The Behavior of Casino Gaming Revenue over the Business Cycle Considering Alternative Measures of "Income"

Working Paper - Please do not cite without Permission

Thomas A. Garrett
Department of Economics
University of Mississippi
PO Box 1848
University, MS 38677
tgarrett@olemiss.edu

Mark W. Nichols
Department of Economics
College of Business
University of Nevada, Reno
Reno, NV 89557
mnichols@unr.edu

Abstract

Reasons exist for believing that casino gaming revenue does not respond equally to all sources of income over the business cycle. We examine the growth and variability of casino revenue resulting from the growth and variability in different sources of income. We find that casino revenue behaves quite differently in response to short-run and long-run variation in each income source, thus revealing that the common use of personal income masks underlying drivers of each state's business cycle. Our results have implications for revenue forecasting models, research on the growth and variability of tax revenue in general, and public policy.

JEL Codes: H72, H79, L83

Keywords: Casino, Revenue, Business-Cycle

The Behavior of Casino Gaming Revenue over the Business Cycle
Considering Alternative Measures of "Income"

1. Introduction

Casino gaming has become a prominent industry in the United States and an important source of tax revenue for state and local governments. Commercial casino gaming is legal in 24 states and generates nearly $41 billion in annual gaming revenue (2016).[1] Nearly 350,000 people are employed in the 490 commercial casinos across the country, and earn over $14 billion in wages and benefits. Tax revenue from the taxation of casino gaming revenue totaled $9 billion in 2015 and accounted for roughly three to four percent of casino states' total tax collections.[2] Annual casino gaming revenue (and thus tax revenue) has generally increased over time, but, similar to the experiences of other industries, casino gaming revenue dropped throughout the 2007-2009 recession. Tax collections from casino gaming are less than the collections from traditional sources of revenue such as income taxes and sales taxes, yet the growth and variability of casino revenue often receives more scrutiny by policy-makers and state officials since revenue from the taxation of casinos is commonly earmarked toward publicly popular programs such as education, senior citizen care, health care, and veteran assistance.

Despite the size of the commercial casino industry in the United States and the importance of gaming tax revenue to state and local governments, it is somewhat surprising that there are very few academic studies that examine the growth and variability of casino gaming revenue. This is contrary to the numerous published studies that explore the growth and variability of income tax revenue and sales tax revenue (as well as other sources of state-level tax revenue) over the

[1] Statistics are from the American Gaming Association's *2016 State of the States* and the Center for Gaming Research at the University of Nevada, Las Vegas. Gaming revenue is defined as revenue to the casino after paying player winnings. Commercial casino gaming refers to those casinos owned by publicly traded corporations. Native American gaming is a separate activity and not considered here, with the exception of Connecticut where we are able to obtain slot machine revenue.

[2] The tax revenue from casino gaming is from the direct taxation of casino gaming revenue and does not consider (indirect) sources of revenue from casinos such as sales taxes and hotel occupancy taxes.

business cycle.[3] Nichols and Tosun (2008) conduct the most recent study of the behavior of state-level casino gaming revenue over the business cycle. Following the methodologies of the studies exploring the growth and variability of revenue from income taxes and sales taxes, Nichols and Tosun (2008) estimate both long-run and short-run elasticities for casino revenue in each of eleven states.[4] The authors find large cross-state differences in both the long-run and short-run elasticities of casino gaming revenue. In addition, they find that casino gaming revenue grows faster than sales tax revenue and slower than income tax revenue; and that, in the short-run, casino gaming revenue is less responsive to business cycle changes than are both taxable income and taxable sales.

The study by Nichols and Tosun (2008) uses personal income from the Bureau of Economic Analysis (BEA) as their measure of the business cycle (as do many studies examining the growth and variability of other tax bases). Personal income is composed of three main income components: earnings income (wages and benefits), wealth income (interest and dividend payments), and transfer payment income (welfare payments, social security payments, etc.). The use of personal income to assess the growth and variability of casino revenue (or, really, any variable) inherently assumes that all individuals spend all forms of income identically and that the three income components behave identically over time. Or, in other words, personal income does not account for the fact that different demographic groups have income from different sources (e.g., older individuals have relatively more wealth income than younger individuals; poorer individuals have relatively more income from transfer payments than do wealthier individuals), as well as the fact that the propensity for an individual to spend (on casino gaming, for example) out of each income source may be different. This idea is supported by Coughlin and Garrett (2009) who show

[3] E.g., see Dye and McGuire (1991), Sobel and Holcombe (1996), and Bruce, Fox, and Tuttle (2006).
[4] Cargill and Eadington (1978) and Babbel and Staking (1983) also examine the elasticity of casino gaming revenue.

that lottery ticket revenue responds quite differently to changes in each of the three income components compared to changes in personal income.

Previous literature on consumer expenditure**s** provides support for the above points.[5] The annual *Consumer Expenditure Survey* (CES) reveals differences in income sources for different demographic groups. For example, older individuals (> age 65) have larger income shares accounted for by wealth and transfer payment than do younger individuals; African Americans have larger income shares accounted for by earnings and transfer payments than do non-African Americans; and high school graduates have larger income shares accounted for by earnings and wealth than do those individuals without a high school diploma. Furthermore, spending patterns also differ by demographic characteristic. For example, durable and non-durable spending varies over an individual's life-cycle (Fernández-Villaverde and Krueger, 2007), and health care spending is a larger share of total expenditures for older individuals (Paulin, 2000). In addition to documenting different income sources and expenditure shares across demographic groups, numerous empirical and theoretical studies have shown that an individual's propensity to consume out of different income sources is different, i.e. an individual may spend a higher percentage of an additional dollar of wealth income than he will for, say, an additional dollar of transfer payment income.[6]

It is thus likely that an assessment of casino gaming revenue over the business cycle as measured by personal income may be muddied if the three income components behave differently over time due to economic shocks that have different impacts on an individual's income sources. As examples, a financial crisis may decrease wealth income for some individuals but increase transfer payment income for others; or, a recession may not reduce wealth income but may reduce earnings income and increase transfer payment income. Casino gaming revenue will therefore be affected

[5] See Coughlin and Garrett (2009) for a survey of the literature.
[6] See, for example, the theoretical studies by Shefrin and Thaler (1988) and Laitner (1999), and the empirical studies by Hymans and Shapiro (1976), Carriker et al. (1993), Case, Quigley, and Shiller (2005), and Baker, Nagel, and Wurgler (2006).

differently due to shocks to different income sources for those individuals who partake in casino gaming. These differences are enhanced if individuals' propensities to gamble out of different income sources are different.

