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Abstract:

In this paper, a model of the costs of a casino is developed that focuses on the implications for economic welfare of different taxation schemes for casinos. The situation being considered is in a country where casinos cater exclusively to foreign tourists. The goal of the country is to determine the maximum amount of taxes that can be extracted from the activities of this sector under different systems of taxation. When the price of gambling is set by regulation above its competitive level, the economic losses created by excessive investment in the sector can be reduced by taxation. A turnover tax on the amount gambled can maximize both tax revenue and the economic welfare of the country. Due administrative constraints, a number of countries rely on the taxation of the casinos' fixed assets or a combination of a turnover tax and a tax on fixed costs. The model is applied to the situation in North Cyprus. The annual economic efficiency loss from its poorly designed tax policies on casino gambling is estimated to be about 0.5 percent of GDP.

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The Economics of Casino Taxation

I. Introduction

Casinos have had a long history as a source of entertainment, excitement and heartbreak. Because of the incidence of the compulsive gambling and associated crime, most states have tried to regulate the spread of casinos and in some instances have tried to control who is allowed to gamble in the casinos. Taxation has often been one of the tools used for the regulation of this sector.

While casinos have been a feature of entertainment in well-known holiday centers such as Las Vegas, Monaco and Macau for decades, since the 1980's casinos have spread rapidly elsewhere. In some countries, such as Canada and Chile, they have been used as a source of revenue for financing municipal and charitable activities. In particular, a rapid expansion of the casino industry has taken place in those countries where they are a part of the entertainment package used to attract tourists. Many of the Caribbean Islands such as Bahamas, Puerto Rico, Belize and the Dominican Republic are using casinos in this way. In the Mediterranean region, Northern Cyprus has built a substantial casino sector to complement their other tourist facilities. Many of the clients are weekend tourists, who come from nearby Turkey and South Cyprus. These are places where casinos are not allowed to operate.

There is a considerable economic literature on the operation and taxation of lotteries (Fink, Marco and Rork, 2004; Glickman and Painter, 2004; Paton, Siegel and Williams, 2004; Clotfelter and Cook, 1993; Clotfelter and Cook, 1990), but the economic literature on the economics of casinos is very limited. Most of the literature has been institutional in nature focusing on the potential of casinos to generate economic development in a region (Eadington (1999); Fink and Rock, 2003; Henrikson (1996); Gazel (1998)); alternative methods of taxation (Smith (2000);

Paton, Siegel and Williams, 2001: 2002b); and the control of money laundering (Financial Transaction Reports Act 1988; Roach (2003), and Nicaso (1998)). An exception to the above literature is the paper by Thalheimer and Mukhtar, 2003. In this paper they specifically examine the determinants of demand for casino gambling including its price elasticity. In this paper, we wish to examine a number of regulatory and taxation issues while incorporating the special characteristics of the casino industry.

An important characteristic of casinos is that the "price" of gambling, defined here as the percentage of the amount gambled that is retained on average by the casino, is usually not determined competitively by the interaction of the casinos in the market and the demand for casino gambling. Except for slot machines, the table games and roulette have a specific minimum expected take by the house that is set by the rules of the game (Eadington, 1999). There is no reason that these minimum prices are anywhere near to the prices that would be set in a perfectly competitive market. Second, in many jurisdictions the price of gambling is set through government regulation or by state gambling boards. In many cases the "price" is set at several multiples of what might be a competitive price[1]. In such a circumstance, the regulatory question is both one of determining the optimal "price" to set as well as the number of casinos allowed to supply the market.

This characteristic is reflected in the efforts of casino operators to try to obtain additional casino licenses. The recent experience of Canada and the UK

[1] In North Cyprus the house take is set at 10 percent based on a previous regulation made by Turkey prior to their abolishing casinos. In Belize, the casino operators association has set the house take as 15 percent. In contrast, in the USA the house take is in the order of 3.5 percent of the amount gambled at website:www.bestpayoutcasinos.net/

indicates the desire by casino operators to expand and the willingness of the casinos to pay heavily to obtain their licenses[2].

In this paper, a model of the costs of a casino is built that allows us to focus on the implications for economic welfare of different schemes for taxing casinos. Several assumptions are made in order to highlight the taxation issues. First, we set aside the issue of the negative externality of the social costs arising from the incidence of compulsive gambling and increased crime that accompanies casino gambling when the local population is allowed to participate in casino gambling. This is done by focusing on tourist destinations where most, if not all, the customers of the casinos are tourists. This is typical of such places as the Caribbean Islands, Belize and North Cyprus. North Cyprus goes so far as to ban the local residents from entering a casino to gamble.[3]

Second, any positive externalities that are created in the other sectors of the economy are excluded. These are items such as the increased sales tax revenues from a higher level of hotel occupancy and from the purchase of goods and services. Third, the effects on the incomes of local factors of production are ignored. Competitive supplies of factor inputs are assumed. In such tourist destinations the slot machines, gambling tables along with much of the labor employed by the casinos are often sourced from abroad.

