and (20).

With an endogenous β^C, the socially optimal number of firms under the entry-regulation regime, denoted by n^C, satisfies:

$$\frac{\partial W}{\partial n} = \pi(y) + (P-c)ny_n + A\cdot NMEB + CT - dY\beta_P^C P'A = 0, \tag{22}$$

which differs from (11) by only an additional term, $-dY\beta_P^C P'A$. We can therefore conclude that as $-dY\beta_P^C P'A > 0$, we must have $n^C > n^Q$ if everything else remains the same. Summarizing,

Proposition 4: (Endogenous β and Entry Regulation) *Under Assumptions 1 and 2 with an endogenous fraction of local casino gamblers, the entry-regulation command optimum features a greater number of casino firms than with an exogenously fixed fraction of local casino gamblers.*

Equation (19) indicates that, if the export effect of the casinos is endogenously determined, increasing the number of casino firms will reduce the price in the casino market and, accordingly, invigorate the demand for casino services and hence lower the ratio of local gamblers β. A lower β (or a higher $1-\beta$) implies that casinos give rise to a greater export effect. As a consequence of this "export-based" benefit, the entry-regulation command optimum features a larger number of casinos when the local government takes the endogenous ratio of local gamblers into account.

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 … [o]ne 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 which impose restrictions on the operations of casinos.

5.2. Dispersed Jurisdiction-wide Casinos

If the legal casinos are dispersed within a jurisdiction (state), the casinos are scattered between 0 and $\bar{z}$ (as illustrated by Figure 4b). Analogous to Section 5.1, the active participation constraint facing each individual is given by:

$$u(x^*(P)) - \delta(z - \bar{z}) \geq 0. \tag{23}$$

where the only difference between (17) and (23) is the disutility term.

By repeating the same procedure, we can solve for the critical value z^D that satisfies equation (23) with equality, $z^D = \frac{u(x^*(P))}{\delta} + \bar{z}$, as well as the equilibrium ratio of local to total casino gamblers

$$\beta^D = \frac{\bar{z}}{z^D} = \frac{\bar{z}}{[u(x^*(P))/\delta] + \bar{z}}. \tag{24}$$

Figure 5b illustrates the relationship between z^D and β^D in equilibrium. By comparing (24) with (19), it can be established that $\beta^D < \beta^C$:

Proposition 5: (Centralized versus Dispersed Statewide Casinos) *Under Assumptions 1 and 2 with an endogenous fraction of local casino gamblers, the entry-regulation command optimum in the dispersed configuration generates a greater export-based benefit and 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.

6. Concluding Remarks

We have constructed an oligopolistically competitive model of legal casinos under laissez-faire or entry or tax regulation regimes in which a number of external effects from casino-style gambling are explicitly taken into account. In the benchmark case, we assume the ratio of local to total gamblers to be exogenous; we later generalize the analysis by allowing the ratio to be determined in equilibrium by considering locationally-differentiated consumers. In this general setup, the configuration of casinos may be centralized or dispersed. We compare equilibrium and command optimum outcomes under various regimes and different casino configurations. The welfare implications are also studied.