In this paper we empirically estimate the growth and variability of casino gaming revenue in response to quarterly changes in earnings income, wealth income, and transfer payment income. As discussed previously, the motivation for our approach is as follows: variation in state personal income comes from the variation in each of the three personal income components and the relative size of each component; economic shocks likely affect the variation in each income component differently depending upon the type of shock; and the impact of the variation in each income component on casino gaming depends upon the income source of casino patrons and their propensity to consume out of each income source. We estimate long-run income elasticities (to assess growth) and short-run income elasticities (to assess variability) for each of the three income components. We also calculate elasticities using personal income as done by Nichols and Tosun (2008) in order examine any differences in the responsive of gaming revenue to changes in each of the three income components compared to the changes in the aggregated personal income. Separate models are estimated for each state in our sample that has commercial casino gaming, and we also separately consider revenue from table games and slot machines.[7]

We note that the previous theoretical and empirical studies on consumer expenditures do not produce specific expectations about how spending on casino gaming might differ across income sources and across states. Although there does exist national survey evidence that documents the demographic characteristics of casino patrons, the fact remains that 1) the typical casino gambler in

[7] Separate state analyses are conducted because, as demonstrated in Table 2, casino revenue and the number of slot machines and table games vary dramatically from state to state. Nevada, for example, has real quarterly revenue that averages over $3 billion, whereas in South Dakota the average is just over $22 million. In addition, slots and tables are separately analyzed because the demographic profile of slot and table players is likely to differ (Chen, et al., 2013). Moreover, Heim (2015), in an article appearing the in Washington Post, notes that casinos are removing slot machines to make room for table games in an effort to attract younger gamblers. For example, the number of slot machines in Nevada decreased from approximately 180,000 to 150,000 between 2004 and 2016. These changes may have important fiscal implications if income elasticities differ between slots and table games.

one area (say, rural Iowa) is likely to have different demographic characteristics than the typical casino gambler in another area (say, urban Pennsylvania) and 2) within each state casino patrons have different sources of income. [8] Or, more simply, different demographic groups have different income sources and the demographic characteristics of casino gamblers are different across states. In addition, our aggregate data on casino gaming revenue and consumer income prevents any specific conclusions regarding individual behavior. Given these points, we do not have strong expectations concerning our empirical results, both within a state or across states. Our goal is to see what insights and policy implications arise from modifying previous models of casino gaming revenue by disaggregating personal income into its three primary components.

2. Empirical Methodology and Data

The section describes the empirical approach and data that we use to assess the growth and variability of casino gaming revenue with respect to changes in earnings income, wealth income, and transfer payment income. Our empirical methodology follows that of Nichols and Tosun (2008), which is based on the earlier works of Sobel and Holcombe (1996), and Bruce, Fox, and Tuttle (2006). Note that casino gaming revenue is the actual tax base from which gaming tax revenue are derived, so our examination of casino gaming revenue provides a direct look at how the tax base for casino gaming varies with respect to changes in each of the three income components.

Long-Run Elasticities

The preliminary model we use to estimate the long-run elasticities is:

(1) $$R_{i,t} = \alpha_0 + \alpha_1 INC_{i,t} + \alpha_2 EINC_{i,t} + \alpha_3 WINC_{i,t} + \alpha_4 TINC_{i,t} + \alpha_5 S_t + \alpha_6 SLOTS_{i,t} + \alpha_7 TABLES_{i,t} + \alpha_8 T + \varepsilon_{i,t},$$

[8] See *Profile of the American Casino Gambler: Harrah's Survey 2006*. The survey is available at https://www.caesars.com/images/PDFs/Profile_Survey_2006.pdf (last accessed September 2017).

where $R_{i,t}$ is the natural log of casino gambling revenue for state *i* at time *t*, $INC_{i,t}$ is the natural log of state personal income, $EINC_{i,t}$ is the natural log of earnings income, $WINC_{i,t}$ is the natural log of wealth income, and $TINC_{i,t}$ is the natural log of transfer payment income. Our regressions will either include only personal income or only the three income components. S_t represents seasonal dummy variables for spring, summer, and fall to account for potential seasonal variation in casino gambling revenue. T is a linear time trend. To account for changes in the supply-side of casino gaming that may influence casino gaming revenue, the model includes the natural log of the number of slot machines ($SLOTS_{i,t}$) and the natural log of the number of tables games ($TABLES_{i,t}$).[9] The coefficients on each of the income variables will provide the respective income elasticity of demand, thus demonstrating the predicted long-run response of casino revenue to a change in income.

Diagnostics reveal that the variables in equation (1) are non-stationary and cointegrated.[10] Although having cointegrated variables allows reasonable estimation of equation (1), Stock and Watson (1993, 2007) argue that inferences may be invalid due to the non-normal distribution of the OLS estimator. Thus, we follow Nichols and Tosun (2008) and modify equation (1) to a dynamic OLS estimator with heteroskedasticity and autocorrelation consistent standard errors. This gives the final equation that we use to calculate the long-run elasticities:

$$(2)\quad R_{i,t} = \alpha_0 + \alpha_1 INC_{i,t} + \alpha_2 EINC_{i,t} + \alpha_3 WINC_{i,t} + \alpha_4 TINC_{i,t} + \alpha_5 S_t + \alpha_6 SLOTS_{i,t} + \alpha_7 TABLES_{i,t} + \alpha_8 T + \sum_{t=-m}^{n} \Delta INC_{i,t} + \sum_{t=-m}^{n} \Delta EINC_{i,t} + \sum_{t=-m}^{n} \Delta WINC_{i,t} + \sum_{t=-m}^{n} \Delta TINC_{i,t} + \varepsilon_{i,t},$$

where Δ is the change in the natural log of income. Minimizing the Bayesian Information Criterion is used to determine the optimal number of lags and leads.

[9] Unlike other tax bases, casino gambling is limited (in most states) either geographically and/or with a fixed number of gaming licenses, with the latter influencing the number of slot machines and table games available. Lagging the number of slot machines and table games by one, two, or three quarters, to avoid any potential contemporaneous endogeneity between revenue and the number of slots and tables did not qualitatively change the empirical results.

