Louisiana Highway Construction Cost Trend after Hurricane Katrina and Rita

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Paper Prepared for the

TRB 2008 Annual Meeting
Washington, D.C.
January 2008

(Word count: 2965 words plus 3 tables and 7 figures
Abstract length: 173 words)

Submission date: 08/01/2007

ABSTRACT

The objective of this study was to reveal the trend in highway construction costs following hurricanes Katrina and Rita in Louisiana. The means of measuring highway construction cost was the Louisiana Highway Construction Index (LHCI), an index made up of the cost of labor, equipment, and 6 major materials used in highway construction. Data from projects let by the Louisiana Department of Transportation and Development from 2003 to the 2nd quarter of 2007 were used to track the change in construction costs. Index values from hurricane-impacted areas (GO Zones) were compared with those in non-GO Zones. The indices revealed that two quarters after hurricane Katrina and Rita, the highway construction cost jumped about 20% statewide and 51% in GO Zone. Two years after the hurricanes, the cost has stabilized to around 30% increase over the pre Katrina and Rita period. This study provides valuable information for the state agency to estimate cost escalation in on-going projects and to estimate future disaster response to highway construction costs.

Keywords: Highway construction cost, index, hurricane

1 INTRODUCTION

Hurricane Katrina, the costliest hurricane in the U.S. history, caused damage estimated at between $200 and $300 billion, primarily in the states of Louisiana and Mississippi. Weeks later, hurricane Rita left billions of dollars of additional destruction in Louisiana and Texas. Damage to infrastructure put immediate pressure on the construction industry in the region. The demand for material, skilled labor, and equipment in a market where a strong demand for material and energy from China and India had already pushed up prices, contributed to an even further escalation in construction costs.

The question faced by state Departments of Transportation (DOTs) was how much had the storms affected highway construction costs? Was cost escalation a short-term or long-term phenomenon? The answer to the question was critical for transportation planning, budgeting and decision making. The purpose of this paper is to show how a measure of highway construction costs in Louisiana pre- and post-Katrina was used to track costs during this period.

Highway construction costs are made up of hundreds of bid items. Since so many factors influence bid prices of individual items, or the overall price of a contract, cost items often show randomness. Short-term changes are generally erratic while long-term changes show the general behavior but still display unpredictable irregularities from time to time (Koppula, 1981). One way of accommodating fluctuations among bid items and contracts let in a particular period is to establish a cost index, composed of multiple indicator cost items, to produce a single, composite measure of construction cost.

Several construction cost indices have been used in the past to track construction costs. The two most popular indices for highway construction are the Engineering News Record's Construction Cost Index (ENR CCI) and the Federal Highway Administrations' Composite Bid Price Index (FHWA CBPI) (Wilmot, 1999). The FHWA CBPI is composed of six indicator items: common excavation, to indicate the price trend for all roadway excavation; Portland cement concrete pavement and bituminous concrete pavement, to indicate the price trend for all surfacing types; and reinforcing steel, structural steel, and structural concrete, to indicate the price trend for structures (FHWA, 2006).

Several state DOTs post their own construction cost indices, similar to the FHWA CBPI, online regularly. Washington State DOT compared their construction cost index with the FHWA CBPI and several states combined, as shown in Figure 1 (WSDOT, 2007). The figure shows that highway construction cost increased dramatically after 2003 for all three indices. Given this as background to conditions in the highway construction industry in the country, how does the change in highway construction costs in Louisiana before and after hurricanes Katrina and Rita compare?

This study investigates the impact of hurricane Katrina and Rita on highway construction costs in southern Louisiana by tracking bid prices in Louisiana Department of Transportation and Development (LADOTD) approximately two years before the storm and two years after, using highway construction cost indices. Highway cost trends are compared among areas directly affected by the hurricane, and those that were not.

The rest of the paper is arranged as follow. The data used in this study is briefly described and the data preparation is introduced. The method to build the Louisiana Highway Construction Cost Index is presented next. Finally, model results and findings are discussed, followed by the conclusion of the study.