Along these lines, one may think whether a certain policy mix, say, a combination of a tax surcharge with a license 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 licenses in order to enhance community welfare. Another concern is related to social norms. Supposing that 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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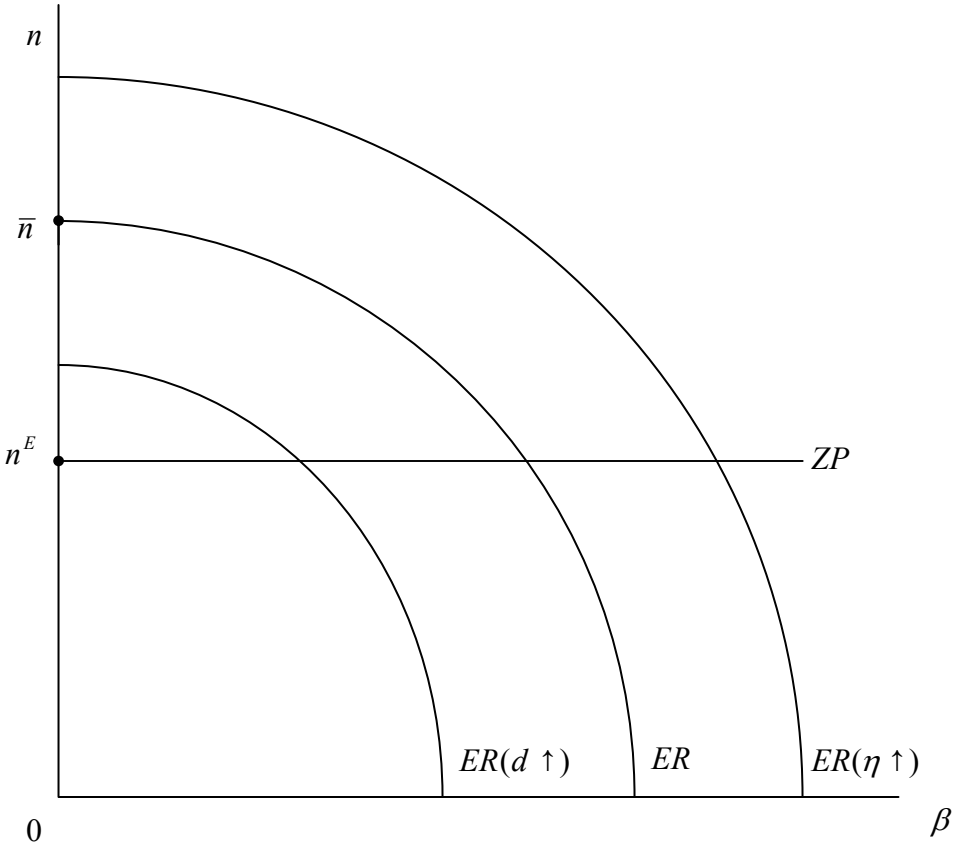