[10] The Augmented Dickey-Fuller test was used to test for stationarity and the Engle-Granger (1987) tests were used to test for cointegration.

Short-Run Elasticities

In the short-run, changes to gaming revenue may come from changes in income or an adjustment toward the long-run cointegrating relationship derived from equation (2), both of which may differ depending on whether the actual values of gaming revenue are above or below the long-run value. We therefore estimate our short-run elasticities using an error-correction model that allows for this asymmetric adjustment toward equilibrium, as done in Bruce, Fox and Tuttle (2006) and Nichols and Tosun (2008). The model we use to estimate our short-run elasticities is:

$$(3)\ \Delta R_{i,t} = \alpha_0 + \alpha_1 \Delta INC_{i,t} + \alpha_2 \Delta EINC_{i,t} + \alpha_3 \Delta WINC_{i,t} + \alpha_4 \Delta TINC_{i,t} + \alpha_5 S_t + \alpha_6 \Delta SLOTS_{i,t} + \alpha_7 \Delta TABLES_{i,t} + \alpha_8 T + \alpha_9 \varepsilon_{i,t-1} + \mu_{i,t},$$

where the variables are described as above. $\varepsilon_{i,t-1}$ is the error correction term and α_9 captures the adjustment at time *t* to the disequilibrium at time *t-1*, i.e., the difference between the last period's actual tax base and the long-run cointegrating relationship predicted by equation (2). As with our long-run elasticity regressions, our regressions to estimate the short-run elasticities will either include only personal income or only the three income components.

Data

We obtained quarterly gross commercial casino gaming revenue for nine states: Illinois, Iowa, Indiana, Colorado, Mississippi, South Dakota, Nevada, Connecticut (slot machine revenue only), and Pennsylvania. The sample period for each of the nine states is based on data availability and statistical confirmation that parameter estimates are stable over the sample period.[11] State tax

[11] The sample periods for each state are: Illinois - 1995:3 to 2016:1; Iowa - 1995:3 to 2016:1; Indiana - 1997:1 to 2016:1; Colorado - 1993:2 to 2016:1; Mississippi – 2001:4 to 2016:1; South Dakota - 1990:2 to 2016:1; Nevada -2004:1 to 2016:1; Connecticut - 1995:3 to 2016:1; Pennsylvania – 2010:3 to 2016:1. The sample periods for Mississippi and Pennsylvania correspond to the availability of slot machine revenue and table game revenue. We did not consider other states with commercial casino gaming due to limited data availability and access. For example, Missouri only has data available since 2013; Louisiana has no data on the number of slots, tables, or slot and table revenue; New Jersey only has data from 2012 to the present.

rates on casino gaming revenue (not profit, like many industries) are quite different, ranging from a top rate in Nevada of 6.75 percent to a top rate in Maryland (for some casinos) of 67 percent. Given this variation in tax rates across states, equation (2) and equation (3) are estimated separately for each of the nine states. Data on state-level casino gaming revenue, as well as data on the number of slot machines and table games in each state, were obtained from each of the nine states' gaming control boards and commissions. All casino revenue data and income data are expressed in 2016:1 dollars.

All quarterly state-level income data are from the Bureau of Economic Analysis (BEA). State personal income is our aggregate measure of income, and is the same variable used in Nichols and Tosun (2008). The official BEA classifications for the three income components we consider are: 1) net earnings by place of residence (which we call earnings income); 2) dividends, interest, and rent (which we call wealth income); and 3) personal current transfer receipts (which we call transfer payment income).[12] The contribution of each income source to overall personal income for each state is shown in Table 1, and state-specific descriptive statistics for all variables used in our empirical analysis are shown in Table 2.

Tables 1 and 2 reveal notable variation across states in both the components of personal income and the size of the casino industry. As shown in Table 1, earnings income, for example, is nearly 70% of personal income in Iowa compared to approximately 45% in South Dakota, which has the greatest percentage of wealth income (22.2%). Table 2 reveals that South Dakota has the fewest number of slot machines on average (2,817), yet slot revenue comprises nearly 90% of total casino revenue. Nevada, not surprisingly, has the greatest number of slots on average (171,350),

---

Finally, because casino revenue growth is quite high in the first few periods after casinos open, the starting dates for each state omit the early quarters of operation in order to avoid the bias that this rapid initial growth could have on the long–run elasticity estimates. We selected the starting dates using Hansen's (1992) test of model stability.

[12] See table CA05—personal income and detailed earnings by industry under "Local Area Personal Income accounts," available at https://bea.gov/regional/downloadzip.cfm (last accessed September 2017). The three income components are found in lines 45, 46, and 47.

but slot revenue makes up only 64% of casino revenue. Slot revenue is the largest source of casino revenue for all states, and, at approximately 93%, is highest for Colorado.

[Table 1]

[Table 2]

3. Empirical Results

This section presents the long-run and short-run income elasticity estimates using personal income and each of the three income components: earnings income, wealth income, and transfer payment income.[13] The long-run and short-run income elasticities for each revenue source - total casino gaming revenue, slot machine revenue, and table game revenue - are examined separately in each subsection below.

One point is worth mentioning before proceeding. Because we are interested in how each of the income-component elasticities differs from the personal-income elasticity, much of the following discussion of our results involves a comparison of the personal-income elasticity estimates with the income-component elasticity estimates, both within a state and across the states, rather than comments and interpretation of the magnitude and sign of specific elasticity estimates. It is enough to recall that a long-run income elasticity estimate greater (less) than one will reveal that casino revenue grows faster (slower) than income; and a short-run income elasticity estimate greater (less) than one will reveal that the variability of casino revenue is greater (less) than the variability of income. In addition, a positive (negative) income elasticity estimate will suggest that casino revenue is pro-cyclical (counter-cyclical) with respect to the income source.

Total Casino Gaming Revenue

The long-run and short-run income elasticity estimates for total casino gaming revenue are shown in Table 3. The long-run estimates using personal income and the three income components

[13] The complete regression results are available from the authors.

are shown in column (1) and column (2), respectively; and the short-run estimates using personal income and the three income components are shown in column (3) and column (4), respectively.

