

AN ECONOMIC ANALYSIS OF DROUGHT CONDITIONS ON LAKE HARTWELL AND THE SURROUNDING REGION

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Background

Lake Hartwell is a United States Army Corps of Engineers (USACE) impoundment of the Savannah River constructed between 1955 and 1963 as a part of a flood control, navigation and hydropower project on the border of South Carolina and Georgia. In addition to the original reasons for its creation, the lake is increasingly used today for tourism and recreational purposes, as well as issues related to water quality, water supply, and fish and wildlife management.

As economic activity on and around the lake has intensified, the perceived importance of the lake as a driver of economic activity has correspondingly strengthened. Increased interest in Lake Hartwell has resulted in the creation of a number of stakeholder associations with the objective of protecting the economic interests of lake property owners and lake-oriented businesses. These stakeholders have increasingly brought their economic concerns into discussions of lake management. The multiyear regional droughts of 1999 to 2003 and 2006 to 2009 escalated stakeholder concerns about the economic impact of prolonged low lake levels on lake-oriented real estate and businesses. As drought conditions worsened throughout 2007 and 2008, stakeholders increasingly called for policy changes that would take greater account of the economic and tourism concerns of lake stakeholders.

This research documents the unique relationship between real estate activity and Lake Hartwell lake levels for the six county region bordering the lake. While this research is a portion of a much larger analysis documenting the economic impacts of drought conditions on the region, this piece of the project is informative for understanding the complexities of the relationship between general economic activity and lake levels.

Drought and Lake Levels

Lake Hartwell is at summer full pool at 660 feet above mean sea level (MSL). Lake levels vary over time under normal Corps lake management practices. But during long droughts Lake Hartwell has remained well below full pool for months at a time (Figure 1). For example, the lake was below full pool over the entire 30 month period between January 2007 and June 2009. The lake hit its lowest level of the recent drought in December 2008, 21 feet below full pool. As the drought worsened throughout 2007 and 2008, public boat ramps, private docks and marinas dried up. As the drought worsened, lake area stakeholders called for changes in the USACE's Drought Management Action Plan. As outflows were reduced according to the Drought Management Plan, environmental and power stakeholders argued against further restrictions on outflows.

