AN ECONOMIC ANALYSIS OF THE DETERMINANTS OF MONTANA ALCOHOL RETAIL LICENSE PRICES

by

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ABSTRACT

In Montana, there are a wide array of different alcohol retail license types. The three major types of retail licenses for on-premises consumption are all-beverage, beer and wine, and restaurant beer and wine. The state limits the number of available licenses of each type, employing city-level quotas for incorporated areas and county-level quotas for unincorporated areas. The licenses may trade freely within each quota area, but generally may not be trade between areas. Differing conditions in each quota area leads to large differences in license prices between the various markets. To help explain the differences in price, the study lays out a theoretical model regarding license values. It then tests the model's predictions using license price data from the Montana Department of Revenue. Empirical results are calculated using ordinary least squares, finding that gambling revenue, university enrollment, income, and tourism are all significant determinants of license price. Additionally, the individual license characteristics are statistically and economically significant. These results support the theoretical predictions, providing evidence that the model is an appropriate way to think about the license system.

1

INTRODUCTION

Alcohol is unique among vice products in that it has unequivocally received the most attention on a national scale in the United States. With the 18th Amendment to the United States Constitution, Prohibition began in 1920, effectively banning the retail sale of alcohol. Even after the ratification of the 21st Amendment, which once again legalized sales in 1933, alcohol production and sales have remained highly regulated. Indeed, every state in the United States continues to license and regulate all businesses that deal in alcohol—manufacturers, wholesalers, and retailers alike. The degree to which states intervene in the market, however, varies a great deal. For example, Nevada leaves most of the regulation to the individual counties. In contrast, seventeen states are "control states," where the state directly controls distribution for certain types of alcohol.[1] Usually, control states hold monopolies over wholesale markets for liquor, frequently defined by alcohol content—either alcohol by volume (ABV) or alcohol by weight (ABW). In some cases, control states own and operate liquor stores as well. In non-control states, manufacturers must sell to wholesalers in most cases, but the state does not directly handle distribution at any level.

Montana is one of the seventeen control states, maintaining a monopoly on the sales of liquor, fortified wine, and beer with high alcohol content at the wholesale level.[2] At the retail level, the Montana Department of Revenue issues many types of retail licenses subject to a quota system. Once issued, state law permits owners to transfer

[1] Maryland has control counties, but is not a control state per se.

[2] High alcohol beer is defined as having an alcohol content of at least 14% ABV.

licenses. Given that the state limits the number of licenses in use, most businesses must purchase a license from a current license owner. The license prices, however, vary widely across license types market areas. While licenses in some markets sell at prices not far above the small annual licensing fees, licenses in others routinely sell at six-figure prices. The highest prices observed in this study were from transfers in Billings, Bozeman, and Missoula, with several all-beverage licenses selling at prices of $1,000,000 each in recent years.

The large disparities in prices between locations and license type lead to several interesting questions, including how prices are determined. To answer this question, the analysis begins by constructing a competitive market model, with the addition of a quota limiting the number of establishments. This basic framework is well established—the introduction of tradable permits in competitive taxi cab markets is literally a textbook example (Hyman 1986). The implications of model, however, have not been rigorously derived or tested empirically, particularly with respect to alcohol retail licenses.

To test the implications of the model, OLS regressions are employed using public-access license price data from the Montana Department of Revenue. Within the department, the Liquor Control Division regulates and tracks license transfers (among other regulatory responsibilities), maintaining a database of all transactions. In addition to the systematic differences in price across the various license types, the results indicate that several other demand factors offer significant explanatory power in pricing licenses. Particularly, gambling, enrollment, and income all show strong positive relationships with the market value of alcohol licenses. Although the relationship is slightly weaker, tourism

appears to be another important predictor of license price. The results are robust to both functional form and the inclusion of controls for the supply of licenses (alleviating concerns of simultaneity bias). The effects largely rely on cross-sectional variation, causing results to be sensitive to functional form if geographic fixed effects are included.

The analysis provides value in two ways. First, it contributes to the literature by developing and empirically testing an existing theory in a new context. Second, understanding the determinants of price in each license market has implications for businesses, e.g., retail establishments and financial institutions. Price determination is a relevant issue, particularly considering that liquor licenses may be used as collateral for loans. Additionally, given the involvement of government in the alcohol industry, examining what economic and social characteristics affect license prices is important in informing policy discussion.

4

BACKGROUND

History

Prior to Prohibition, Montana had relatively few regulations regarding the issuance of alcoholic beverage licenses; all that the state required was a licensing fee (Revenue Oversight Committee 1980). Once Congress voted to enact Prohibition, however, Montana moved relatively quickly, becoming the seventh state to ratify the 18th Amendment to the United States Constitution on February 19th, 1918. Along with the rest of the United States, the retailing of alcoholic beverages was effectively illegal in Montana between 1920 and 1933. When the United States repealed Prohibition through the ratification of the 21st Amendment in 1933 (Montana did not ratify it until 1934), the state created the Montana Liquor Control Board to regulate alcohol sales (Congressional Research Service 2004).[3]

Modeling their control system on that of Alberta, Montana owned and operated all package alcohol stores in the state. The Liquor Control Board (LCB) maintained a monopoly on all liquor sales, with bars and taverns limited to serving beer (Quinn 1970).[4] In 1937 the legislature passed House Bill 196, which permitted liquor-by-the-drink sales in licensed establishments statewide. To acquire a license to serve liquor, however, establishments also had to hold a beer retail license. In 1947, the legislature created the quota system for incorporated communities (Quinn 1970). The system laid out in 1947 has served as the basis of the current licensing system.

[3]For a timeline of events, see the Appendix A.

[4]Wine was also under the authority of the LCB, but did not gain popularity in Montana until the 1960s (Quinn 1970).

In 1963, the state created a quota for liquor licenses in unincorporated communities, which previously were issued licenses subject to the board's discretion (Quinn 1970). The number of beer retail licenses, however, remained under control of the board. State liquor stores held a monopoly on all off-premises sales until 1967. In that year, the state created a license for off-premises beer sales, also to be issued at the board's discretion (Revised Code of Montana 1967).[5]

The state witnessed a great deal of change in the licensing system in the 1970s. In 1972, Montana ratified a new constitution, reorganizing the state government. As a result, the Montana Liquor Control Board was dissolved. The responsibilities were transferred to the newly created the Liquor Control Division, within the Department of Revenue (Subcomittee on Judiciary 1974). The state also made major changes to on-premises licenses in 1974-1975: a wine amendment was created for beer-only retail licenses, jointly held liquor and beer licenses were folded into "all-beverage" licenses, and the state created "floater" all-beverage licenses, which could move between communities under certain conditions. Similarly, licensing for off-premises sales changed significantly around the same time. State liquor stores were banned from selling beer in 1975, while off-premises beer licensees were granted the right to sell wine by voter initiative in 1978 (Revenue Oversight Committee 1980).

More recently, Montana closed all state-run stores in 1995, moving instead to licensing privately run state agency stores (Montana Department of Revenue 2012). Though the state ended its explicit control over dedicated liquor stores, it instituted a

[5]Permitted businesses included dedicated beer stores, grocery stores, and drugstores licenses as pharmacies.

quota, based on population, limiting the number of agency franchise agreements per community. Shortly thereafter, Montana expanded the total number of retail licenses, creating a beer and wine license specifically for restaurants in 1997. The quota for the restaurant licenses was set as a percentage of the beer retail license quota, which limited RBW licenses to incorporated communities. In 2007, the legislature voted to double the number of a vailable restaurant beer and wine licenses.

The mid-2000s saw two other important changes: Montana began allowing out-of-state persons to own licenses, and instituted a ban on smoking. State law limited ownership of alcohol retail licenses to state residents until 2005, when the law was challenged in court. The Federal District court struck down the law as unconstitutional, opening ownership to non-residents (Montana Department of Justice 2005). Also in 2005, the state legislature passed a state-wide indoor smoking ban. The law, however, temporarily exempted bars from having to comply, allowing smoking in bars until October of 2009 (Montana Department of Public Health & Human Services 2009).

A relatively unusual aspect of Montana's alcohol licensing system is the explicit packaging of gambling rights with alcoholic beverage licenses. Gambling was illegal in Montana until 1972, when the new constitution granted the legislature the right to legalize games of chance. In 1976, the Montana Supreme Court legalized video keno, but ruled that video poker was illegal in 1984. Shortly thereafter, the legislature passed the Video Poker Machine Act, allowing five video poker machines per alcoholic beverage license. The move tied gaming rights to all-beverage and on-premises beer licenses in 1985.[6] In

[6]The restaurant-specific licenses created in 1997 did not permit gambling.

1991, the legislature removed the limit on video poker machines, but set the overall cap for licensees at 20 gaming machines per license (Montana Department of Justice 2013). In 1997, the legislature voted to curtail gaming for on-premises beer and wine licensees, limiting gambling rights to licenses issued in unincorporated areas.[7] Similarly, the legislature revoked gambling rights on all-beverage floater licenses transferred after 2007.

License Descriptions

Montana employs a three-tier system for alcohol: the state licenses manufacturers (and importers), wholesalers, and retailers separately, placing limitations on the interactions between the different tiers. Manufacturers and wholesalers are prohibited from holding a financial interest in any business that sells alcohol at retail. Similarly, manufacturers and importers may not own or have financial control over a wholesaler. State law also limits the amount of advertising tools, paraphernalia, and gifts that manufacturers and wholesalers may provide to retailers. Manufacturers, with several exceptions, must sell to wholesalers—in the case of liquor, manufacturers may only sell to Department of Revenue. Wholesalers must sell to retailers, who in turn may sell to consumers.

The Department of Revenue issues new licenses to businesses in each tier subject to an application process. Similarly, the department reviews all license transfers—applicants for new and transferred licenses must satisfy the same ownership requirements. Particularly, the department vets potential licensees to ensure that

[7]The state grandfathered all licenses issued prior to 1997.

businesses observe the constraints on interactions between tiers.

Manufacturers' licenses come in three basic categories: brewery, winery, and distillery. Breweries may have storage depots in Montana (apart from the brewery) and must sell to wholesalers with few exceptions. Their contracts with wholesalers must be exclusive by brand within the wholesalers area of business, but need not be exclusive by manufacturer.[8] In addition, brewers may not terminate contracts with wholesalers without just cause. Wineries may produce, blend, bottle, store, import, and export wine. Unlike breweries, they may sell to both consumers and wine distributors (wine wholesalers). Their contracts with distributors are not required to be exclusive, and may be terminated with 60 days notice. Distilleries must sell liquor to the state, shipping directly to state warehouses, with few exceptions. It is up to the Department of Revenue's discretion as to the number of manufacturer's licenses issued.

State law makes exceptions to the brewery and distillery sales requirements, based on manufacturer size. A "small" brewery produces between 100 and 10,000 barrels of beer annually, while a microdistillery may produce up to 25,000 gallons of liquor. In each case, the licensee may sell directly to consumers in limited quantities. Small breweries may sell up to 48 ounces of beer per person per day.[9] Microdistilleries may sell up to two ounces of liquor for on-premises consumption and 1.75 liters for off-premises consumption per person per day. Sales for both must occur between 10 a.m. and 8 p.m.

The department licenses three types of wholesalers for beer and wine. The first,

[8]Manufacturers may sell under several different brand names, e.g., Budweiser and Michelob are both brewed by Anheuser-Busch.

[9]Breweries that produce fewer than 20,000 barrels of beer face an initial licensing fee of $20,000.

beer wholesalers, must have a fixed place of business, although they may operate subsidiary establishments. They must sell large quantities in original packaging to retailers; they may not sell to the public. All sales must be delivered by the wholesaler, except for limited quantities of beer that are not generally available.[10] The second, table wine distributors, have the same requirements as beer wholesalers, except that they are not required to deliver wine to retailers. A business may hold both a beer wholesaler license and table wine distributor license concurrently. The third type of wholesaler license is the sacramental wine license, which permits a business to sell wine directly to religious organizations exclusively for religious purposes. The department may determine the number of wholesaler's licenses to issue.

Montana allows two types of businesses to sell alcohol exclusively for off-premises consumption. For the retail sale of liquor, the state may enter into agency franchise agreements. Agency liquor stores are privately operated state franchises that operate both as retailers and wholesalers. They may sell liquor and wine (but not beer) directly to consumers for off-premises consumption, and also act as an additional wholesaler of liquor for on-premises establishments.[11] Agency stores may purchase wine through private distributors, and are free to set the retail price. For liquor, however, the Department of Revenue sets a uniform posted price (i.e., a price floor per bottle) that applies to all retail sales. For bulk sales to on-premises licensees, agency stores may offer

[10]"Not generally available" means the wholesaler received less than 600 barrels from the manufacturer in the previous quarter, less than 1,200 barrels in the previous two quarters, or the manufacturer produces less than 150,000 barrels per year (MCA 16-3-220).

[11]Liquor must go through both the state warehouses and an agency franchise store before being stocked in a bar.

no more than an eight percent discount below the posted price. Agency stores must purchase liquor from the state, at a price set as a percentage of the posted price.[12] Persons or entities cannot hold a financial interest in more than one agency store, which holds a franchise agreement that is renewable every ten years. The department may establish one agency store for the first 12,000 people in a municipality, with an additional store for increments of 40,000 people over the initial 12,000. If the department chooses to establish a new agency store, they select the new agent based on competitive sealed proposals. The franchisee may assign an agency agreement to a new person or entity, with 60-day notice to the department, subject to approval.

In addition to franchising agency stores, the department issues beer and wine licenses for package sales. The licenses allow businesses to sell beer, wine, or both to consumers for off-premises consumption only. The state may only issue these licenses to dedicated beer and wine stores, grocery stores, or drugstores. An establishment must maintain $3,000 of food-inventory at all times to qualify as a grocery store, while drugstores must be licensed as pharmacies to be eligible for a license. Licensees may not hold a financial interest in an agency store or in a retail all-beverage license. Unlike agency stores, the number of beer and wine off-premises licenses is not subject to a quota.

Numerous license types exist for on-premises sales. The three major types, which are the focus of the present study, consist of retail all-beverage licenses, beer retail licenses, and restaurant beer and wine licenses.[13] Each type is eligible for an optional

[12]The price agency stores pay the state depends on the store's size, volume of sales, and the population and number of other agents in the store's area.

[13]Additional on-premises license types include: resort all-beverage, airport all-beverage, golf course beer and wine, tribal and military, veterans/fraternal organization, non-profit arts, West-Yellowstone Airport, Mon-

catering endorsement, which allows alcohol to be served at off-site events held within 100 miles of the licensee's establishment. The issuance or transfer of any of the three major licenses is subject to a ten-day waiting period. If the department receives a sufficient number of letters of protest during that time, they must hold a public hearing to determine whether there is sufficient cause to deny an application. The department may only issue one license per premises. If there are available licenses, the department allocates them via lottery if the number of applicants exceeds the number of licenses. Retail licensees may operate other businesses simultaneously in the same building, provided that the on-premises portion is physically separated by floor-to-ceiling walls. Licensees of each type may not hold an interest in an agency store.

All three license types are subject to quotas, based on the population within a market area. For incorporated communities, the quota is set based on the population within the relevant city limits (see Appendix B for details). Quotas for an incorporated community apply for a radius of five miles beyond the boundaries of the community. If two communities have overlapping five-mile radii, the quota is determined based on the collective population of both.[14] In all cases, the quota is "soft"—communities may have more licensed establishments than the quota explicitly permits. The excess of licenses occurs for a variety of reasons. First, the law passed in 1947 grandfathered existing businesses. Second, the state does not automatically rescind any licenses in the case of

tana Heritage Preservation and Development, passenger carrier, and special (temporary).

[14]There are six combined quota areas: Bozeman/Belgrade, Helena/East Helena, Whitefish/Columbia Falls, Red Lodge/Bear Creek, Hamilton/Pinesdale, and Eurkea/Rexford. Additionally, Butte/Silver Bow County and Anaconda/Deer Lodge County are each single quota areas.

shrinking population.[15] Third, communities may float all-beverage licenses into their quota areas, in excess of their quota (within certain well-defined limits).

Retail all-beverage licensees are permitted to sell beer, wine, and liquor by the drink for on-premises and off-premises consumption. Licensees may include self-service shelves or coolers exclusively for off-premises consumption, provided that they are contiguous but physically walled-off from the on-premises area.[16] Licensees may also offer gambling in the form of cards, sports pools, and video gaming machines. The number of machines is limited to 20 per establishment, and there is a 15 percent tax on revenue produced from gaming machines. The quota for licenses applies to both incorporated an unincorporated areas. Licenses may be sold within a quota area, and under certain limited conditions may be transferred between quota areas. A licensee may own an interest in no more than three licenses or half the licenses in a quota area, whichever is less.[17]

If a municipality is over quota by less than 43 percent (33 percent if the population is less than 10,000) and an additional license would not put it over that threshold, the state may hold a lottery (if necessary) to issue a floater license.[18] Whoever wins the floater license may purchase a license from another quota area ("floating" it into his or her own area), provided that the seller's area is over quota by more than 25 percent and will not fall below that threshold due to the sale. Floater licenses are gaming-restricted as of 2007 (i.e.,

[15]The state may revoke licenses, but only for violation of state law or if a licensee does not operate for a period of 90 days; the period may be extended beyond 90 days for extenuating circumstances.

[16]Licensees may not provide the same amenities for on-premises consumption.

[17]Prior to 2013, an individual could hold an interest in only one all-beverage license.

[18]A city is eligible to float in a license if $\frac{\text{The no. of licenses issued} + 1}{\text{The license quota}} \leq 1.43$

licensees may not offer gambling), may not be re-transferred for five years, and must remain permanently in their new quota area.

Beer retail licenses permit the sale of beer for on-premises or off-premises consumption. With a wine amendment, licensees may also sell wine. In order to obtain an amendment, licensees must demonstrate that wine would complement their food service. For off-premises sales, licensees must abide by the same rules as all-beverage establishments. Depending on when and where the department issued a license, licensees may offer the same gambling services as all-beverage establishments. All licenses issued in unincorporated communities may offer gambling, but licenses issued in incorporated communities after 1997 are gaming-restricted. The number of beer retail licenses is subject to the quota within incorporated communities, but is left to the department's discretion in unincorporated areas. The number of licenses an individual holds is not limited by state law. All transfers of beer retail licenses must take place within the licensee's quota area.

The third type of on-premises license is the restaurant beer and wine (RBW) license. RBW licensees face a more restrictive set of constraints than the other two types of on-premises retail licensees. Establishments holding an RBW license may sell beer and wine, but only for on-premises consumption; no off-premises sales of any kind are allowed.[19] Similarly, licensees may not offer gambling under any circumstances. To qualify for a restaurant beer and wine license, establishments must provide individually-priced meals, prepared and served on site, with 65 percent of total revenue

[19]This restriction applies to unfinished bottles of wine.

coming from food. In addition, the department may issue no more than 25 percent of all RBW licenses to restaurants with seating capacities of over 100.

The quota and allocation process are also different for RBW licenses. Rather than a direct function of population, state law sets the quota for RBW as a percentage of the beer retail quota (the exact percentage varies by population size—see Appendix B for details). In unincorporated areas, there is no beer retail quota, so the department only issues RBW licenses within the quota areas for incorporated communities. Like all-beverage and beer retail licenses, the department holds a lottery for RBW licenses if necessary. The lottery for restaurant licenses, however, is a priority lottery. Applicants with preference must be awarded licenses before those without it. The department grants preference to those applicants who do not possess an alcohol license, but operate a restaurant in the area. Additionally, state law limits the ability of business to "trade down" licenses—if a business sells its beer and wine retail license, it must wait a full year before purchasing an RBW license.

LITERATURE

Economics of Alcohol

While an extensive literature exists regarding the economics of alcohol, the majority of it does not directly relate to the issue of licensure. Rather, most studies tend to focus on the demand-side of the retail market and the effects of consumption. The literature is well developed regarding the effects of advertising and legal changes on alcohol sales, along with the associated (potentially negative) effects of drinking. A smaller subset of the literature examines the production of alcohol, with particular emphasis on the brewing industry.

Given that alcohol consumption has the potential to create negative externalities, examining how advertising and institutions affect consumption has definite policy implications. Tremblay and Okuyama (2001) find that although there is little evidence that advertising increases market demand, consumption may still increase. Advertising may lead to greater price competition among producers, increasing the quantity supplied. On the other side of the issue, Saffer and Dave (2002) examine at advertising bans. Their results differ somewhat, as they find that in light of a decline in drinking across several countries, advertising bans still have a significant negative impact on alcohol consumption.

Along with limiting advertising, government may institute other regulations to potentially reduce the consumption of alcohol. Taxation of alcohol, for example, is universal across U.S. states. A less common regulation is the Sunday sales ban (also known as a blue law). Cook and Tuachen (1982) examine how liquor excise taxes affect

consumption, using liver cirrhosis as a proxy for long-term heavy drinking. All else equal, they find that a one dollar increase in liquor excise taxes reduces heavy drinking by 5.4 percent, with a possible larger long run decline. Sunday sales restrictions, however, have a less profound effect. They find that allowing sales on Sundays may increase consumption on Sundays, but does not have a significant effect on total consumption (Cook and Tuachen 1982).

Health effects related to alcohol consumption extend well beyond direct mortality for the person drinking. Another large portion of the literature attempts to measure the impact of alcohol on traffic-related accidents and deaths. Particularly, the literature addresses legal changes regarding the purchase of alcohol. McMillan and Lapham (2006) find that lifting the Sunday off-premises sales ban in New Mexico leads to an increase in Sunday traffic accidents by 29 percent. They employ a time series for a single state, however, making it hard to attribute causality. Indeed, with a state-level panel, lifting blue laws shows no measurable impact on traffic accidents or fatalities (Lovenheim and Steefel, 2011). Similarly, Miron and Tetelbaum (2009) re-evaluate the claim that increasing the minimum drinking age to 21 decreased alcohol-related deaths, finding that the purported effects are probably overstated.

In addition to the effects on traffic accidents, another large portion of the literature looks at the connection between alcohol and crime. Markowitz finds that amidst other drug regulations, beer taxes have a negative relationship with some violent crime. Assaults decrease with higher beer taxes, but rape and robbery do not (Markowitz 2005). Similarly, zero-tolerance drunk driving laws do not have a measurable impact on violent

crime, but may lead to a slight decrease in petty criminal offenses (Carpenter 2007). Using a county panel in Virginia, Heaton re-examines the effect of blue law repeals within the context of crime. Employing difference-in-difference and triple-difference approaches, the evidence suggests that allowing package sales on Sundays increases both petty and violent crime (Heaton 2012).

While many studies look at demand and the effects of consumption, a large literature also looks at the supply side of alcohol. In manufacturing, for example, there was a large decline in the number of breweries prior to the 1990s. Gokhale and Tremblay (2012) examine this market concentration, finding that competition did not substantially decrease with the number of breweries. With respect to wholesalers, many states, including Montana, mandate exclusive distribution territories. Such arrangements serve to increase retail beer prices, although overall quantity supplied remains constant (Sass and Saurman 1993). Similarly, several states have post and hold laws, requiring wholesalers to publicly publish their prices. Cooper and Wright find that although the laws are associated with a moderate decrease in overall consumption, they do not affect drunk driving or other risky behavior (Cooper and Wright 2012).

Of the studies that explicitly treat the licensing of retail sales, off-premises establishments are the predominant topic. Smith (1982) examines the political economy of liquor store laws, evaluating the effects that special interests have on the licensing structure across the United States. Similarly, Seim and Waldfogel (2013) examine the Pennsylvania liquor control system. The state is the sole owner and operator of off-premises liquor stores, leading to different numbers and locations of stores relative to a

license-to-operate system. While Toma (1988) examines retail license quotas, the analysis is limited to the context of dry/wet counties—states with more restrictive licensing appear to have higher numbers of dry counties.

Within the economics of alcohol literature, there is a contribution to be made by examining how the market prices tradable retail licenses. Broadly speaking, relatively little has been done examining on-premises retailers. More specifically, no literature exists looking at license prices in the context of quotas. This topic also has relatively wide applicability, as almost half of states allow transfers of retail licenses (although not all have license quotas).[20]

Supporting Literature

While the issue of tradable alcohol retail licenses remains untreated in the economics of alcohol, the topic of tradable permits is pertinent in other several other areas of economics. Several other areas in economics have well developed literatures on the trading and pricing of permits and production quotas, informing how the issue of alcohol licenses may be approached.

In the field of environmental and resource economics, the literature on tradable permits has existed since the 1960s. Crocker (1966) and Dales (1968) describe systems to govern pollution of air and water, respectively, using markets for pollution rights. Establishing tradable pollution permits may be a more efficient management mechanism to reduce the negative externalities of emissions than direct regulation or a tax/subsidy

[20]Just over twenty states permit the transfer of retail licenses. This figure was compiled examining all fifty states' online statutes individually.

system, as the market is more responsive to emitter/receptor preferences (Crocker 1966). Similarly, by employing a market system rather than charging producers directly for water rights, regulators are relieved of the need to establish the price level necessary to achieve the desired reduction in pollution (Dales 1968). The work of both Crocker and Dales is widely applicable, serving as the foundation for a broad literature on tradable pollution rights.

Similarly, tradable production permits are used with relative frequency in agriculture. For example, the United States has employed both tobacco and peanut production quotas (Rucker et al. 1995). The federal quota system for tobacco, in particular, is similar in certain respects to the Montana alcoholic beverage license quota system. Tobacco quota may be transferred by producers within counties, but cannot cross county lines—alcohol retail licenses face similar transfer restrictions. Such limitations create divergent prices (quota lease rates and sale values) between areas, with potential gains from allowing trade. That said, Leasers of high price quota would be less well off financially, while lessees would be better off financially (Rucker et al. 1995).

Another license market exhibiting similar characteristics to the Montana alcohol licensing system is the famous example of taxicab medallions in New York City. The city requires taxis to possess a medallion to operate, limiting the number of taxicabs in use. Medallions are freely tradable, frequently fetching prices upwards of $ 1 million (NYC Taxi & Limousine Commission 2013). Like alcohol retail licenses, possession of a medallion confers the right to operate, but does not directly limit output. This system is distinct from pollution and agricultural quotas, which strictly limit production. While the

imposition of the quota confers monopoly rents on those who were currently operating, entrants into the market face normal profits as the medallion price rises to dissipate profit (Tullock 1975). The existence of a positive price for medallions, however, does not necessarily imply an inefficient outcome. For example, the barrier to entry may reduce externalities associated with congestion. It may also secure a premium for honest drivers—licensing may tend to push up quality in taxi services (Demsetz 1982, Cairns and Liston-Heyes 1996).

Also related is the literature on big-game hunting permits. Several western states allocate hunting permits via lottery, the same process by which Montana issues new alcohol retail licenses. The Colorado permit lotteries, moreover, are preferential, not unlike the issuance of RBW licenses (Buschena et al. 2001). Unlike the alcohol licenses, the hunting permit lotteries occur on an annual basis. While the states frequently distribute non-transferable hunting licenses annually, alcohol retail licenses are issued once, then may be subsequently traded on the open market. While this limits the implications of this literature for alcohol licensing, several underlying characteristics of the two systems remain the same. People will tend to enter lotteries, for example, until the cost of entering equals the expected value (Nickerson 1990, Scrogin et al. 2000, Buschena et al. 2001). Similarly, restrictions on licenses (e.g., antlerless hunt permits or gaming restricted liquor licenses) will unequivocally have non-positive effects on demand (Nickerson 1990). This last point is directly applicable to the license system in Montana, which allows different activities based on license type.