In this situation, the economic benefits of casinos in the economy will be through the tax revenues obtained by the government from this activity. Any

[2] The Globe and Mail (2005) Ontario puts brakes on slot machines, Toronto, Ontario, Canada, January 21, 2005, p. A5; Khaleej Times (2004) Casinos' number to double after bill, reprinted from Daily Mail, UK,,Abu Dhabi, October 24, 2004, p. 24.

[3] In North Cyprus, it is against the law for a local resident to enter a casino to gamble. Until recently this was also the law in the Dominican Republic.

economic efficiency loss arising from the creation of excess capacity in the sector will reduce the amount of tax revenues that the government could potentially collect.

To develop the parameters for the most efficient supply of casino gambling services, we start by assuming a casino sector that is characterized by perfect competition where, contrary to real life, the "price" of gambling services is determined in a competitive market. Given the total cost function of such a casino and the total demand function facing the country for casino gambling, we obtain the equilibrium conditions for the situation when competition leads to a zero economic profit outcome. Expressions are derived for the optimal size of each casino, q_0, the competitive price for gambling, P, the total amount of gambling undertaken, Q_0^D, and the equilibrium number of casinos, n_0, when free entry is allowed into the sector.

Expressions for these variables are then developed for the case where the price of gambling is set above its competitive level by either government regulation or by the rules of the games. At the same time, free entry of casinos is allowed into the sector.[4] It is assumed that the casinos are all identical and compete with each other for the business until their average costs are equal to the price of gambling, hence, a zero profit situation[5]. This is a fair description of the casino sector in either the Dominican Republic, or North Cyprus today. The governments are not able to effectively restrict the number of casinos entering the market. The casino owners and operators are well connected politically, and if they request additional licenses, they are unlikely to get much resistance from the politicians or the bureaucracy. In the

[4] The condition of free entry of casinos into the sector is critical for the subsequent findings in the paper. As many tourist destinations allow free entry or actively recruit firms to set up casinos in their regions, we feel that it is important that the economic losses inflicted as a consequence of such policies be clearly understood.

[5] This is similar to the situation discussed by Mankiw, N. G. and Whinston M. D. (1986) Free Entry and Social Inefficiency, *The Rand Journal of Economics*, **17**, 1, 48-58

past these governments have promoted the entry of casinos as a way to expand their tourist sectors.

Using this model, a set of expressions are derived for the volume of gambling services supplied by a typical casino, the total quantity of gambling resources demanded in the market, and the number of casinos that is expected to enter the market. The costs of supplying the gambling services for the quantity demanded by the market are then compared with the costs of supplying this volume of gambling if each casino would have been operating at the point of its minimum average costs. The difference in costs between these two situations measures the economic loss suffered from allowing the free entry of casinos when the price of gambling is set by regulation above the competitive price. It also measures the value of lost tax revenues.

Casinos are typically taxed either on the turnover of money gambled or by annual taxes on their fixed costs (or both). To evaluate the potential role of taxation of casinos to raise revenues and regulate the sector, the tax rate on gross turnover is found that would minimize the total economic costs of supplying the casino services now demanded at the non-competitive price. This revenue maximizing rate of tax is exactly equal to the difference between what would be the competitive price and the actual regulated non-competitive price.

An expression is also derived for the revenue-maximizing combinations of turnover taxes and taxes on annual fixed costs. With a tax on fixed costs and free entry, each casino will operate where the average cost of the casino becomes equal to the non-competitive price “s”, that is set above the casino’s minimum average costs. The maximum revenue raising combination of taxes therefore be set so that for each casino the average combined tax rate expressed as a rate of q is exactly equal to the

difference between the competitive price and the regulated price of s. This condition is satisfied at the same level of output that would exist if the casino market were perfectly competitive.

An Evaluation of the Welfare Costs of Regulation and Taxation in the Casino Sector in North Cyprus

The assumptions used in the development of the theoretical models below are broadly descriptive of the casino sector in North Cyprus. With a total population of 200,000 souls, it is home to 22 casinos. The market for the casino services is focused exclusively on the tourists visiting the state, primarily from Turkey, the UK and recently South Cyprus. Information through interviews was obtained from three casinos and from the government regulators on the amount of investment made for gambling tables, slot machines, rental cost for the facilities, the structure of variable costs, and the turnover of casinos operating in North Cyprus. The illustrative parameter values used in the estimations of the revenue and welfare implications of current policies are based on the information obtained from these sources.[6]

After estimating the values of the fixed cost items for a typical casino in North Cyprus, we found that the average total annual value of the fixed costs per casino, K, is approximately US$ 572,000 per year.[7]

[6] In this paper we make the simplifying assumption that there is only one size of casino in terms of the fixed costs incurred by casinos in this market. If there are economies of scale in casinos, then if the size of the casino were increased due to greater investment and greater fixed costs, the conclusion of this paper would be further strenghtened. There would be a larger welfare gain if there were fewer casinos but each having a larger volume of business and operating more efficiently.