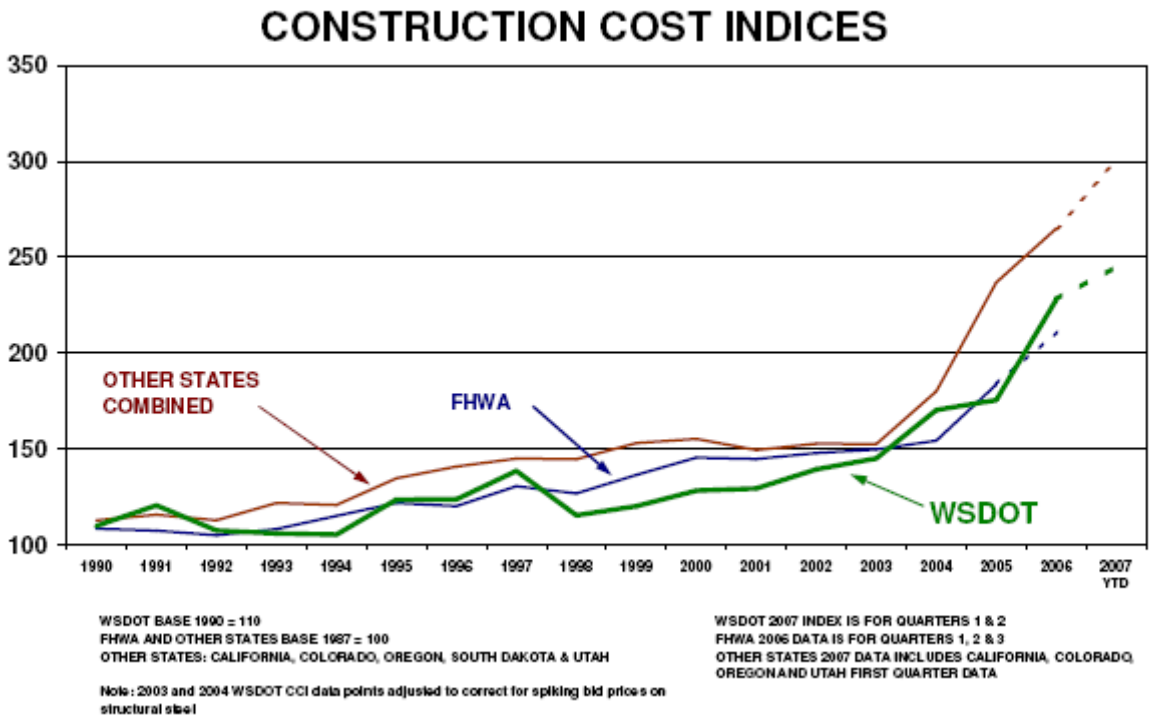

FIGURE 1 Highway Construction Cost Indices Comparison by WSDOT.

2 DATA

2.1 Representative Bid Items

Bid prices reflect change in the price of labor, equipment, and material as well as the influence of competition, risk and uncertainty. Highway project bid data are available from the LADOTD Construction Letting Information website for projects let between 2001 and 2007. A total of 1107 projects were let during this period, and each project contains information on letting date, contract number, geographic location, route name, type of construction, competitors and pay item information. Pay items are individual components of construction for which prices are proposed by the contractor (i.e. they are bid) at the time of preparing a contract estimate. Each individual pay item has an item number, description, quantity, unit, unit price and bid amount. Item prices from successful bids were used in this study.

Cheng (1999) identified 5 representative pay items for a highway construction cost index in Louisiana in an earlier study. Using data on highway construction projects for the period 1987-1996, the items were identified by first observing which construction sections experience major expenditure, and then identifying the largest expenditure pay item expressed in unit costs in each section. He found the major expenditure sections to be, excavation and embankment, Portland cement concrete pavement, bituminous concrete pavement, reinforcing steel and structural concrete. The procedure was repeated with data from 2003-2007 and identical results were obtained. However, engineers at LADOTD requested an additional section on subsurface pavement material. The highest cost item in each section was selected as the representative bid item, and the results are shown in Table 1. The representative pay items were identical in the two analyses with the exception that asphaltic concrete (item 501-01) changed to Superpave asphaltic concrete (item 502-01) in the later analysis.

TABLE 1 Representative Bid Items

No.	Pay Items
1	Embankment (item 203-04)
2	Asphaltic Concrete(item 502-01)
3	Base Course (item 302-01)
4	Concrete Pavement (item 601-01 (I)(G)(K)) *
5	Structural Concrete (item 806-01)
6	Reinforcing Steel (item 806-01)

* In the Portland cement concrete section, the top three highest cost items (10", 9" and 8" thick concrete pavement) were selected. The unit prices were converted into unit price per inch thickness.

The data were checked for outliers. Outliers were identified by assuming unit costs to be normally distributed within each year and values with less than 0.5% chance of belonging to the population being labeled as outliers. This involved identifying those unit costs whose standard normal deviate had an absolute value greater than 2.575. The identified outliers were omitted from the data.