While there does not exist a specific literature regarding the issuance and trade of

alcohol retail licenses, other areas may provide insight into developing tools for analysis. The topics of agricultural production quotas and taxicab medallions have particular relevance for Montana's licensing system, given the tradable nature of the quota. Even so, relatively little has been done in terms of determining how transferable operational licenses are priced. Coupled with the lack of work in the area of alcoholic beverage retailers, again, a clear contribution to the literature is possible.

THEORY

The Competitive Market Model

The basic model consists of a competitive, constant cost industry with identical price taking firms—long-run supply is perfectly elastic under free-entry conditions, with downward sloping market demand. In the absence of a quota for licenses, assuming a constant cost industry with price taking firms and free entry, the *i*th individual establishment has a short run profit function:

$$\pi_i = p_B \cdot q_i - c(q_i, \boldsymbol{\alpha}) - F \tag{1}$$

where p_B is the market price of bar services that is exogenous to the establishment.[21] q_i is its quantity produced and $\boldsymbol{\alpha}$ is a vector of other factors (i.e., supply shifters). Together, $p_B \cdot q_i$ forms total revenue. Variable cost $c(q_i, \boldsymbol{\alpha})$, a function of quantity, and fixed cost F comprise total cost. As a profit maximizer, the establishment will seek to produce in the short run where marginal revenue equals marginal cost; that is, where $p_B = c'(q_i)$. Theoretically, the establishment could solve for the optimal output as a function of price, i.e., $q_i(p_B, \boldsymbol{\alpha})$. Market supply is the horizontal aggregation of the individual firms' supply functions, given by:

$$Q_S = S(p_B, \boldsymbol{\alpha}) = \sum_{i=1}^{k} q_i(p_B, \boldsymbol{\alpha}) \tag{2}$$

[21] Bar services may be thought of in this context as an index of goods and services, such as alcoholic beverages, food, gambling, ambiance, etc.

where k is the total number of competing establishments. For the purposes of the model, short run supply is assumed to have an upward slope.

In a competitive industry model, profit and loss determine the long-run number of firms operating in the market. If price is above an establishment's average cost, it earns positive profit. In figure 1, case 1 presents the profit-earning case graphically, with the shaded area denoting economic profit. If existing establishments are earning profit, additional businesses will enter, shifting market supply out. As a result, price declines and economic profits decrease. Conversely, if price is below an establishment's average cost, the business experiences negative profit (loss), denoted by the shaded area in case 2. Economic loss causes establishments to exit, reducing market supply and increasing price, causing profits to increase. If price equals average cost, there is no profit, illustrated in case 3. When economic profit is equal to zero, there will be neither entry nor exit in the market. Given entry or exit, market supply shifts until price equals average cost, as in case 3. All else equal, the long run market supply is perfectly elastic, as firms enter or exit until profit equals zero.

Consequently, market demand sets the long run equilibrium quantity. Market quantity demanded is given by the function:

$$Q_D = D(p_B, \boldsymbol{\beta}) \tag{3}$$

where $\boldsymbol{\beta}$ is a vector of factors that affect demand (i.e., demand shifters). By setting the long run equilibrium quantity, market demand determines the long run number of

establishments as well. Thus, the long run number of establishments in the market, k^*, is a function of market price, with zero profit for each establishment in equilibrium.

Quota for Licenses

The introduction of a binding license quota to the model limits the number of establishments to fewer than would exist under free entry. Because fewer establishments operate under the license system, supply shifts back and becomes less elastic relative to the free entry scenario. In figure 2, S and S' denote the short-run market supplies for the free entry and license quota scenarios, respectively. Supply under the license quota, S', does not become perfectly inelastic. The quota is on the number of establishments, rather than on output directly. Establishments may still adjust along other margins to increase quantity (e.g., they may increase available seating). The reduction in supply causes an increase in the equilibrium price, from p_B to p'_B, which would create profit in the short run (the shaded area in figure 2). If the licenses are tradable, however, this profit does not persist. Rather, a market forms for the licenses. In addition, Long run supply is no longer perfectly elastic with the addition of a quota. New firms cannot freely enter to bid down profit.

In the market for licenses, supply is perfectly inelastic, set exogenously by a regulatory agency. Thus, quantity supplied is given by the function:

$$Q_S^L = \bar{L} \tag{4}$$

In figure 2, the supply of licenses is also denoted by $\bar{L}$. Each establishment is limited to a single license; a businesses' willingness to pay for each license is equal to profit. Thus, the demand for licenses depends not only on license price (p_L), but also on the market price for bar services. Quantity demanded for licenses is given by the function:

$$Q_D^L = L(p_L, p_B) \tag{5}$$

The model assumes that demand for licenses is downward sloping. The horizontal intercept of the demand curve, denoted by D_L in figure 2, is at k^*—the free-entry equilibrium number of firms. Given that supply is perfectly inelastic, the price of licenses is determined entirely by demand.

The market price for licenses, p_L, is the mechanism by which establishments compete profits down to zero. To enter the market, a business must first purchase a license. Similarly, existing establishments must bear the opportunity cost of holding a license—it could be sold for up to p_L (and the proceeds invested). In either case, average cost increases until establishments no longer earn positive profit. In figure 2, this is the shift from AC to AC', where p_L is equal to the shaded area.[22] Additionally, each licensed establishment increases output, from q_i to q_i'.[23] The model may be extended to include multiple periods without substantially changing the implications. Rather than current-period profit, the license price reflects the present value of current and expected

[22]The model necessarily produces downward sloping demand, assuming that average cost shifts, but marginal cost does not.

[23]Market quantity decreases with a binding quota. Under free entry, the market quantity is $k^* \cdot q_i$ (assuming identical firms). Under the quota, market quantity is $\bar{L} \cdot q_i'$.

future profits.

Additionally, profit (or expected profit) may differ based on license attributes. In the context of Montana's licensing system, there are several tiers of licenses. All-beverage, beer and wine, and RBW licenses may be thought of as having distinct markets, each following the model above. The licenses are imperfect substitutes, with premiums for certain license types. An all-beverage license should yield a higher expected profit than a beer and wine or RBW license, as it permits the largest scope of services. Similarly, a license that allows gambling should sell for a higher price than a gaming-restricted license, all else equal.

Market Differentials

Suppose that demand for licenses in two different areas, market 1 and market 2, intersect the quotas at different price points. For example, demand for licenses in market 1 may be relatively high compared to market 2. Consequently, market 1 would observe a higher equilibrium license price, presented in figure 3. Assuming that licenses are only tradable within their respective markets, market 1 will have fewer establishments relative to market demand. Should the regulatory agency in charge of licensing seek to reduce the price differential between the two markets, two options exist: a regulatory remedy and a market remedy.

In the "regulatory remedy," the agency could manipulate the number of licenses in each location, adjusting the quota until the profit earned in each market was the same. For example, the quota could be increased in market 1, pushing out $\bar{L}_1$ until $p_1 = p_2$ in figure

3. Similarly, the quota could be reduced in market 2 to reduce the price differential. In either case, the adjustment of the quota and subsequent license price effects would lead to similar licensing costs between markets.

In the "market remedy," rather than directly increasing or decreasing the number of licenses in each market, the regulatory agency could allow trades between the markets. In this case, establishments wishing to enter market 1 could purchase licenses from market 2. As a result, licenses issued would increase in market 1 and decrease in market 2, as licenses floated between areas. In the absence of transaction costs, the licenses will be reallocated across markets until $p_1 = p_2$. Again, the reduction in the price differential would lead to similar licensing costs between markets. In addition, allowing trade would maximize social net benefits from the total number of licenses ($\bar{L}_1 + \bar{L}_2$) across the two markets .

Application of the Model

Using the competitive market model with a binding quota, several testable implications arise. Consider the four equation system, comprised of equations 2-5. These include quantities supplied and demanded for alcohol retail services (Q_S and Q_D), and quantity supplied and demanded of licenses (Q_S^L and Q_D^L):

$$Q_S = S(p_B, \bar{L}, \boldsymbol{\alpha}) \qquad Q_D^L = L(p_L, p_B)$$

$$Q_D = D(p_B, \boldsymbol{\beta}) \qquad Q_S^L = \bar{L}$$

This system may be theoretically solved by setting $Q_S = Q_D$ and $Q_S^L = Q_D^L$ and finding equilibrium prices as a function of the parameters. Under equilibrium conditions, identities replace the equations, as $p_B^*(\bar{L}, \alpha, \beta)$ and $p_L^*(\bar{L}, \alpha, \beta)$ definitionally clear the market for any values the parameters take on. Thus, in equilibrium, the model consists of a two identity system:

$$S\left(p_B^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta}), \bar{L}, \boldsymbol{\alpha}\right) \equiv D(p_B^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta}), \boldsymbol{\beta}) \tag{6}$$

$$\bar{Q} \equiv L(p_L^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta}), p_B^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta})) \tag{7}$$

The equilibrium model produces comparative statics results, with associated testable predictions. For example, the effect of a positive demand shifter, β_1, should have a positive effect on the market price for alcohol retail services. This can be confirmed by finding the comparative statics result for β_1 on $p_B^*(\cdot)$ (the equilibrium price). The two identity system may be differentiated with respect to β_1 and solved for $\frac{\partial p_B^*(\cdot)}{\partial \beta_1}$, producing the prediction:[24]

$$\frac{\partial p_B^*(\cdot)}{\partial \beta_1} = \frac{\frac{\partial D(\cdot)}{\partial \beta_1}}{\left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)}\right)} > 0$$

The result confirms the expectation that the price of alcoholic beverage services should increase (decrease) as demand shifts to the right (left), holding all else constant. It should be noted that the system is differentiated in equilibrium. Restricting the analysis to small changes near the equilibrium allows the sign of the comparative statics results to be

[24]The derivations of the comparative static results are presented in the Appendix C.

determined with relative ease. Thus, the derivative of $p_B^*(\cdot)$ is taken (with respect to β_1). The prediction is local, only applying to values near the equilibrium price.

A more interesting effect is that an increase in β_1 should have a positive effect on the price for a license, $p_L^*(\cdot)$. This prediction is perhaps less intuitive than the previous result, as β_1 relates only indirectly to the market for quota. Nonetheless, the model produces a comparative statics results that supports this expectation. Again, the two identity system may be differentiated with respect to β_1, but solved for $\frac{\partial p_L^*(\cdot)}{\partial \beta_1}$. This process produces the testable implication:

$$\frac{\partial p_L^*(\cdot)}{\partial \beta_1} = \frac{-\frac{\partial D(\cdot)}{\partial \beta_1} \cdot \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)}}{\left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)}\right) \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}} > 0$$

Thus, the price of licenses should increase (decrease) as the demand for alcohol retail services increases (decreases) as well. Factors such as student population and tourism should all positively influence the price of alcoholic beverage licenses for a given quota level. Conversely, the restriction of gambling rights placed on certain licenses, or shrinking population in a quota market should depress prices in the license market.

Similarly, the model produces testable predictions regarding changes in the quantity of licenses available under the quota. The comparative statics result for $\bar{L}$ on price in the market for alcohol retail services is:

$$\frac{\partial p_B^*(\cdot)}{\partial \bar{L}} = \frac{\frac{\partial S(\cdot)}{\partial \bar{L}}}{\left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right)} < 0$$

The result implies that the price of services should decrease (increase) as the quota increases (decreases). Again, the result is fairly intuitive, given how the assumptions of the model. An increase in quota will increase market supply, leading to a lower prices for bar services. Another more interesting testable implication arises for the effect of $\bar{L}$ on the price of licenses. Differentiating they system with respect to $\bar{L}$ and solving for $\frac{\partial p_L^*(\cdot)}{\partial \bar{L}}$ produces the result:

$$\frac{\partial p_L^*(\cdot)}{\partial \bar{L}} = \frac{\left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) - \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial S(\cdot)}{\partial \bar{L}}}{\left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}} < 0$$

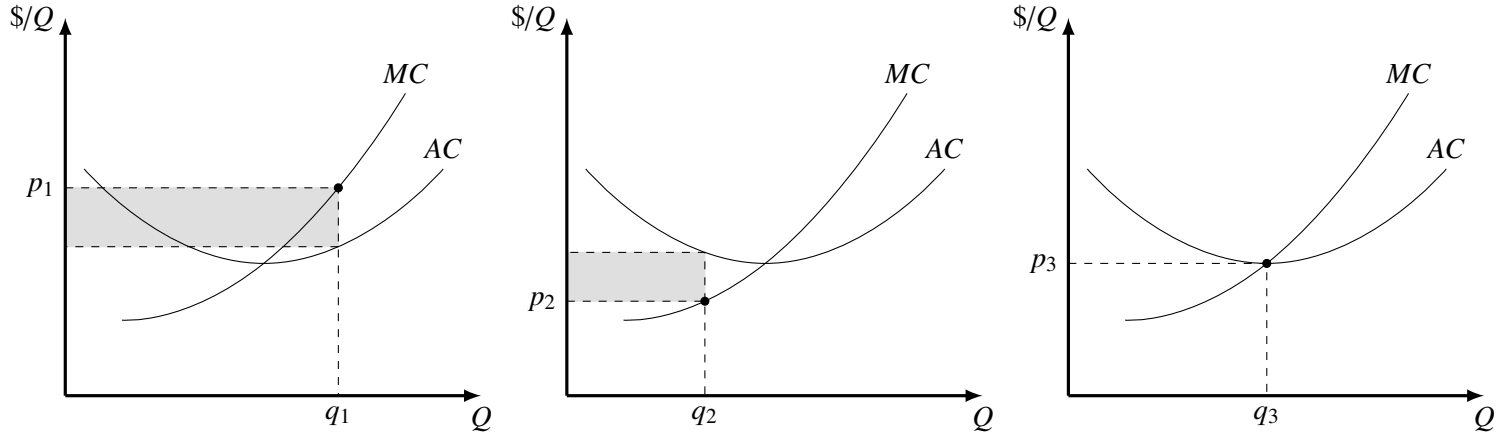
For an increase (decrease) in the quantity of available licenses, the price of licenses will decrease (increase). This straightforward result has implications for both the regulatory and market remedy for divergent prices above. For example, releasing additional RBW licenses in 2007 should cause the price of such licenses should decrease.

Under limited circumstances, establishment owners may transfer floater licenses between quota areas. The buyer's area should observe lower prices as the number of licenses in circulation increases, while the seller's area should observe the opposite effect. Given the limited conditions under which such trades occur, however, the effects of floater licenses moving between areas tends to be quite small. Adding one additional license to the 98 all-beverage licenses currently in Billings only constitutes a 1.02 percent increase. As a result, the prediction is unlikely to be supported empirically in such conditions.

A caveat to the license price predictions is that they only apply to cases where the quota for licenses is binding. If an area is under quota, the free-entry number of firms operate in the market. In figure 2, this scenario would occur if $\bar{L}$ were in excess of k^*.

There would be no economic profit, leading to a zero-price for licenses. Marginal changes in license demand or quota would not cause license prices to change. A marginal change could conceivably cause $\bar{L}$ to become equal to k^*, but price would remain zero. Thus, the predicted effects regarding $p_L^*(\cdot)$ above should be zero in non-binding areas.

Figure 1: Positive, Negative, and Zero Proft



Case 1: Profit

Case 2: Loss

Case 3: Zero Profit

Figure 2: Market, Firm, and License Market

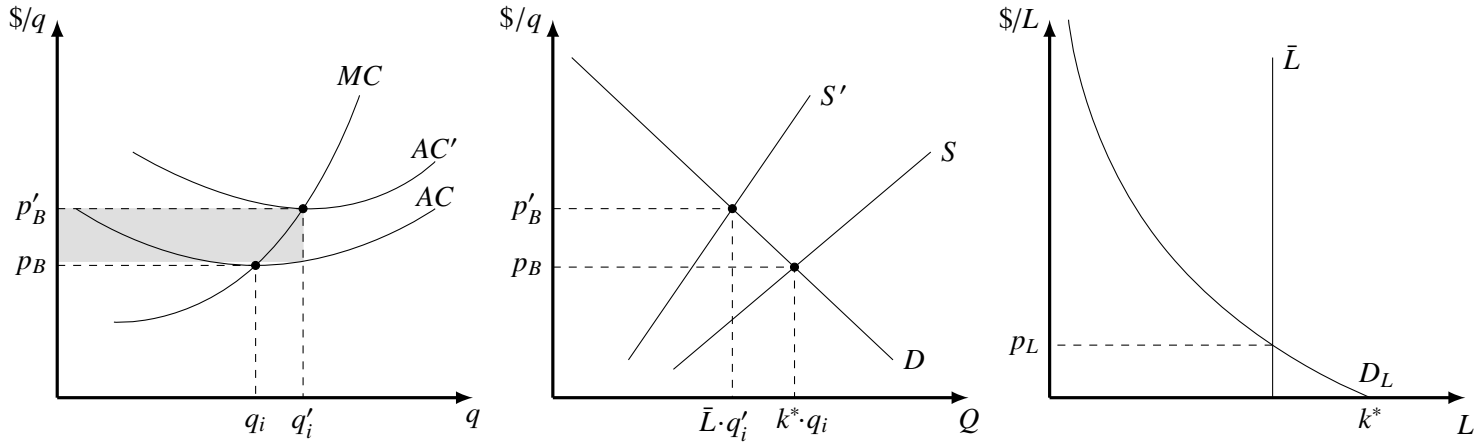
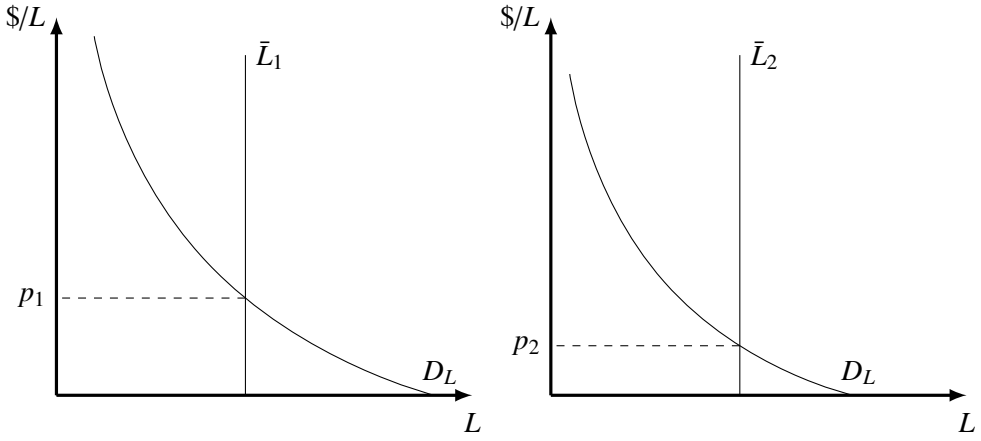


Figure 3: Market Differentials



Market 1 Market 2

DATA AND METHODOLOGY

Data

The Montana Department of Revenue must approve all transfers of alcohol licenses. As part of the approval process, the department records data on all transfers, including the sale price, buyer's quota area, transaction type, application date, and approval date. Transaction types include transfer of ownership (sale of a license with the establishment), transfer of ownership and location (sale of a license to a new establishment), transfer of location (no sale, but a relocation of the establishment), new issuance, and corporate structure change (a term that includes business decisions ranging from restructuring where no money changes hands to sales of a partial financial interest in a license). The information is public record, published on the department's website with transactions from 2006-2013. Additionally, earlier price data from 2002-2007 are available, also obtained from the Department of Revenue.[25]

The two data sets partially overlap for 2006-2007. In total, there are 1,227 observed transactions forming pooled cross-sections over time. Included in the data are 781 all-beverage, 234 beer retail, and 157 restaurant beer and wine transactions.[26] Further, the data contain only 48 transactions involving the major license types prior to 2005 (the file was not completed for 2002-2004), all of which are dropped. Similarly, other data used in the analysis, including census estimates and tax revenue numbers, are not yet

[25]These data were obtained prior to the new computer system implemented by the department in 2007, and are now unavailable.

[26]The infrequency of the other license types precludes analysis. Only seven observations across all other license types involved trades between private parties.

available for 2013, causing the most recent year's data to be dropped (50 observations).

New issuances do not involve market prices. Rather, the department collects a fixed initial licensing fee based on a schedule.[27]. Similarly, transfers of location do not involve changes in the ownership of a license or an exchange of money.[28] In the case of a death of a licensee, the ownership of the license may revert to the estate, or to whomever has financial control over the estate. These transactions do not involve market prices, and have been omitted from the analysis.

Several low-price observations are also dropped from the data set. Observations listing a price of zero are omitted, with all such transactions coming from the 2002-2007 data. This change makes the earlier and later data more consistent, as the department does not include any zero-price transactions in their data post-2007. Similarly, several very low-priced transactions from 2007-2013 are dropped. Selling a license for $1.00-10.00 (well below annual licensing fees) when licenses trade routinely for six-figure values, is indicative of some unobservable characteristic in the data (e.g., a father selling a license to son). As a result, these observations are dropped. Finally, six inconsistent observations are omitted. The transactions appear to be duplicates, either across space (i.e., listed in both Missoula and Petroleum counties) or time (i.e., the same information with overlapping dates). With the inconsistent observations, the information from the newer data set is used in place of the older data. Table 1 illustrates the breakdown of the number of observations

[27]Initial licensing fees may be found in M.C.A. 16-4-420 and 16-4-501.

[28]As a result, transfers of location should list a price of zero. In the data, however, several transactions recorded as transfers of location list non-zero prices. To identify which transactions are mislabeled, all observations flagged as a transfer of location listing a price of over $800.00 are changed to "transfer of ownership and location." Several transfers of location appear to list the annual licensing fee as the price; $800 is the highest annual fee, serving as the line of demarcation.

and those that are omitted.

Further observations have potential clerical errors, either between or within each data set. For each type of potential problem, the observation is flagged with a binary variable. The most commonly flagged issue is for a missing transaction type, with 71 occurrences.[29] Further, all observations missing an application date fall into this category, with 53 observations in 2006. As a result, these observations cannot be treated as random. The application date for each is imputed using the mean time between application and approval, and a dummy variable is included for regressions. In effect, "missing" is treated as a distinct transaction type.

Between 2005 and 2012, 52 of the 56 counties in Montana observe at least one transaction, with the six most populous counties (Yellowstone, Missoula, Flathead, Gallatin, Cascade, Lewis & Clark) observing the the greatest number of transactions. Table 2 reports the the total number of transfers of ownership across every county in Montana for 2005-2012.

Just as the largest counties have the most transactions, the largest cities in Montana observe more trades than the smaller areas. In addition, they tend to observe higher prices, with Billings, Missoula, and Bozeman each observing a maximum price of $1,000,000 (nominal) for an all-beverage license. For transfers of ownership and transfers of ownership and location, the average prices of all-beverage licenses (excluding floaters) by

[29]Other potential errors include incomplete entries from 2002-2007; inconsistent dates and/or prices between data sets; observations that appeared in the 2007-2013 data in Aug. 2013 but not Feb. 2014, or vice-versa; unusually long times between application and approval; and mismatches of license type. In all cases, if an observation appears in both data sets, the newer value supersedes the older. A binary variable for each potential error was initially included in the regressions. They were insignificant, however, and are not included in the results section.

year in the 15 largest cities in Montana are reported in table 3. Floaters are excluded, as the licenses are purchased from a low-price area but reported in the buyer's quota area. Buyers act as monopsonists–the purchase prices should tend to reflect the market conditions in the seller's location, which is not identified in the data. Not every major city records a transaction for each license type every year, and those that do may have low numbers of trades. Bozeman, for example, records approximately two transfers of ownership or transfers of ownership and location of all-beverage licenses each year, making the mean price susceptible to outliers (e.g., the dramatic dip in price in 2010). The markets for all-beverage licenses may be the deepest, but the usable license price data covers all transfer types across the three major license classes.

In evaluating the determinants of license price, economic characteristics of each quota area are important controls to include, as they should affect the derived demand for alcohol retail licenses. Provided that the goods and services licensed establishments offer are normal, higher incomes will shift demand for alcohol out and increase license values, all else equal. Conversely, the effect of unemployment is unclear—higher unemployment could cause license prices to move in either direction.[30] Median household incomes, reported at the county level, are obtained from the U.S. Census Bureau's Small Area Income and Poverty Estimates. Unemployment, also reported at the county level, are from the U.S. Bureau of Labor Statistics. Table 4 reports the median household incomes in the 15 largest counties and Montana overall for 2005-2012.[31] Table 5 does the same for

[30]The short run effect can be positive or negative. In the long run, lower incomes should decrease consumption (lowering license values).

[31]2012 is the most recent available data.

unemployment.

Another important factor for both supply and demand for licenses is population. The U.S. Census Bureau provides annual city-level population estimates for all incorporated communities, along with the unincorporated county balance (the population of a county, less the population residing in incorporated areas). Population growth may also be important, as state law sets quotas based on current population, but proprietors value licenses based on expected future income. While positive growth may have a limited effect (licensees probably anticipate the state issuing more licenses), negative growth should decrease license prices (the state does not take licenses away if population shrinks). Population level may serve as a better control than growth, however, as a 1 percent growth rate in Billings is fundamentally different than 1 percent growth in Broadview. In Billings, 1 percent growth is about half of what is necessary to increase the quota by an additional license; Broadview would require a much higher growth rate to secure a larger quota.

Table 6 reports the population growth rates for the 15 largest towns in Montana. Immediately apparent are the drops in the population growth rate in the some of the previously fastest growing cities. Belgrade, Bozeman, and Kalispell each witnessed large drops in growth in 2009-2010, with Belgrade's changing sign in 2009. Similarly, the growth rates in Livingston and Whitefish, while smaller in the preceding years, also turn negative in 2009-2010. In contrast, Billings and Helena maintain consistent growth over the timeframe. Another interesting phenomena to note is that Anaconda and Butte, while having reputations as shrinking communities, tend to have growth around zero. Given there is no consistent shrinking population, the growth rate will probably not affect license

prices over the time frame of this study.[32]

Along with population, demographic makeup may also serve as important controls. The U.S. Census Bureau produces age, gender, racial, and ethnic population estimates at the county level. Of these measures, the age brackets, reported in five-year intervals, may be the most interesting. The proportion of an area's population between the ages of 20-44, for example, may tend to have a positive effect on demand. The variation in the demographic information, however, is quite low. While there are differences across counties, there is very little change across time.

University population and the rate of tourism will tend to have a positive effect on demand for bar services, all else equal. The licensing system bases communities' quotas on permanent population, not taking into account students, visitors, or tourists. As a result, cities that have a large university population relative to permanent population should see higher derived demand for licenses, with correspondingly higher prices. The National Center for Education Statistics provides annual fall enrollments for all two and four year institutions in Montana, through the Integrated Postsecondary Education Data System (IPEDS). These data include numbers for public, private, and tribal institutions. Table 7 reports enrollment for each quota area with a school.[33]

Unfortunately, the number of visitors and tourists to any particular community in a given year is not generally available. Instead, the Montana hotel and lodging tax may

[32] Again, positive growth should have little impact on prices, while negative growth should push prices down.

[33] Although the different types of universities may be expected to have different impacts, they are treated the same in the analysis. The results are robust to separating enrollment by type (e.g., private/public/tribal, or two-year/four-year.

serve as a proxy. Collected by the Department of Revenue, the lodging tax consists of a flat 4 percent on rent charged for rooms, plus a 3 percent sales tax (for a total tax of 7 percent). The tax is not an exact measure of the number of guests, as the reported revenue is subject to differences in room rates. The supply of hotel rooms, however, will probably tend to be quite inelastic over any relatively short period of time. As a result, demand should drive most of the changes in revenue within a given county.