[Table 3]

A comparison of the income-component elasticities with the personal income elasticity reveals that the personal-income elasticity estimate is quite different than the elasticity estimates for earnings income, wealth income, and transfer payment income, suggesting that the use of personal income masks an understanding of how casino revenue in each state responds to that state's business cycle. The long-run elasticities using personal income are greater than unity (ranging from 1.49 to 3.41) and are statistically significant in seven of the eight states, a finding that is generally consistent with that of Nichols and Tosun (2008). A more detailed picture emerges, however, when looking at the three income-component elasticities. The long-run earnings-income elasticities are positive and significant for each of the eight states (ranging from 0.68 to 2.99), but for each state, with the exception of Colorado and Indiana, the estimate is qualitatively different than the personal income elasticity estimate. The wealth-income elasticities are significant in four states, with one positive wealth-income elasticity (Nevada, 0.22) and three negative wealth-income elasticities (Indiana, -0.69; Iowa, -0.48; South Dakota, -1.15); again revealing differences that are masked by the personal-income elasticities in these states. Finally, growth in transfer payment income, wealth income, and earnings income all have different and significant effects on casino revenue in South Dakota, where the insignificant personal-income elasticity masks these differences.

In general, these results suggest that earnings income is the predominant driver of each state's business cycle, but the effect of growth of earnings income on the growth of casino revenue is different across the states. Wealth income affects casino revenue growth in some of the states, where the effect is negative in three states and positive in one state. Not only do the income-component elasticities reveal the differences in each state's business cycle and the varying impact

that these differences have on casino revenue, the regressions that consider income components better explain the total variation in casino revenue over time as evident from the higher adjusted R^2 values in seven of the eight states.

Several conclusions emerge from the short-run income elasticity estimates shown in column (3) and column (4) of Table 3. The short-run personal-income elasticity is positive and significant in Colorado, Indiana, Mississippi, and Nevada (ranging from 0.67 to 1.72). These results too are generally consistent with those of Nichols and Tosun (2008). The short-run income-component elasticities, however, reveal differences compared to the short-run personal-income elasticities in these states. For example, the short-run earnings-income elasticity is significant and different than the personal-income elasticity in Colorado, Indiana, and Mississippi, and the short-run transfer-payment income elasticity is positive and significant in Mississippi. Furthermore, of four states having a statistically insignificant short-run personal-income elasticity (Illinois, Iowa, Pennsylvania, South Dakota), several of the short-run income-component elasticities are statistically significant in these states - earnings and wealth in Pennsylvania; earnings and transfer payments in South Dakota. Thus, as with the long-run results, the consideration of income components instead of personal income reveals important differences in the drivers of each state's business cycle and the impact of this business cycle on casino revenue. The inclusion of short-run income-component elasticities also improves model fit - the regressions containing the income-component elasticities have higher adjusted R^2 values in six of the eight states.

There are several main conclusions from our results thus far. First, within a given state, we find that the income-component elasticities are quite different than the personal-income elasticity, and that the growth and variability in earnings income is most-often the dominant driver of casino revenue compared to wealth income and transfer-payment income. Second, the magnitude and sign of each income-component elasticity are quite different across the states; specifically, the demand for casino gaming is earnings-income-inelastic in one state (Nevada) and earnings-income-

elastic in the other states. Third, the greater number of overall significant long-run elasticity estimates suggests that casino revenue is less responsive to short-run income changes than it is to the long-run growth in each of the three income components.

Slot Machine Revenue

As noted above, casinos have recently begun substituting table games for slot machines in order to attract younger gamblers. To understand the potential fiscal implications of this change, we estimate elasticities for slot and table revenue separately. The long-run and short-run income elasticity estimates for slot machine revenue are shown in Table 4. The long-run income elasticity estimates are shown in the first two columns of Table 4. Eight of the nine long-run personal-income elasticities are significant and greater than unity (ranging from 1.32 to 3.59). However, as with the total revenue results presented earlier, the personal-income elasticities mask differences in the behavior of individual income components. The long-run earning-income elasticities in all nine states (ranging from 0.84 to 3.17) are positive and significant, and are, in most states, different than the long-run personal-income elasticity estimate. Also, the wealth-income elasticity is significant in five of the nine states, with Colorado, Indiana, Iowa, and South Dakota each having a negative wealth-income elasticity (ranging from -0.30 to -0.98) and Nevada having a positive long-run wealth-income elasticity of about 0.20. Growth in transfer payment income, wealth income, and earnings income are all statistically significant yet have different effects on slot machine revenue in South Dakota, where the insignificant personal-income elasticity would suggest income growth has no effect on slot machine revenue growth. Finally, the regressions containing the income-component elasticities have greater explanatory power than the regression containing only personal income in seven of the nine states.

[Table 4]

The short-run elasticity estimates are shown in the last two columns of Table 4. The short-run personal-income elasticity is positive and significant in Colorado, Connecticut, Illinois, Indiana, Mississippi, and Nevada (ranging from 0.85 to 1.73). The short-run income-component elasticities, however, reveal differences compared to the short-run personal-income elasticities in these states. For example, the short-run earnings-income elasticity is significant and different than the short-run personal-income elasticity in Colorado, Connecticut, Indiana, Mississippi and Nevada; and the short-run transfer-payment income elasticity is positive and significant in Indiana and South Dakota. The inclusion of income-component elasticities also improves model fit, with the regressions containing the short-run income-component elasticities having higher adjusted R^2 values in seven of the eight states.

Table Game Revenue

The long-run and short-run income elasticity estimates for table revenue are shown in Table 5. The long-run income elasticity estimates are shown in the first two columns of Table 5. The long-run personal-income elasticities are statistically significant and greater than unity (ranging from 1.51 to 3.92) in five of the eight states – Illinois, Indiana, Iowa, Mississippi, and Nevada. As before, a more detailed picture emerges when looking at the three income-component elasticities. The long-run earnings-income elasticities are positive and significant in four of these five states, but for each state the earnings-income elasticity estimate is different than the personal income elasticity estimate. Furthermore, the earnings-income elasticity is positive and statistically significant in Colorado and South Dakota, whereas the personal-income elasticity is not statistically significant. The long-run wealth-income elasticities are significant in three states (Colorado, Indiana, South Dakota), with only Indiana also having a statistically significant long-run personal-income elasticity estimate. Finally, the long-run transfer-payment income elasticity is negative and significant in three states (Illinois, Iowa, and Mississippi) and positive and significant in Indiana,

with point estimates again being different than the positive and statistically significant long-run personal-income elasticity estimate.