[7] It is estimated that the investment costs for the equipment in a typical casino with 4 roulette tables, 5 gaming tables and 85 slot machines is approximately US$ 520,000. Casino decorations, kitchen, equipment and vehicles bring the total investment costs (excluding the buildings) for such a casino averages US$ 832,000. If an annual user cost of capital of 15 percent of the value of these assets is assumed, the annual cost of these assets would be US$ 124,800. The rental cost of the building is estimated to be approximately US$ 52,000 per year. The annual cost of the utilities amounts to approximately US$ 31,200 per year, and the fixed labor cost associated with the operation of such a casino is approximately US$ 364,000 per year. The user cost of 15 percent is based on a real opportunity cost of funds of 10 percent plus an annual rate economic depreciation of the fixed assets of 5 percent of their market.

The variable costs associated with the volume of gambling carried out in a casino in North Cyprus are primarily associated with the marketing efforts undertaken to attract gamblers, including the subsidization of the transportation costs from Turkey to North Cyprus, the cost of food, drinks and entertainment provided by the casino, and some variable labor costs needed to run the casino at a higher level of utilization. The pattern of marketing costs incurred to attract gambling to the casinos from Turkey also provides an empirical basis for the form of the total cost function that is assumed. Marginal costs eventually rise as the volume of gambling increases in a casino because of the declining marginal effectiveness of the promotional expenditures made to attract gamblers to the casino.[8]

Some illustrative estimations are made of the economic efficiency and losses from the present tax and regulation policies for casinos in North Cyprus. The findings are that the current tax system is far from its welfare maximizing or revenue maximizing levels. There is an incentive for overinvestment in the sector that causes highly wasteful investments to be made. This amount of wasteful overinvestment represents approximately 50 percent of the annual total fixed costs incurred by the sector. The magnitude of the annual economic efficiency losses is equal to approximately 0.5 percent of GDP.

II. The Price of Gambling is Set Competitively

As indicated above, it is assumed that the casino sector only services the foreign tourist population. Given that the country whose economic welfare was being maximized is not concerned with the economic welfare of the tourists, but only with

[8] Casino operators report that as they increase their promotions offering "free" airfares to potential tourists from Turkey to gamble in the casinos of North Cyprus, the proportion of people who accept their offer but spend large amounts of time on the beach increases.

their money, our goal is to determine the maximum amount of taxes that can be extracted from the activities of this sector under different systems of taxation.

In order to develop an economic efficient base case that can be used to compare with the less efficient situations, the analysis begins by assuming that the casino sector is a perfectly competitive industry with free entry of casinos. The market price of gambling, P, is determined by the minimum average costs of a typical casino. Casinos can enter or exit the industry freely until the quantity of gambling services supplied is equal to the quantity demanded at that price.

Let us assume each casino has a cost function of the following form,

(1) $TC = K+bq+cq^2$,

where q is the volume of gambling done in each casino per period. K is the amount of fixed costs per period for the typical casino, and $bq+cq^2$ describes how total variable costs of the casinos change with the volume of gambling undertaken in the casinos per period.

A simple constant elasticity of demand function describes the market's demand for casino gambling[9].

(2) $Q_0^D = a\ P^e$

where the price, P, is the proportion of the turnover of the amount gambled that is retained on average by the casino. The own price elasticity of demand for casino gambling is denoted as "e", and the constant term "a" reflects the effects of all the other variables affecting the size of the market for casino gambling. It follows from (1) that average cost and marginal cost of a typical casino are,

(3) $AC = \frac{K}{q} + b + cq$

[9] For casino gambling on riverboats in the U.S. the value of the price elasticity of demand for casino gambling, was found by Thalheimer and Mukhtar (2003) to be approximately -1.0.

(4) MC = b+2cq.

In a competitive market, each casino would be operating at a level where,

P_c=MC=AC.

With free entry into the market for casino gambling, the market price (P) will be determined by the minimum average cost of the last casino entering this market. Hence, as all the casinos are assumed to be identical, the quantity of gambling done by each casino, q, will be where AC = MC. Equating equations (3) and (4) we have,

(5) $$\frac{K}{q} + b + cq = \text{b+2cq} \Rightarrow q_0 = \sqrt{\frac{K}{c}},$$

where q_0 denotes the volume of gambling done in each casino when the price of gambling is determined competitively. The competitive price for casino gambling in the market is determined by substituting the expression (5) for q_0 into the marginal cost function of the casino. Because all casinos are identical, then the market price will be,

(6) $$P_c = b + 2\sqrt{cK}.$$

This competitive equilibrium is shown in Figure 1 for a typical casino with all equilibrium price of P_c and a volume of turnover of q_0.

By substituting equation (6) for the competitive price into the market demand equation (2), the total quantity of gambling demanded by the market is given as,

(7) $$Q_0^D = a(b + 2\sqrt{cK})^e.$$

With free entry and the market price determined competitively, the number of casinos operating in the market, n_0, will be given by

(8) $$n_0 = a(b + 2\sqrt{cK})^e / \sqrt{\frac{K}{c}}.$$

Taken together, equations (5), (6), (7) and (8) yield the competitive solution for q_0, P_c, Q_0^D, and n_0.