The Department of Revenue reports the lodging tax at a county level, with several smaller counties reported jointly.[34] To impute county-level revenue numbers for the few jointly reported counties, the total revenue is divided based on the number of hotels in each county (e.g., if there are four hotels across two counties, one in the first and three in the second, the first county would have 25 percent of the total reported revenue imputed as the county-level number).[35] Table 8 reports annual lodging tax revenue, for the 15 largest counties in Montana.

Immediately apparent is the relationship between the hotel tax revenue and the mean license prices in table 3. Gallatin, Yellowstone, Missoula, and Flathead counties tend to have the highest average license prices (and the most transactions). Similarly, the tax revenue produced by the hotel industry in each town is far above the other larger counties. In addition to being potential tourist destinations, the presence of the two largest Montana universities in Bozeman and Missoula probably boost the lodging tax revenues for their respective counties.

[34]Counties whose lodging tax revenues were aggregated to protect proprietors privacy include Carter/Golden Valley/Treasure, Prairie/Wibaux, Garfield/McCone, and Judith Basin/Liberty/Petroleum.

[35]How the data is imputed does not influence the results. The jointly reported areas log very few transactions, all with very low prices.

An important facet of Montana's alcohol licensing system is the packaging of gambling rights with all-beverage and beer retail licenses. In addition to gambling license fees, the Montana Department of Justice collects a 15-percent income tax on net revenues from gambling machines (the money fed into the machines less the money paid out in winnings). The department reports the tax revenue, along with the number of licensed establishments and the number of video gaming machines. For the earlier biennial reports (pre-2007), the Department of Justice reports numbers for all incorporated communities, along with numbers for the county balance. In later reports (post-2007), the department begins reporting at the county-level, along with several major cities.

To impute city-level revenue for the post-2007 data, the historical average split from the pre-2007 data are used. For example, the Gallatin County total revenue, less Bozeman and Belgrade, is divided between Manhattan, Three Forks, West Yellowstone, and the county balance. The average proportion of the revenue attributed to each area from 2001-2006 (once Bozeman and Belgrade have been subtracted from the county total) is used to impute revenue numbers for each of the smaller communities. The same process is used for each county in Montana. Table 9 reports video gambling tax revenue for major cities, by year.

The supply of licenses in a quota area is perfectly inelastic for any given year, set by the formula using population laid out in state law. The Department of Revenue updates the quotas annually, using the previous year's city-level population estimates from the U.S. Census Bureau. Measures of quota and the number of issued licenses are currently available from the department for all-beverage, beer retail, and restaurant beer and wine

for 2008-2013, along with an existing report from 2005.[36] For 2006 and 2007, updated city-level population estimates from the U.S. Census Bureau are used to impute quotas.[37]

Similarly, the number of licenses issued for 2006 and 2007 are interpolated using the 2005 and 2008 quota reports. The interpolated number of all-beverage and beer and wine licenses issued in 2006 is one-third the difference between 2008 and 2005, added to the 2005 issued licenses; 2007 values are assigned using the 2008 numbers less one-third the difference. Both values are rounded to the nearest whole number. For RBW licenses, the 2006 licenses issued take on the 2005 value, while the 2007 interpolated number is the average of 2005 and 2008. The functions differ, as the RBW quota doubles in 2007 due to a legislative change in the quota formula. A confounding factor is the merging of Bozeman and Belgrade in 2006. Prior to 2006, the town's respective quota areas did not overlap. In 2006, however, it was determined that the city limits for each town were within 10 miles of each other. Tables 10-12 gives the quota and licenses issued for all-beverage, beer retail, and RBW licenses in the 15 largest cities.

Each of the largest towns are all significantly over quota. All except Billings, moreover, exceed 143 percent of quota, meaning that they are not eligible to float in additional licenses. While the towns listed above are well over their quotas, they are hardly exceptional. Indeed, much of the state has more licenses issued than technically allowed by the quota. Several areas with the greatest surplus of licenses are Butte, Anaconda, and Red Lodge, each of which is over quota by more than 300 percent. For 2012, Butte and

[36]The 2005 quota spreadsheet was obtained before the update to the Department of Revenue's computer system in 2007; it is no longer available from the department.

[37]These imputed quotas will not be perfect replicas the original (unavailable) quota spreadsheets. The department uses initial estimates, which the Census Bureau subsequently updates.

the surrounding county (Silver Bow) are alloted 25 licenses, with 86 total licenses in use; Anaconda (and Deer Lodge County) stands at 9 and 30; Red Lodge, 4 and 16. Overall, 119 of the 176 quota areas are at or above their respective quotas for 2005-2012.

While most incorporated communities are over quota, many counties are not. Indeed, the unincorporated areas of the six most populous counties in Montana are tend to be under quota, ranging from 11 under (Cascade, Lewis and Clark) to 32 under (Yellowstone) as of 2012. Collectively, however, the Department of Revenue has issued more total licenses statewide than the official quota as set by state law, with 81 of the 176 distinct areas over quota.[38]

Collectively, 758 observations are from areas that are at or above their all-beverage license quotas. Of the 134 observations from non-binding areas, 95 are from areas more than one license below their quota. These tend to be from the unincorporated areas in the larger counties, mentioned above. 39 observations are from areas that are technically non-binding, but are short of meeting their quota by one license. Further, of those 39, 28 are from areas that have binding quotas for at least one year between 2005-2012. These observations are interesting in that the associated license prices look more like the prices from binding areas than non-binding (the prices in non-binding areas should be near zero). It is possible that entrants into the almost-binding markets would rather purchase a license an existing license than apply for a new one. If the prices are relatively low, buying a license may be worth avoiding an additional competitor. Unfortunately, the relative lack of observations in these markets precludes statistical analysis on the topic.

[38]The difference between the total number of operational licenses in the state and the sum of the quotas across all areas is +271 for 2012.

Unlike the all-beverage licenses, the other two on-premises license types, beer and wine retail and restaurant beer and wine, do not systematically exceed their respective quotas. As of 2012, only 15 of the 176 quota areas have beer and wine licenses in excess of quota, with only Butte and Whitefish exceeding quota by more than 2 licenses. Similarly, only two areas consistently exceed the RBW license quota—Whitefish and Kalispell. Collectively, the department has issued fewer total beer retail and RBW licenses than quota would permit across the state. One phenomenon to note about RBW licenses is the relatively slow adjustment. With the doubling of the RBW quotas in 2007, even the highest-price markets take several years to bring the additional licenses into use.

Additional variables of potential interest include the number of small breweries and domestic distilleries in a quota area. Both types of manufacturers may operate on-premises establishments, acting as substitutes for establishments with a retail license. A list of breweries and their years of operation was compiled using Montana Beer: A Guide to Breweries in Big Sky Country, complemented using breweries' commercial websites. Unfortunately, there is quite limited variation across the span of the data, with the majority of growth occurring at the very end of the panel. Similarly, the Montana Department of Agriculture lists only four domestic distilleries, with the oldest beginning operations in 2009 (Harrison, 2011). As such, variables for the number of small breweries and domestic distilleries have been omitted.

Although the time frame of the data is relatively short, prices are deflated to be directly comparable. The Producer Price Index (PPI) for Beer, Wine, and Liquor is used to license prices in 2005 dollars. Similarly, the Mountain-Plains CPI is used to deflate

income, gambling revenue, and hotel revenue. Both indices are obtained from the Bureau of Labor Statistics.

Figure 4 shows the distribution of license prices in 2005 dollars. The prices are clearly clustered near zero (the first bin contains prices around $30,000 and under), with a long tail to the right. Given how skewed the distribution is, it is probably preferable to transform the data. Figure 5 illustrates the distribution after taking the natural log of license price. Although the distribution of log prices still has a large number of observations in each tail, the prices are clustered much more closely around the mean. From the distributions, it appears that log license prices are preferable to levels. Particularly, transforming the data reduces concerns of hetoerscedasticity and bias from outliers.

To get a sense for the variation that drives the results, the variables may summarized across the two different dimensions. Table 13 presents the means and standard deviations of log license prices and the major right-hand side variable, by year and for the entire data set. For ease of reporting and interpretation, the values for gambling and hotel are reported as total revenues instead of tax revenues. Both are taxed at constant rates: 15 percent for gambling, 7 percent for hotels. Thus, total revenue for gambling is the reported tax revenue over 0.15; for hotels, it is reported tax revenue over 0.07. In addition, the revenues are reported in thousands for the sake of brevity.

The most notable features in table 13 are the dips in several variables in 2008. The decrease in the mean is driven by where trades occur, however, not by an overall drop in

the variables.[39] Otherwise, the means and standard deviations within year look to be fairly consistent across time, and consistent with the values for the data as a whole.

Table 14 reports the means and standard deviations for the same variables, across the 10 largest cities in Montana. As expected, the means for are much higher certain cities than for the data set as whole. For example, Billings reports a mean gambling revenue more than four times larger than the data set mean; Bozeman's average hotel revenue is more than than triple the data set mean. More striking is the discrepancies in the standard deviations between the individual cities and the data overall. Excepting log license price, the variation within cities (over time) is vastly smaller than across all variables. Indeed, for many of the variables the standard deviations within city are routinely an order of magnitude smaller.

Comparing the statistics in tables 13 and 14 help identify can where the variation used to identify results is coming from. The means and standard deviations are far more consistent when pooled by time than when pooled by city. Thus, finding measurable effects are far more likely if regression rely on cross-sectional rather than on temporal variation.

Empirical Methodology

To determine what factors affect how alcohol retail license prices are determined, the basic econometric specification uses a log-level functional form. The dependent variable is the natural log of license price, while the other right-hand side variables listed

[39] In 2008, Billings had fewer than half the trades it had in 2007.

above are measured in levels. As a result, the regression fits an exponential relationship between the dependent and independent variables. Because the supply of licenses is perfectly inelastic in each year, the most basic specification does not include any variable for license supply. The quotas are subject to change across years, however, so alternative specifications include controls for supply. Thus, the basic econometric specification takes the form:

$$\ln(Price_{ijt}) = \beta_0 + \beta_1 Gambling_{jt} + \beta_2 Hotel_{jt} + \beta_3 Population_{jt} + \beta_4 Age_{jt} + \beta_5 Female_{jt}$$
$$+\beta_6 Enrollment_{jt} + \beta_7 Income_{jt} + \beta_8 Unemployment_{jt} + \beta_9 GamingRestricted_{ijt}$$
$$+\boldsymbol{LicenseType}_{ijt}\boldsymbol{\gamma} + \boldsymbol{TransactionType}_{ijt}\boldsymbol{\delta} + \varepsilon_{ijt}$$

$\ln(Price_{ijt})$ is the natural log of the license price for transaction i, in quota area j, in year t. $Gambling_{jt}$ is total gambling revenue in the relevant quota area and year. Similarly, $Hotel_{jt}$ is the total county-level hotel revenue attributed to quota area j in year t.[40] $Population_{jt}$ is the estimated population, while Age_{jt} and $Female_{jt}$ are the proportion of the population between 20 and 44 and the proportion that is female, respectively. $Enrollment_{jt}$ measures university/college enrollment (taking on a value of zero for most of the data), while $Income_{jt}$ and $Unemployment_{jt}$ control for quota-area and time economic characteristics.

$\boldsymbol{LicenseType}_{ijt}$ is a vector of indicator variables for floater, beer and wine, and RBW licenses.[41] Similarly, $\boldsymbol{TransactionType}_{ijt}$ is a series of dummies for the transaction

[40] Again, the same hotel revenue is used for every observation in a county. For example, the 2005 hotel number from Gallatin County is used for both the Bozeman and Three Forks quota areas in 2005.

[41] For the purposes of the study, the ten resort all-beverage licenses in the data are included among the typ-

type: transfer of ownership, corporate structure change, or missing (transfer of ownership and location is the omitted type).[42] Finally, $GamingRestricted_{ijt}$ is dummy variable that takes a value of 1 if a beer and wine, floater, or all-beverage license does not have gambling rights.

Across the different regressions, the specifications are first compiled without supply variables, then add controls for license supply. With supply variables, the vector $\boldsymbol{QUOTA}_{jt}$ is included, specified in one of two ways. The first includes indicator variables for binding beer retail and RBW quotas, along with percentage all-beverage quota and percentage all-beverage quota squared. For the purposes of defining the dummy variable for beer retail and RBW quotas, binding is defined as at or above quota.[43] Unincorporated quota areas have neither beer retail nor RBW quotas and take on a value of zero for each indicator variable by default. A linear and quadratic term are included for percentage of all-beverage quota, for a more flexible functional form.[44] The second way the vector is specified consists of the number of licenses issued for each of the three major license types.

Because the regressions are specified in log-level form, the coefficients represent

ical all-beverage licenses. Although issued under different circumstances, resort all-beverage license prices are not statistically distinguishable from all-beverage license prices. As such, the specifications do not distinguish between the ten resort all-beverage and the other all-beverage licenses.

[42]The specifications do not include license/transaction type interactions, as there are not enough observations for each combination for the interaction term to be meaningful (e.g., two or three observations for each interactive term). The results, however, are robust to their inclusion.

[43]A relatively small number of communities are above their beer retail quota. Areas appear to be above quota for one of two reasons. First, several areas appear to have had historic decreases in population (e.g., Butte and Anaconda). Second, the U.S. Census bureau may have over-estimated population in their initial intercensal estimates. If a population estimate is subsequently revised to a lower value, the relevant quota may decrease.

[44]If a quota area is well below or well above their established quota, prices are expected to be low. Including a quadratic term allows license values to peak. Unlike the other two license types, there is significant variation in percentage of quota.

percentage changes in price for a level change in the continuous right-hand side variables. Coefficients on indicator variables, however, take on a slightly different interpretation, as they are inherently discontinuous. If the dummy variable for a beer and wine retail license takes on a value of one (with all-beverage as baseline), for example, the coefficient does not represent the percentage difference in price compared to all-beverage licenses. Rather, the coefficient must be transformed to produce an intuitive interpretation. The transformation is relatively straight forward: supposing β is the estimated coefficient on a dummy variable with $\ln(y)$ on the left hand side, the relative effect of the dummy taking a value of 1 is

$$\%\triangle Y = 100 \cdot \left(e^{\beta} - 1\right)$$

This transformation provides the correct percent change in the dependent variable (Halvorsen and Palmquist, 1980). It should be noted, however, that for coefficients with magnitudes near zero, the reported values provide a close approximation.

The log-level functional form is employed initially for two reasons. First, the distribution of log license prices avoids the long tail present in the distribution of level license prices. The transformed data reduces potential bias from outliers, and reduces concerns over heteroscedasticity. Second, the log-level regression produces the best fit out of the different functional forms. The R-squared for the log-level is better than a log-log model, making the former specification preferable. Comparing the log-level and the level-level, however, is slightly more complicated.

Because the models employ different dependent variables, the sum of squared

residuals (and thus the goodness of fit) may not be used to compare the appropriateness of the specifications directly. Rather, a Box-Cox transformation may be employed to scale the variances, putting the sum of squared errors in the same units (Rao and Miller, 1971).[45] Employing the transformation yields a sum of squared residuals (SSR) of 1,758 for the log-level model, compared to a SSR of 11,012 for the level-level. The difference in the SSR between the log-level and the level-level model is significant at the 1 percent level, indicating that the specifications with the log license prices is more appropriate.

In addition to the basic regression, three other sets of regressions are run as robustness checks. In the first case, regressions are run on subsets of the data to look for differential effects. Second, the basic regression is run employing two other functional forms—specifically, level-level and log-log.[46] Although the fundamental estimated relationship between variables is different, significance should remain more or less the same across the different functional forms. Finally, a set of results are produced employing quota-area and year fixed effects, which is expected to condition out much of the identifying variation.

The inclusion of fixed effects for year (but not quota-area) might also be interesting. The variables for year could capture macroeconomics trends, without conditioning out the cross-sectional variation of interest. The baseline results, however, do not change in year fixed effects are included. In addition, the year dummy variables are

[45]The transformation consists of scaling the dependent variable. If the comparison consists of log and level dependent variables, the scaling factor is simply the inverse of the geometric mean. The results are then compiled with the scaled left-hand side variable, for both specifications.

[46]Another potential specification is level-log. The results are similar, but somewhat less intuitive. Additionally, it unequivocally provides the worst fit of all the different specifications. It is omitted for the sake of brevity.

not individually or jointly significant.[47] Thus, time fixed effects are not included in the baseline results.

All standard errors are calculated clustering at the quota area level. Clustering by quota area allows for a flexible dependency structure spatially and temporally, as opposed to clustering by area-time which does not account for potential autocorrelation. There are a relatively small number of transactions per quota area per year—during transaction negotiation, historical values are almost certainly used in determining current-period price. Additionally, license prices within a quota area are far more likely to be correlated (over time and space) than at a higher geographic level (i.e., by county). Thus, clustering at the quota area level seems to be the most appropriate methodology.

[47]For the initial specification omitting any variables for supply, the p-value for a Wald test of joint significance is 0.53; for the specifications including percentage of quota and licenses issued, the p-values are 0.60 and 0.16, respectively.

Table 1: Number of Omitted Observations, by Type

	All-Beverage			Beer Retail		RBW	Total
	All-Bev.	Floater	Resort	Beer	Beer & Wine		
Total	684	22	12	21	190	145	1074
Omitted:							
New Issuance	30	0	2	0	18	55	105
Location Transfer	6	1	0	1	5	5	18
Death of Licensee	3	0	0	0	4	0	7
Low Price	35	0	0	0	9	2	46
Inconsistent	3	1	0	0	1	1	6
Net	**607**	**18**	**10**	**20**	**153**	**82**	**892**

Note: New issuances, transfers of location, and deaths do not involve market prices. Similarly, transactions with extremely low prices (e.g., $1.00 for an asset worth six-figures) do not reflect market conditions. Thus, these transactions are not included in the analysis. Finally, transactions that are inconsistent across the different data sets are omitted.

Table 2: Number of Usable Observations, by County and Year

County	2005	2006	2007	2008	2009	2010	2011	2012	Total
Beaverhead	2	0	1	1	1	2	4	2	13
Big Horn	1	1	0	2	0	1	1	0	6
Blaine	1	1	1	0	0	1	0	0	4
Broadwater	1	3	1	0	0	1	0	1	7
Carbon	3	3	3	2	3	1	4	1	20
Carter	0	0	0	0	0	0	0	0	0
Cascade	12	12	3	6	2	3	1	2	41
Chouteau	1	4	0	1	0	0	0	0	6
Custer	3	2	0	2	3	0	2	0	12
Daniels	1	1	0	2	0	0	0	1	5
Dawson	1	2	1	2	0	0	2	0	8
Deer Lodge	1	4	2	2	2	0	1	0	12
Fallon	1	1	1	0	0	1	0	0	4
Fergus	2	5	0	1	2	2	4	1	17
Flathead	17	24	8	7	4	9	7	3	79
Gallatin	13	13	13	10	12	11	10	10	92
Garfield	0	0	0	1	0	0	0	0	1
Glacier	3	2	0	1	0	2	0	0	8
Golden Valley	0	0	0	0	0	0	0	0	0
Granite	1	2	0	1	0	1	1	0	6
Hill	2	2	1	2	0	3	1	1	12
Jefferson	3	4	3	1	1	0	1	1	14
Judith Basin	1	0	4	0	0	0	0	2	7
Lake	6	4	3	1	2	0	1	0	17
Lewis & Clark	8	4	3	1	3	3	4	2	28
Liberty	0	1	0	0	0	0	0	0	1
Lincoln	1	5	2	1	0	3	3	2	17
Madison	4	7	1	1	4	2	2	5	26
McCone	1	1	0	0	1	0	1	1	5
Meagher	1	2	0	1	0	1	1	1	7
Mineral	1	2	0	0	0	0	0	0	3
Missoula	7	6	8	2	5	14	5	13	60
Musselshell	1	0	1	0	1	0	0	0	3
Park	2	4	8	2	3	1	6	1	27
Petroleum	0	0	0	0	0	0	0	0	0
Phillips	2	0	1	4	1	3	0	0	11
Pondera	0	1	1	0	0	0	1	0	3
Powder River	0	0	2	0	1	0	0	0	3
Powell	2	1	1	2	0	1	1	1	9
Prairie	0	0	0	0	0	0	0	0	0
Ravalli	6	10	3	2	1	6	5	1	34
Richland	1	2	1	0	0	1	3	3	11
Roosevelt	0	2	0	2	2	0	1	2	9
Rosebud	0	0	1	1	0	1	2	0	5
Sanders	3	1	3	1	0	2	0	2	12
Sheridan	1	0	0	0	1	1	0	2	5
Silver Bow	10	16	10	7	9	4	4	1	61
Stillwater	2	1	1	0	1	1	0	2	8
Sweet Grass	0	1	0	0	1	0	2	0	4
Teton	3	1	0	3	1	0	1	2	11
Toole	3	1	1	0	1	1	0	1	8
Treasure	1	0	0	0	1	0	0	0	2
Valley	4	4	2	1	2	2	2	2	19
Wheatland	0	1	0	0	0	1	0	0	2
Wibaux	0	0	0	0	0	1	0	0	1
Yellowstone	20	21	17	6	13	6	16	7	106
Total	**160**	**185**	**112**	**82**	**84**	**93**	**100**	**76**	**892**

Note: Carter, Golden Valley, Petroleum, and Prairie counties do not observe any transactions for 2005-2012.

Table 3: Average All-Beverage License Price (Nominal), By City and Year

	2005		2006		2007		2008		2009		2010		2011		2012	
City	Price	*n*	Price	*n*	Price	*n*	Price	*n*	Price	*n*	Price	*n*	Price	*n*	Price	*n*
Billings	417,222	9	501,722	9	677,333	9	866,667	3	698,333	6	800,000	1	404,500	3	318,500	2
Missoula	512,500	2	623,333	3	679,167	6		0	750,000	1	694,167	6	798,333	3	630,000	5
Great Falls	392,000	5	336,667	6	360,000	3	437,500	2	400,000	1	375,000	1	425,000	1	312,500	2
Bozeman*	500,000	1	611,250	2	850,000	1	875,000	2	318,750	2	25,500	2	425,267	3	600,000	1
Butte*	30,500	5	35,714	7	60,625	8	66,400	5	67,750	8	50,000	2	40,000	2	45,000	1
Helena*	350,000	1		0	412,500	2	485,000	1	566,667	3	400,000	1	650,000	1	575,000	1
Kalispell	425,000	3	625,000	3	200,000	2		0		0	625,000	1	399,500	2		0
Havre	138,133	1		0	110,000	1	120,000	1		0	20,000	1	75,000	1		0
Anaconda*	15,000	1	22,500	2	31,250	2	10,000	1	42,000	2		0		0		0
Miles City	66,667	3	65,000	2		0	172,500	2	140,000	1		0	150,000	1		0
Belgrade*	500,000	1	600,000	2												
Livingston	55,000	2	60,000	2	100,000	3	130,000	1	97,500	2	100,000	1	125,000	1	58,000	1
Laurel	30,000	1	295,000	2	475,000	2		0	365,000	1		0		0		0
Whitefish*	306,667	3	260,000	2	650,000	1	297,500	2	320,000	1	450,000	1	400,000	1	300,000	1
Lewistown		0	85,000	2		0	200,000	1	70,000	1	100,000	1	150,000	1		0
Montana	**131,180**	**102**	**179,893**	**89**	**235,110**	**80**	**154,061**	**60**	**198,864**	**49**	**162,856**	**52**	**188,761**	**47**	**180,159**	**38**

*Belgrade and Bozeman merged quota areas in 2006. Similarly, Butte and Silver Bow County, Helena and East Helena, Anaconda and Deer Lodge County, and Whitefish and Columbia Falls are each joint quota areas, with the numbers reported as such.

Table 4: Household Median Income (Nominal), by County

County	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Yellowstone	41,171	43,407	47,947	49,337	47,139	48,059	47,346	49,405
Missoula	41,283	38,880	42,598	43,260	40,130	44,084	42,082	44,320
Flathead	39,917	44,413	45,122	44,013	45,594	42,278	44,006	45,742
Gallatin	45,312	46,928	50,511	53,042	47,065	49,354	50,042	51,394
Cascade	37,877	39,146	41,999	42,528	40,434	41,827	42,525	42,192
Lewis & Clark	45,299	44,382	46,647	49,959	52,317	50,889	52,510	54,096
Ravalli	36,914	39,872	42,450	43,613	40,444	39,409	39,421	38,445
Silver Bow	33,414	34,739	40,053	38,439	40,055	37,851	39,586	39,835
Lake	35,751	34,668	34,732	38,505	35,888	35,558	37,135	33,021
Lincoln	30,407	32,956	33,680	33,383	32,676	33,908	33,656	34,764
Hill	35,868	37,349	39,155	40,341	40,778	39,678	42,014	41,194
Park	35,761	36,630	40,173	39,847	39,525	37,835	42,332,	40,399
Glacier	30,285	29,954	36,054	36,149	29,941	32,460	33,766	34,508
Big Horn	30,680	31,705	33,004	37,798	32,223	34,507	34,778	36,322
Fergus	34,251	35,922	37,259	39,561	37,402	37,669	38,912	40,114
Montana	**38,503**	**40,299**	**43,000**	**43,948**	**42,222**	**42,303**	**44,011**	**45,030**

Source: U.S. Census Bureau Small Area Income and Poverty Estimates.

Table 5: Unemployment, by County

County	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Yellowstone	2.9	2.7	2.6	3.4	4.4	5.2	4.9	4.4
Missoula	3.3	3.0	3.3	4.4	5.6	6.7	6.3	5.9
Flathead	4.1	3.6	3.8	6.0	10.4	11.0	10.2	9.0
Gallatin	2.6	2.3	2.5	3.7	6.1	6.5	5.9	5.3
Cascade	3.6	3.1	3.3	4.1	4.8	5.6	5.8	5.4
Lewis & Clark	3.3	3.0	2.9	3.7	4.4	5.1	5.1	4.9
Ravalli	4.4	3.9	4.3	5.8	8.1	9.0	8.8	8.0
Silver Bow	3.8	3.5	3.5	4.3	5.5	5.8	6.0	5.8
Lake	4.9	4.5	5.3	6.7	8.2	9.4	9.8	8.9
Lincoln	3.9	2.9	2.8	3.7	3.8	5.5	4.9	5.3
Hill	3.8	3.6	3.9	4.5	4.8	5.1	5.6	5.5
Park	3.5	3.1	3.4	4.7	7.0	7.5	7.2	6.4
Glacier	6.6	6.3	7.7	8.2	8.2	9.4	11.2	10.2
Big Horn	7.7	6.4	6.4	7.4	8.4	10.8	12.0	12.8
Fergus	4.4	3.9	3.8	4.2	4.8	5.9	5.7	5.3
Montana	**3.9**	**3.3**	**3.4**	**4.6**	**6.3**	**6.9**	**6.6**	**6.0**

Source: U.S. Bureau of Labor Statistics Local Area Unemployment Statistics.
Note: units are percentage points.