Figure 1

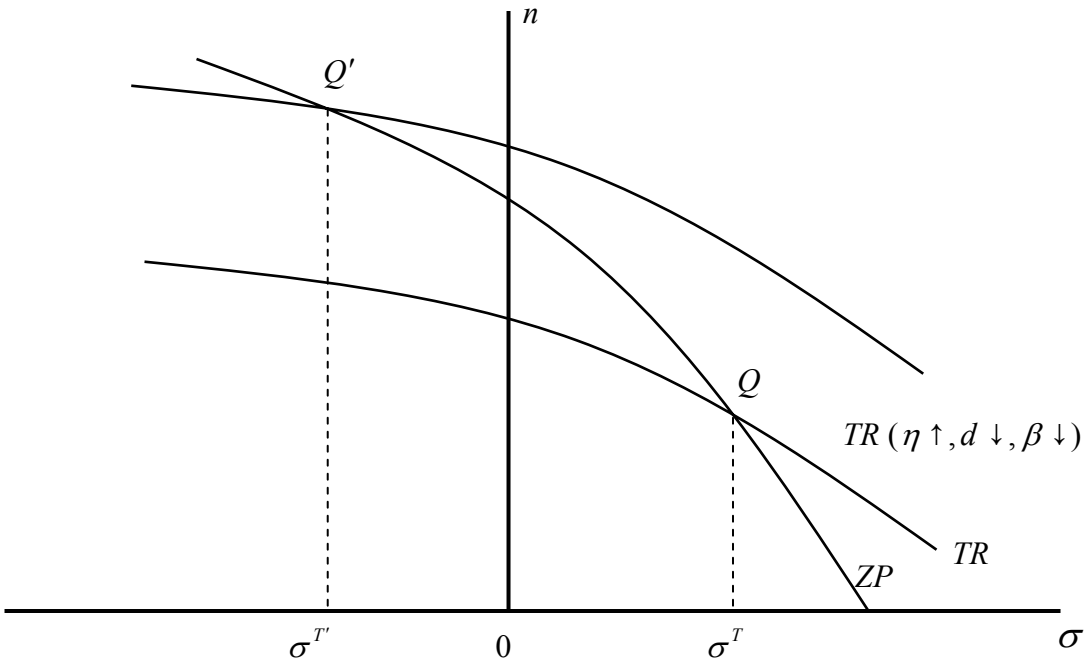


Figure 2

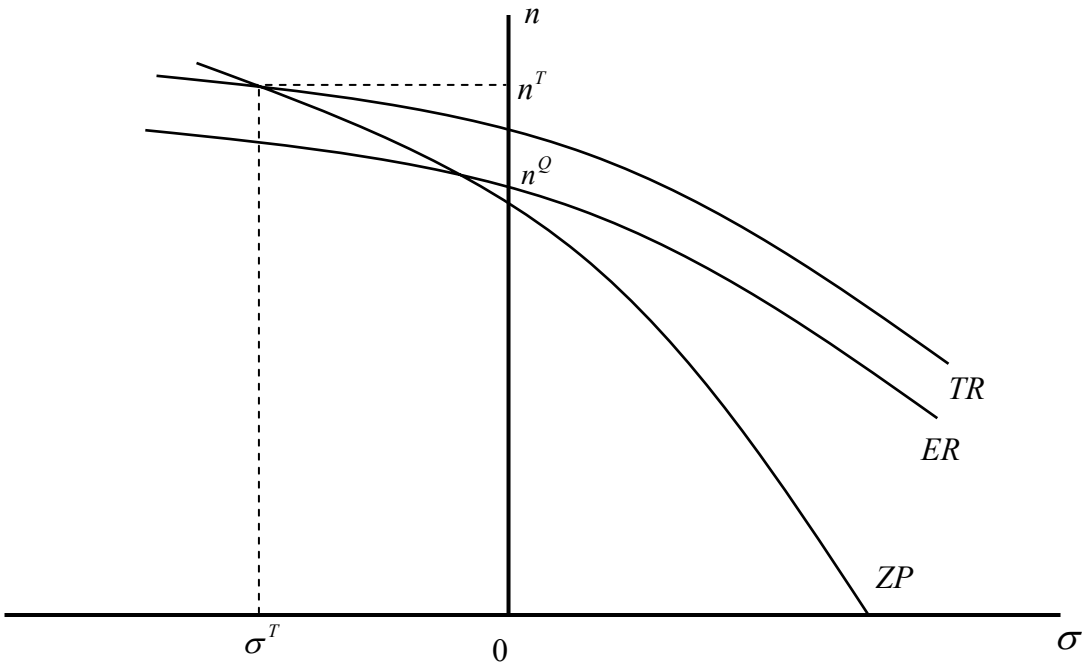


Figure 3a