There are sample problems in the data. The number of certain representative bid items in some quarters is small. Criteria were set that if the sample size in a quarter is say, less than 3, the average price in that quarter will be compared with the average item price immediately before and after that quarter. If the price is more than 300% or less than 30% of the adjoining average prices, the price is adjusted by combining the data immediately before and after that quarter.

2.2 Hurricane Impacted Zones

The Gulf Opportunity Zone Act of 2005 (H.R. 4440 passed by Congress on Dec. 16, 2005, and signed by President Bush on Dec. 21, 2005) was established to give tax incentives and bond provisions to rebuild the local and regional economies devastated by hurricanes Katrina and Rita. The act is commonly referred to as the "GO Zone Act." The GO Zones were used to identify the areas which were hit directly by the storms.

The GO Zones were defined by parish. Figure 2 shows hurricane Katrina affected parishes, the hurricane Rita affected parishes, and those affected by both storms. The GO Zones were used to compare highway construction costs between GO Zone and Non GO Zone areas.

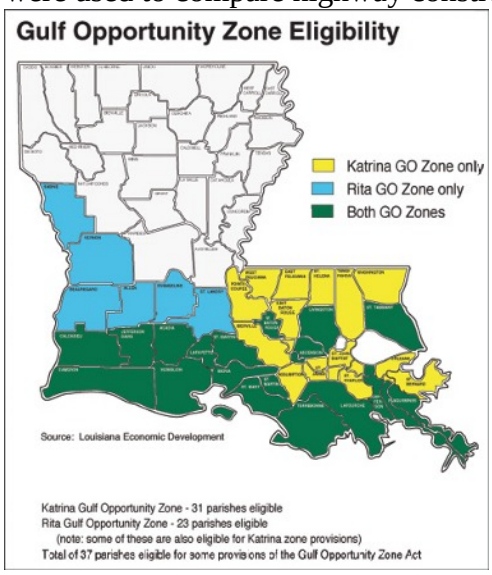

FIGURE 2 Louisiana GO Zone.

3 METHODOLOGY

In order to track the highway construction cost trend before and after Hurricane Katrina and Rita, a new Louisiana Highway Construction Index (LHCI) was compiled using the 6 representative items described above. As stated above, the unit price information of the representative items is from successful bids on six of the most prominent construction items. The index reflects a composite cost for a completed item of work and includes the cost of labor, equipment and materials as well as the influence of subjective factors such as competition, risk and uncertainty, since all these factors are taken into account when a contractor prepares bid prices.

The Louisiana Highway Construction Index uses the second quarter of 2003 as the base quarter. Bid item prices are weighted by the quantity of the item over the entire analysis period of 2003-2007 to provide as representative an indication of the relative contribution of each item to overall construction costs as possible. The relative weight of each representative item is shown in Figure 3. The LHCI is defined as:

$$\text{Louisiana Highway Construction Index} = \frac{\sum_{i=1}^{6} \overline{P}_{in} Q_i}{\sum_{i=1}^{6} \overline{P}_{2003-2nd\ quarter} Q_i} \times 100$$

where:

$\overline{P}_{in}$ = average unit cost of the i[th] representative item in quarter n,

$\overline{P}_{2003-2ndseasoni}$ = average unit cost of the i[th] representative item in the second quarter of 2003

Q_i = total quantity of the i[th] representative item from 2003 to 2007.