Table 6: Annual Population Growth Rate, by City

County	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Billings	1.6	1.3	1.3	1.9	1.5	1.2	1.0	1.4
Missoula	1.5	2.2	1.8	1.7	1.0	0.9	0.8	1.3
Great Falls	-0.2	0.0	0.2	0.6	0.3	1.3	0.4	-0.1
Bozeman	4.2	4.7	3.2	2.8	0.5	0.6	2.1	1.6
Butte	0.0	0.1	0.1	1.0	0.6	0.7	0.4	0.1
Helena	0.2	1.1	1.3	1.3	1.0	1.2	1.4	1.5
Kalispell	3.4	3.8	3.7	3.1	1.5	0.7	1.5	1.1
Havre	-0.4	0.7	0.3	-0.9	0.6	2.4	1.6	0.1
Anaconda	0.0	-1.0	0.9	0.9	-1.0	0.5	-0.7	-0.2
Miles City	-0.9	-0.4	0.6	0.1	1.0	0.3	1.0	1.0
Belgrade	3.8	4.2	2.9	2.4	-0.1	0.2	1.4	.8
Livingston	0.7	0.3	0.8	0.4	-1.1	-1.0	-0.4	0.8
Laurel	0.8	0.7	0.7	1.3	0.9	0.8	1.3	1.6
Whitefish	1.3	1.7	1.7	1.1	-0.4	-0.8	0.5	1.2
Lewistown	-1.7	-0.3	-1.2	-1.0	0.2	-0.3	-0.6	-0.4
Montana	**1.1**	**1.3**	**1.3**	**1.2**	**0.8**	**0.7**	**0.7**	**0.7**

Source: U.S. Census Bureau City and Town Intercensal Estimates.
Note: units are percentage points.

Table 7: University Enrollment, by City/County

City/County	2005	2006	2007	2008	2009	2010	2011	2012
Missoula	13,569	13,925	13,628	14,207	14,921	15,642	16,669	14,946
Bozeman	12,143	12,052	11,932	11,976	12,348	13,081	13,671	14,379
Billings	4,828	4,596	4,651	4,259	4,513	4,788	6,316	6,168
Great Falls	2,653	2,676	2,790	2,944	3,300	2,707	2,949	2,839
Helena	2,376	2,233	2,446	2,589	2,842	2,973	3,145	3,090
Butte	2,234	2,357	2,347	2,402	2,694	2,864	2,803	2,816
Kalispell	2,094	1,878	1,911	1,899	2,501	2,539	2,495	2,395
Havre	1,347	1,359	1,215	1,217	1,275	1,304	1,273	1,282
Dillon	1,159	1,176	1,148	1,190	1,255	1,365	1,379	1,483
Lake Co.	1,142	1,092	1,040	993	1,204	1,158	1,112	906
Miles City	491	464	506	511	502	486	491	441
Browning	485	467	471	492	533	473	464	407
Glendive	549	466	446	414	441	560	443	312
Poplar	408	441	422	436	437	452	513	438
Rosebud Co.	554	359	437	443	472	433	374	361
Chouteau Co.	344	397	305	236	303	332	410	501
Big Horn Co.	259	312	272	337	415	410	366	325
Harlem	175	161	244	168	236	214	169	221

Source: National Center for Education Statistics Integrated Postsecondary Education Data System.

Table 8: Hotel Tax Revenue (Nominal), by County

County	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Yellowstone	1,825,915	2,050,573	2,361,740	2,419,192	2,356,489	2,481,541	2,841,937	3,101,854
Missoula	1,736,689	1,978,422	2,175,701	2,250,799	2,085,784	2,156,742	2,285,656	2,426,703
Flathead	1,700,598	1,880,401	2,125,504	2,186,500	1,928,873	2,204,580	2,341,672	2,722,194
Gallatin	3,401,413	3,693,597	4,249,929	4,200,722	3,689,634	4,079,062	4,399,477	4,878,447
Cascade	858,289	954,573	1,081,631	1,186,769	1,151,200	1,240,594	1,375,864	1,476,244
Lewis & Clark	707,756	773,436	855,148	862,092	842,786	857,801	966,884	990,194
Ravalli	195,404	210,040	224,676	220,614	196,619	214,173	227,716	245,852
Silver Bow	609,213	666,349	756,162	754,608	731,236	758,855	771,095	816,917
Lake	122,877	130,132	133,473	125,186	110,531	120,065	126,319	144,569
Lincoln	97,661	112,193	118,459	120,081	108,767	104,466	103,418	116,623
Hill	147,557	157,316	178,098	196,039	192,458	221,242	230,762	242,315
Park	669,431	741,764	840,488	903,613	873,911	968,324	980,788	1,065,924
Glacier	543,197	515,891	573,240	617,197	619,189	684,955	611,055	622,505
Big Horn	115,264	125,523	138,913	135,192	134,101	139,548	143,274	145,881
Fergus	101,001	107,088	122,021	132,254	92,255	124,447	134,450	136,668

Source: Montana Department of Revenue.

Table 9: Video Gambling Tax Revenue (Nominal), by City

City	2005	2006	2007	2008	2009	2010	2011	2012
Billings	8,762,899	9,415,570	10,311,552	10,687,566	10,437,471	8,939,597	8,692,498	9,523,601
Missoula	4,522,858	4,685,431	5,141,335	5,420,935	5,313,798	4,391,756	3,903,609	4,157,666
Great Falls	5,175,359	5,354,594	5,208,916	5,661,521	5,553,418	4,771,039	4,415,471	4,638,398
Bozeman	1,690,899	1,880,179	2,062,417	2,266,621	2,097,763	1,703,421	1,620,240	1,739,160
Butte	3,170,705	3,167,198	3,481,967	3,708,166	3,622,405	3,232,022	2,887,081	3,016,603
Helena	2,730,244	2,935,392	3,260,744	3,546,891	3,367,438	2,975,186	2,807,969	2,965,696
Kalispell	2,087,198	2,295,036	2,521,407	2,608,050	2,493,439	2,177,727	2,286,599	2,454,372
Havre	1,069,912	1,122,986	1,293,018	1,202,021	1,260,274	1,064,721	929,246	965,979
Anaconda	698,228	678,290	700,387	797,421	789,230	689,032	632,130	667,236
Miles City	839,355	890,574	962,328	1,044,526	1,019,339	821,917	879,947	955,716
Belgrade	698,510	883,345	1,107,409	996,549	1,004,376	758,206	690,152	717,911
Livingston	656,007	693,169	670,640	701,648	684,229	557,800	486,323	509,939
Laurel	545,011	567,641	643,172	802,365	842,942	723,644	677,132	759,994
Whitefish	1,167,686	1,248,703	1,322,163	1,355,821	1,280,244	1,039,082	1,073,842	1,082,249
Lewistown	490,005	556,717	589,153	615,439	613,812	499,807	483,817	519,984

Source: Montana Department of Justice.

Table 10: All-Beverage License Quota and Licenses Issued

	2005		2006		2007		2008		2009		2010		2011		2012	
City	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued
Billings	67	91	67	92	68	93	70	95	72	97	73	98	72	98	73	97
Missoula	44	70	44	70	45	70	47	71	48	72	48	72	47	73	47	73
Great Falls	40	79	41	80	41	81	42	83	42	84	42	84	42	84	42	84
Bozeman**	24	33	29	41	30	41	33	43	34	45	34	46	33	48	33	48
Butte*	25	86	25	85	25	85	24	85	24	87	24	87	25	87	25	86
Helena*	22	42	21	42	22	42	23	42	23	42	24	42	23	42	23	42
Kalispell	14	25	14	26	15	28	16	30	17	30	17	30	16	30	16	30
Havre	9	18	9	18	9	18	9	18	9	20	9	20	9	21	9	21
Anaconda*	9	35	9	34	9	33	8	33	8	32	8	30	9	30	9	30
Miles City	8	20	8	20	8	20	8	20	8	21	8	21	8	21	8	21
Belgrade**	7	8														
Livingston	7	20	7	20	7	20	7	20	7	21	7	21	7	21	7	21
Laurel	7	10	7	10	7	10	7	10	7	10	7	10	7	10	7	10
Whitefish*	9	23	10	23	10	23	11	24	12	24	12	24	10	24	10	24
Lewistown	7	11	7	11	7	11	6	11	6	15	6	15	6	15	6	15

*The numbers include other towns within ten miles; the five mile buffers overlap, resulting in joint determination of quota.
**Bozeman and Belgrade merged quota areas in 2006.

Table 11: Beer and Wine License Quota and Licenses Issued

	2005		2006		2007		2008		2009		2010		2011		2012	
City	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued
Billings	52	52	52	52	53	53	54	54	55	54	56	54	56	54	56	54
Missoula	34	34	35	34	35	35	37	36	38	37	38	38	37	38	37	38
Great Falls	32	33	32	33	33	33	33	33	33	33	33	33	33	33	33	33
Bozeman**	20	19	24	26	24	26	27	26	27	26	27	27	26	27	26	27
Butte*	20	31	20	31	20	31	20	31	20	31	20	29	21	29	21	28
Helena*	18	19	18	19	18	19	19	19	19	19	20	19	19	20	19	20
Kalispell	12	13	12	13	13	13	14	13	14	14	14	14	13	14	14	14
Havre	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9
Anaconda*	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9
Miles City	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Belgrade**	7	7														
Livingston	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Laurel	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Whitefish*	9	14	9	14	9	14	10	14	10	14	10	14	9	14	9	14
Lewistown	7	7	7	7	7	7	6	7	6	7	6	7	6	7	6	7

*The numbers include other towns within ten miles; the five mile buffers overlap, resulting in joint determination of quota.
**Bozeman and Belgrade merged quota areas in 2006.

Table 12: Restaurant Beer and Wine License Quota and Licenses Issued

	2005		2006		2007		2008		2009		2010		2011		2012	
City	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued	Quota	Issued
Billings	21	19	21	19	42	25	43	30	44	33	45	35	45	41	45	43
Missoula	14	17	14	17	28	21	30	25	30	28	30	29	30	29	30	30
Great Falls	16	10	16	10	32	11	33	12	33	13	33	14	33	14	33	14
Bozeman**	10	11	12	13	24	15	27	18	27	26	27	27	26	27	26	27
Butte*	10	1	10	1	20	2	20	2	20	1	20	3	21	3	21	3
Helena*	9	10	9	10	18	13	19	16	19	17	20	18	19	19	19	19
Kalispell	10	10	21	12	14	14	14	14	14	14	14	14	21	14	14	17
Havre	6	0	6	0	13	1	13	1	13	1	13	1	13	1	13	1
Anaconda*	6	0	6	0	13	0	13	0	13	0	13	0	13	0	13	0
Miles City	6	0	6	0	13	0	13	0	13	0	13	0	13	1	13	1
Belgrade**	6	2														
Livingston	6	0	6	0	11	2	11	3	11	4	11	4	11	4	11	3
Laurel	6	0	6	0	11	0	11	0	11	0	11	0	11	0	11	0
Whitefish*	9	10	9	10	18	13	20	16	20	18	20	20	18	20	18	20
Lewistown	6	3	6	3	11	3	10	3	10	2	10	3	10	5	10	5

*The numbers include other towns within ten miles; the five mile buffers overlap, resulting in joint determination of quota.
**Bozeman and Belgrade merged quota areas in 2006.

Figure 4: Distribution of License Prices (2005 Dollars)

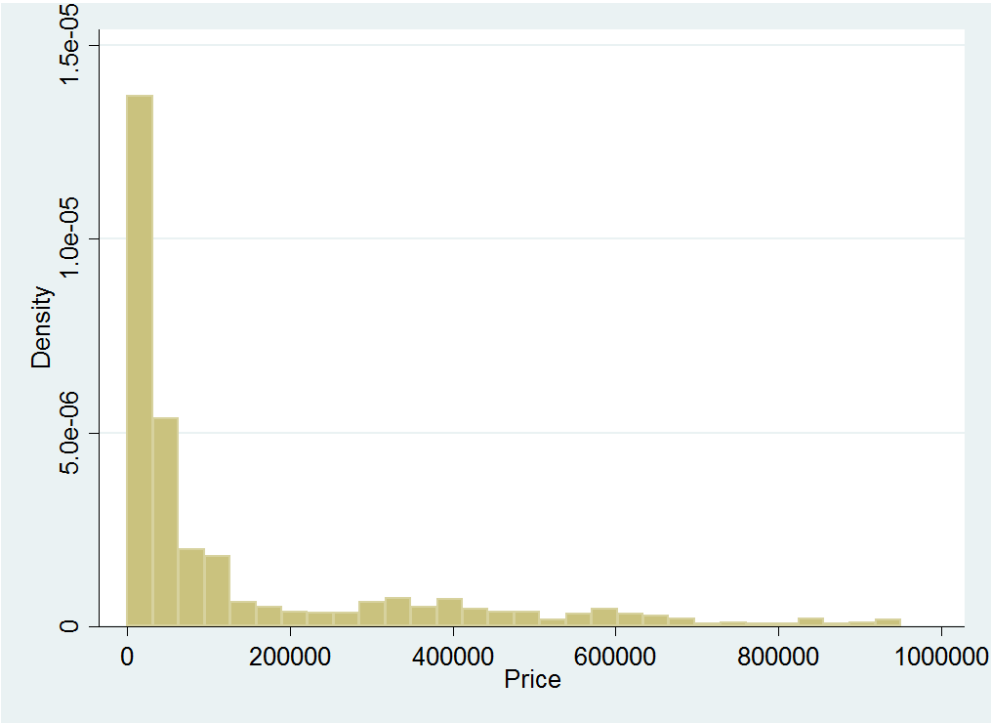


Figure 5: Distribution of Log License Prices (2005 Dollars)

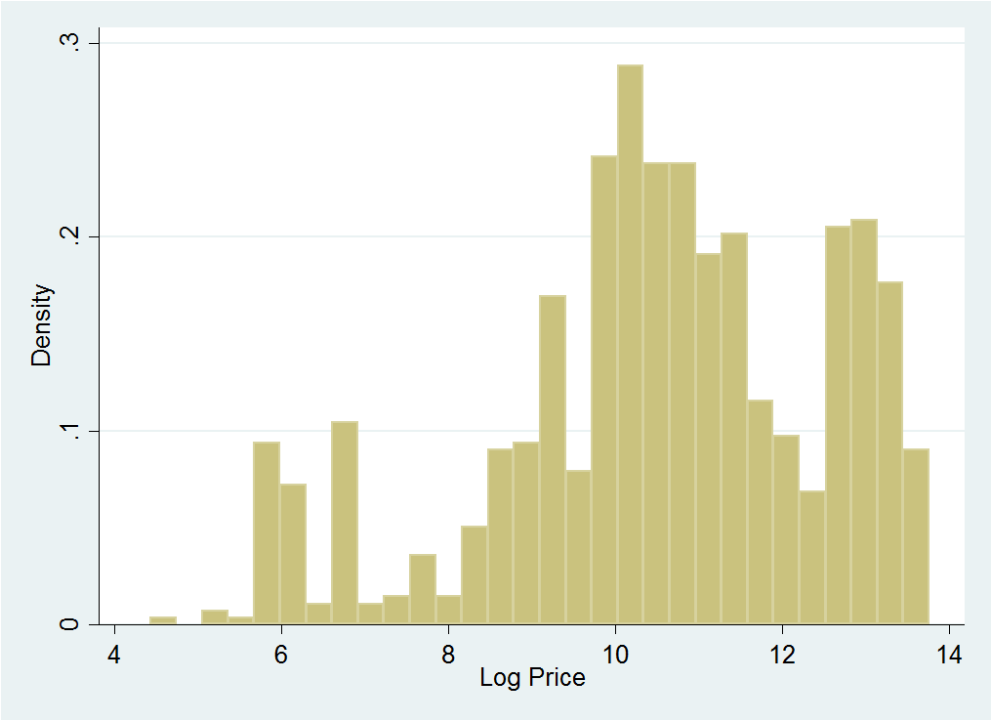


Table 13: Means and Standard Deviations, by Year

Year	Log Price	Gamb. Rev.	Hotel Rev.	Population	% 20-44	% Female	Enrollment	Med. Inc.	Unemp.
2005	10.44	13961	13683	27576	30.66	49.79	1954	37975	3.67
	(2.09)	(18626)	(14321)	(31101)	(5.18)	(1.57)	(3480)	(4842)	(0.94)
2006	10.32	13387	13863	27664	29.76	49.81	1819	37941	3.40
	(2.12)	(17920)	(14835)	(30226)	(5.04)	(1.26)	(3463)	(4944)	(0.91)
2007	10.87	16051	18231	30028	30.61	49.62	2256	40104	3.41
	(2.04)	(20946)	(18094)	(33025)	(6.05)	(1.47)	(3874)	(5559)	(1.01)
2008	10.58	11011	14990	21488	29.61	49.46	1568	38340	4.71
	(1.84)	(16561)	(17763)	(27055)	(6.12)	(1.98)	(3206)	(5699)	(1.41)
2009	10.66	17658	17109	32751	30.20	49.62	3023	38511	5.56
	(1.87)	(21116)	(16799)	(34976)	(6.38)	(1.22)	(4520)	(4758)	(1.50)
2010	10.85	11774	17435	28956	30.42	49.49	4164	37699	7.27
	(1.76)	(13714)	(17428)	(29771)	(6.57)	(1.53)	(6141)	(5036)	(2.61)
2011	10.30	12095	17281	29665	29.44	49.67	2593	38303	6.47
	(1.90)	(16911)	(18225)	(35670)	(5.69)	(1.46)	(4323)	(4622)	(2.42)
2012	10.53	12595	19588	31087	30.79	49.17	4534	38524	5.82
	(1.95)	(16226)	(20864)	(35174)	(7.07)	(1.70)	(6204)	(5347)	(2.22)
Total	**10.54**	**13628**	**16032**	**28507**	**30.18**	**49.63**	**2551**	**38374**	**4.73**
	(1.99)	**(18065)**	**(16940)**	**(31973)**	**(5.85)**	**(1.51)**	**(4411)**	**(5103)**	**(2.14)**

Note: Standard Deviations are reported in parentheses below the variable mean. Gambling and Hotel revenue are reported in thousands.

Table 14: Means and Standard Deviations, by City

Year	**Log Price**	**Gamb. Rev.**	**Hotel Rev.**	**Population**	**% 20-44**	**% Female**	**Enrollment**	**Med. Inc.**	**Unemp.**
Billings	12.15	58967	30863	101286	32.51	51.16	5012	42534	3.58
	(1.61)	(4816)	(3609)	(3346)	(0.37)	(0.08)	(700)	(1347)	(0.97)
Missoula	12.43	27472	28038	66130	38.96	49.75	14763	38770	5.23
	(1.29)	(3404)	(1458)	(2117)	(0.24)	(0.07)	(817)	(1438)	(1.48)
Great Falls	12.38	33185	13888	57665	32.20	50.21	2755	37899	3.78
	(1.28)	(2691)	(1759)	(524)	(0.46)	(0.13)	(151)	(752)	(0.83)
Bozeman	11.85	15945	52493	42788	41.86	48.09	12715	44923	4.51
	(1.32)	(2964)	(3632)	(4081)	(0.66)	(0.12)	(832)	(1573)	(1.73)
Butte	10.37	20853	9457	33699	30.03	49.76	2460	34872	4.29
	(0.80)	(1451)	(458)	(334)	(0.30)	(0.24)	(207)	(1546)	(0.96)
Helena	12.32	22150	11230	29812	30.14	50.67	2738	45429	4.09
	(1.16)	(2017)	(697)	(914)	(0.52)	(0.04)	(343)	(1409)	(0.93)
Kalispell	11.97	14328	26948	18885	29.80	50.11	2150	40366	6.22
	(1.90)	(921)	(2425)	(1088)	(0.71)	(0.04)	(264)	(1737)	(3.04)
Havre	10.57	6726	2538	9357	30.73	49.64	1294	36050	4.54
	(1.89)	(876)	(355)	(186)	(0.37)	(0.18)	(53)	(508)	(0.80)
Anaconda	9.84	4482	438	9249	26.74	47.59	0	30730	5.47
	(0.87)	(322)	(23)	(61)	(0.22)	(0.33)	(0)	(1016)	(1.07)
Miles City	10.62	5806	3172	8335	28.02	50.44	493	35059	3.72
	(1.68)	(424)	(584)	(87)	(0.53)	(0.17)	(15)	(1309)	(0.51)
Total	**10.54**	**13628**	**16032**	**28507**	**30.18**	**49.63**	**2551**	**38374**	**4.73**
	(1.99)	**(18065)**	**(16940)**	**(31973)**	**(5.85)**	**(1.51)**	**(4411)**	**(5103)**	**(2.14)**

Note: Standard deviations are reported in parentheses below the variable mean. Gambling and Hotel revenue are reported in thousands. Hotel revenue, percent ages 20-44, percent female, household median income, and unemployment are county-level figures.

RESULTS

Baseline Specifications

The initial specification employs a pooled-OLS model with a log-level functional form, including all usable observations.[48] The baseline results are reported in table 15.[49] Column 1 does not include any variable relating to the supply of licenses. Column 2 reports estimates using percentage of all-beverage quota and indicator variables for binding beer and wine and RBW quotas. Column 3 explicitly includes the number of licenses issued. For the ease of interpretation, the regression measures gambling revenue and hotel revenue in millions of dollars. Along the same lines, population, enrollment, and household median income are measured in thousands.

In the first column, the specification provides evidence that gambling revenue, hotel revenue (used as a proxy for tourism), college enrollment, and income are statistically an economically significant positive determinants of license price. The coefficient on gambling revenue, for example, indicates a 15 percent increase in license price for million-dollar increase in gambling revenue. Similarly, the the estimated effect of income is a 5.6 percent increase in license prices for an additional $1,000 in median income, while enrollment pushes up prices by 23 percent for an additional 1,000 students. The coefficient on enrollment, however, is not entirely plausible—more than half of

[48]The dummies for potential clerical errors are omitted throughout the section. The results across specifications are robust to the inclusion of the variables, and are robust to the exclusion of the flagged observations.

[49]Historic market conditions might be expected to influence license prices, particularly if adaptive expectations are assumed. Including lagged independent variables, however, does not qualitatively change the analysis. Several estimates are somewhat peculiar, however, with current and past period coefficients being equal in magnitude but opposite in sign.

typical students are not legally permitted to consume alcohol. Thus, the effect is probably overstated. Hotel revenue is less significant, both in statistical and economic terms. For an additional million dollars of hotel revenue, license prices would only be expected to increase by 1.6 percent. This result, moreover, is more sensitive to specification than the other coefficients.

Several results are somewhat unexpected. First, unemployment is positive and significant. While there are no ex ante expectations for the sign of unemployment, the magnitude and significance of the coefficient are peculiar. The coefficient is not particularly plausible—a 12 percent increase in license prices for a 1 percentage-point increase in unemployment seems quite large. Concern over the estimate should be tempered, however, for two reasons. First, the effect of unemployment is more sensitive to functional form than the other variables.[50] Second, it appears that the variation driving the result may be from outliers. For 2009-2012, prices in Flathead County tend to be in the six-figure range, even though unemployment spikes to double-digit levels. Similarly, several of the counties with the lowest unemployment rates tend to have the lowest prices.[51] Running the regression without these observations decreases the coefficient estimate to 0.09, while significance decreases to the 10 percent level. Although the estimated effect remains high, the 95-percent confidence interval includes more plausible magnitudes for short-run effects.[52]

[50]The variable is still significant in a level-level model, but significance largely disappears with a log-log functional form. Similarly, none of the fixed-effect specifications attribute a significant effect to unemployment.

[51]These include Chouteau, Fallon, McCone, Richland, Stillwater, Sweet Grass, and Toole counties. These counties account for 15 observations, while Flathead accounts for 79.

[52]In the long run, an increase in unemployment should produce a negative effect as incomes decrease.

Second, the coefficient on the percentage of the population that is female is positive and significant at the 10 percent level. Again, there is no prediction regarding the sign. The result is not as statistically strong as the others and is moderately sensitive to specification. As is the case with unemployment, the identifying variation appears to be concentrated in a small area. Billings has the highest female population in the state (by number and percentage), along with the highest license values. Running the regression without Billings results in percent female becoming insignificant (the other variables remain significant).

Finally, the fact that population is estimated to have a negative effect is rather perplexing. Holding other demand factors constant, the effect of increasing population should be small. More people who gamble less (on average) should have a smaller impact on price than an increase in population without controlling for other factors. Holding percentage of quota constant, moreover, might be expected to cause population to have a negative effect. In Column 2, the number of licenses implicitly increases with population, holding gambling, tourism, and enrollment constant.[53] Holding the number of licenses constant, however, should at least attenuate this result.[54] The quotas are set via population, however, so the estimates may suffer from endogeneity bias with respect to license supply.

Of additional interest are the coefficients assigned to the license type and transaction type indicator variables.[55] As expected, the results indicate that all-beverage

[53] An increase in population, with a corresponding increase in licenses but less gambling/tourism/students on average, would mean less gambling revenue and fewer tourist/students spread out over a larger number of licensees.

[54] The results is not sensitive to functional form. Including a squared population term, or specifying population in logarithmic terms does not change the the qualitative result.

[55] All-beverage and transfer of ownership and location are the omitted variables.

licenses trade at a large premium over each of the the other license types. Although floater licenses allow the same privileges as all-beverage licenses (except for gambling on floaters issued after 2007), the results indicate that they are sold for 70 percent less on average.[56] The prices on floaters, however, tend to reflect the market conditions from the license seller's area, not the buyer's. The state issues floaters one at a time, allocating them via lottery. Whoever wins the lottery goes to a lower-price market to purchase a license. The buyer acts as a monopsonist, purchasing a license near the seller's market price.

The disparity between all-beverage and the other two license types (beer and wine retail and RBW licenses), on the other hand, reflects the differences in the privileges associated with each license type. Beer retail licensees may offer the same services as all-beverage licensees, with the notable exception of selling liquor. The discount for beer and wine licenses is estimated at 52 percent, on average. RBW licensees may not sell for off-premises consumption, nor may they offer gambling under any circumstances. Additionally, the more stringent constraints (e.g., the revenue requirement for food sales) on RBW licenses should push prices down even further. The results provide evidence to this effect, estimating that RBW licenses sell for 90 percent less than all-beverage licenses.

Given that state law allows gambling exclusively in establishments licensed to sell alcohol, gambling revenue appears to affect the price of licenses in the expected manner. Licenses that preclude gambling should sell for lower values. The coefficient on gaming restrictions measures the relative difference in price between licenses with and without gambling attached.[57] The estimate (-0.897) is negative and both economically and

[56]Employing the transformation described above: $100 \cdot (\exp\{-1.196\} - 1) = -69.76$

[57]The dummy variable only takes on a value of 1 for all-beverage, floater, and beer and wine retail licenses.

statistically significant, predicting a 63 percent discount for gaming restricted licenses. A point of caution, however, is that the variation driving the estimate comes almost exclusively from beer and wine retail licenses.[58]

More intriguing is the coefficient for transfers of ownership (TRF-O). Ex ante, the prices associated with the transfers of ownership (but not location) are expected to be lower. It may be easier to obtain a larger loan if hard assets (i.e., land and a physical structure) are acquired with a license. As a result, there may be an incentive to (marginally) adjust how much value is assigned to a license versus a building. Similarly, a transaction may involve a lower price if an establishment and a licenses are purchased simultaneously. The estimated effect is negative and significant, supporting the predication that licenses attached to a location trade at lower values—the magnitude of the discount is slightly less than 30 percent. Not all transfers of ownership involve the sale of a building, however. Thus, the estimate should serve as a lower bound on the estimated effect of purchasing a license with physical property.

The sign on the coefficients for the other two transaction types(corporate structure change and the missing transaction type) are negative, as expected. The estimated discount for CSCs, moreover, is significant at the 10 percent level. The significance is somewhat surprising, given the high variation in price for CSCs (a CSC may range from a partial buy-out to a full transaction).