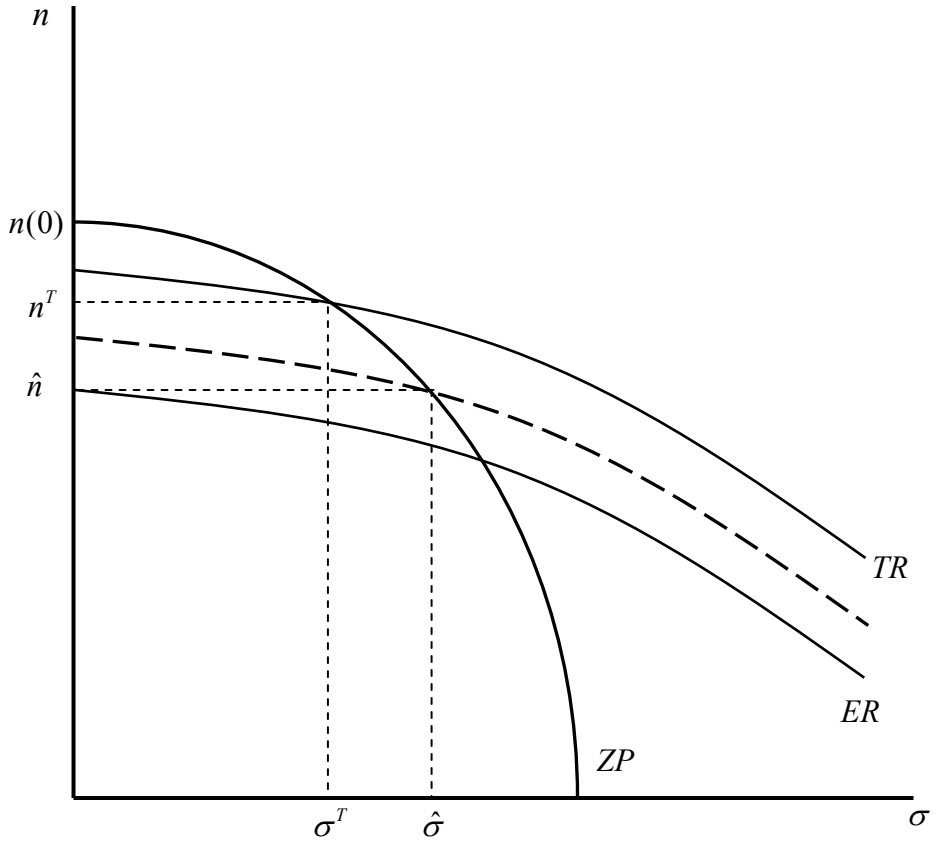


Figure 3b

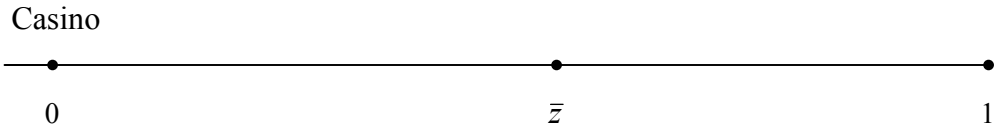


Figure 4a