(Insert Figure 1 here)

III. Price of Gambling Set by Regulation

Suppose that instead of the price of casino gambling being set competitively, it is set either by the government through regulation, or set by the odds of the games at a level "s" above the competitive price. We now wish to examine the implications for the volume of gambling, q, and the number of casinos operating in the market, n, if free entry into the casino sector is allowed. When casinos are allowed to freely enter into the market, they will continue to enter until there are zero economic profits being earned by each casino. At this point, each casino will be operating where its average cost is just equal to s,

(9) $AC = s$

Now, the casinos will not be operating at the level of output where their average costs are minimized. If we assume all casinos are identical with the same cost function given by (1), then

(10) $AC = \frac{K}{q} + b + cq = s$

The equilibrium quantity of turnover for each casino denoted by $q = q_1$ will now be:

(11) $q_1 = \frac{s-b}{2c} - \frac{\sqrt{b^2 - 2bs + s^2 - 4cK}}{2c}$

Comparing equations (5) and (11), when the regulated price is set so that s>P, the turnover, q_1, of a casino will be smaller than in the perfect competitive case, q_0. In order to solve for the number of casinos that will enter the market, we first need to determine the quantity of the gambling services demanded in the market at the fixed price of (s). From (2) and setting P = s then,

(12) $Q_d^{'} = as^e$.

Using equations (11) and (12), the number of casinos, n_1, supplying the market is found as $n_1 = \frac{Q^{'}_d}{q_1}$, or

(13) $$n_1 = \frac{2c(as^e)}{s - b - \sqrt{b^2 - 2bs + s^2 - 4cK}}.$$

Each casino will be operating a smaller volume of business than in the competitive case. For a given quantity of such services demanded, i.e. $Q_d^{'}$, there will be more casinos entering the market than there would be if each casino were operating at a level of output where its average cost was minimized.

Economic Welfare Costs of Excess Capacity

With free entry, in equilibrium the average cost of each casino operating at a level of q_1 will be equal to s as in equation (10). Under perfect competition, each casino would be operating at a level of q_0, and its minimum average costs will be equal to the competitive price, P_c, as given by equation (6). The difference between these two average costs times the quantity of gambling done in the market, measures the economic loss of allowing free entry with a non-competitive price set at s. The welfare cost, WC, is given by

(14) $WC = (s - b + 2\sqrt{cK})as^e$.

When the price of gambling is set by regulation higher than P_c, the loss in consumer surplus is not considered part of the welfare cost because of our assumption that all the gamblers are non-residents.

IV. Regulation by Taxation

A common form of control over the size and number of casinos is to impose taxation on the activities of casinos. The two types of taxation will be considered here: a tax levied on the turnover or the amount of money gambled in a casino, and an annual tax levied on the fixed costs of the casinos.

Many countries, such as North Cyprus, tax their casinos with some combination of a turnover tax (t*) on the amount gambled and a set of annual taxes (T*), on various components of the fixed costs of the casino. In such a situation, the total cost function for our typical casino is now written as,

(15) $TC' = cq^2 + bq + t^*q + K(1+T^*)$,

with average costs inclusive of taxes, AC',

(16) $AC' = cq + b + t^* + \frac{K}{q}(1+T^*)$.

In equilibrium with free entry and zero profits,

(17) $AC' = s$.

In these circumstance level of gambling carried out in each casino, $q = q_2$ will be determined by,

(18) $$q_2 = \frac{s - b - t^*}{2c} - \frac{\sqrt{(-b - t^* + s)^2 - 4cK(1+T^*)}}{2c}.$$

The volume of turnover of each casino, q_2, will be a function of the variables s, t* and T*. This equilibrium for a typical casino is shown in Figure 1 with s=AC' and the quantity of turnover of each casino equal to q_2.

The number of casinos that will enter the market, $n = n_2$, is found by dividing the total quantity demanded in the market, Q_d', by q_2, giving us,

(19) $$n_2 = \frac{2c(as^e)}{(s - b - t^*) - \sqrt{(-b - t^* + s)^2 - 4cK(1+T^*)}}.$$

The total revenue paid by the casino sector, TR, can be expressed as,

(20) $TR = TR_{t^*}+TR_{T^*} = t^*Q'_d+T^*Kn_2$.

The total tax revenue raised from a typical casino is shown as the area sbav in Figure 1.

Economic Welfare Cost of Combination of Turnover tax t* and Annual Tax on Fixed Costs T*

The welfare cost of such a tax system (WC) will be equal to the total costs incurred by the casinos (TC') in the sector less total costs (TC) that would be incurred if the same quantity of services had been supplied by casinos operating at a competitive level of output. Again, because tax revenues do not represent economic costs, we subtract out the revenues collected via the tax on fixed costs. In market equilibrium, it must hold that $TC'n_2 = AC'q_2n_2 = s\,Q'_d$. This value is compared to the total combined costs of all the casinos, $AC(Q'_d)$, if each is operating at its most efficient level of q_0, and where Q'_d is the total quantity of casino services demanded at a market price of s. Given these relationships, the expression for the welfare cost of a combination of a turnover tax t* and an asset tax of T* can be written as,

(21) $WC = (s-AC)Q'_d - TR_{T^*} - TR_{t^*}$.

Estimation of the WC of the Existing Price Regulation Tax System in North Cyprus (At the present time in North Cyprus the price of gambling is set at 10 percent by regulation.)