Columns 2 and 3 add controls for percentage of quota and number of licenses

Restaurant licenses may not offer gambling under any circumstances. Thu, they are not flagged as "gaming restricted'.

[58]Of the observations flagged as gaming restricted, 18 are beer and wine licenses, 9 are floaters, and 1 is an all-beverage license.

issued, respectively. The results for the variables in the first column are fairly robust to the inclusion of either set of controls for the supply of licenses. The qualitative interpretations of the effects are quite similar, with the exception of losing significance on the coefficient for hotel revenue. The coefficients on the continuous variables, however, tend to decrease by around one standard error. The results for the license and transaction type variables are qualitatively identical.

The similarity in the qualitative results indicates that there is probably is not enough evidence to reject the idea that simultaneity bias is limited with respect to the variables other than population. Treating license supply as exogenous (with respect to everything but population) is consistent with the institutional details of the Montana licensing system. This is particularly true for the supply of all-beverage licenses, at least within any given year. For the other license types, exogeneity is somewhat less likely to hold, as beer and wine licenses are not always limited by a quota. Although simultaneity bias is not necessarily expected ex ante, it is still possible that the specification could suffer from bias if the supply of licenses is endogenous with respect to the other variables.

The variables for license supply are also significant, which increases concerns over potential bias in the coefficient estimates. That said, only the RBW supply variables are significant across both Column 2 and Column 3. Percentage of the all-beverage quota and and percentage squared are significant in Column 2, but all-beverage licenses issued is not significant in Column 3. Similarly, the supply variables for beer and wine is not significant across both. Given that significance is sensitive to whether supply is specified in relative or absolute terms, the results should not be overly concerning.

Subsamples

As robustness checks, similar regression specifications may be run on subsets of the data to test for differential effects. The baseline specifications include data from all of the quota areas that recorded usable transactions. There are reasons to believe, however, that the identifying variation is coming from a subset of the data. To evaluate that idea, regressions are run on a restricted sample and on all-beverage licenses only.

To restrict the sample, several criteria are used. First, the specifications drop additional low-priced transactions. The logic for doing so is consistent with that outlined above. While not as extreme as $1.00 sales, a price of $10,000 in a market that routinely assigns six-figure values to licenses raises concerns about the nature of such transactions. Relative to a more typical, higher-priced sale, the low price probably reflects unobserved factors in the transaction. Thus, the specifications drop observations listing a license price more than two standard deviations below the quota-area/transaction type mean (taken over time).

Similarly, the specification only includes transactions from areas at or above their all-beverage quotas.[59] If the license quota is non-binding in an area, the expected price should be quite close to zero. This is frequently borne out in the data, with prices in many non-binding areas mirroring the annual licensing fee.[60] If a quota area employs fewer licenses than permitted by law, marginal changes in demand factors should have little to

[59]For the purposes of the regression, "at or above" included areas above 100 percent of quota.

[60]The license fees tend to be $400-$650, depending on population and license type. For a full listing of license fees, see M.C.A. 16-4-501.

no impact on license price.

A caveat to the non-binding quotas is the licenses attached to businesses near incorporated areas. As communities expand, so too does the five-mile buffer around city limits. If a license is absorbed into the quota area, it potentially gains a great deal of value. As such, the value of an unincorporated license in Gallatin or Missoula County near Bozeman or Missoula, respectively, may be influenced by the market conditions of the nearby quota areas. A similar price effect may persist, even well beyond the five-mile buffer. Tourist locations near a major city, for example, may be well outside the buffer, but still push up license prices.[61]

Finally, the specifications include only transfers of ownership and transfers of ownership and location (omitting corporate structure changes and observations missing transaction type). Focusing on full sales may provide better estimates, as the effects of market forces may be muted on the other transaction types. If the prices of many CSCs reflect the values associated with different-sized partial financial interests, the estimated effects may not be as clean. Unfortunately, observations missing the transaction type are also omitted, as there is no way to identify if they are full sales or not.[62]

Table 16 reports the results from employing the restricted data set, following the same pattern as the results reported above. Column 1 omits any control for license supply, while Columns 2 and 3 include quota percentages and licenses issued, respectively. Overall, the regressions include 595 data points, slightly more than two-thirds of the data.

[61]The highest license price observed in a non-binding quota area was from a 2006 sale in Missoula County at the Lolo Hot Springs near Missoula. The license sold for $400,000.

[62]There are 66 CSCs in the data, and 70 missing transaction types.

The results are relatively consistent qualitatively with the specifications including all usable observations, with a slightly improved fit.

The results in Column 1 identify the same significant effects as the baseline specifications, although the magnitudes are somewhat attenuated. Particularly, the estimated effects of gambling revenue, population, and enrollment are almost twice as large in table 15 than in table 16. Although marginal changes in each variable might be expected to have a larger effect on the restricted sample, many of the observations from smaller areas are dropped. Thus, there is a less cross-sectional variation driving the results.

In contrast, the magnitude of the estimates on the indicator for license types remain very consistent when the data set is restricted. The coefficients for floaters and and beer and wine licenses increase slightly, while the estimated discount for beer and wine licenses decreases slightly. The coefficient for restricted gaming licenses does not change systematically compared to the original estimates. In each case, the changes are all within a single standard error of the original estimates.

Table 16 only includes transfers of ownership and transfers of ownership and location, dropping CSCs and observations missing the transaction type. Thus, the only transaction variable included in the regression is that for transfers of ownership relative to sales including a change in location. The estimated discount decreases to roughly 23 percent, although the coefficient is statistically identical to the baseline estimate.

Columns 2 and 3 add controls for quota percentages and licenses issued, respectively. As before, the estimated effects are relatively robust to including controls for license supply. The differences between the columns are smaller in table 16 than in the

baseline regressions. Unlike the previous results, however, hotel revenue is only significant when percentage of quota is controlled for (although the point estimate is relatively constant). In addition, the results for population and unemployment are less robust. Again, this is probably due to the reduction in cross-sectional variation from omitting observations. The rest of the coefficients, however, are within roughly one standard error of each other across all three columns within table 16.

Overall, it appears that much of the variation driving the results comes from the non-low price, full transfer transactions in binding quota areas. The qualitative results are quite similar to the specifications including more observations, but with slightly decreased magnitudes in several cases. These results are possibly better estimates of marginal effects, as the restrictions on the data limit the sample to relatively similar areas, reducing variation due to large differences across areas. While there is still a great deal of identifying variation in the remaining observations, it is clear that some important variation is still lost.

The second subsample of the data consists of all-beverage licenses exclusively. In the baseline results presented in table 15, the coefficients of each explanatory variable is restricted to having the same estimated value across all-beverage, beer and wine, and RBW licenses. Optimally, the data would be expansive enough to run a fully interacted model and test to see if the estimated effects are constant across each license type. Similarly, separate regressions for each license type could be run to the same effect.

All-beverage licenses trade far more frequently than the other license types, making up almost 70 percent of the observations. Unfortunately, the remaining

observations for the other license types are relatively sparse.[63] Consequently, a fully interacted model (or separate regressions exclusively on beer retail or RBW licenses) is not a viable option. The large number of all-beverage transactions, however, make an all-beverage exclusive specification feasible. Table 17 reports the results from dropping non-all-beverage transactions.

The columns follow the same pattern as above, beginning with no supply variables and reporting the alternative specifications in the the next two columns. The estimated effects look virtually identical to the baseline results in terms of both significance and magnitude. The only exceptions are the loss of significance of hotel revenue in Column 1 and an increase in significance for percent female in Column 2. Similarly, the results are robust to the inclusion of the different variables for license supply, even more so than the baseline results.

The robustness of the results to excluding non-all-beverage licenses provides evidence that the effects are consistent across the different license types. This result is unsurprising, as the vast majority of the data are comprised of all-beverage transactions—the chance of finding differential effects is relatively small. A point of interest is that the controls for beer and wine and RBW license supply are exogenous to the all-beverage license market. The similarity in results between tables 15 and 17 supports that endogeneity bias is limited in the baseline specification.

Results are not produced combining the restrictions for the two different

[63]There are 173 Beer/Wine transactions and 82 RBW transactions. Running a regression on observations other than all-beverage licenses produces similar results for gambling, population, enrollment, and transfers of ownership, losing significance for each of the other variables. In addition, hotel revenue is significant on right-tail test.

subsamples. If the data are restricted to full sales of all-beverage licenses in binding quota areas, the sample size dwindles to just over 300. In addition to the small sample size (which would only employ a little over a third of the usable data), both restrictions leave relatively little cross-sectional variation. As such, there is very little to be gained by narrowing the focus of the analysis any further.

Alternative Functional Forms

As an additional check for robustness, the model is specified across two alternative functional forms: level-level and log-log. In addition to changing the interpretations of the coefficients, specifying a model using different functional forms fundamentally changes what the estimated relationships look like. If the results are robust across the different functional forms, it provides additional evidence supporting the qualitative predictions of the baseline model.

Table 18 reports the results produced using a level-level specification. Both the dependent variable (license prices) and the independent variables are specified in level. The estimated coefficients, then, represent the slope of the linear relationships between the variables. The scale of several variables also differs in the level-level regressions, for ease of interpretation. Rather than millions, gambling and hotel revenues are measured in thousands. Population, enrollment, and household median income are all scaled back to the original reported values.

Column 1 reports results that are qualitatively similar to the baseline output in table 15. Again, gambling revenue, hotel revenue, enrollment, and income are all identified as

significant positive determinants of license price. The quantitative interpretations, however, are different. The estimated effects of an additional $1,000 in gambling and hotel revenue are an increase in license values of $10.86 and $2.42, respectively. Enrollment is also a major factor, with an estimated effect of around $20.00 for an additional student. Similarly, for an additional dollar of income, the estimated effect is an increase license prices by $7.72. While the interpretation of coefficients differ, the relative magnitudes of the coefficients are also consistent across with the log-level models. Converting the log-level estimates to dollar values at the mean license price, hotel revenue and income are not statistically different between the two functional forms. The magnitude of gambling revenue, however, is significantly smaller in the level-level model.[64]

Again, population, percent female, and unemployment are significant, with slightly odd signs and magnitudes. The results are qualitatively similar to the baseline, with percent female and unemployment being more sensitive to specification than the other variables. In addition, the indicator variables for license and transaction type are negative and consistent, also in line with the results in table 15. The magnitudes are also easier to interpret.

All-beverage floaters trade at roughly $200,000 less than typical all-beverage licenses. As mentioned above, floater prices reflect market conditions in the license seller's area, and tend to float to growing, high-priced markets. The estimated discount for beer and wine licenses is around $55,000, while for RBW licenses the the average difference in value compared to an all-beverage license is almost $300,000. Finally, the

[64]In the log-level model, the 15 percent increase in license prices for a $1 million dollar increase in gambling revenue translates into a $30 level change at the mean.

premium for gambling is just short of the anecdotal prediction of $250,000.[65] These estimates are quite large compared to the average price of an all-beverage license (around $160,000 in the data set). Transactions involving floaters and RBW licenses, however, tend to be observed in the higher-priced markets, which have an average all-beverage price of around $450,000.[66]

The transaction type variables differ slightly in terms of significance. Compared to the baseline results, table 18 reports that corporate structure changes are negative and more statistically significant. While the signs match between the results, the significance level is noticeably increased in the level-level specification. Conversely, transfers of ownership decrease in significance. In Column 1, the coefficient on the indicator variable is only significant at the 10 percent level on a left-tail test.[67] The estimated discount is slightly greater than $20,000.

Columns 2 and 3, which control for the supply of licenses, report very similar results. The largest discrepancies between the specifications in table 18 are the loss of significance in hotel revenue and simultaneous increase in significance of percent female in Column 3. Similarly, while the variables for percentage of quota are insignificant in Column 2, licenses issued for beer and wine and RBW licenses are highly significant in Column 3. In light of the regression output in table 15, however, these results are quite sensitive to specification, lending additional support that the supply of licenses is not

[65] According to Neil Peterson of the Gaming Industry Association of Montana, licenses with gambling rights are worth around a quarter-million dollars more than a license without.

[66] The markets considered here are Billings, Missoula, Great Falls, Bozeman, Helena, Kalispell, and Whitefish.

[67] It is appropriate to consider a left-tail test, as there is an ex ante prediction that the coefficient should be less than zero.

endogeneous with respect to the other variables (excepting population).

The second alternative functional form is log-log: the dependent variable is the natural log of price, and several of the right-hand side variables are also specified in log terms.[68] In this case, the coefficients represent estimated elasticities, rather than linear slopes. To interpret the coefficients on indicator variables, the same transformation used in the log-level specification is required.

Table 19 presents the output from the log-log regressions. As is the case with the level-level specifications, the log-log results in Column 1 are qualitatively similar to the baseline output. The largest differences are the relative increase in magnitude of the effect of hotel revenue, and the loss of significance on the coefficients for percent female and unemployment. In contrast to the results in table 15, which had the effects of gambling and hotel revenue differing by an order of magnitude, table 19 has them much closer. Holding all else constant, a 1 percent increase in gambling or hotel revenue produces an increase of 0.25 or 0.14 percent, respectively.

The estimated discounts for the different license and transaction types should all have the same interpretations as the baseline. The overall results for the dummy variables, while qualitatively similar, differ slightly in both magnitude and significance. The estimated coefficients in table 19, Column 1, decrease in magnitude for floater and beer and wine licenses by less than a standard error. The estimated discount for RBW licenses also is closer to zero, but the difference is slightly greater. The largest difference between the log-level and log-log models is the result for restricted gaming. Although the point

[68] Variables specified in percentage terms (e.g., unemployment) are left in levels. Similarly, licenses issued are not specified in log terms.

estimate is within a standard error of the baseline result, significance decrease to the 10 percent level on a left-tail test. Conversely, the significance and magnitudes increase for both CSCs and transfers of ownership.

Of the three functional forms, the log-log specifications are the least robust to the inclusion of supply variables. Particularly, the estimated effects of gambling revenue, population, enrollment, and income all vary significantly across Columns 1-3 in table 19. For example, the estimated effect of a 1 percent increase in gambling revenue ranges 0.11 to 0.25, almost two standard errors difference. Population and enrollment show similar sensitivity. More concerning is the lack of significance of income in Column 3. While the first two columns report more than a 2 percent increase in license prices for a 1 percent increase in income, including licenses issued causes the coefficient to lose all significance.

Given the sensitivity of the other variables to the inclusion of supply variables, it is unsurprising that much of the explanatory power in the the log-log model is assigned to the controls for license supply. Every supply variable is significant in table 19, with the exception of RBW licenses issued (the only significant licenses issued variable in the baseline specifications). Although the point estimates vary across the specifications in table 19, the qualitative results are still very similar to those from the baseline regressions.

Fixed Effects

A third set of robustness checks consists of adding fixed effects to the regressions, across each functional form. While the baseline regressions provide a descriptive analysis, including fixed effects may help isolate causality in the right-hand side variables.

Including quota-area fixed effects conditions out systematic, time-invariant cross-sectional variation (e.g., different drinking cultures or proximity to a tourist location). Similarly, adding year fixed effects accounts for any variation caused by state-wide systematic changes that are invariant across quota areas (e.g., the smoking ban that went into effect in 2009). Thus, the identifying variation is that which is exogenous to both the time invariant differences between quota areas and the quota-area invariant differences across time. Optimally, the remaining variation in the right-hand side variables will explain marginal changes in the dependent variable, giving a better idea of the causal relationships between variables.

As described above, including both sets of fixed effects conditions out a great deal of variation. Particularly, in the context of alcohol retail license prices, their inclusion drastically reduces the cross-sectional variation. Table 14 shows that the within-quota-area standard deviations are quite small relative to the data set as a whole. Including quota-area fixed effects leaves only that variation within the quota areas, which in turn is reduced by year fixed effects. As a result, there is very little identifying variation left to drive results—many coefficients are expected to be highly attenuated.

Table 20 reports the results from the log-level specifications with fixed effects, including all usable observations. As expected, the regressions do not identify significant effects for many of the covariates. Of the continuous variables, the coefficient on population is the only one that remains statistically significant. Interestingly, the point estimates in Columns 1 and 2 are not statistically different from the baseline results. Hotel revenue nears significance on a right-tail test, with increased economic significance,

though the effect still remains questionable. For a million-dollar increase in hotel revenue, license prices would only increase by 4 percent.[69]

While many of the continuous demand factors have no measurable effect, the license type indicator variables are extremely robust to the inclusion of fixed effects. Again, the estimated average discount of an all-beverage floater license relative to a typical all-beverage license is just over 70 percent. Similarly, the estimated discount for beer and wine retail licenses is 55 percent, while RBW licenses trade at a 92 percent discount. Finally, the estimated effect of restricting gaming rights is a decrease in license price of 66 percent. Each result is qualitatively the same as in the baseline results reported in table 15.

Similarly, the estimated discount for transfers of ownership is consistently negative and significant. The fixed effect estimates are noticeably smaller than the results in table 15, although the coefficients differ at most by only slightly more than a standard error. The estimates in table 20 are still economically significant, putting the average discount for transfers of ownership (compared to transfers of ownership and location) at just over 18 percent.

The estimated effects are almost identical across the three columns, with the exception of the coefficient on population in Column 3. Although adding licenses issued has little to no effect on most of the variables, it causes the estimated coefficient on population to decrease dramatically. In Column 3, the estimated impact of increasing population by 1,000 is a 20 percent decrease in license price.[70] The coefficient on the

[69]Restricting the observations to higher-priced, full-sale transactions in binding quota areas, hotel revenue becomes significant on a right-tail test, but the estimated effect declines.

[70]Again, licenses issued should be endogenous with respect to population, but not with the other variables.

number of beer and wine retail licenses issued also indicates a positive effect on license prices. The estimated effect of an additional beer and wine license is an 11 percent increase in license prices. Although the result is identical to that found in table 19, it is not robust across the different specifications (indeed, table 18 reported a negative, highly significant effect).

Table 21 reports results for the level-level specification with fixed effects. Several differences between the results in table 21 and those from the baseline regressions are immediately apparent. First, hotel revenue is consistently positive and significant, both statistically and economically. For a $1,000 increase in hotel revenue, the estimated effect is an increase of over $9.00 in license prices. On the other hand, the other continuous variables lose significance, with the exception of gambling revenue and income. In addition, population, enrollment, and unemployment change signs. Losing significance in several variables is expected, as a great deal of identifying variation is lost with the inclusion of fixed effects. Nonetheless, it is odd that the effects, for enrollment in particular, change so drastically.

As is the case in for the log-level fixed effect results, several estimated effects are very robust. Gambling revenue and household median income retain a high degree of significance in table 21, with very consistent point estimates. Even more so than gambling and income, the indicator variables for license type and transfer of ownership are robust to adding fixed effects. The estimated discount for floaters remains just under $200,000; for beer and wine licenses it stands at $55,000; for RBW licenses, the coefficient decreases slightly, to -$300,000. Similarly, restricting gambling is estimated to push license prices

down by around $230,000, while transfers of ownership have a $20,000 average discount. These results are qualitatively the same as the baseline results, and statistically identical to those for the level-level results in table 18.

Finally, table 22 reports the results from the log-log fixed effect specifications. The results are consistent across all three columns, in contrast to the results in table 19. As in the log-level fixed effect specifications, gambling and hotel revenue have no measurable impact on license prices.[71] Similarly, population has a negative estimated effect that is both statistically and economically significant. For a 1 percent increase in population, each specification estimates a decrease in license prices by 2.3 - 3.9 percent. As in the log-level models, the result is consistent with the baseline specifications.

The biggest difference between the log-log and the other fixed effect specifications' results is the effect of enrollment. Neither of the other two models attributed a measurable effect to the number of students in a quota area. In contrast, table 22 reports a positive coefficient with a high degree of statistical significance. For a 1 percent increase in university enrollment, license prices are estimated to increase by just over 0.2 percent. This result, however, is consistent with the estimated effect in the baseline regressions.

The indicator variables for license type and transaction type have the same interpretation as the log-level model. The qualitative and quantitative results remain the same, as expected (log price is still the dependent variable). Each license type coefficient is negative and significant at the 1 percent level, with the point estimates remaining virtually identical to the log-level fixed effect results. Similarly, the results for transaction

[71] Additionally, hotel revenue does not approach significance.

type remain unchanged, with transfers of ownership having the only significant effect. As is the case for the log-level fixed effect results, the estimated discounts for the different license and transaction types in table 22 are not statistically different from the baseline results.

With fixed effects included in the specifications, the results differ (particularly in terms of significance) from the pooled OLS models. Similarly, the fixed effects results differ substantially across the different functional forms. The probable cause of the differences is that many of the explanatory variables do not differ much from the quota-area fixed effects. In other words, there is more cross-sectional variation than within-area variation. Thus, the inclusion of locational fixed effects leaves very little residual variation to drive the results; the inclusion of time fixed effects eliminates even more. Consequently, the various functional forms only pick up the effect of one or two variables, given the limited identifying variation. Interestingly, the significant results in each of the fixed effects regressions are consistent with the baseline, but none of the fixed effect specifications pick up all of the effects simultaneously.

Thus, while the inclusion of fixed effects reduces the potential omitted variable bias from unobserved heterogeneity, it also excludes enough variation to preclude identifying any consistent effects. The relatively short length of the data set (8 years) exacerbates the issue. Assuming that license prices factor in all future expected earnings, year-to-year fluctuations in demand factors should not have large effects on license values. This year-to-year variation is most of what is left to drive the results if quota-area fixed effects are included. Given a longer time frame, the changes within quota area would

provide more information. With the relatively small number of years, however, it is difficult to separate noise from long-term changes in demand factors.

Another confounding factor is that the markets are thinly traded (e.g., Bozeman records roughly 2 full sales of all-beverage licenses each year). If licenses traded more frequently, de-meaning the data with fixed effects might be the preferred methodology. Marginal changes in the right-hand side variables would be more likely to cause marginal changes in license prices. Given the relative sparseness of transactions in each year, however, it is unlikely that license prices are very responsive to small changes in gambling, tourism, enrollment, etc. Thus, looking at the large-scale differences across areas may offer more information than examining smaller changes within quota areas.

Additional Robustness Checks

Although the log-level specification statistically outperforms the other functional forms, there may still be value in additional checks as to which specification provides the best fit for the data. A simple visual inspection of the fitted (predicted) values compared to several independent variables provides an intuitive, straightforward test for fit.[72]

To produce the fitted values, the regressions are run omitting the independent variable of interest. Fitted values are then extracted from the regression and plotted against the omitted variable. Thus, the fitted values are different in each of the plots. If the relationship looks systematic, the omitted variable probably contains important information in predicting license prices. The plots provided are for three of the

[72]The fitted values refers to the predicted license prices: $\hat{\mathbf{Y}} = \hat{\boldsymbol{\beta}}\mathbf{X}$. The vector $\mathbf{X}$ omits the independent variable in question.

explanatory variables: gambling revenue, household median income, hotel revenue. The first two are robust across the different specifications, while hotel revenue is more sensitive to specification.

Figure 6 plots the relationship between fitted prices and gambling revenue for the baseline log-level model (i.e., all usable data with no fixed effects). Figure 7 does the same for a level-level specification, while figure 8 looks at a log-log functional form. Visually, the relationship appears stronger for the log-level and level-level specifications than for the log-log. The largest difference between figures 6 and 7 is the spread of the data points around the linear fitted line. It slightly higher for the moderate values of gambling revenue in figure 6, but lower towards the right tail. Otherwise, the two are hard to distinguish between. The correlation between gambling revenue and the fitted values is highest, however, in the level-level model (though only marginally).[73]

For household median income, figures 9-11 display the plots for fitted values against household median income. Compared to the gambling revenue, there does not appear to be a strong relationship in any of the specifications. That said, unlike gambling revenue, which varies at the quota level, income only varies at the county level. Still, the lack of a strong visual trend is somewhat surprising, as the estimated coefficient on income was also quite robust different specifications. Again, the level-level result (in figure 10) has the highest correlation, but the plot may raise concerns over heteroscedasticity.[74]

Figures 11-13 repeat the plots, looking at hotel revenue versus the relevant fitted

[73]For gambling revenue, the correlation for the log-level is 0.55; for the level-level model it is 0.57; for the log-log it is 0.51.

[74]For income, the correlation for the log-level is 0.21; for the level-level model it is 0.33; for the log-log it is 0.24.

prices. The relationships in figure 12 and 13 look slightly less systematic than the analogous plots for gambling revenue. That said, like income, hotel revenue varies at the county level—slightly less predictive power is expected. The log-log model, on the other hand, produces a marginally more systematic-looking relationship between the predicted prices and hotel revenue than it did for gambling. Again, the correlation is highest for the level-level model.[75]

The results comparing the fitted values are a little peculiar, given that the Box-Cox transformation and comparison of sum of squared residuals supported the log-linear model as the best fit. Given the plots, the log-level and level-level models look comparable, although the simple correlations may support the level-level model. That said, the variation is reduced with the logged prices, as the distribution is more tightly clustered. It may be that the relative outliers in the level prices bias the correlations sufficiently to produce the results above. In any case, examining the fitted values does not strongly support any of the functional forms over another.

An additional concern is how to properly cluster the errors in each of the models. Given that the errors are sure to be correlated within space and across time, the errors should be clustered at a geographic level (as opposed clustering by location/time, which would only allow dependencies within a location-year). Figures 15 and 16 plot the predicted residuals from the first baseline log-level specification (Column 1—no supply variables), by quota area and county, respectively.[76] The error terms are predicted

[75]For hotel revenue, the correlation for the log-level is 0.34; for the level-level model it is 0.48; for the log-log it is 0.44.

[76]The plots of the residuals from the level-level and log-log specificiations show similar patterns. The plots from the level-level specifications are more pronounced, as logging license prices reduces the variation in the

post-regression, then plotted against one of the independent variables.[77]

It is clear that the variance in the error terms vary drastically across space. From the plots, it looks as if clustering at either level is appropriate. Figure 16 shows clearer discrepancies, but there are approximately one-third as many counties as quota areas in the usable data. In both cases, however, there are clusters that include single (or very few) observations. To avoid small clusters, an alternative clustering methodology is also employed. For deeper markets, quota areas serve as the cluster level. For the other areas, clustering is done at a multi-county level, separated by binding and non-binding areas. A table illustrating the alternative clusters is presented in the Appendix E.

In terms of results, none of the methodologies consistently produced wider confidence intervals around the coefficients than the others. Given that the markets are typically limited to quota area, however, the quota-area clusters are employed in the analysis. For comparison's sake, figure 17 illustrates the errors by year (as opposed to geography). While they do not appear to be strictly uniform across time, the variance of the errors looks far more consistent when partitioned by year as opposed to location.

While clustering the errors mitigates some of the concerns over heteroscedasticity, it is still probably valuable to visually examine the residuals for several other independent variables. If the data appear to display a large degree of heteroscedasticity, alternative estimation methods might need to be considered (e.g., a GLS model). Figures 18-20 plot the residuals from the same specification for gambling revenue, income, and hotel

errors.

[77]The errors are the observed values of Y minus the fitted values: $\boldsymbol{\varepsilon} = \mathbf{Y} - \mathbf{X}\hat{\boldsymbol{\beta}}$. In this case, the vector $\mathbf{X}$ contains all the independent variables in the regression.

revenue, respectively.