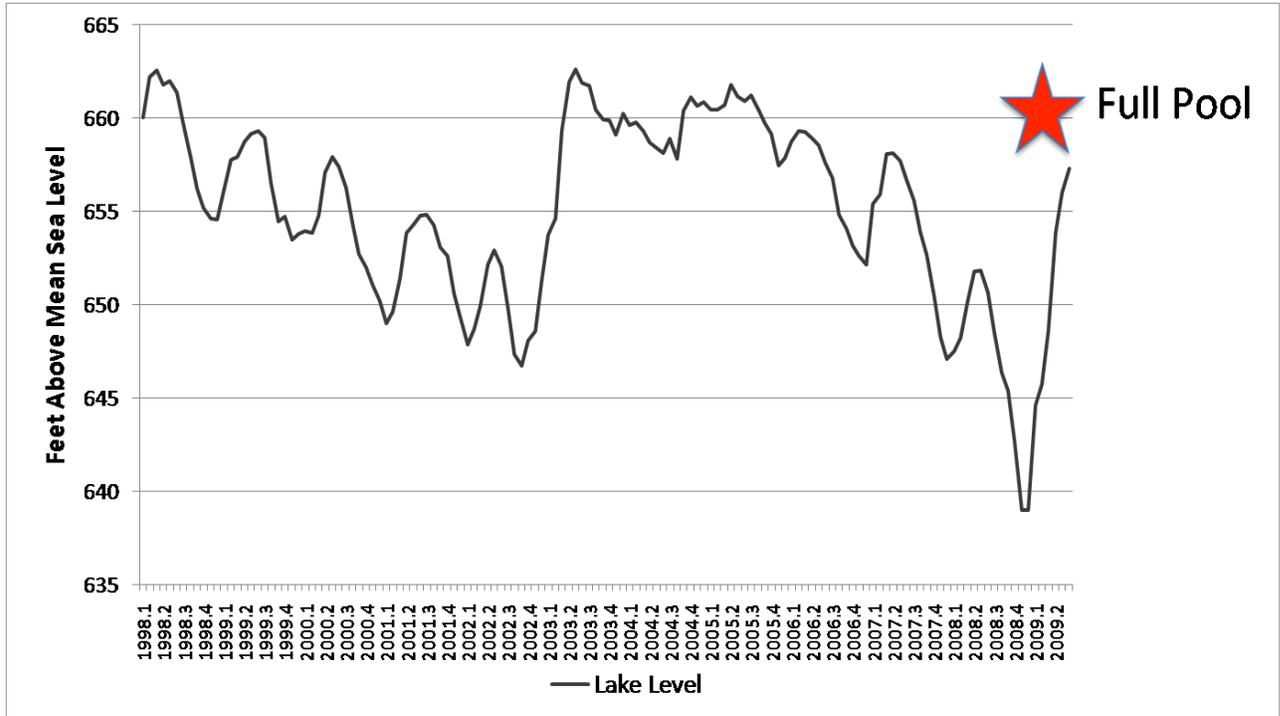


Figure 1: Lake Hartwell average monthly lake levels in feet above mean sea level.
 Source: United States Army Corps of Engineers, <http://www.usace.army.mil/>

Literature Review

One of the most relevant studies for this project is The University of Tennessee’s Center for Business and Economic Research *Economic and Fiscal consequences of TVA’s Draw Down of Cherokee and Douglas Lakes* completed in October 1998. This analysis used three different methodological approaches to estimate the overall economic impacts of higher lake levels. The first methodology estimated the increase in expenditures from non-resident visitors in response to higher lake levels. Using survey data, estimates indicate that higher lake levels will result in an increase of \$1 million to \$1.8 million in nonresident expenditures. The resulting employment is estimated to generate total personal income in the region of between \$588,000 and \$976,000.

Using a statistical model relating county-level retail sales to lake level, the second approach estimated higher lake levels would create \$1.6 million in additional retail sales in the local region, generating 43 annual full-time positions and \$700,000 in personal income. The third model used a survey of area retail businesses to estimate the direct impacts of higher lake levels. Based on survey responses, higher lake levels in August and September were estimated to increase area spending by \$7 million through the first of October supporting 351 annual full time positions with an income impact of \$4.2 million. These three different approaches all suggest that higher lake levels will generate positive economic benefit to the region and the authors conclude that their analysis is a lower bound estimate of the economic impacts of higher lake levels. (University of Tennessee, Center for Business and Economic Research, 1998)

METHODOLOGY AND DATA COLLECTION

A thorough economic impact analysis attempts to measure direct, indirect and induced economic impacts of specific types of economic activity. Because this research is a portion of a much larger study measuring

the overall economic impact of drought on the six counties, this study only addresses one measure of economic activity. The essential independent variable is Lake Hartwell’s average monthly level measured in feet above MSL. Local stakeholders identified real estate transactions as an important measure of economic activity and were thus chosen as the dependent variable for this analysis. Data was collected for monthly lake level from 1998-2008 and for monthly real estate transactions for all counties from 1998-2008.

To estimate the relationship between real estate transactions and drought conditions both linear regression and structural break regression models were utilized to characterize this relationship. Independent variables for seasonal variation and general economic conditions were also used to control for other key determinants of real estate activity.

Results

Simple observation of total lake access real estate transactions against Lake Hartwell water levels suggests there may be a relationship between the two. However, real estate transactions are possibly influenced by a host of other economic and demographic variables. The technique selected to examine the strength of the statistical relationship between sales of lake access real estate and lake level is linear regression analysis with structural breaks. Structural break models allow for the analysis of independent variables that are partitioned into different intervals or clustered groups. The intervals are bounded by “breakpoints,” which for this analysis are represented as different lake levels in feet below Lake Hartwell’s full pool (BFP).

Structural breakpoints from one foot below full pool to 20 feet below full pool were tested for their statistical significance. In addition, models with more than one breakpoint were also tested. For each model, a Chow test was used to confirm that lake level is a variable that is more accurately modeled with this regression technique, as opposed to a single linear model. The results of this analysis illustrate that the relationship between lake level and real estate transactions is unique for each county bordering Lake Hartwell (Table 2). Four counties had at least one statistically significant structural breakpoint. Three counties had at least one example of two statistically significant structural breakpoints.

Single Breakpoint Models

Anderson County had two models with different, but statistically significant breakpoints. The first model estimates that when the Lake Hartwell is seven feet or more BFP, 2.15 real estate transactions are lost for every foot decline in lake level in this range. However, when the lake is between full pool and four feet below full pool, for every foot decline in lake level Anderson County gains 3.65 real estate transactions. These results reveal a range between full pool and a reduced lake level where real estate transactions may be stable or even growing. When Lake Hartwell is four feet or more BFP, Oconee County loses less than one (0.8) real estate transactions for every one-foot decline in lake level in this range.