The taxation system in North Cyprus consists of a set of taxes on the annual fixed costs which includes the annual rental of the machines, and tables, plus an annual license fee of US$ 125,000 per year. For our hypothetical casino, this amounts to US$ 226,050 per year or a rate of T* on fixed costs equal to 0.395. In

addition, there is a tax on the gross revenues of the casino that translates into a rate of t* on turnover of 1.5 percent.

If approximately US$ 10 million is gambled each year in a typical casino, then the parameter values of 0.006 for b and 0.0004 for c results in a total variable cost of about US$ 100,000, an amount that is approximately what is observed. In summary, the parameter values of the variables used in the model used to illustrate the situation for North Cyprus are:

K = US$ 572,000, c = 0.0004, b = 0.006, T* = 0.395, t* = 0.015

Substituting these parameter values into equation (15), the total cost function becomes,

$TC' = 0.0004q^2 + 0.021q + 0.798$.

If s = 0.10, and free entry occurs until zero profits are being earned, then using equation (18), the equilibrium quantity of turnover for each casino will now be US$ 10.64 million.

At the present time there are 22 casinos in North Cyprus. Hence, the total quantity of the gambling services demanded from the 22 casinos in the market must be approximately US$ 234.08 million. With this volume of gambling the total annual tax revenue from the 1.5 percent tax on turnover, (TR_{t*}), (equation 21) is therefore TR_{t*} = (0.015)*234.08 = US$ 3.51 million/year. The total annual tax revenue (equation 27) from the tax on fixed costs, TR_{T*}= T*(K)n_2 = 0.395(0.572)(22)=US$ 4.97 million/year. The total tax revenue estimated by this model is therefore approximately US$ 8.48 million per year. This estimate is close to the actual revenues collected from casino sector in North Cyprus in 2004 of US$ 8.13.

For the competitive case, from (5), the total turnover of the amount gambled in a casino per year would have been $q_0 = US\$37.82$ million and from (8), there would have been only n_0=234.08/37.82=6.2 casinos operating[10].

From (3), the minimum AC would be equal to 0.036, which would also be equal to, the competitive price, P_c, for gambling in the North Cyprus casinos[11]. Substituting the above values for s, AC, $Q_d^{'}$, TR_{T*} and TR_{t*} into (21), the annual welfare cost of the existing taxation system for casinos in North Cyprus is estimated to be US$ 6.44 million per year. This is a very substantial economic loss for a very small economy, representing approximately 0.5 percent of GDP per year.

Tax Policy Options

Given the relatively large economic losses resulting from the existing tax system for casinos in North Cyprus, further tax policy options should be considered. Four possible options will be considered below. They are:

A. The existing tax on fixed costs of 0.395 could be abolished and a single revenue maximizing turnover tax, t, could be applied. A rate would be selected that would maximize the revenue collected by the government, given the regulated price s=0.10.

B. The existing tax on fixed costs, T*, at a rate of 0.395 of annual could be retained but also a turnover tax could be levied at a rate that will maximize total tax revenues.

[10] In the real world a partial number of casinos such as 6.2 will not exist. However, for the purpose of this illustrative example we have allowed for a fractional number of casinos to exist in order to make the computations easier for the reader to follow.

[11] A casino retention rate of 3.6 percent of the amount gambled is close to what is obtained for casinos in such places like Las Vegas where the rates are set in a more competitive environment. (website:www.bestpayoutcasinos.net/)

C. The existing turnover tax, t*, of 0.015 could be retained, but then a tax on fixed cots could be designed that would maximize the overall tax revenues from the sector.

D. Only a tax on fixed costs of, T, is levied at a rate that will maximize tax revenues from the sector.

(a) Revenue Maximizing Turnover Tax

In this case, a turnover tax is imposed at a rate t. The total cost function inclusive of taxes, TC', then becomes,

(22) $TC' = K+bq+cq^2 \Rightarrow TC' = cq^2+ bq+tq+K.$

Average costs are,

(23) $AC' = cq+b+t+\frac{K}{q}$,

and marginal costs inclusive of tax MC' are,

(24) $MC' = 2cq+b+t.$

The tax rate that will cause casinos to meet the market demand efficiently needs to be set at a level so that each casino will operate at the level q_0, as in equation (5), where its average costs are minimized. To bring this about it must be set so that MC' = AC' = s. Now, setting marginal costs inclusive of the tax (24) equal to the regulated price of (s), we have,

(25) $MC' = 2cq+b+t = s \Rightarrow t = s - 2cq - b$.

Now substituting $\sqrt{\frac{K}{c}}$ for $q=q_3$ in (25) in order that each casino will operate at its minimum average costs, one can solve for the value of (t) that will bring this about,

(26) $t = s - b - 2\sqrt{cK}$.

The tax rate will be exactly the difference between the regulated price (s) and the competitive price given by equation (6). This situation is illustrated in Figure 2 where MC'=AC'=s and t=AC'-AC and the equilibrium quantity produced by each casino is q_0.