For gambling revenue in figure 18, the errors also appear to narrow moving to the right. The pattern raises concerns about heteroscedasticity, as the variance in the errors may be systematic. The highest values of gambling revenue, however, are all from a single city. Billings has by far the most gambling revenue, making up the entire right hand side of the graph. While the errors still may have a lower variance moving to the right, omitting Billings from the plot alleviates some of the concern. This is the only variable that shows this type of relationship, however, lending support to the idea that clustering errors is a sufficient methodology to account for the variance structure.

For income and hotel revenue (figures 19 and 20), the error terms do not seem to be particularly systematic with respect to either variable. The errors for income in figure 19, particularly, look to be quite random. While there are large gaps in the values of gambling and hotel revenue, the variance of the residuals looks more or less constant throughout. Like gambling revenue, the cluster of errors in the right tail are driven by a single location. In this case, the highest hotel revenue is observed in Gallatin County. That said, the variance in the errors does not look sufficiently systematic to raise concerns.

Another potential issue is bias in the estimates from endogeneity in the supply of licenses. The overall results, however, do not support the idea that license supply is endogenous to the right-hand side variables. This is particularly true when fixed effects are included—there do not appear to be any large changes to license supply in any quota area (outside of the expansion of RBW license quotas in 2007). To directly test to see whether or not the supply of licenses is exogenous with respect to the right-hand side

variables, regressions may be run using licenses issued and percentage of quota as the dependent variables.

Given the the quota system is arranged, population is expected be the only statistically and economically significant variable in predicting supply. If the other major covariates from the license price regressions do not effectively predict license supply, it supports the idea that supply in the market is exogenous to those variables. If that is the case, the model should not suffer from the simultaneity bias common in models trying to predict price.

Table 23 shows the results from the regressions using the number of licenses issued as the dependent variable. The data used in the regression come from the quota and licenses issued reports, not from the data used to estimate the price effects in tables 15-22.[78] Thus, the data employed in table 23 span all quota areas in the state.

Column 1 reports the results for all-beverage licenses, Column 2 reports the results for beer and wine licenses, and Column 3 does the same for restaurant beer and wine licenses. The regressions include the major explanatory variables used above, along with an indicator variable for unincorporated areas (which have no beer/wine or RBW quota). Column 3 uses fewer observations, as RBW licenses are only issued in incorporated areas.

For all-beverage licenses, the results in Column 1 indicate that population is the best predictor of the license supply. The coefficients on gambling revenue and unemployment are also significant, however. The coefficient on gambling revenue is small—for an additional $1,000 of revenue, the predicted increase in licenses is only

[78]The data used to produce the main results would weight the dependent variable heavily towards Billings, Missoula, and the other deeper markets.

0.0009. Given the all-beverage quotas are non-binding in many unincorporated areas, gambling revenue probably influences the number of licenses issued in those locations. More troubling is the coefficient on unemployment. The estimated effect is both statistically and economically significant. While the coefficient indicates a 5 percent increase in unemployment is necessary to increase licenses issued by 1, unemployment in Montana varies from 1.6 to 15 percent across counties and time. Thus, it is quite possible that the estimated effects of unemployment in the baseline results are biased.

The results for beer and wine and RBW licenses are more peculiar. Gambling revenue is significant in Column 2, and follows the same logic as above (a caveat is that there are no quotas for beer and wine licenses in unincorporated areas). The fact that population has the wrong sign, along with the significance of over half of the covariates, indicates that the supply of beer and wine licenses may not be exogenous. The same is true of RBW licenses, in Column 3. There may be reason to believe, however, that the number of licenses issued for both types should not be strictly exogenous. First, there are no quotas for beer and wine licenses in unincorporated areas. Second, RBW license quotas are non-binding in many quota areas. Thus, the number of licenses issued for both may depend on factors other than population. Because the majority of the data is comprised of all-beverage licenses, bias from endogenous beer and wine and RBW licenses is probably limited.

Table 24 reports the same regressions, but includes quota-area fixed effects. The coefficients on population (measured in thousands) increase across each regression, and are all significant at the 1 percent level. With the exception of enrollment in Column 3, the

remaining statistically significant results are not economically significant. The estimated effect of enrollment, however, supports that perhaps the number of RBW licenses in an area is not exogenous. The variation driving the RBW results is mainly from post-2007. The quotas for RBW licenses doubled in 2007, but the number of licenses adjusted relatively slowly to the increase. Overall, in contrast with table 23, these results provide more evidence that the supply of licenses within a quota area are exogenous. Given the extreme R-squared values, however, the regressions in table 24 are almost certainly over-specified.

Table 15: Determinants of License Price (Log-Level)

VARIABLES	(1) Log Price	(2) Log Price	(3) Log Price
Gambling Revenue	0.151***	0.114***	0.116***
	(0.0132)	(0.0146)	(0.0211)
Hotel Revenue	0.0161*	0.00945	0.00371
	(0.00968)	(0.00769)	(0.00805)
Population	-0.0815***	-0.0554***	-0.0790***
	(0.00742)	(0.00968)	(0.00895)
% 20-44	-0.0130	-0.0121	0.0192
	(0.0284)	(0.0272)	(0.0262)
% Female	0.0573*	0.0393	0.0491*
	(0.0309)	(0.0267)	(0.0291)
Enrollment	0.228***	0.185***	0.142***
	(0.0249)	(0.0228)	(0.0227)
Household Median Income	0.0557**	0.0556**	0.0470**
	(0.0215)	(0.0220)	(0.0209)
Unemployment	0.116***	0.0958***	0.0649**
	(0.0336)	(0.0270)	(0.0290)
All-Beveverage Floater	-1.196***	-1.023**	-1.296***
	(0.377)	(0.407)	(0.335)
Beer and Wine	-0.743***	-0.851***	-0.762***
	(0.252)	(0.260)	(0.235)
Restaurant Beer and Wine	-2.314***	-2.475***	-2.500***
	(0.268)	(0.318)	(0.308)
Corporate Structure Change	-0.353	-0.316	-0.408*
	(0.264)	(0.259)	(0.233)
Missing Transaction Type	-0.128	-0.120	-0.153
	(0.261)	(0.235)	(0.250)
Transfer of Ownership	-0.341**	-0.273**	-0.322***
	(0.135)	(0.114)	(0.121)
Gaming Restricted	-0.897***	-0.861***	-1.126***
	(0.294)	(0.321)	(0.346)
% All-Beverage Quota		1.283***	
		(0.476)	
% All-Beverage Quota Squared		-0.261**	
		(0.120)	
100% Beer and Wine Quota		0.277	
		(0.188)	
100% RBW Quota		0.468**	
		(0.200)	
All-Beverage Licenses Issued			0.00214
			(0.00944)
Beer and Wine Licenses Issued			0.0109
			(0.0240)
RBW Licenses Issued			0.0624***
			(0.0179)
Observations	892	892	892
R-squared	0.499	0.528	0.518

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the percentage change in license price for a level change in covariates. Gambling and hotel revenue are measured in millions. Population, enrollment, and income are measured in thousands. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Table 16: Determinants of License Price (Log-Level, Restricted Observations)

	(1)	(2)	(3)
VARIABLES	Log Price	Log Price	Log Price
Gambling Revenue	0.0834***	0.0624**	0.0958***
	(0.0296)	(0.0288)	(0.0260)
Hotel Revenue	0.0175	0.0179*	0.00910
	(0.0145)	(0.0100)	(0.0104)
Population	-0.0406**	-0.0235	-0.0585***
	(0.0186)	(0.0179)	(0.0214)
% 20-44	0.0156	-0.00619	0.0356
	(0.0440)	(0.0352)	(0.0391)
% Female	0.0835**	0.0362	0.0749**
	(0.0351)	(0.0277)	(0.0337)
Enrollment	0.124***	0.103***	0.107***
	(0.0452)	(0.0389)	(0.0370)
Household Median Income	0.0700**	0.0656**	0.0551*
	(0.0335)	(0.0325)	(0.0325)
Unemployment	0.0945**	0.0825***	0.0631
	(0.0411)	(0.0309)	(0.0393)
All-Beverage Floater	-1.537***	-1.355***	-1.567***
	(0.379)	(0.411)	(0.380)
Beer and Wine	-0.883***	-0.946***	-0.869***
	(0.261)	(0.267)	(0.260)
Restaurant Beer and Wine	-2.279***	-2.412***	-2.409***
	(0.281)	(0.343)	(0.316)
Transfer of Ownership	-0.265**	-0.217**	-0.258**
	(0.122)	(0.102)	(0.112)
Gaming Restricted	-0.953***	-0.920**	-1.067***
	(0.353)	(0.377)	(0.363)
% All-Beverage Quota		1.297**	
		(0.606)	
% All-Beverage Quota Squared		-0.265*	
		(0.138)	
100% Beer and Wine Quota		0.386**	
		(0.188)	
100% RBW Quota		0.440*	
		(0.245)	
All-Beverage Licenses Issued			-0.00127
			(0.0171)
Beer and Wine Licenses Issued			0.00644
			(0.0586)
RBW Licenses Issued			0.0410*
			(0.0223)
Observations	595	595	595
R-squared	0.502	0.537	0.512

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the percentage change in license price for a level change in covariates. Gambling and hotel revenue are measured in millions. Population, enrollment, and income are measured in thousands. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Table 17: Determinants of License Price (Log-Level, All-Beverage Only)

VARIABLES	(1) Log Price	(2) Log Price	(3) Log Price
Gambling Revenue	0.152***	0.105***	0.128***
	(0.0116)	(0.0125)	(0.0224)
Hotel Revenue	0.00502	0.000599	-0.00481
	(0.0116)	(0.0101)	(0.0106)
Population	-0.0824***	-0.0531***	-0.0852***
	(0.00590)	(0.00865)	(0.00904)
% 20-44	0.0168	0.00882	0.0382
	(0.0312)	(0.0298)	(0.0292)
% Female	0.0990**	0.0851**	0.0912*
	(0.0466)	(0.0382)	(0.0461)
Enrollment	0.216***	0.174***	0.134***
	(0.0352)	(0.0302)	(0.0323)
Household Median Income	0.0503**	0.0505**	0.0379*
	(0.0226)	(0.0247)	(0.0222)
Unemployment	0.121***	0.100***	0.0751**
	(0.0369)	(0.0311)	(0.0305)
Corporate Structure Change	-0.586*	-0.532	-0.586*
	(0.324)	(0.324)	(0.312)
Missing Transaction Type	-0.218	-0.208	-0.298
	(0.276)	(0.255)	(0.282)
Transfer of Ownership	-0.357**	-0.278**	-0.359**
	(0.153)	(0.135)	(0.156)
% All-Beverage Quota		1.514***	
		(0.459)	
% A-Beverage Quota Squared.		-0.311***	
		(0.114)	
100% Beer and Wine Quota		0.381*	
		(0.197)	
100% RBW Quota		0.198	
		(0.206)	
All-Beverage Licenses Issued			0.0111
			(0.00966)
Beer and Wine Licenses Issued			-0.0130
			(0.0265)
RBW Licenses Issued			0.0736***
			(0.0220)
Observations	618	618	618
R-squared	0.501	0.531	0.516

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the percentage change in license price for a level change in covariates. Gambling and hotel revenue are measured in millions. Population, enrollment, and income are measured in thousands. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Table 18: Determinants of License Price (Level-Level)

VARIABLES	(1) Price	(2) Price	(3) Price
Gambling Revenue	10.86***	9.710***	15.89***
	(1.340)	(1.054)	(2.357)
Hotel Revenue	2.421**	1.910**	0.820
	(1.179)	(0.788)	(0.792)
Population	-4.409***	-3.435***	-5.460***
	(0.728)	(0.624)	(1.214)
% 20-44	-4,012	-3,434	1,544
	(3,122)	(2,386)	(1,953)
% Female	5,492	2,958	4,774*
	(4,174)	(3,003)	(2,793)
Enrollment	21.48***	18.39***	19.48***
	(4.224)	(3.997)	(3.698)
Household Median Income.	7.722***	6.232***	4.311***
	(2.504)	(2.042)	(1.346)
Unemployment	9,049***	6,962***	3,738*
	(2,745)	(2,568)	(1,983)
All-Beverage Floater	-192,473***	-190,992***	-204,565***
	(41,606)	(41,961)	(38,293)
Beer and Wine	-56,455***	-60,842***	-48,987***
	(17,305)	(17,663)	(17,161)
Restaurant Beer and Wine	-271,273***	-282,124***	-290,095***
	(52,258)	(47,904)	(51,635)
Corporate Structure Change	-43,110*	-41,539*	-54,512***
	(22,608)	(23,216)	(19,985)
Missing Transaction Type	-16,511	-23,689	-27,629
	(20,508)	(18,715)	(19,654)
Transfer of Ownership	-21,606	-21,155*	-26,888**
	(13,371)	(12,200)	(12,734)
Gaming Restricted	-212,202***	-211,466***	-238,272***
	(48,713)	(47,496)	(50,074)
% All-Beverage Quota		59,250	
		(39,343)	
% All-Beverage Quota Squared.		-18,144	
		(11,446)	
100% Beer and Wine Quota		22,862	
		(17,351)	
100% RBW Quota		40,718	
		(28,222)	
All-Beverage Licenses Issued			263.7
			(905.6)
Beer and Wine Licenses Issued			-7,767***
			(2,499)
RBW Licenses Issued			8,225***
			(1,869)
Observations	892	892	892
R-squared	0.590	0.608	0.625

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the level change in license price for a level change in covariates. Gambling and hotel revenue are measured in thousands. Population, enrollment, and income are measured in ones. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Table 19: Determinants of License Price (Log-Log)

VARIABLES	(1) Log Price	(2) Log Price	(3) Log Price
Log Gambling Revenue	0.248***	0.109**	0.168***
	(0.0826)	(0.0429)	(0.0582)
Log Hotel Revenue	0.142*	0.102	0.186***
	(0.0773)	(0.0701)	(0.0655)
Log Population	-0.529***	-0.238**	-0.180*
	(0.155)	(0.117)	(0.106)
% 20-44	-0.0162	-0.00871	-0.0319
	(0.0360)	(0.0306)	(0.0268)
% Female	0.0197	0.0333	-0.0638
	(0.0604)	(0.0429)	(0.0526)
Log Enrollment	0.269***	0.197***	0.119***
	(0.0643)	(0.0518)	(0.0453)
Log Household Median Income	2.354*	2.186**	0.898
	(1.257)	(1.071)	(0.789)
Unemployment	0.0735	0.0561*	0.0338
	(0.0452)	(0.0306)	(0.0343)
All-Beverage Floater	-1.045***	-0.806*	-1.313***
	(0.382)	(0.442)	(0.375)
Beer and Wine	-0.568**	-0.763***	-0.767***
	(0.245)	(0.276)	(0.225)
Restaurant Beer and Wine	-1.930***	-2.231***	-2.312***
	(0.322)	(0.328)	(0.298)
Corporate Structure Change	-0.460*	-0.385	-0.368
	(0.242)	(0.242)	(0.228)
Missing Transaction Type	-0.366	-0.307	-0.0916
	(0.292)	(0.245)	(0.247)
Transfer of Ownership	-0.469***	-0.353***	-0.247**
	(0.155)	(0.110)	(0.120)
Gaming Restricted	-0.699	-0.648	-1.166***
	(0.451)	(0.417)	(0.352)
% All-Beverage Quota		2.123***	
		(0.511)	
% All-Beverage Quota Squared		-0.453***	
		(0.144)	
100% Beer and Wine Quota		0.444***	
		(0.156)	
100% RBW Quota		0.432*	
		(0.219)	
All-Beverage Licenses Issued			-0.0502***
			(0.00644)
Beer and Wine Licenses Issued			0.109***
			(0.0150)
RBW Licenses Issued			0.0164
			(0.0127)
Observations	892	892	892
R-squared	0.367	0.442	0.488

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the percentage change in license price for a percentage change in covariates. Gambling and hotel revenue are measured in millions. Population, enrollment, and income are measured in thousands. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Table 20: Determinants of License Price (Log-Level, Area & Year Fixed Effects)

VARIABLES	(1) Log Price	(2) Log Price	(3) Log Price
Gambling Revenue	0.0173	0.0183	0.00786
	(0.0331)	(0.0348)	(0.0354)
Hotel Revenue	0.0425	0.0399	0.0489
	(0.0353)	(0.0360)	(0.0357)
Population	-0.0722**	-0.0598*	-0.206***
	(0.0357)	(0.0356)	(0.0664)
% 20-44	0.0335	0.0494	0.0548
	(0.150)	(0.153)	(0.148)
% Female	0.0896	0.0833	0.0530
	(0.315)	(0.323)	(0.309)
Enrollment	0.101	0.0803	-0.0279
	(0.159)	(0.156)	(0.187)
Household Median Income	0.0156	0.0108	0.0148
	(0.0389)	(0.0392)	(0.0389)
Unemployment	-0.00213	-0.00462	-0.00128
	(0.0765)	(0.0777)	(0.0688)
All-Beverage Floater	-1.215***	-1.204***	-1.223***
	(0.401)	(0.411)	(0.406)
Beer and Wine	-0.801***	-0.810***	-0.815***
	(0.286)	(0.290)	(0.286)
Restaurant Beer and Wine	-2.575***	-2.570***	-2.591***
	(0.370)	(0.391)	(0.383)
Corporate Structure Change	-0.360	-0.354	-0.350
	(0.304)	(0.305)	(0.300)
Missing Transaction Type	-0.271	-0.270	-0.293
	(0.323)	(0.318)	(0.334)
Transfer of Ownership	-0.200*	-0.201*	-0.202*
	(0.114)	(0.113)	(0.116)
Gaming Restricted	-1.084***	-1.053***	-1.087***
	(0.376)	(0.390)	(0.388)
% All-Beverage Quota		-0.0360	
		(1.281)	
% All-Beverage Quota Squared.		0.0222	
		(0.235)	
100% Beer and Wine Quota		0.121	
		(0.171)	
100% RBW Quota		0.288	
		(0.363)	
All-Beverage Licenses Issued			0.0389
			(0.0425)
Beer and Wine Licenses Issued			0.110**
			(0.0544)
RBW Licenses Issued			0.0325
			(0.0246)
Observations	892	892	892
R-squared	0.640	0.641	0.641

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the percentage change in license price for a level change in covariates. Gambling and hotel revenue are measured in millions. Population, enrollment, and income are measured in thousands. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Table 21: Determinants of License Price (Level-Level, Area & Year Fixed Effects)

VARIABLES	(1) Price	(2) Price	(3) Price
Gambling Revenue	9.241***	8.573***	9.812***
	(1.957)	(3.222)	(2.755)
Hotel Revenue	9.354*	9.512*	9.416*
	(4.758)	(4.934)	(5.527)
Population	0.293	0.656	-5.819
	(5.503)	(6.094)	(7.606)
% 20-44	-4,235	-4,583	-2,994
	(7,349)	(6,868)	(7,554)
% Female	-14,686	-14,609	-15,921
	(19,239)	(19,310)	(19,065)
Enrollment	-14.06	-16.82	-22.61
	(23.33)	(19.47)	(26.61)
Household Median Income	6.373**	6.381**	6.267**
	(3.082)	(2.947)	(2.916)
Unemployment	-355.6	-820.1	-162.8
	(4,719)	(4,284)	(4,916)
All-Beverage Floater	-191,072***	-191,120***	-189,972***
	(44,182)	(44,114)	(43,199)
Beer and Wine	-55,370**	-55,301***	-55,961**
	(21,277)	(21,109)	(22,066)
Restaurant Beer and Wine	-302,176***	-301,125***	-305,194***
	(53,794)	(53,293)	(54,642)
Corporate Structure Change	-50,827*	-50,983*	-51,813**
	(25,839)	(26,370)	(25,772)
Missing Transaction Type	-23,713	-23,999	-23,780
	(23,202)	(22,967)	(23,745)
Transfer of Ownership	-22,902*	-22,936*	-22,386*
	(12,699)	(12,741)	(12,367)
Gaming Restricted	-231,783***	-231,343***	-235,885***
	(54,015)	(54,162)	(55,510)
% All-Beverage Quota		-60,168	
		(82,448)	
% All-Beverage Quota Squared		12,139	
		(14,301)	
100% Beer and Wine Quota		9,694	
		(22,580)	
100% RBW Quota		-3,758	
		(46,948)	
All-Beverage Licenses Issued			-3,138
			(5,334)
Beer and Wine Licenses Issued			5,830
			(12,461)
RBW Licenses Issued			4,004
			(3,475)
Observations	892	892	892
R-squared	0.695	0.695	0.696

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the level change in license price for a level change in covariates. Gambling and hotel revenue are measured in thousands. Population, enrollment, and income are measured in ones. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Table 22: Determinants of License Price (Log-Log, Area & Year Fixed Effects)

VARIABLES	(1) Log Price	(2) Log Price	(3) Log Price
Log Gambling Revenue	-0.0335	-0.0416	-0.0357
	(0.129)	(0.127)	(0.132)
Log Hotel Revenue	0.231	0.271	0.243
	(0.761)	(0.768)	(0.765)
Log Population	-2.302*	-2.207*	-3.826*
	(1.322)	(1.195)	(2.073)
% 20-44	0.0470	0.0609	0.0680
	(0.187)	(0.188)	(0.187)
% Female	0.162	0.158	0.142
	(0.313)	(0.318)	(0.310)
Log Enrollment	0.232***	0.201***	0.224***
	(0.0488)	(0.0492)	(0.0529)
Log Household Median Income	0.852	0.586	0.935
	(1.369)	(1.392)	(1.409)
Unemployment	0.00549	-0.00287	0.0154
	(0.0826)	(0.0829)	(0.0851)
All-Beverage Floater	-1.222***	-1.193***	-1.218***
	(0.421)	(0.416)	(0.426)
Beer and Wine	-0.800***	-0.806***	-0.801***
	(0.285)	(0.288)	(0.286)
Restaurant Beer and Wine	-2.553***	-2.537***	-2.547***
	(0.367)	(0.392)	(0.380)
Corporate Structure Change	-0.373	-0.363	-0.372
	(0.303)	(0.305)	(0.306)
Missing Transaction Type	-0.269	-0.271	-0.281
	(0.321)	(0.316)	(0.333)
Transfer of Ownership	-0.197*	-0.196*	-0.200*
	(0.112)	(0.111)	(0.116)
Gaming Restricted	-1.112***	-1.080***	-1.120***
	(0.370)	(0.371)	(0.392)
% All-Beverage Quota		-0.0430	
		(1.311)	
% All-Beverage Quota Squared		0.0165	
		(0.241)	
100% Beer and Wine Quota		0.207	
		(0.166)	
100% RBW Quota		0.222	
		(0.348)	
All-Beverage Licenses Issued			0.0183
			(0.0422)
Beer and Wine Licenses Issued			0.0578
			(0.0582)
RBW Licenses Issued			-0.00360
			(0.0185)
Observations	892	892	892
R-squared	0.640	0.642	0.641

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the percentage change in license price for a percentage change in covariates. Gambling and hotel revenue are measured in millions. Population, enrollment, and income are measured in thousands. Standard errors are in parentheses, clustered by quota area. Variable definitions may be found in Appendix D.