[Table 5]

The short-run elasticity estimates are shown in the last two columns of Table 5. The short-run personal-income elasticity is statistically significant only in Indiana. However, the remaining seven statistically insignificant short-run personal-income elasticities mask statistically significant underlying behavior of income components in several of these states: The short-run earnings-income elasticity is positive and significant in Mississippi and Pennsylvania; the short-run wealth-income elasticity is negative and significant in Colorado and Pennsylvania; and the short-run transfer-payment income elasticity is negative in Mississippi. For all eight states, the adjusted R^2 is higher in the models that contain the income-component elasticities than the models that contain only the personal-income elasticity.

Conclusion

Previous research on the growth and variability of casino revenue, as well as the growth and variability of other tax revenue sources like income and retail sales, use personal income as the measure of the business cycle. However, there exists both theoretical and empirical evidence from the consumer expenditure literature that different demographic groups have income from different sources, and that the propensity for an individual to spend out of each income source may be different. The use of personal income to assess the growth and variability of casino revenue therefore inherently assumes that all individuals spend all forms of income identically and that the components of personal income behave identically over time. Thus, the use of personal income to assess the growth and variability of casino revenue may mask the important drivers of each state's business cycle and the differing effects these drivers may have on casino revenue across states.

In this paper we empirically estimated the growth and variability of state-level casino gaming revenue in response to changes in earnings income, wealth income, and transfer payment income. The elasticities for each of these income components were compared with the traditional personal-income elasticity estimates. The results revealed significant differences in the drivers of each state's business cycle that are not captured by the use of personal income. In general, we find that in some states the income-component elasticities have different magnitudes and signs than the personal-income elasticity estimate, whereas in other states we find that the personal-income elasticity is not statistically significant (thus suggesting no short-run and long-run relationship with the business cycle) but that the income component-elasticities are statistically significant. Short-run and long-run changes in earnings income appears to the be main driver of each state's business cycle and resulting impact on casino revenue, but in several states the growth and variability in wealth income and transfer-payment income are also important, sometimes having opposing effects.

Our results demonstrate that it is important to consider the components of personal income, not just personal income. Particularly, the growth and variability of earnings income is a key determinant of the growth and variability of total casino revenue. Our results also demonstrate the importance of considering the components of total casino revenue as well. Specifically, while both slot machine and table game revenue are influenced more by earnings income than other sources of income, the elasticity estimates of earnings income for table games in Colorado, Illinois, Iowa, Nevada, Pennsylvania and South Dakota are qualitatively smaller, suggesting table game revenue grows more slowly relative to slot machine revenue with respect to earnings income. Changing demographics may alter the proportion of personal income derived from various sources and induce casinos to alter their mix of slot and table games. For states reliant on casino tax revenue, it is important to understand how changing components of income and the industry's mix of table and slot games influence the growth and variability of casino tax revenue.

Our results have implications for casino gaming research, research on the growth and variability of tax revenue in general, and public policy. Forecasting casino gaming revenue could be improved by incorporating income components rather than personal income and by separating slot and table revenue. Not only would this likely provide clearer evidence on those income components that drive casino revenue and its components over time, it would also allow one to better examine the influence of more specific public policy changes (such as a policy toward changing transfer payments or increasing taxes on earning) and different economic shocks on casino gaming. In addition, our results also suggest that previous studies that have explored state-level growth and variability of income tax revenue and sales tax revenue over the business cycle could be revisited and enhanced with the inclusion of income components, thus possibly altering our understanding of how income and sales tax bases vary over the business cycle.

Disclosure Statement

The authors have no financial arrangements that might give rise to conflicts of interest with respect to the research reported in this paper.

References

Babbel, David F. and Kim B. Staking. "An Engel Curve Analysis of Gambling and Insurance in Brazil." *Journal of Risk and Insurance* 50, no. 4 (December 1983): 688-96.

Baker, Malcom, Stefan Nagel, and Jeffrey Wurgler. "The Effects of Dividends on Consumption." National Bureau of Economic Research Working Paper, 2006, Cambridge, MA.

Bruce, Donald, William F. Fox, and M.H. Tuttle. "Tax Base Elasticities: A Multi-State Analysis of Long-Run and Short-Run Dynamics." *Southern Economic Journal* 73, no. 2 (October 2006): 315-41.

Cargill, Thomas F. and William R. Eadington. "Nevada's Gaming Revenues: Time Characteristics and Forecasting." *Management Science* 24, no. 12 (August 1978): 1221-30.

Case, Karl E., John M. Quigley, and Robert J. Shiller. "Comparing Wealth Effects: The Stock Market versus the Housing Market." *Advances in Macroeconomics* 5, no. 1 (May 2005): 1-32.

Carriker, Gordon, Michael Langemeier, Ted Schroeder, and Allen Featherstone. "Propensity to Consume Farm Family Disposable Income from Separate Income Sources." *American Journal of Agricultural Economics* 75, no. 3 (August 1993): 739-44.

Chen, Sandy C., Stowe Shoemaker, Dina Marie V. Zemke. "Segmenting Slot Machine Players: A Factor-Cluster Analysis." *International Journal of Contemporary Hospitality Management* 25, no 1. (2013), 23-48.

Dye, Richard F. and Theresa J. McGuire. "Growth and Variability of State Individual Income and General Sales Taxes." *National Tax Journal* 44, no. 1 (March 1991): 55-66.

Engle, Robert and Clive Granger. "Cointegration and Error Correction: Representation, Estimation, and Testing." *Econometrica* 55, no. 2 (March 1987): 251-76.

Fernández-Villaverde, Jesús and Dirk Krueger. "Consumption Over the Life Cycle: Factors from Consumer Expenditure Survey Data." *Review of Economics and Statistics* 89, no. 3 (August 2007): 552-65.

Garrett, Thomas A. and Cletus C. Couglin. "Income and Lottery Sales Transfers Trump Income from Work and Wealth." *Public Finance Review* 37, no. 4 (July 2009): 447-69.

Hansen, Bruce. "Testing for Parameter Instability in Linear Models." *Journal of Policy Modeling* 14, no. 4 (August, 1992): 517–33.