In this case, with a regulated price of (s), and a tax rate of (t) set by (26), the number of casinos entering the sector will be,

$$(27) \quad n_3 = \frac{as^e}{\sqrt{\frac{K}{c}}}.$$

Total Revenue from Turnover Tax

The total tax revenue, TR_t, from the turnover tax is calculated as $TR_t = t(as^e)$. Substituting equation (26) for (t) in the expression for TR_t,

$$(28) \quad TR_t = (s - b - 2\sqrt{cK})as^e.$$

This tax will capture an amount of revenues equal to the entire surplus between the regulated price s and the net of tax minimum average costs of the casinos, times the total volume of gambling. The total tax revenue raised from a typical casino is shown in Figure 2 as the area $sfcP_c$.

(Insert Figure 2 here)

Economic Welfare Cost of Turnover Tax

The welfare cost of the tax can therefore be estimated as the difference between the total financial costs of the casinos' operations with the turnover tax, less the total costs incurred by the casinos in servicing the same quantity demanded, if every casino operated at its perfectly competitive level of output. From this difference we need to subtract the amount of tax revenues that the government

collects. Taxes are simply financial transfers, not economic costs of the casinos' operations.

This can be written $WC_t = (AC' - AC)(as^e) - TR_t$. Substituting (23) for AC', (3) for AC, (28) for TR_t and setting $q = \sqrt{\frac{K}{c}}$, we find that $WC_t = 0$. In this case, the turnover tax set at a level (t) as in equation (26) will have a zero economic welfare cost.

Estimation of Revenue from Revenue Maximizing Turnover Tax:

In this case, the rate for the revenue maximizing turnover tax is derived using equation (26). The rate of tax (t) is equal to 0.064. Substituting this tax and the amount of turnover of US$ 234.08 million/year into equation (28), we find that the total tax revenue would be equal to US$ 14.92 million/year. The single rate of turnover tax at its revenue maximizing level will result in the same number of casinos entering the sector as in the competitive case. Hence, the welfare cost of this tax will be equal to zero. In fact, by imposing this tax, the economic efficiency in the casino sector will be improved by US$ 6.44 million.

The chief difficulty with levying a single turnover tax on the casino sector is one of tax administration. A number of countries have experienced a high degree of tax evasion and fraud when they attempted to levy a significant tax rate on the purchase of the chips used in gambling. Hence, other designs for the taxation of casinos need to be considered.

(b) Revenue Maximizing Level of t, given that T* and s are known

In this case, we assume that the rate of tax on the fixed costs is given as T*, now we want to see what would be the rate of turnover tax, t that would maximize the overall revenue yield from the sector.[12]

The total cost function for the casinos is now written as,

(29) $TC' = cq^2+bq+tq+K(1+T^*)$,

with average costs equal to

(30) $AC' = cq + b + t + \frac{K(1+T^*)}{q}$

To have a least cost equilibrium given the existence of T* we need to find the value of t so that the competitive level of output, q_0, will exist and every casino will be operating where AC'=s.

From (30),

(31) $s = cq + b + t + \frac{K(1+T^*)}{q}$

By substituting for the quantity $q = q_4=q_0$ into equation (31), we find the revenue maximizing rate of turnover tax t, given T=T* is,

(32) $t = s - b - 2\sqrt{cK} - \sqrt{cK}T^*$

Using $q_4=q_0$ and the market demand of Q'_d, we can now solve for the number of casinos $n = n_4$ that will now supply the market as,

(33) $n_4 = (as^e)/\sqrt{\frac{K}{c}}$.

In this situation, the total tax revenues paid by the sector in a year can be expressed as,

[12] This tax policy question might arise when either a state or province levies a tax of T* on the fixed costs of casinos (perhaps through its licensing authority), while central government has the authority to levy taxes on the turnover of the casinos.

(34) $TR = tQ'_d + T^*Kn_4$.

Estimation of Tax Revenue from Revenue Maximizing Level of t, given that T* and s are known

One way of reducing the rate of the revenue maximizing tax on turnover for casinos in North Cyprus would be to retain the current asset tax of 0.395 on annual fixed costs and then to solve for the revenue maximizing turnover tax. Using (32), we find that the revenue maximizing turnover tax, t, would be equal to t=0.058 when T*=0.395. From (33) we find that the equilibrium number of casinos would be n_4=234.08/37.82=6.19. The tax revenue in this case has two components. First, the revenue from the turnover tax is calculated using (28) to be TR_t=US$ 13.523 million/year and second, the revenue from the tax on fixed costs is calculated using (34) to be TR_{T^*}=0.395(0.572)(6.19)=US$ 1.399 million/year. The total tax revenue estimated is therefore approximately equal to US$ 14.922 million per year. Substituting these values into (21), the annual welfare cost of the concerned tax policy is zero per year.

(c) Revenue Maximizing Level of T given that t* and s are Already known

In this case, we assume that the rate of tax on the turnover is given as t*, now we want to find the rate of tax, T, on the fixed costs that would maximize overall tax revenues from the sector. This approach to taxation may be necessitated when it is not possible for the authorities to administer a substantial rate of turnover tax, but it is possible to tax the physical assets of the casinos such as the number of slot machines, and tables. The total cost function for the casinos is now written as,

(35) $TC' = cq^2 + bq + t^*q + K(1+T)$,

with average costs equal to,

(36) $AC' = cq + b + t^* + \frac{K(1+T)}{q}$.