Figure 6: Log-Level, Fitted Values and Gambling Revenue

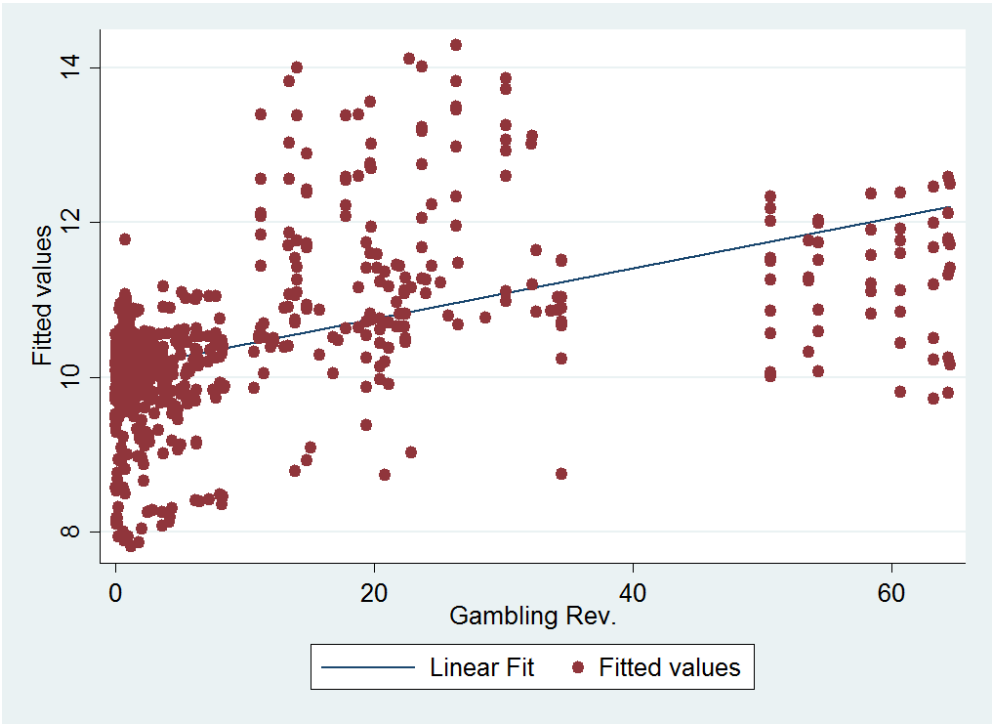


Figure 7: Level-Level, Fitted Values and Gambling Revenue

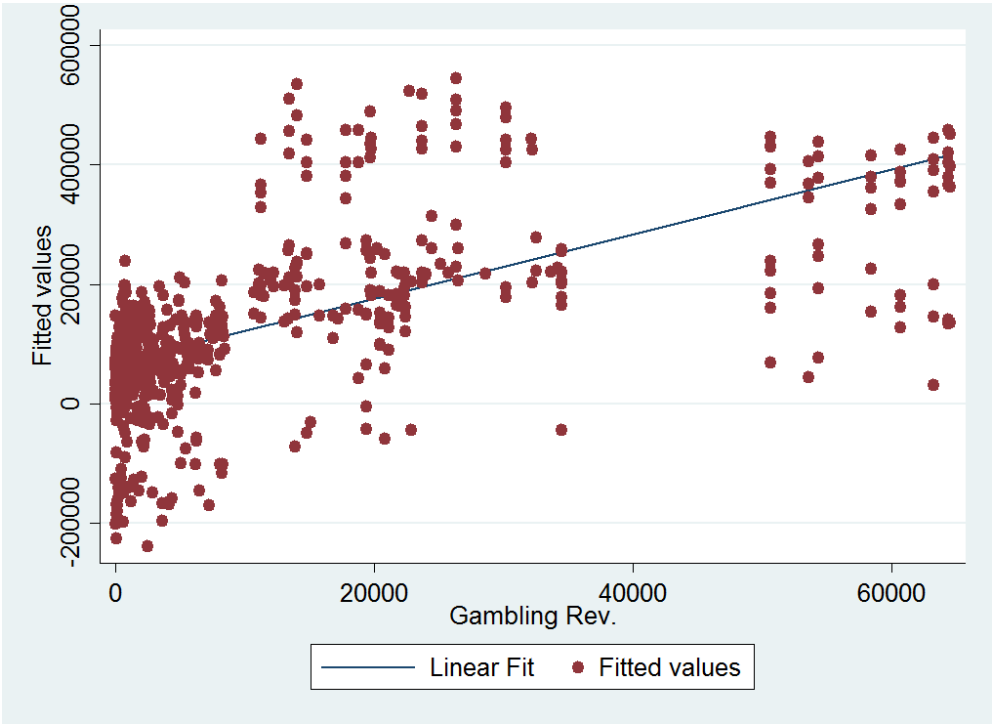


Figure 8: Log-Log, Fitted Values and Log Gambling Revenue

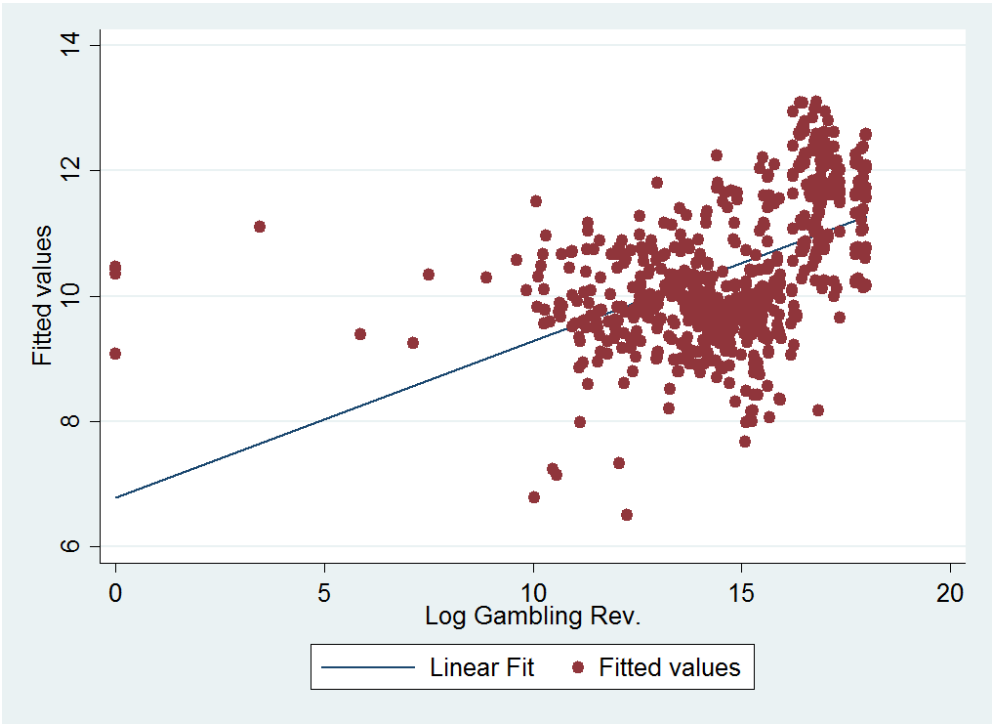


Figure 9: Log-Level, Fitted Values and Median Income

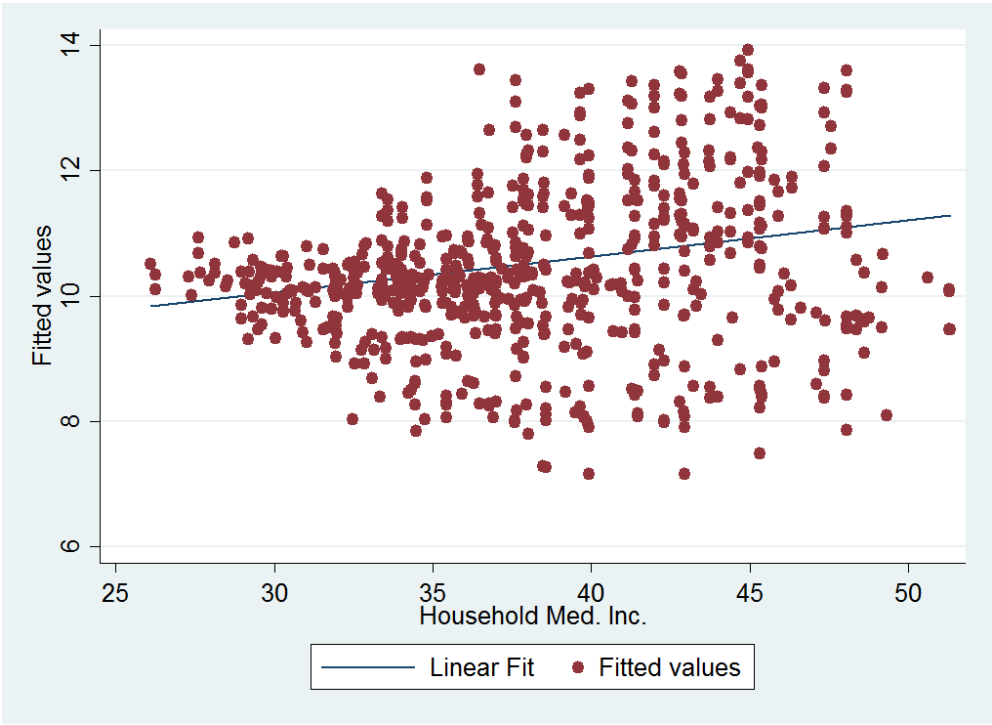


Figure 10: Level-Level, Fitted Values and Median Income

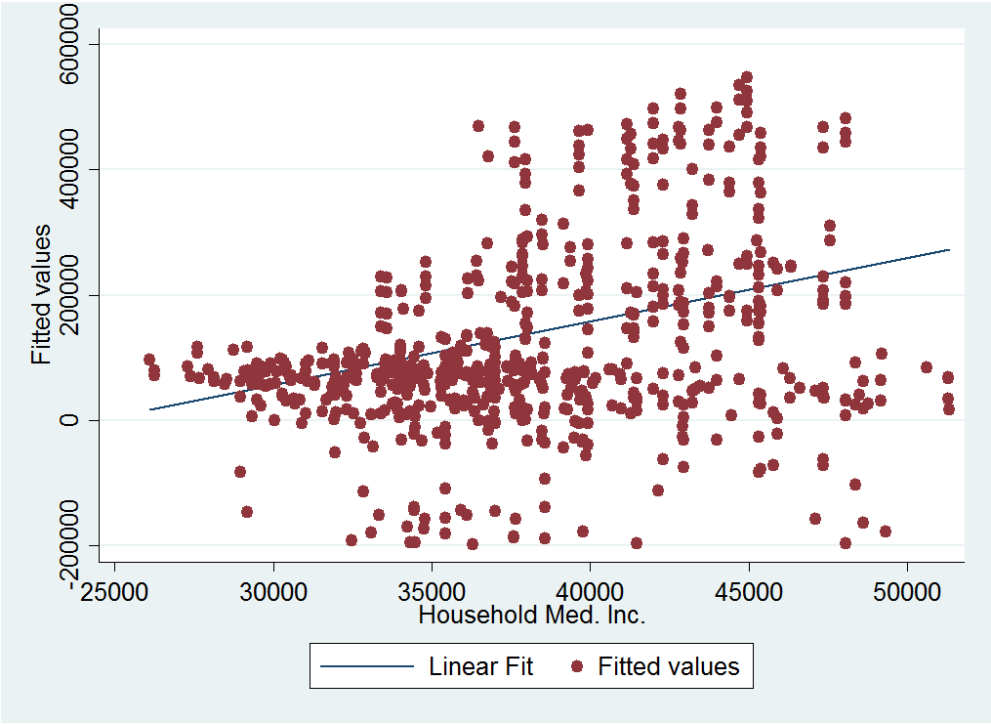


Figure 11: Log-Log, Fitted Values and Log Median Income

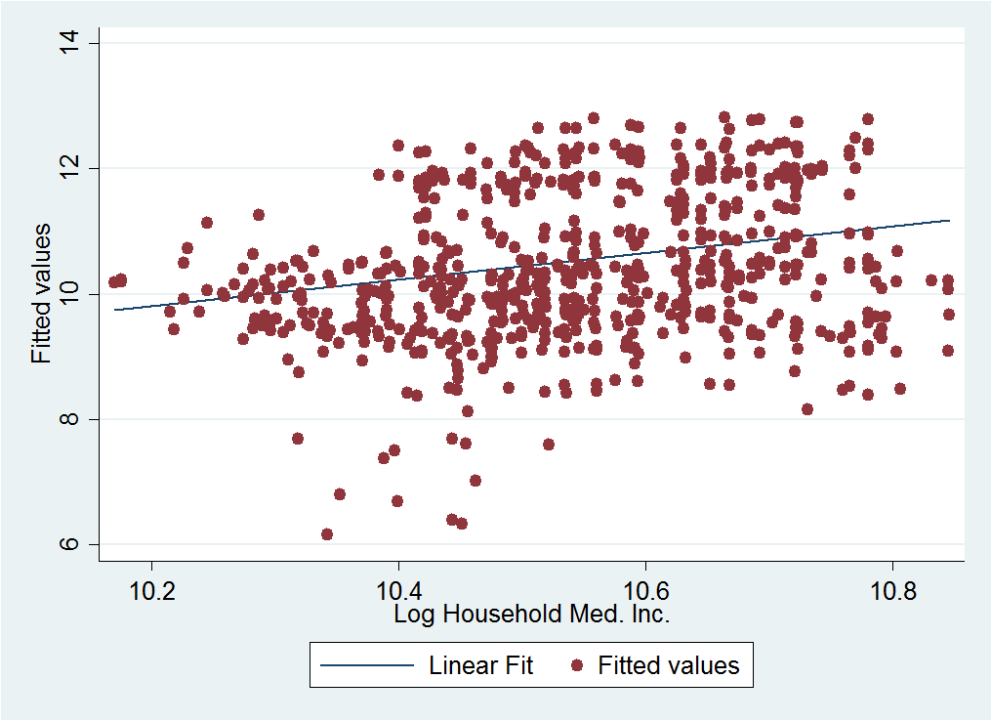


Figure 12: Log-Level, Fitted Values and Hotel Revenue

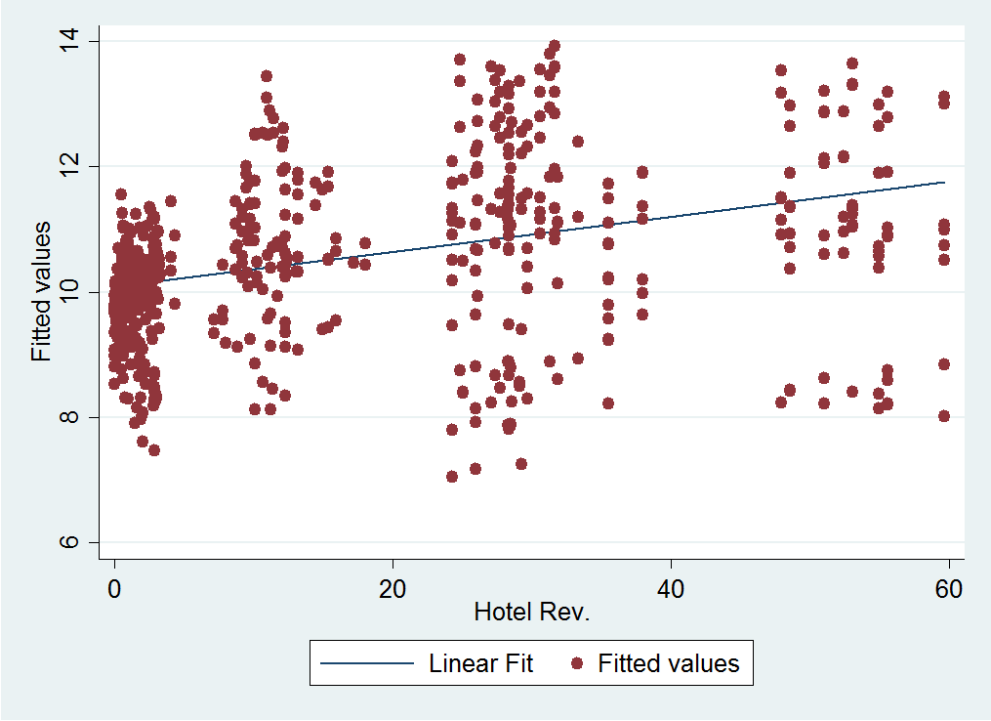


Figure 13: Level-Level, Fitted Values and Hotel Revenue

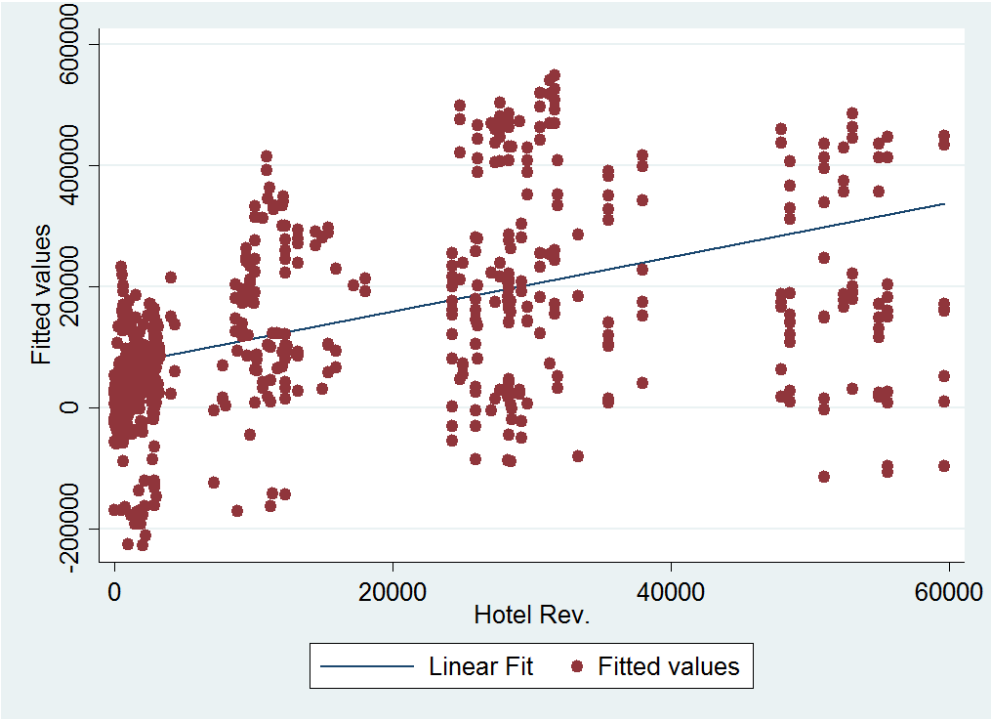


Figure 14: Log-Log, Fitted Values and Log Hotel Revenue

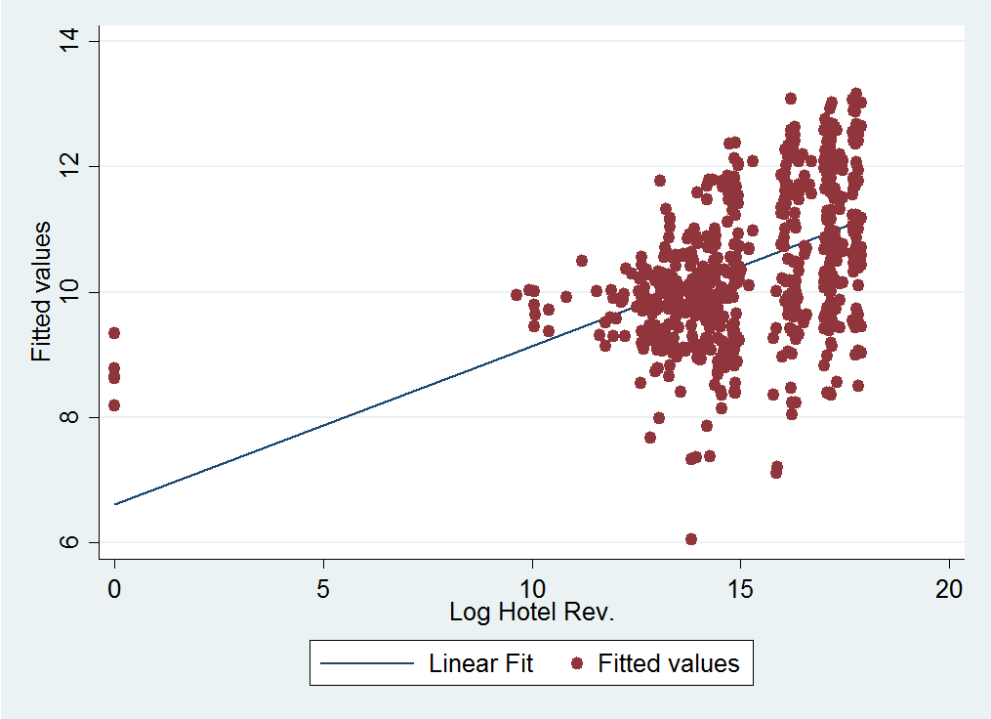


Figure 15: Residuals, by Quota Area

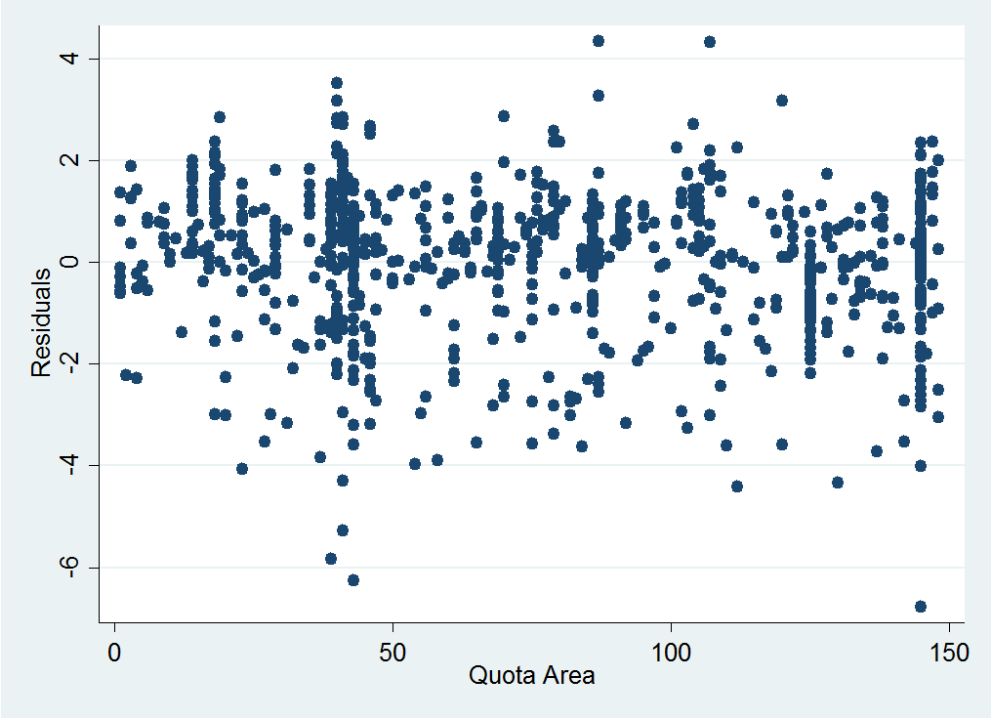


Figure 16: Residuals, by County

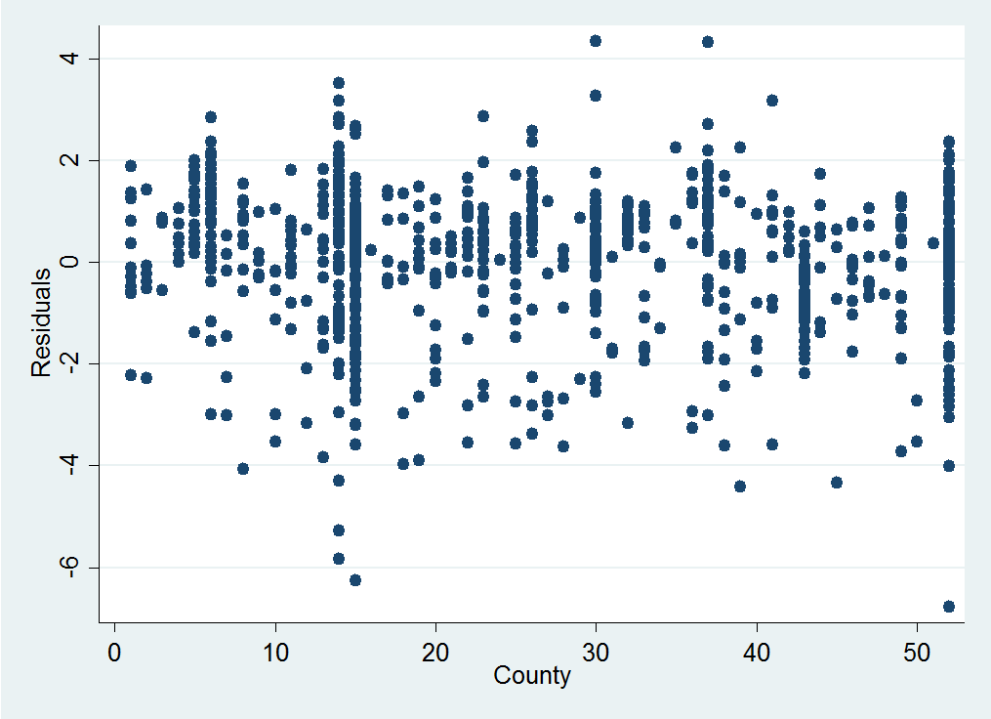


Figure 17: Residuals, by Alternative Cluster Area

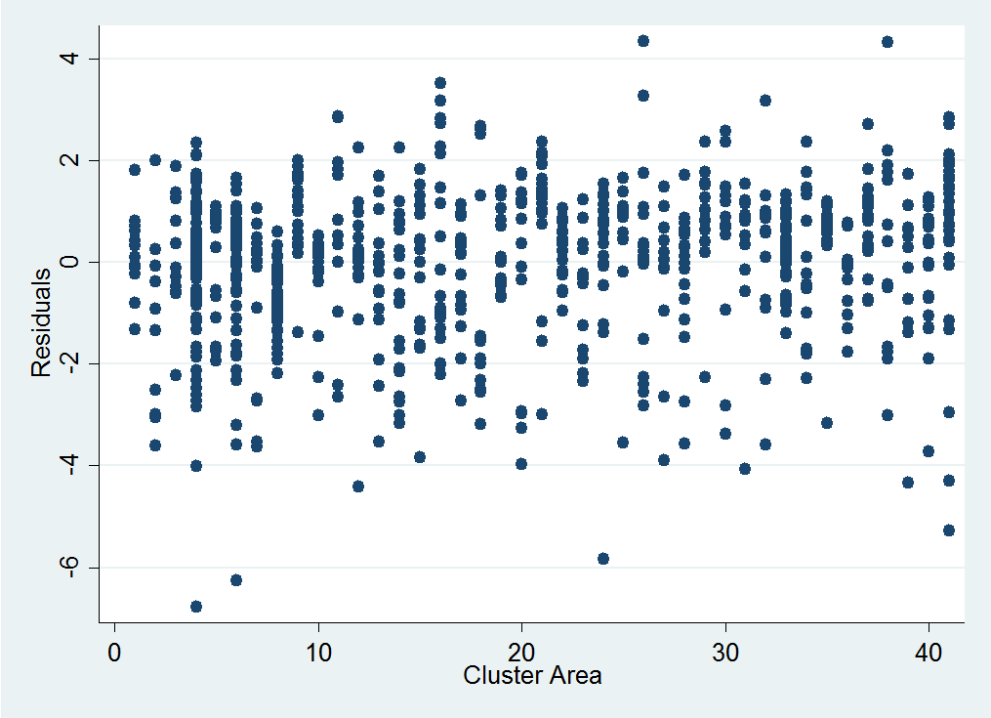


Figure 18: Residuals, by Year

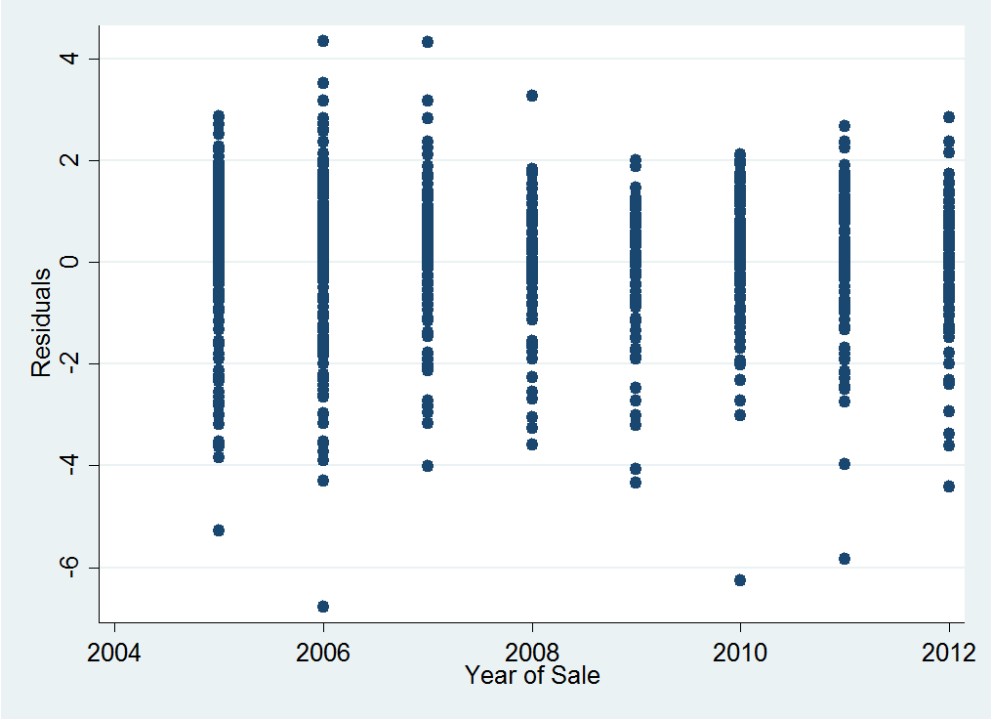


Figure 19: Residuals, by Gambling Revenue

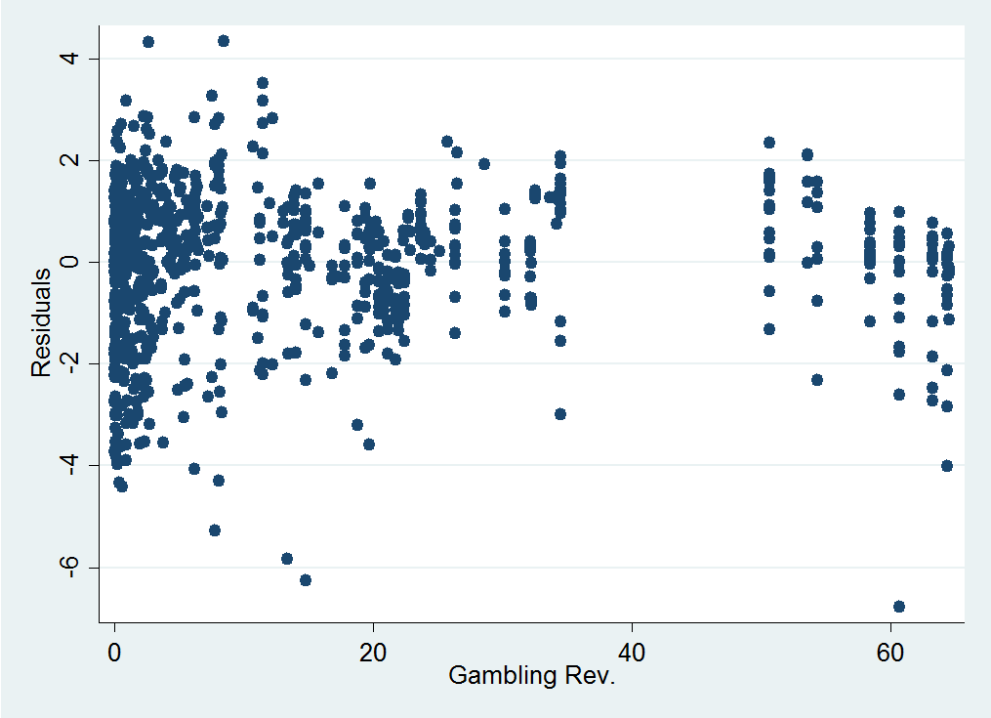


Figure 20: Residuals, by Income

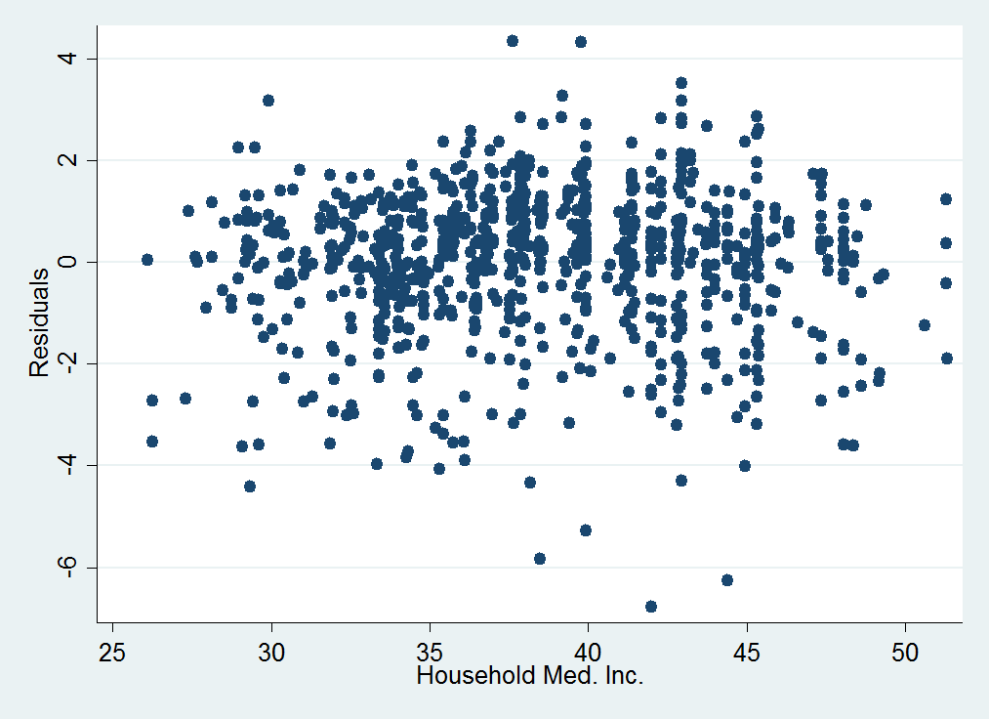


Figure 21: Residuals, by Hotel Revenue



Table 23: Determinants of Licenses Issued

VARIABLES	(1) AB Lic. Issued	(2) BW Lic. Issued	(3) RBW Lic. Issued
Gambling Revenue	0.000931**	0.00100***	0.000105
	(0.000393)	(0.000107)	(0.000235)
Hotel Revenue	-5.58e-05	3.57e-05	0.000132***
	(4.47e-05)	(2.50e-05)	(4.18e-05)
Population	0.679***	-0.0973**	0.212
	(0.0982)	(0.0453)	(0.159)
% 20-44	18.36	3.067	-20.49***
	(14.66)	(4.494)	(5.315)
% Female	-26.35	-12.13*	4.222
	(18.08)	(6.751)	(6.939)
Enrollment	-0.498	0.620***	0.349
	(0.549)	(0.186)	(0.268)
Household Median Income	-0.0481	-0.0471*	0.0855***
	(0.0792)	(0.0264)	(0.0315)
Unemployment	0.206**	0.0672*	0.299***
	(0.103)	(0.0393)	(0.0706)
Unincorporated	-0.749	-1.086**	
	(1.321)	(0.418)	
Constant	12.38	7.487*	-1.572
	(10.65)	(3.882)	(3.642)
Observations	1,472	1,472	1,024
R-squared	0.849	0.911	0.801

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the level change in license number for a level change in covariates. Gambling and hotel revenue are measured in thousands. Population, enrollment, and income are measured in ones. Standard errors are in parentheses, clustered by quota area. Column 1 considers all-beverage licenses issued; Columns 2 and 3 consider beer and wine and restaurant beer and wine licenses issued, respectively. RBW licenses are only issued in incorporated areas, hence the lower observation count.

Table 24: Determinants of Licenses Issued (Area Fixed Effects)

	(1)	(2)	(3)
VARIABLES	AB Lic. Issued	BW Lic. Issued	RBW Lic. Issued
Gambling Revenue	-1.18e-05	9.10e-05***	-8.65e-05
	(5.59e-05)	(2.90e-05)	(0.000123)
Hotel Revenue	-4.25e-05	-1.92e-05	0.000153**
	(2.79e-05)	(1.68e-05)	(6.92e-05)
Population	0.957***	0.460***	0.636***
	(0.0437)	(0.0344)	(0.0839)
% 20-44	0.927	-1.066	-2.449
	(2.005)	(1.083)	(3.275)
% Female	6.016	3.613	8.566
	(6.200)	(2.457)	(5.744)
Enrollment	0.150	0.262	3.364***
	(0.685)	(0.378)	(0.540)
Household Median Income	-0.0193*	-0.00973**	-0.0258
	(0.0107)	(0.00409)	(0.0186)
Unemployment	0.0222	-0.0181*	0.180***
	(0.0205)	(0.00982)	(0.0519)
Unincorporated	-25.36***	-19.84***	
	(2.113)	(1.267)	
Constant	7.874**	2.559**	-8.333***
	(3.062)	(1.063)	(3.163)
Observations	1,472	1,472	1,024
R-squared	0.999	0.999	0.976

Significance levels: *** p<0.01, ** p<0.05, * p<0.10

Estimates are calculated using OLS, representing the level change in license number for a level change in covariates. Gambling and hotel revenue are measured in thousands. Population, enrollment, and income are measured in ones. Standard errors are in parentheses, clustered by quota area. Column 1 considers all-beverage licenses issued; Columns 2 and 3 consider beer and wine and restaurant beer and wine licenses issued, respectively. RBW licenses are only issued in incorporated areas, hence the lower observation count.

CONCLUSION AND DISCUSSION

Implications of the Study

This study both lays out a theoretical model for tradable licenses to operate and empirically tests the implications that the model yields. The effect of positive demand shifters, particularly, appear to be significant determinants of license values. Gambling, income, university enrollment, and, to a lesser extent, tourism (using hotel revenue as a proxy) all are statistically and economically significant predictors of license price. These results, moreover, are robust to the inclusion of supply variables, and robust to alternative functional forms. Thus, the empirical analysis provides a great deal of support for the demand-side predictions of the model.

The most consistent determinants of license prices, however, are the attributes of an individual license. License type, along with whether or not a license carries the right to gamble, are strong predictors of how much a license is worth on the market. Even more so than the continuous demand variables, indicator variables for license attributes are robust to different specifications. The qualitative and quantitative estimated effects remain consistent when supply variables are added, and are extremely robust to different functional forms. Even more noteworthy is the robustness of the variables to the inclusion of fixed effects, which conditioned out most of the identifying variation in the data. Again, these empirical results support the predictions produced by theory.

The estimated magnitudes of the effects, however, should be treated with caution. Although licenses issued in a quota system typically are thought of as exogenous, the

quotas in Montana's licensing system are not always firm. Many areas are allowed to be over quota, occasionally by a wide margin (e.g., Butte has three times the licenses permitted by their quota). The robustness of the results, however, mitigates some of the concerns over endogeneity bias. Similarly, the analysis is descriptive—the estimates provide predictive information, as opposed to strictly causal effects. Given the infrequency with which licenses trade, however, the large-scale cross-sectional differences in the data probably still provide a good deal of insight into why licenses are priced as they are.

While the empirical analysis supports the predictions regarding the demand-side determinants in the model, the results do not provide much evidence supporting the prediction regarding changes in quota. The model predicts that an increase in quota should lead to lower prices, provided the quota is binding. Unfortunately, the particulars of the Montana alcohol licensing system do not provide many opportunities to cleanly test the implication. Montana expanded the RBW license quota in 2007, but several factors preclude a simple analysis of the impacts of the change. the analysis. First, many areas had non-binding quotas to begin with, which negates the prediction. Second, the areas with binding quotas adjusted relatively slowly to the increase in available licenses.[79]

Additionally, all-beverage floater licenses do not provide a clean way to evaluate the prediction. While the licenses float to an area with high license demand, both locations involved in the transaction are definitionally over quota. If the buyer's area was not over 100 percent of the allowable licenses, a new license could be issued by the department. Both markets involved, moreover, typically see only marginal changes in the supply of

[79]It is not easy to tell whether this was due to an overall lack of interest in the new RBW licenses, or due to time lags in the application approval process, or a combination thereof.

licenses. If licenses float out of Butte and into Billings, neither location sees a large relative change in supply. Again, this makes it difficult to identify the effect of a change in the number of licenses.

Although the implications surrounding changes to the number of licenses are not effectively tested, the analysis is still the first to explicitly lay out and test the model's predictions in the context of alcohol retail licensure. The results also provide evidence that the model is an appropriate way think about Montana's licensing system, particularly for the demand-side determinants of price. Thus, a clear contribution is made to the economics of alcohol literature particularly, and to the business licensure literature more generally. The results, moreover, provide insight into several policy changes. For example, the estimated discount for restricted gambling rights provides a quantitative result that may be used to evaluate the effects of the 1997 and 2007 restrictions on gambling (for incorporated beer and wine and floater licenses, respectively). Given how involved the Montana state government is in the retail alcohol industry, the analysis provides valuable information regarding future policy discussion.

Possibilities for Future Analysis

While examining the price determinants of Montana's alcohol retail licenses provides a clear addition to the literature, the licensing system provides several other avenues for future research. In particular, the rents created by the system lend themselves well to economic analysis. While getting at the value of the total rents within certain quota areas is relatively straightforward (i.e., multiply the average license price by the number of

licenses active in a quota area), it is more difficult to get at the total value state-wide. Using the results of the model, values may be imputed for the areas that are more thinly traded. This analysis would also provide insight into what would occur if licenses could trade freely across quota areas. Licenses would move to the higher-priced areas, until rents were equal across the different markets.

Similarly, an interesting issue is how rents have changed over time. When the system was instituted in 1947, the state grandfathered existing establishments. At that point, license prices and rents were probably close to zero.[80] Between the inception of the quota program and now, rents appear to have increased a great deal (at least in nominal terms). Thus, it appears that the adjustment factor in licenses in incorporated areas (one additional all-beverage license per 1,500 people after a certain threshold) is not sufficient to keep up with the increase in demand. In incorporated communities, licenses have substantial value. In unincorporated areas, however, the increase in licenses associated with population growth (one license per 750 people) appears to out-pace the growth in demand. In many counties (the larger counties population-wise in particular), license values are quite close to zero.

Another testable implication of the model consists of the increase in quantity supplied by each establishment. With the introduction of a binding quota, the number of operating businesses declines. Each licensed establishment, however, increases their own quantity supplied (from q_i to q_i' in figure 2, above). Thus, areas with binding quotas are expected to see increased quantity supplied for each establishment—this could take the

[80]Rents were not necessarily zero with the inception of the program. If population growth was expected, capping the number of bars may have increased expected future profit.

form of increased seating or increased floorspace. The effect on both margins could conceivably be tested empirically.

Two other issues also lend themselves well to analysis. Market liquidity, for example, is another pertinent issue, particularly for those concerned with issuing loans with a license as collateral. In the event of a default, whoever assumes ownership of the license (on non-use status) must sell it within 180 days.[81] Thus, the ease with which a license may be transferred is of paramount importance if they are used as collateral. Using the proportion of licenses traded by quota area/year as the dependent variable, various factors could be used to predict when licenses change hands.