Heim, Joe. "Casinos Bet on Growth in Table Games, Removing Slot Machines to Make Room." *Washington Post*, June 7, 2015. Available at https://www.washingtonpost.com/local/maryland-casinos-shed-slots-as-demand-grows-for-table-games/2015/06/07/e6c0fbb8-0b0c-11e5-95fd-d580f1c5d44e_story.html?utm_term=.cd7d76e28ad3 Accessed November 6, 2017.

Hymans, Saul H. and Harold T. Shapiro. "The Allocation of Household Income to Food Consumption." *Journal of Econometrics* 4, no. 2 (May 1976): 167-88.

Laitner, John. "Means-tested Public Assistance and the Demand for State Lottery Tickets." *Review of Economic Dynamics* 2, no. 4 (January 1999): 273-90.

Nichols, Mark W. and Mehmet Serkan Tosun. "The Income Elasticity of Gross Casino Revenue: Short-Run and Long-Run Estimates." *National Tax Journal* 61, no. 4 (December 2008): 635-52.

Paulin, Geoffrey D. "Expenditure Patterns of Older Americans, 1984-97." *Monthly Labor Review* 123 (2000): 3-28.

Shefrin, Hersh M. and Richard H. Thaler. "The Behavioral Life-Cycle Hypothesis." *Economic Inquiry* 26, no. 4 (October 1988): 609-43.

Sobel, Russell S. and Randle G. Holcombe. "Measuring the Growth and Variability of Tax Bases Over the Business Cycle." *National Tax Journal* 49, no. 4 (December 1996): 535-52.

Stock, James and Mark Watson. "A Simple Estimator of Cointegrating Vectors in Higher-Order Integrated Systems." *Econometrica* 61, no. 4 (July 1993): 783-820.

Stock, James and Mark Watson. *Introduction to Econometrics*. Boston: Addison Wesley, 2007.

Table 1 - Income Components as a Percentage of Personal Income

State	Earnings Income (%)	Wealth Income (%)	Transfer Income (%)
Illinois	55.3	18.7	13.7
Iowa	69.7	18.2	15.7
Indiana	53.2	15.9	17.1
Colorado	54.8	19.9	11.1
Mississippi	46.8	15.2	22.8
South Dakota	44.9	22.2	14.4
Nevada	51.6	21.7	14.2
Connecticut	50.1	20.0	12.1
Pennsylvania	48.8	16.8	19.2

Note: Percentages are averages over the sample period (see text for sample dates) and do not sum to one.

Table 2 - Descriptive Statistics

	Observations	Mean	Standard Deviation
COLORADO			
Casino Gaming Revenue	92	196,391.9	34,386.2
Slot Machine Revenue	92	183,596.4	35,176.9
Table Revenue	92	12,795.5	5,705.7
Personal Income	92	210,427.5	39,180.7
Earnings Income	92	115,765.0	19,040.9
Wealth Income	92	41,849.3	7,996.7
Transfer Payment Income	92	22,992.5	7,448.7
Number of Slots, Table Games	92	14,372/242	1,612/53
CONNECTICUT			
Casino Gaming Revenue			
Slot Machine Revenue	83	400,083.0	96,804.3
Table Revenue		-------	-------
Personal Income	83	210,321.1	21,896.5
Earnings Income	83	106,201.0	6,577.9
Wealth Income	83	41,870.5	6,214.9
Transfer Payment Income	83	25,231.9	4511.8
Number of Slots	83	33,524	8,154
ILLINOIS			
Casino Gaming Revenue	83	469,203.4	88,457.3
Slot Machine Revenue	78	392,567.1	89,115.9
Table Revenue	78	77,755.8	24,129.9
Personal Income	83	578,477.3	39,790.6
Earnings Income	83	321,203.7	18,064.25
Wealth Income	83	108,441.6	7,435.4
Transfer Payment Income	83	78,067.3	14,982.9
Number of Slots, Table Games	78	9,810/286	955/70
INDIANA			
Casino Gaming Revenue	77	653,219.4	113,798.7
Slot Machine Revenue	77	542,645.2	107,584.1
Table Revenue	77	110,574.2	16,771.3
Personal Income	77	243,437.5	14,434.5
Earnings Income	77	130,135.2	4,620.5
Wealth Income	77	39,020.6	2,070.1
Transfer Payment Income	77	40,665.3	9,366.7
Number of Slots, Table Games	77	18,404/668	3,690/64
IOWA			
Casino Gaming Revenue	83	224,371.9	39,647.2
Slot Machine Revenue	83	198,091.6	43,834.9
Table Revenue	83	26,280.3	5,657.2
Personal Income	83	121,617.9	13,319.6
Earnings Income	83	60,591.2	5,116.7
Wealth Income	83	22,364.1	1,653.6
Transfer Payment Income	83	18,819.9	3,785.3
Number of Slots, Table Games	83	10,143/311	2,781/43
MISSISSISSPI			
Casino Gaming Revenue	58	702,989.0	145,709.8
Slot Machine Revenue	58	587,985.1	120,554.2
Table Revenue	58	102,688.9	26,088.3
Personal Income	58	98,124.3	5,719.7
Earnings Income	58	44,985.5	1,247.9

Wealth Income	58	14,661.5	1,285.7
Transfer Payment Income	58	23,268.9	3,319.9
Number of Slots, Table Games	58	33,672/858	4,770/135
NEVADA			
Casino Gaming Revenue	49	3,099,184.0	373,973.2
Slot Machine Revenue	49	1,998,667.0	292,474.5
Table Revenue	49	1,100,517.1	118,726.7
Personal Income	49	114,387.6	5,704.9
Earnings Income	49	59,101.6	3,859.9
Wealth Income	49	24,870.0	2,107.0
Transfer Payment Income	49	16,071.8	3,191.9
Number of Slots, Table Games	49	171,350/5,945	10,755/171
PENNSYLVANIA			
Casino Gaming Revenue	23	791,936.0	29,736.1
Slot Machine Revenue	23	612,604.6	30,413.2
Table Revenue	23	179,331.5	25,532.7
Personal Income	23	608,966.7	17,129.5
Earnings Income	23	295,060.8	9,484.6
Wealth Income	23	102,189.3	5,942.2
Transfer Payment Income	23	118,324.5	2,632.2
Number of Slots, Table Games	23	26,399/1,016	314/132
SOUTH DAKOTA			
Casino Gaming Revenue	104	22,175.9	6,275.2
Slot Machine Revenue	104	19,959.4	5,909.8
Table Revenue	104	2,112.6	630.5
Personal Income	104	30,237.5	6,020.9
Earnings Income	104	13,617.9	2,483.5
Wealth Income	104	6,740.4	1,261.3
Transfer Payment Income	104	4,327.4	1,079.9
Number of Slots, Table Games	104	2,817/85	675/18

Notes: All revenue and income data are in thousands of real 2016:q1 dollars. Data on slot and table revenue for Illinois are missing between 1997:q3 and 1998:q3.