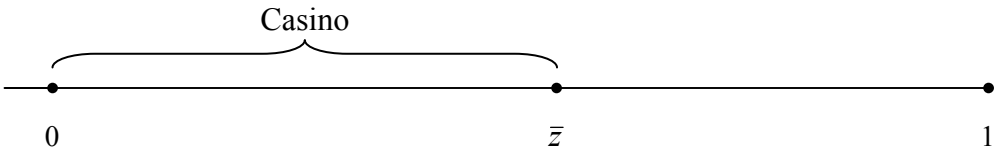


Figure 4b

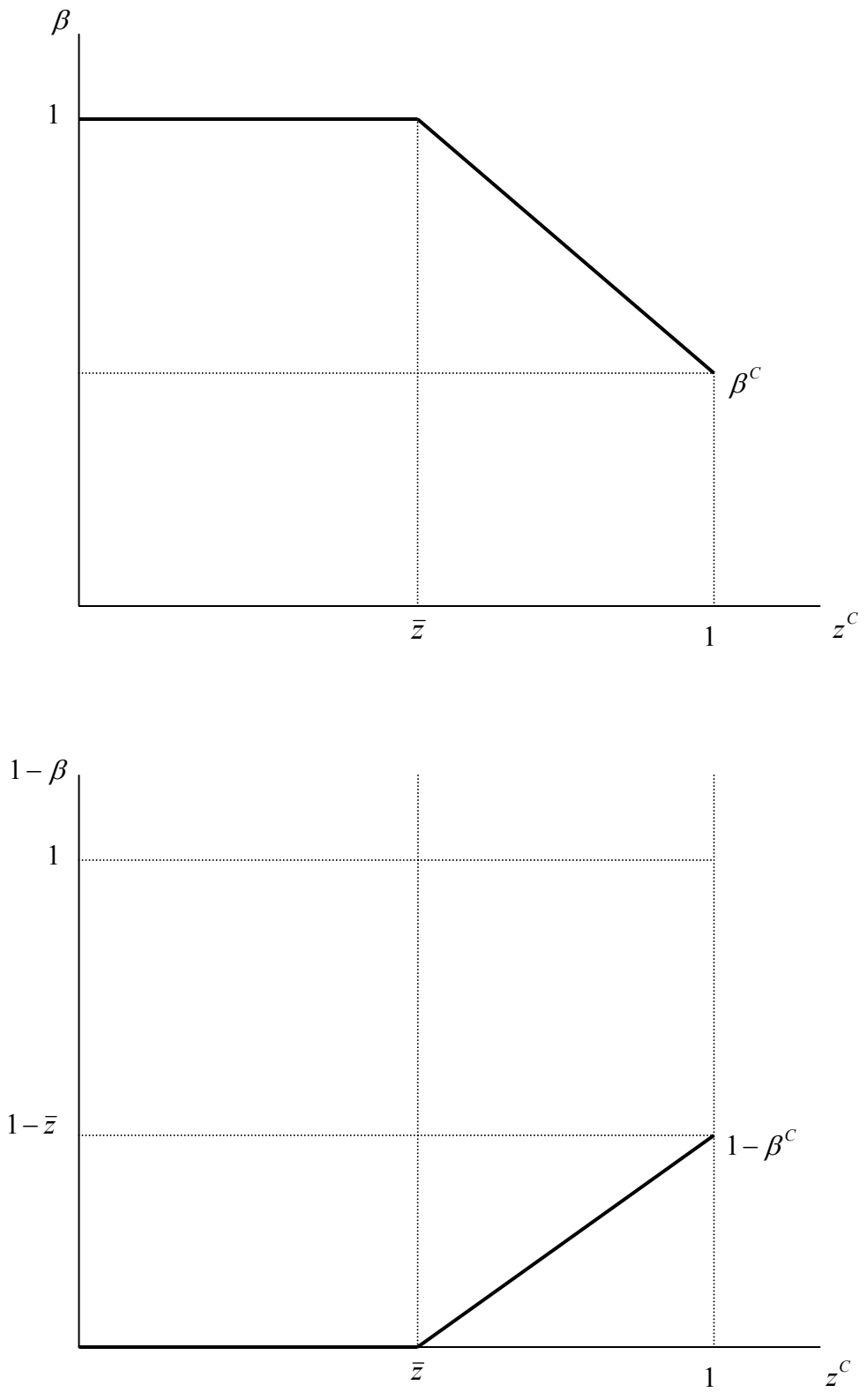
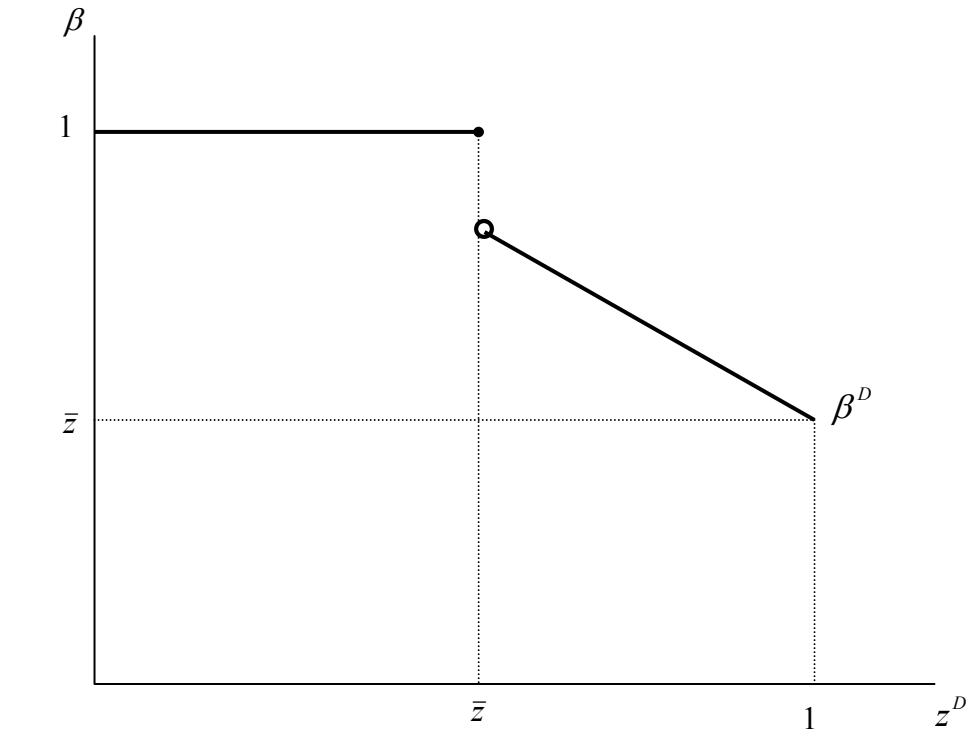