To have a least cost equilibrium, given the existence of t*, we need to find the rate of T that will maximize revenue with each casino operating where,

(37) $AC' = s$

Using equation (37) and setting $q_5=q_0$, the revenue maximizing rate of asset tax T, is found to be

(38) $T = \left[\left(\frac{s-b-t^*}{K} \right) \sqrt{\frac{K}{c}} \right] - 2.$

Using q_0 and the total quantity of demand in the market, Q'_d, we can now solve for the number of casinos $n=n_5$ entering the market,

(39) $n_5 = \frac{as^e}{\sqrt{\frac{K}{c}}}$.

In this situation, the total revenue paid by the sector in a year can be expressed as,

(40) $TR = t^*Q'_d + TKn_5$.

Estimation of Tax Rate and Revenue from Revenue Maximizing Level of T given that t* and s are Known

Due to difficulty of taxing the turnover of casinos, countries such as the Dominican Republic have had to rely more on the taxation of the casinos' fixed costs. In the following illustrative estimations, we assume that it is not possible to raise the rate of turnover tax in North Cyprus above its current rate of 0.015. To complement this tax, we now estimate what would be the revenue maximizing rate of tax on fixed costs, T, given t*=0.015 and s=0.10. From (38) we find that the revenue maximizing annual tax, T, is equal to 3.223 times the annual fixed costs. With

t*=0.015 and T=3.223. With $Q_d^{'}$ = US$ 234.08 million per year, the number of casinos will be n_5=234.08/37.82=6.19. The tax revenue in this case has two components as well. First, the revenue from the turnover tax is calculated using (28) to be TR_t*=US$ 3.511 million/year. Second, the revenue from the tax on fixed costs is calculated using (34) to be TR_T= US$ 11.411 million/year. The total tax revenue is again estimated to be approximately equal to US$ 14.922 million/year. Substituting the above values into (21), the annual welfare cost of the concerned tax policy is also calculated as being equal to zero.

(d) Revenue Maximizing Tax on Fixed Costs T is levied with no Turnover Tax

A decision to levy a tax only on fixed costs might occur if the degree of tax evasion with respect to a turnover or income tax is very high. In recent years the Dominican Republic has had to revert to such a tax system due to uncontrollable tax evasion with other forms of taxation. In this case firms will enter until AC'=s. In this situation the revenue maximizing rate of tax must be so that AC'=s at a level of output of q_0 so each casino is operating in an economically efficient manner.

The expression for the revenue maximizing rate of tax T can be found directly from (38) by setting t*=0. This gives us,

(41) $$T = \frac{s - b - 2\sqrt{cK}}{\sqrt{cK}}$$

This case is illustrated by Figure 3. The final equilibrium is at point h for each casino with it operating at an output level of q_0. The tax on fixed costs has shifted the average costs to AC'. The maximum tax revenue for a typical casino is is shown at the area $shgP_c$.

With the asset tax, T, set so that each casino will produce $q_6 = q_0$, the number of casinos, $n=n_6$, that will enter the market will be the same as in (39),

(42) $$n_6=\frac{as^e}{\sqrt{\frac{K}{c}}}.$$

In this situation, the total revenue paid by the sector in a year can be expressed as,

(43) $TR = TKn_6.$

(Insert Figure 3 here)

Estimation of Tax Rate and Revenue from Revenue Maximizing Level of T

In this case, we estimate the revenue maximizing rate of asset tax, T, given t*=0 and s=0.10. From (41) we find that the revenue maximizing annual asset tax, T, is equal to 4.215. With T=4.215 and $Q_d^{'}$ = US$ 234.08 million per year, the number of casinos will be n_6=234.08/37.82=6.19. The revenue from the tax on fixed costs is calculated using (43) to be TR_T= US$ 14.922 million/year. Substituting the above values into (21), the annual welfare cost of the concerned tax policy is also calculated as being equal to zero.

V. Conclusions

In Table 1, we have summarized the results of the analysis. The magnitude of the efficiency losses from levying too low a set of tax rates while allowing free entry into the casino sector is reported for each case. At the present time, the economic efficiency cost on average is equal to 80% of the revenue collected. From tax policy case (a), we find that if a single turnover tax could be enforced, the additional revenue would be approximately US$ 6.44 million with the welfare cost falling by

the same amount. Case (b) where the tax on fixed costs is retained and a revenue raising turnover tax is added and case (c) where the turnover tax is retained and a revenue maximizing tax on fixed costs is added, the results are exactly the same in terms of revenue and economic efficiency as if there was a single revenue maximizing rate of turnover tax case (a), or a single revenue maximizing tax on fixed costs, case (d).

(Insert Table 1 here)

This paper has shown that in jurisdictions where the price of gambling is set by regulation above its competitive price, and where entry into the sector can not be effectively controlled, then a serious resource miscalculation will occur if the countries do not tax away the potential economic rents accruing to the sector.