Table 3: Long-Run and Short-Run Income Elasticity Estimates of Total Casino Gambling Revenue[a]

State	Income Measure	Long-Run Elasticity	Long-Run Elasticity	Short-Run Elasticity	Short-Run Elasticity
Colorado (1993:q2-2016q1)					
	Personal Income	1.486*** (0.203)		0.897*** (0.335)	
	Earnings Income		1.427*** (0.169)		0.536* (0.308)
	Wealth Income		-0.357 (0.242)		0.207 (0.193)
	Transfer Income		0.211 (0.327)		0.041 (0.137)
Adj. R^2		0.907	0.908	0.854	0.857
Illinois (1995:q3-2016:q1)					
	Personal Income	3.322*** (0.497)		0.727 (0.487)	
	Earnings Income		1.847*** (0.621)		0.131 (0.414)
	Wealth Income		0.119 (0.258)		0.182 (0.262)
	Transfer Income		-0.249 (0.230)		0.162 (0.179)
Adj. R^2		0.813	0.837	0.424	0.407
Indiana (1997:q1-2016q1)					
	Personal Income	3.040*** (0.456)		1.720*** (0.396)	
	Earnings Income		2.993*** (0.383)		1.152*** (0.319)
	Wealth Income		-0.685** (0.260)		0.127 (0.188)
	Transfer Income		0.083 (0.276)		0.367** (0.150)
Adj. R^2		0.804	0.881	0.692	0.704
Iowa (1995:q3-2016:q1)					
	Personal Income	1.643** (0.781)		0.238 (0.335)	
	Earnings Income		2.018*** (0.307)		0.376 (0.471)
	Wealth Income		-0.483** (0.226)		0.069 (0.197)
	Transfer Income		-0.316 (0.343)		0.004 (0.170)
Adj. R^2		0.837	0.918	0.714	0.706
Mississippi (2001:q4-2016q1)					
	Personal Income	3.407*** (0.559)		1.137** (0.539)	
	Earnings Income		2.491*** (0.444)		1.801*** (0.526)
	Wealth Income		0.157 (0.121)		0.247 (0.179)
	Transfer Income		0.044 (0.192)		0.264* (0.149)
Adj. R^2		0.936	0.951	0.854	0.883

Nevada (2004:q1-2016:q1)					
	Personal Income	1.515*** (0.130)		0.671** (0.331)	
	Earnings Income		0.677*** (0.142)		0.479 (0.337)
	Wealth Income		0.226*** (0.071)		0.067 (0.179)
	Transfer Income		-0.045 (0.106)		0.0289 (0.144)
Adj. R^2		0.932	0.933	0.607	0.660
Pennsylvania (2010:q3-2016:q1)					
	Personal Income	1.756*** (0.519)		-0.640 (0.412)	
	Earnings Income		1.406*** (0.448)		0.871* (0.480)
	Wealth Income		-0.098 (0.207)		-0.342** (0.154)
	Transfer Income		0.467 (0.647)		-0.030 (0.488)
Adj. R^2		0.789	0.683	0.783	0.809
South Dakota (1990:q2-2016:q1)					
	Personal Income	-0.002 (0.401)		0.162 (0.484)	
	Earnings Income		2.133*** (0.447)		1.370* (0.718)
	Wealth Income		-1.152*** (0.269)		-0.445 (0.406)
	Transfer Income		0.399* (0.234)		0.575* (0.303)
Adj. R^2		0.907	0.929	0.921	0.937

[a] *, **, and *** represent statistical significance from zero at the 10, 5, and 1 percent level, respectively. Newey-West standard errors in parentheses. All time-series regressions include number of slot machines and table games as control variables, with the exception of Connecticut where no data on number of table games or table revenue are available. Additional control variables include a trend, quarterly dummy variables, and various lags and/or leads of the income measures necessary for the Dynamic OLS regression to minimize the Bayesian Information Criteria.

Table 4: Long-Run and Short-Run Income Elasticity Estimates of Slot Machine Gambling Revenue[a]

State	Income Measure	Long-Run Elasticity	Long-Run Elasticity	Short-Run Elasticity	Short-Run Elasticity
Colorado (1993:q2-2016q1)					
	Personal Income	1.569*** (0.200)		0.989*** (0.336)	
	Earnings Income		1.442*** (0.171)		0.524* (0.311)
	Wealth Income		-0.276 (0.241)		0.282 (0.194)
	Transfer Income		0.229 (0.323)		0.060 (0.137)
Adj. R^2		0.925	0.942	0.858	0.860
Connecticut (1995:q3-2016:q1)					
	Personal Income	2.971*** (0.367)		1.054*** (0.363)	
	Earnings Income		2.698*** (0.183)		0.569** (0.283)
	Wealth Income		-0.300*** (0.097)		0.200 (0.203)
	Transfer Income		-0.141 (0.118)		0.261 (0.202)
Adj. R^2		0.940	0.976	0.802	0.819
Illinois (1995:q3-2016:q1)					
	Personal Income	3.592*** (0.469)		1.096** (0.495)	
	Earnings Income		2.317*** (0.597)		0.370 (0.424)
	Wealth Income		0.117 (0.273)		0.241 (0.269)
	Transfer Income		0.009 (0.261)		0.245 (0.184)
Adj. R^2		0.853	0.866	0.460	0.486
Indiana (1997:q1-2016q1)					
	Personal Income	3.389*** (0.493)		1.726*** (0.427)	
	Earnings Income		3.174*** (0.409)		1.001*** (0.347)
	Wealth Income		-0.715** (0.295)		0.225 (0.205)
	Transfer Income		-0.007 (0.289)		0.329** (0.163)
Adj. R^2		0.841	0.900	0.704	0.710
Iowa (1995:q3-2016:q1)					
	Personal Income	1.734** (0.839)		0.203 (0.329)	
	Earnings Income		2.499*** (0.369)		0.469 (0.461)
	Wealth Income		-0.545** (0.236)		0.117 (0.193)
	Transfer Income		-0.217 (0.359)		0.042 (0.165)
Adj. R^2		0.872	0.941	0.726	0.722