The second potential area of interest is lottery system in place to allocate new licenses. This literature is well developed, particularly in resource economics (relating to hunting permits), but not in the area of retail licenses. Additionally, Montana has made several large changes to the entry requirements for license lotteries. For example, the state increased the credit requirement in 2007. Potentially, this should lower the number of applicants, as the costs to enter the lottery are higher. Similarly, there is the issue of the preferential lottery with RBW licenses, as well as recently instituted holding periods.

Although examining the determinants of license prices provides significant insight into the licensing system in Montana, there are still a plethora of other questions that could be addressed. Given the complexities of the system, there are deep economic implications in the way the state deals with licensing alcoholic beverage retailers. Similarly, there are a host of other economically relevant topics surrounding wholesalers and manufacturers.

[81] See M.C.A. 16-4-801.

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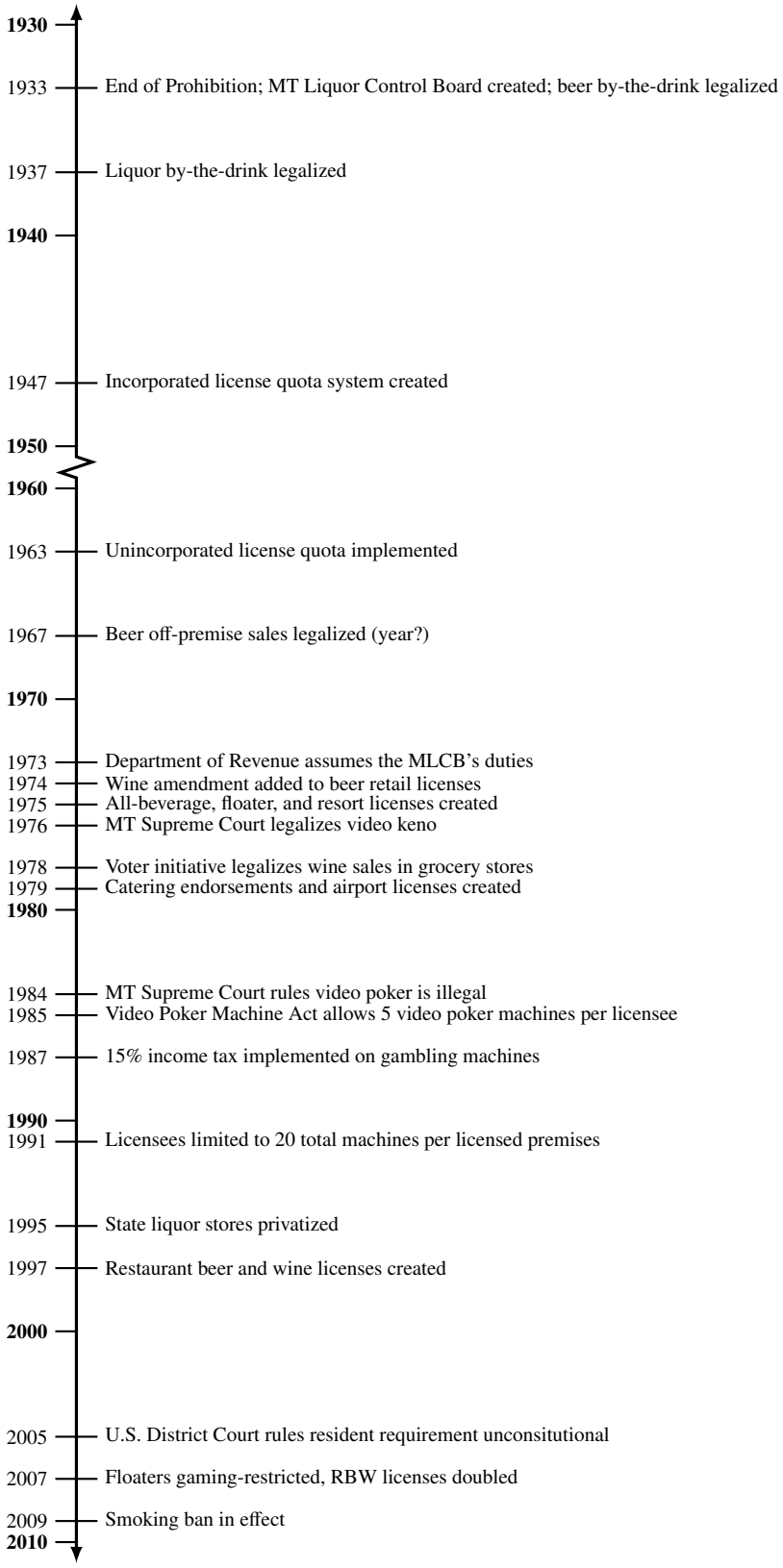
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APPENDICES

APPENDIX A

TIMELINE

Figure 22: Timeline of MT Alcohol Laws



APPENDIX B

QUOTA FORMULAS

Table 25: All-Beverage Quota Formula

Population	Quota
Less than 500	2 total
500 - 3,000	3 for the first 1,000; 1 for each additional 1,000
Greater than 3,000	5 for the first 3,000; 1 for each additional 1,500
Unincorporated	1 per 750

Table 26: Beer and Wine Quota Formula

Population	Beer and Wine License Quota:
Less than 500	1 total
500 - 2,000	1 per 500
Greater than 2,000	4 for the first 2,000; 2 for the next 2,000; 1 for each additional 2,000
Unincorporated	Subject to Department Discretion

Table 27: Restaurant Beer and Wine Quota Formula

Population:	License Quota
Less than 5,000	80% of Beer Retail Quota; 1-time adjustment of +4 if quota is met
5000-20,000	160% of Beer Retail Quota
20,000-60,000	100% of Beer Retail Quota
Greater than 60,000	80% of Beer Retail Quota
Unincorporated	None
Resort Community	200% of Beer Retail Quota

Table 28: Resort All-Beverage Quota Formula

Population:	Quota
N/A	1 for the first 100 accomodation units; 1 for each additional 50

APPENDIX C

COMPARATIVE STATICS RESULTS

The two-identity system in equilibrium:

$$S(p_B^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta}), \bar{L}, \boldsymbol{\alpha}) \equiv D(p_B^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta}), \boldsymbol{\beta})$$

$$\bar{L} \equiv L(p_L^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta}), p_B^*(\bar{L}, \boldsymbol{\alpha}, \boldsymbol{\beta}))$$

Differentiating the system with respect to β_1 to find the comparative statics results associated with a positive demand shifter: :

$$\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial p_B^*(\cdot)}{\partial \beta_1} = \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial p_B^*(\cdot)}{\partial \beta_1} + \frac{\partial D(\cdot)}{\partial \beta_1}$$

$$0 = \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \cdot \frac{\partial p_L^*(\cdot)}{\partial \beta_1} + \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial p_B^*(\cdot)}{\partial \beta_1}$$

Rearranging and putting it into matrix notation:

$$\begin{bmatrix} \left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)}\right) & 0 \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{bmatrix} \begin{bmatrix} \frac{\partial p_B^*(\cdot)}{\partial \beta_1} \\ \frac{\partial p_L^*(\cdot)}{\partial \beta_1} \end{bmatrix} = \begin{bmatrix} \frac{\partial D(\cdot)}{\partial \beta_1} \\ 0 \end{bmatrix}$$

Using Cramer's Rule to solve for $\frac{\partial p_B^*(\cdot)}{\partial \beta_1}$:

$$\frac{\partial p_B^*(\cdot)}{\partial \beta_1} = \frac{\begin{vmatrix} \frac{\partial D(\cdot)}{\partial \beta_1} & 0 \\ 0 & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{vmatrix}}{\begin{vmatrix} \left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)}\right) & 0 \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{vmatrix}} = \frac{\frac{\partial D(\cdot)}{\partial \beta_1} \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}}{\left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)}\right) \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}}$$

Assuming that supply has an upward slope and demand a downward slope in the retail market, $\frac{\partial p_B^*(\cdot)}{\beta_1} > 0$.

Using Cramer's Rule to solve for $\frac{\partial p_L^*(\cdot)}{\partial \beta_1}$:

$$\frac{\partial p_L^*(\cdot)}{\partial \beta_1} = \frac{\begin{vmatrix} \left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)}\right) & \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & 0 \end{vmatrix}}{\begin{vmatrix} \left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial \beta_1}\right) & 0 \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{vmatrix}} = \frac{-\frac{\partial D(\cdot)}{\partial \beta_1} \cdot \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)}}{\left(\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)}\right) \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}}$$

Assuming that supply has an upward slope and demand a downward slope in the retail market, and demand has a downward slope in the license market, $\frac{\partial p_L^*(\cdot)}{\partial \beta_1} > 0$.

Differentiating the two-identity system with respect to $\bar{L}$ to find the comparative statics results associated with a change in quota:

$$\frac{\partial S(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial p_B^*(\cdot)}{\partial \bar{L}} + \frac{\partial S(\cdot)}{\partial \bar{L}} = \frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial p_B^*(\cdot)}{\partial \bar{L}}$$

$$1 = \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial p_B^*(\cdot)}{\partial \bar{L}} + \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \cdot \frac{\partial p_L^*(\cdot)}{\partial \bar{L}}$$

Rearranging and putting it into matrix notation:

$$\begin{bmatrix} \left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) & 0 \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{bmatrix} \begin{bmatrix} \frac{\partial p_B^*(\cdot)}{\partial \bar{L}} \\ \frac{\partial p_L^*(\cdot)}{\partial \bar{L}} \end{bmatrix} = \begin{bmatrix} \frac{\partial S(\cdot)}{\partial \bar{L}} \\ 1 \end{bmatrix}$$

Using Cramer's Rule to solve for $\frac{\partial p_B^*(\cdot)}{\partial \bar{L}}$:

$$\frac{\partial p_B^*(\cdot)}{\partial \bar{L}} = \frac{\begin{vmatrix} \frac{\partial S(\cdot)}{\partial \bar{L}} & 0 \\ 1 & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{vmatrix}}{\begin{vmatrix} \left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) & 0 \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{vmatrix}} = \frac{\frac{\partial S(\cdot)}{\partial \bar{L}} \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}}{\left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}}$$

Assuming that supply has an upward slope and demand a downward slope in the retail market, and increasing the quota as a positive effect on retail supply, $\frac{\partial p_B^*(\cdot)}{\partial L} < 0$.

Using Cramer's Rule to solve for $\frac{\partial p_L^*(\cdot)}{\partial \bar{Q}}$:

$$\frac{\partial p_L^*(\cdot)}{\partial \bar{L}} = \frac{\begin{vmatrix} \left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) & \frac{\partial S(\cdot)}{\partial \bar{L}} \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & 1 \end{vmatrix}}{\begin{vmatrix} \left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) & 0 \\ \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} & \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)} \end{vmatrix}} = \frac{\left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) - \frac{\partial L(\cdot)}{\partial p_B^*(\cdot)} \cdot \frac{\partial S(\cdot)}{\partial \bar{L}}}{\left(\frac{\partial D(\cdot)}{\partial p_B^*(\cdot)} - \frac{\partial S(\cdot)}{\partial p_B^*(\cdot)}\right) \cdot \frac{\partial L(\cdot)}{\partial p_L^*(\cdot)}}$$

Assuming that supply has an upward slope and demand a downward slope in the retail market, increasing the quota as a positive effect on retail supply, and demand has a downward slope in the license market, $\frac{\partial p_L^*(\cdot)}{\partial L} < 0$.

APPENDIX D

VARIABLE DEFINITIONS

Table 29: Variable Definitions

VARIABLE	DEFINITION
Gambling Revenue	Gambling revenue, equal to gambling tax revenue over 0.15. Specified in millions with log-prices and in thousands with level.
Hotel Revenue	Hotel revenue, equal to hotel tax revenue over 0.07. Specified in millions with log-prices and in thousands with level.
Population	Estimated annual population. Specified in thousands with log-prices and in ones with level.
% 20-44	Estimated proportion of the county population ages 20 and 44.
% Female	Estimated proportion of the county population that is female.
Enrollment	Annual fall enrollment for all two and four year institutions.
Household Median Income	Estimated annual household median income by county.
Unemployment	Estimated annual unemployment by county.
All-Beverage	Indicator variable for an all-beverage licenses (omitted).
All-Beverage Floater	Indicator variable for an all-beverage floater license.
Beer and Wine	Indicator variable for a beer/beer and wine retail license.
Restaurant Beer and Wine	Indicator variable for a restaurant beer and wine license.
Corporate Structure Change	Indicator variable for a corporate structure change.
Missing Transaction Type	Indicator variable for a missing transaction type.
Transfer of Ownership	Indicator variable for a transfer of ownership.
Transfer of Ownership & Location	Indicator variable for a transfer of ownership and location (omitted).
Gaming Restricted	Indicator variable for a license classified as gaming restricted. Takes on a value of 1 for gaming restricted all-beverage, floater, and beer and wine retail licenses.
% All-Beverage Quota	Percentage of a quota area's all-beverage quota, defined as licenses issued over license quota.
% All-Beverage Quota Squared	Percentage of all-beverage quota squared.
100% BW Quota	Indicator variable for a quota area being at or above the BW quota.
100% RBW Quota	Indicator variable for a quota area bineg at or above the RBW quota.
All-Beverage Licenses Issued	The numer of all-beverage licenses (including resort and floater licenses) issued in a quota area.
Beer and Wine Licenses Issued	The number of beer and wine retail licenses issued in a quota area.
RBW Licenses Issued	The number of RBW licenses issued in a quota area.

APPENDIX E

ALTERNATIVE CLUSTERS

Table 30: Alternative Clusters

Location(s)	Observations
Billings	92
Butte	61
Bozeman/Belgrade	59
Missoula (City)	48
Whitefish	30
Great Falls	29
Flathead, Uninc.†	28
Park Co.	27
Helena	21
Kalispell	21
Ravalli, Inc.	21
Carbon Co.	20
Fallon/Garfield/McCone/Powder River/Rosebud/Treasure Cos.	20
Cascade/Chouteau/Judith Basin Cos.*	19
Daniels/Sheridan/Roosevelt Cos.	19
Valley Co.	19
Gallatin, Inc.*	18
Dawson/Richland/Wibaux Cos.	17
Fergus Co.	17
Licoln Co.	17
Broadwater/Meagher/Wheatland Cos.	16
Big Horn/Musselshell/Yellowstone, Cos.*	16
Glacier/Toole Cos.	16
Lake/Missoula, Uninc.†	16
Blaine/Phillips Cos.	15
Gallatin, Uninc.†	15
Granite/Powell Co.	15
Mineral/Sanders Cos.	15
Jefferson Co.	14
Pondera/Teton Cos.	14
Beaverhead Co.	13
Hill/Liberty Cos.	13
Cascade/Lewis & Clark, Uninc.†	13
Lake, Inc.	13
Madison, Inc.	13
Madison, Uninc.	13
Ravalli, Uninc.†	13
Anaconda	12
Miles City	12
Stillwater/Sweet Grass Cos.	12
Big Horn/Dawson/Richland/Yellowstone, Uninc.†	10

†Denotes the area(s) is under quota by more than 1 license.
*The observation counts for Cascade, Gallatin, Big Horn, and Yellowstone counties are compiled after other areas listed have been removed.
Inc., Uninc, and Cos. refer to incorporated, unincorporated, and total county areas, respectively.