Figure 5a



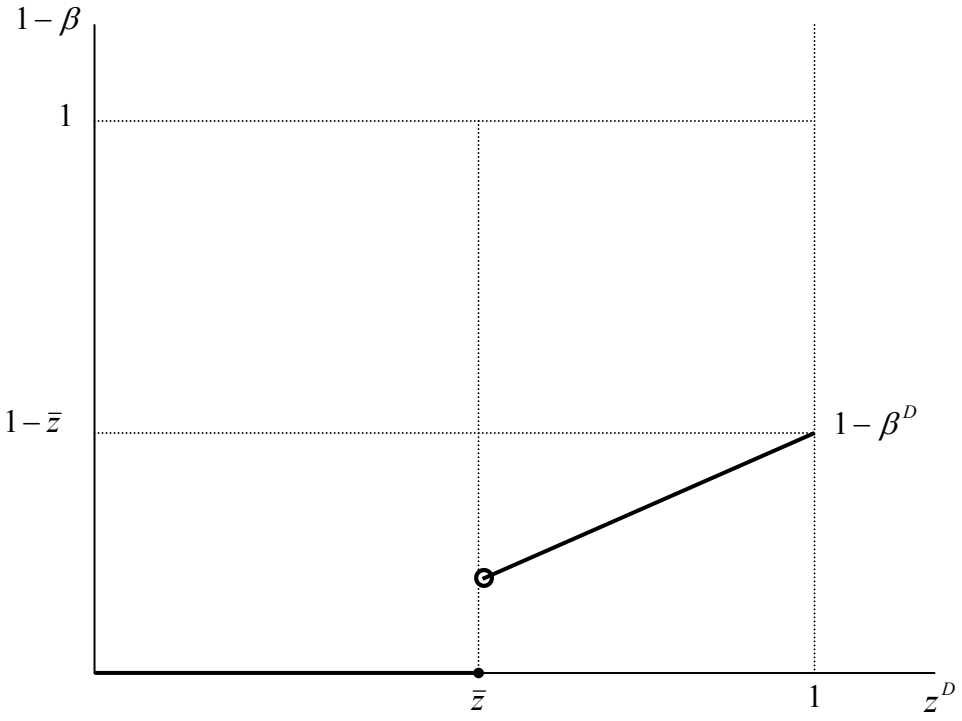


Figure 5b

Number	Author(s)	Title	Date
04-A005	Juin-Jen Chang Ching-Chong Lai Ping Wang	On the Public Economics of Casino Gambling	02/04
04-A004	Ming-Fu Shaw Shu-Hua Chen Ching-Chong Lai Juin-Jen Chang	Interest Rate Rules, Target Policies, and Endogenous Economic Growth in an Open Economy	02/04
04-A003	Po-Hsuan Hsu Chung-Ming Kuan	Re-Examining the Profitability of Technical Analysis with White's Reality Check	02/04
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