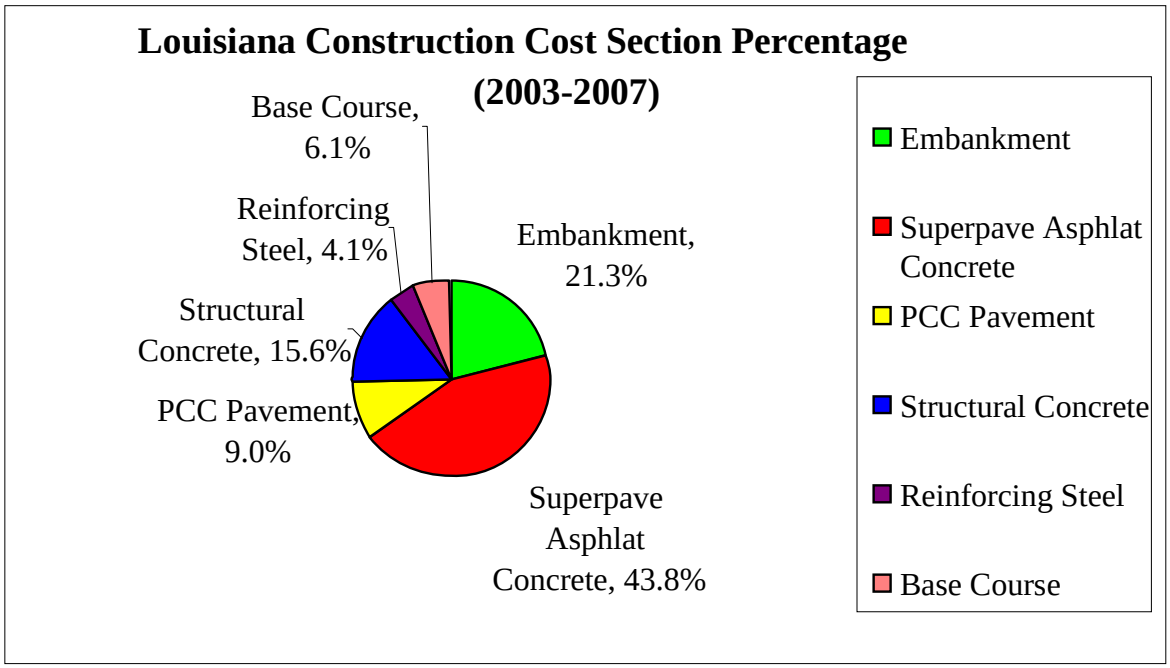

FIGURE 3 Louisiana highway construction cost section percentage.

4 RESULTS

Table 2 and Figure 4 show annual values of the LHCI from the 2nd quarter of 2003 to the 2nd quarter of 2007 for GO Zone and Non GO Zone areas.

TABLE 2 Louisiana Highway Construction Index (LHCI)

Quarters	GO Zone	Non GO Zone
2003-02	96	89
2003-03	120	124
2003-04	114	86
2004-01	149	112
2004-02	113	78
2004-03	101	86
2004-04	78	126
2005-01	108	108
2005-02	126	97
2005-03	104	126
2005-04	135	103
2006-01	158	111
2006-02	151	140
2006-03	152	115
2006-04	131	150
2007-01	122	143
2007-02	146	139

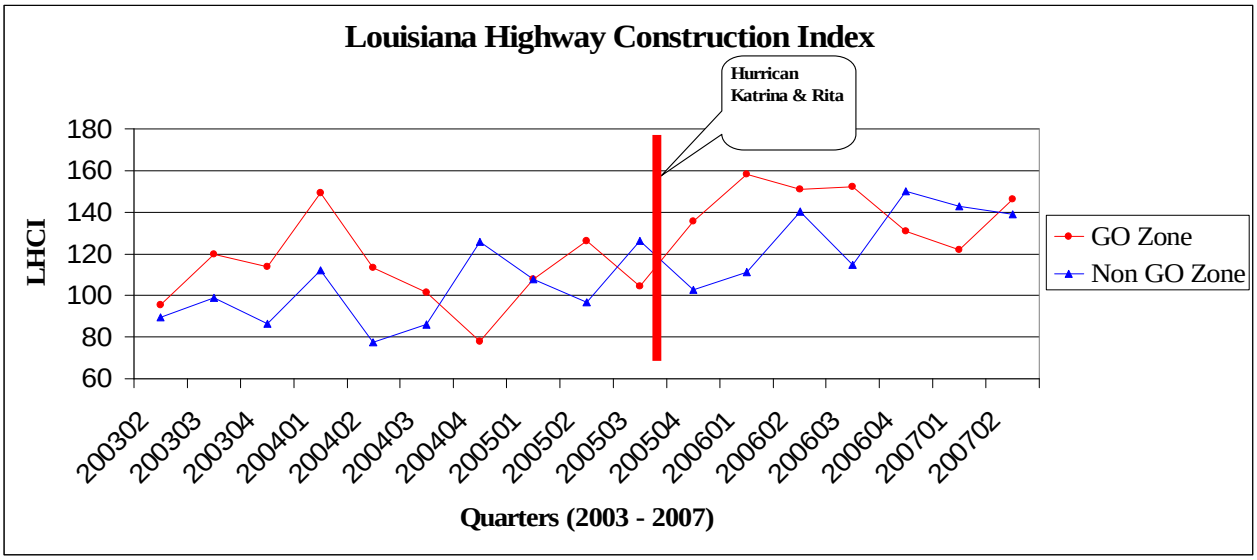

FIGURE 4 Louisiana Highway Construction Index Quarterly Trend (2003-2007).