Table 2. Structural Break Real Estate Sales Models*

One Structural Break Point			
County	Lake Level	Number of Real Estate Transactions Lost/Gain Per Foot Decline	R-squared (Non-Adjusted)

Georgia			
Hart	2 feet or more BFP	-0.35	0.21
Hart	5 feet or more BFP	-0.33	0.26
Stephens	3 feet or more BFP	-0.30	0.32
S. Carolina			
Anderson	7 feet or more BFP	-2.15	0.26
Anderson	4 feet or less BFP	+3.65	0.25
Oconee	4 feet or more BFP	-0.80	0.49
Two Structural Break Points			
Georgia			
Franklin	Between Greater than 3 feet BFP and Less than or Equal to 5 feet BFP	-2.15	0.41
S. Carolina			
Anderson	Less than 3 feet BFP Or 7 feet or more BFP	+8 (less than 3 feet) or -2.15 (7 feet or more)	0.33
Oconee	Between Greater than 4 feet BFP and Less than or Equal to 11 feet BFP	-2.04	0.60

*All structural break models presented had significant Chow tests, along with a significant lake level break at some defined lake level.

Hart and Stephens Counties also had statistically significant individual structural breakpoints. When Lake Hartwell is two feet or more BFP, Hart County loses 0.35 real estate transactions for each foot decline in the lake. In other words, a three foot lake level decline from 657 feet to 654 feet (above MSL) results in one less lake access real estate transaction in Hart County. Similar results were found for Hart County when the lake is more than five feet BFP. When Lake Hartwell is more than three feet BFP, Stephens County loses 0.30 real estate transactions for each foot decline in the lake. In all models, ranges of lake levels that are not mentioned did not show statistically significant relationships between lake level and real estate transactions.

Multiple Breakpoint Models

Models that allow for more than one breakpoint in lake level refine the analysis of the relationship between lake level and real estate sales. Anderson, Oconee, and Franklin Counties all had models with two statistically significant structural breakpoints. When Lake Hartwell is three feet or less BFP, Anderson County gains eight transactions for every foot decline in lake level. However, the county loses 2.15 transactions for every foot decline in the lake when Lake Hartwell is more than seven feet BFP.

In Oconee County there is a structural break range from four feet BFP to less than or equal to 11 feet BFP. When Lake Hartwell falls within this range, for every foot decline in the lake, Oconee County loses two real estate transactions. Franklin County also has a structural break range but it is a much narrower range than Oconee County. When Lake Hartwell is between three feet BFP and five feet BFP, for every foot decline in lake level the county loses 2.5 fewer real estate transactions.

These models illustrate that each county's real estate market has a unique relationship to Lake Hartwell. One explanation for the differences in these relationships among counties is the volume of lake access property relative to the total real estate market in the county. The geography of the lakefront varies around the lake as well, which likely impacts how quickly consumers respond to changes in lake level. Overall these results confirm stakeholder assertions that lake access real estate transactions are negatively impacted by declining lake levels. However, the overall economic impact of these lost transactions is likely to be quite small within the region, largely affecting lake-oriented real estate and related firms.

CONCLUSION

While Lake Hartwell was primarily constructed for purposes of flood control, navigation, and power generation, it has become a component of regional economic activity. The lake is an attractive location for retirees from Georgia, South Carolina, and other states which, along with other factors, have encouraged luxury real estate development on and near the lake, as well as new retail and service businesses associated with that type of growth. Communities and neighborhoods around the lake now strongly identify themselves with Lake Hartwell. As a result, two major droughts in the period between 1998 and 2008 have highlighted concerns about lake level management and the effect on local economies.

This study was a part of a much larger analysis designed to estimate the amount by which changes in lake level affect local economic activity. For this research, the economic variable of interest was county lake access real estate transactions. Our findings indicate the average number of monthly sales of property with access to Lake Hartwell decreases as the water drops below certain levels, which vary by county. In South Carolina, Anderson and Oconee counties lose the largest number of real estate transactions at low lake levels. However, these two counties are both relatively populous and have some of the longest shorelines of the six counties in the study. The Georgia counties had much smaller real estate transaction loss at different lake levels, as well as narrower ranges where lake level BFP was statistically significant. These results confirm stakeholder assertions that lake access real estate transactions are negatively impacted by declining lake levels. However, the overall economic impact of these lost transactions is likely to be quite small within the region, largely affecting lake-oriented real estate and related firms. We hypothesize that the diversity of economic activity in these six counties may serve as a mitigating force in reducing the overall impact that declining lake levels may have on general economic activity across the region.

LIST OF REFERENCES

United States Army Corps of Engineers (2009). <http://www.usace.army.mil>

University of Tennessee, Center for Business and Economic Research. (1998). *Economic and Fiscal Consequences of TVA's Lake Draw-Down of Cherokee and Douglas Lakes*. Prepared for the Tennessee Valley Authority, October 1998.