Mississippi (2001:q4-2016q1)					
	Personal Income	2.949*** (0.603)		1.172** (0.482)	
	Earnings Income		2.351*** (0.439)		2.217*** (0.477)
	Wealth Income		0.179 (0.116)		0.228 (0.163)
	Transfer Income		-0.091 (0.260)		0.0327 (0.138)
Adj. R^2		0.906	0.938	0.889	0.906
Nevada (2004:q1-2016:q1)					
	Personal Income	1.523*** (0.089)		0.845*** (0.199)	
	Earnings Income		0.836*** (0.098)		0.675*** (0.206)
	Wealth Income		0.198*** (0.054)		0.152 (0.109)
	Transfer Income		0.029 (0.077)		0.039 (0.086)
Adj. R^2		0.984	0.983	0.749	0.769
Pennsylvania (2010:q3-2016:q1)					
	Personal Income	1.317* (0.657)		-0.043 (0.538)	
	Earnings Income		1.387** (0.639)		0.738 (0.574)
	Wealth Income		0.014 (0.273)		-0.253 (0.180)
	Transfer Income		0.263 (0.712)		-0.092 (0.587)
Adj. R^2		0.778	0.775	0.838	0.825
South Dakota (1990:q2-2016:q1)					
	Personal Income	0.203 (0.454)		0.737 (0.727)	
	Earnings Income		2.796*** (0.701)		1.527 (1.086)
	Wealth Income		-0.978*** (0.315)		-0.011 (0.606)
	Transfer Income		0.792** (0.367)		0.794* (0.458)
Adj. R^2		0.846	0.869	0.864	0.892

[a] A *, **, and *** represent statistical significance from zero at the 10, 5, and 1 percent level, respectively. Newey-West standard errors in parentheses. All time-series regressions include number of slot machines and table games as control variables, with the exception of Connecticut where no data on number of table games or table revenue are available. Additional control variables include a trend, quarterly dummy variables, and various lags and/or leads of the income measures necessary for the Dynamic OLS regression to minimize the Bayesian Information Criteria.

Table 5: Long-Run and Short-Run Income Elasticity Estimates of Table Game Gambling Revenue[a]

State	Income Measure	Long-Run Elasticity	Long-Run Elasticity	Short-Run Elasticity	Short-Run Elasticity
Colorado (1993:q2-2016q1)					
	Personal Income	0.129 (0.343)		-0.128 (0.591)	
	Earnings Income		0.961*** (0.212)		0.766 (0.509)
	Wealth Income		-1.245*** (0.287)		-0.712** (0.320)
	Transfer Income		0.045 (0.437)		-0.289 (0.227)
Adj. R^2		0.936	0.960	0.756	0.793
Illinois (1995:q3-2016:q1)					
	Personal Income	3.197*** (0.782)		-0.724 (0.705)	
	Earnings Income		1.156*** (0.732)		-0.514 (0.555)
	Wealth Income		-0.371 (0.259)		-0.193 (0.352)
	Transfer Income		-1.485*** (0.279)		-0.395 (0.242)
Adj. R^2		0.837	0.906	0.261	0.403
Indiana (1997:q1-2016q1)					
	Personal Income	2.531*** (0.464)		2.111*** (0.598)	
	Earnings Income		2.986*** (0.374)		2.062*** (0.453)
	Wealth Income		-0.555*** (0.185)		-0.253 (0.267)
	Transfer Income		0.489* (0.272)		0.6112*** (0.215)
Adj. R^2		0.689	0.816	0.453	0.541
Iowa (1995:q3-2016:q1)					
	Personal Income	2.082** (0.923)		0.325 (0.538)	
	Earnings Income		0.827* (0.479)		0.161 (0.727)
	Wealth Income		-0.031 (0.907)		-0.108 (0.302)
	Transfer Income		-1.034** (0.402)		-0.401 (0.266)
Adj. R^2		0.808	0.872	0.567	0.575
Mississippi (2001:q4-2016q1)					
	Personal Income	3.923*** (0.846)		-0.828 (0.561)	
	Earnings Income		2.254*** (0.473)		1.804*** (0.530)
	Wealth Income		0.212 (0.135)		-0.0177 (0.176)
	Transfer Income		-0.840*** (0.171)		-0.557*** (0.151)
Adj. R^2		0.922	0.962	0.847	0.887

Nevada (2004:q1-2016:q1)					
	Personal Income	1.514*** (0.268)		0.285 (0.745)	
	Earnings Income		0.409 (0.398)		0.233 (0.721)
	Wealth Income		0.281 (0.285)		-0.052 (0.376)
	Transfer Income		-0.156 (0.297)		0.026 (0.303)
Adj. R^2		0.615	0.615	0.593	0.669
Pennsylvania (2010:q3-2016:q1)					
	Personal Income	1.523 (1.125)		0.314 (1.054)	
	Earnings Income		1.531 (1.333)		1.794* (0.911)
	Wealth Income		-0.520 (0.409)		-0.747** (0.332)
	Transfer Income		1.164 (1.039)		0.052 (0.966)
Adj. R^2		0.939	0.937	0.625	0.758
South Dakota (1990:q2-2016:q1)					
	Personal Income	-0.682 (0.713)		-0.937 (0.658)	
	Earnings Income		1.365* (0.825)		0.126 (1.091)
	Wealth Income		-2.419*** (0.480)		-0.933 (0.646)
	Transfer Income		-0.774 (0.525)		0.379 (0.453)
Adj. R^2		0.805	0.852	0.798	0.802

[a] A *, **, and *** represent statistical significance from zero at the 10, 5, and 1 percent level, respectively. Newey-West standard errors in parentheses. All time-series regressions include number of slot machines and table games as control variables, with the exception of Connecticut where no data on number of table games or table revenue are available. Additional control variables include a trend, quarterly dummy variables, and various lags and/or leads of the income measures necessary for the Dynamic OLS regression to minimize the Bayesian Information Criteria.