It is found that a tax on the turnover of funds gambled is an equally efficient to one that taxes the annual fixed costs of the casinos. However, because of the ease of taxing fixed costs in contrast to taxing turnover, it might be welfare improving to maintain a low turnover tax, and use a tax on the annual fixed costs of the casinos to tax away the rest of the economic rents. In all cases the economic welfare of the country will be improved as the level of taxation is increased on the casinos up to the point where tax revenue is maximized.

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Table 1. Tax Policy Options – Annual Revenue and Welfare Cost

Tax Policy Cases	q	N	t	T	WC Millions of US$	Revenue Millions of US$
Existing tax system	10.64	22	0.015	0.395	6.44	8.48
a. Revenue maximizing turnover tax only	37.82	6.19	0.064	0.00	0.00	14.922
b. Revenue maximizing t, given T* and s	37.82	6.19	0.058	0.395	0.00	14.922
c. Revenue maximizing tax T on fixed costs, given t* and s	37.82	6.19	0.015	3.223	0.00	14.922
d. Revenue maximizing tax on fixed costs only	37.82	6.19	0.00	4.215	0.00	14.922

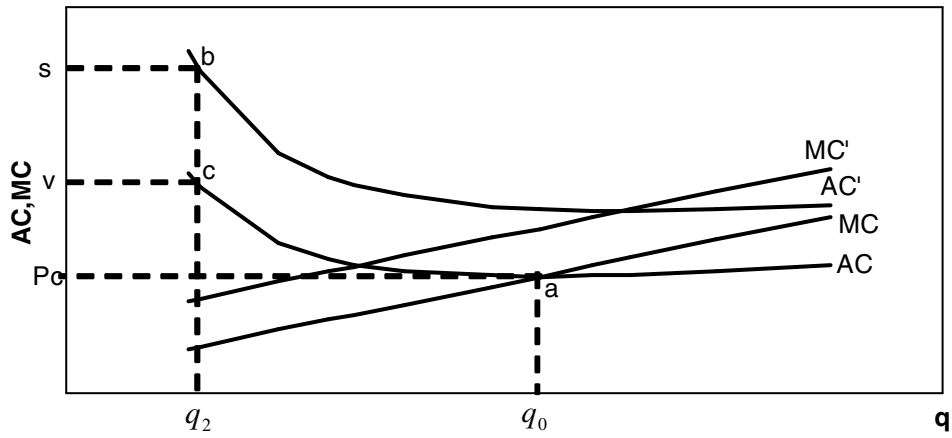

Fig. 1. Existing System in North Cyprus

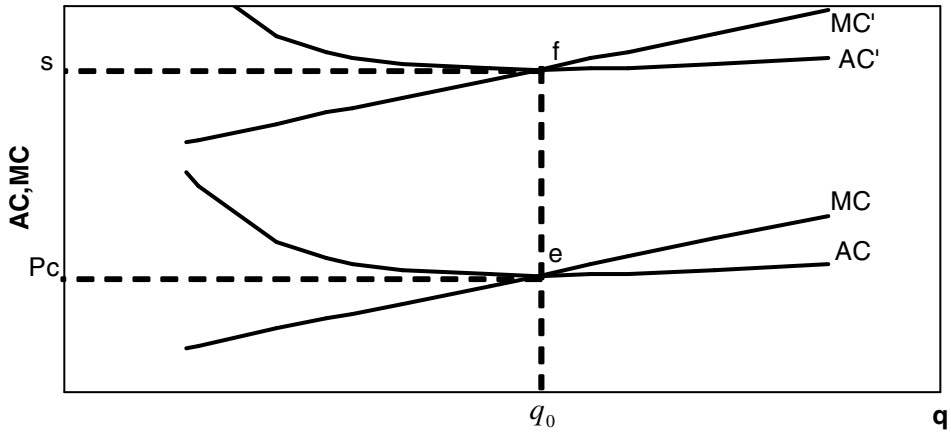

Fig. 2. Revenue Maximizing Turnover Tax only

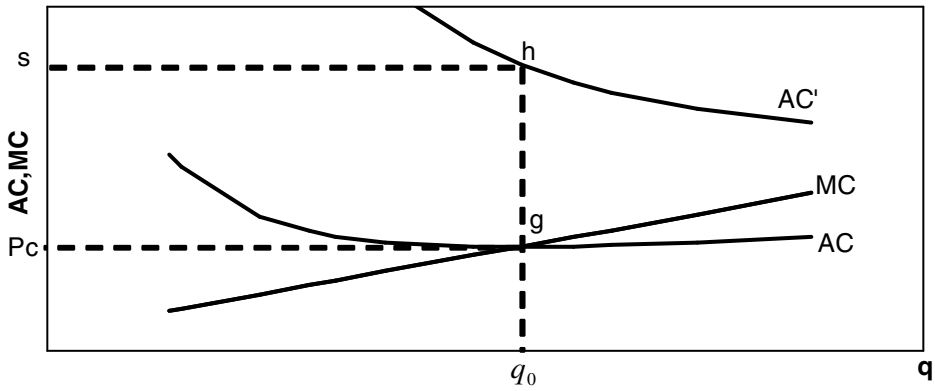

Fig. 3. Revenue Maximizing Tax on Fixed Costs