The LHCIs showed the highway construction price escalation after the two storms. The LHCI in GO Zones jumped 51% in the two quarters following hurricanes Katrina and Rita (i.e. from 3rd quarter of 2005 to 1st quarter of 2006) and then declined and appears to have stabilized. The Non GO Zone first declined 23% immediately following the storms and then jumped 36% in

the following two quarters before, apparently, stabilizing. This suggests GO Zones experienced an immediate price escalation due to the difficulties presented by the storm (e.g. limited local of labor, shortage of materials, no housing for workers), while an initial decline in price in the Non Go Zone areas occurred because the absence of those difficulties there resulted in increased competition in those areas unaffected by the storm. However, after two or three quarters, bid prices in the GO Zone appear to have slowly reduced to match those in the rest of the state, even though the trend is volatile.

The statewide trend shown in Figure 5 is somewhat less volatile. The LHCIs showed the highway construction price escalation after the two storms. The statewide index jumped 24% in three quarters from 3rd quarter of 2005 to 2nd quarter of 2006 and then stabilized.

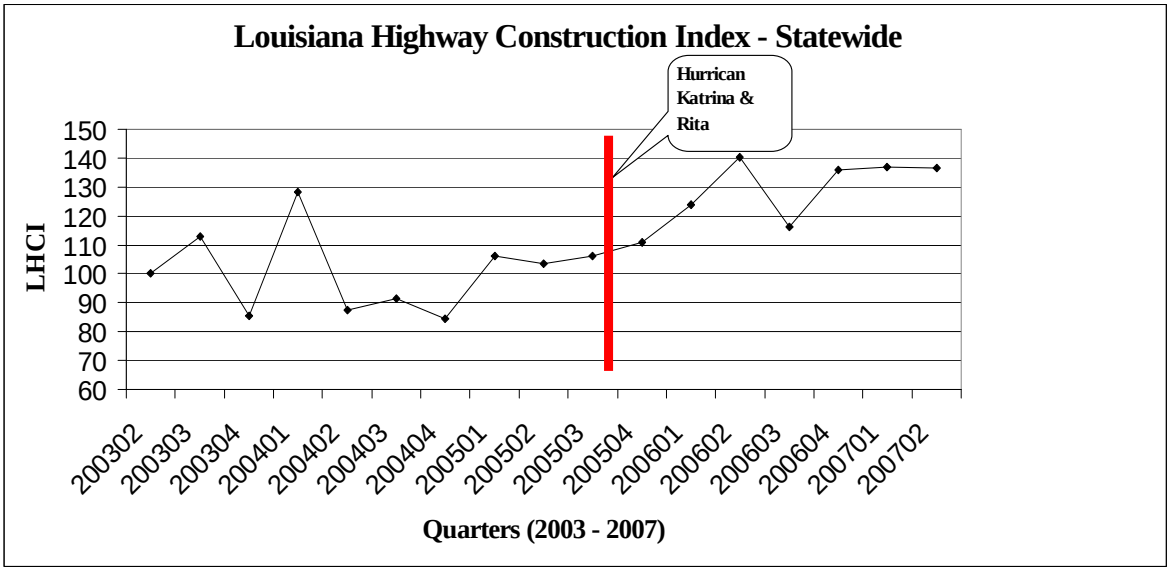

FIGURE 5 LHCI Statewide Quarterly Trend (2003-2007).

Highway construction cost trend is influenced by many factors. Besides material, labor, and equipment costs, construction cost is also influenced by market competition. A possible surrogate for market competition is quarterly/annual bid volumes and the number of bidders per project. Figure 6 shows the quarterly bid volume for the LADOTD for the period 2003-2007. The bid volumes in the GO Zone in 4th quarter of 2005, 2nd and 4th quarters of 2006 and 2nd quarter of 2007 are significantly larger than the other quarters. The reason for this quarterly fluctuation is not known but the general increase in bid volume in the GO Zone area relative to the Non GO Zone area is probably due to repair projects necessitated by the storms. The bid volume increased approximately fourfold between the third quarter of 2003 and the second quarter of 2007.

Figure 7 shows the quarterly average number of bidders per project for the period 2003-2007. There are approximately 3.5 bidders per project before hurricanes Katrina and Rita, but these numbers drop to approximately 3 per project after the storms. Overall, it does not appear as if the storms had a dramatic impact on the number of bidders per project, but rather that there is a gradual reduction in the number of bidders per project over time. There is little difference between conditions in the GO Zone and Non GO Zone areas with respect to number of bidders.

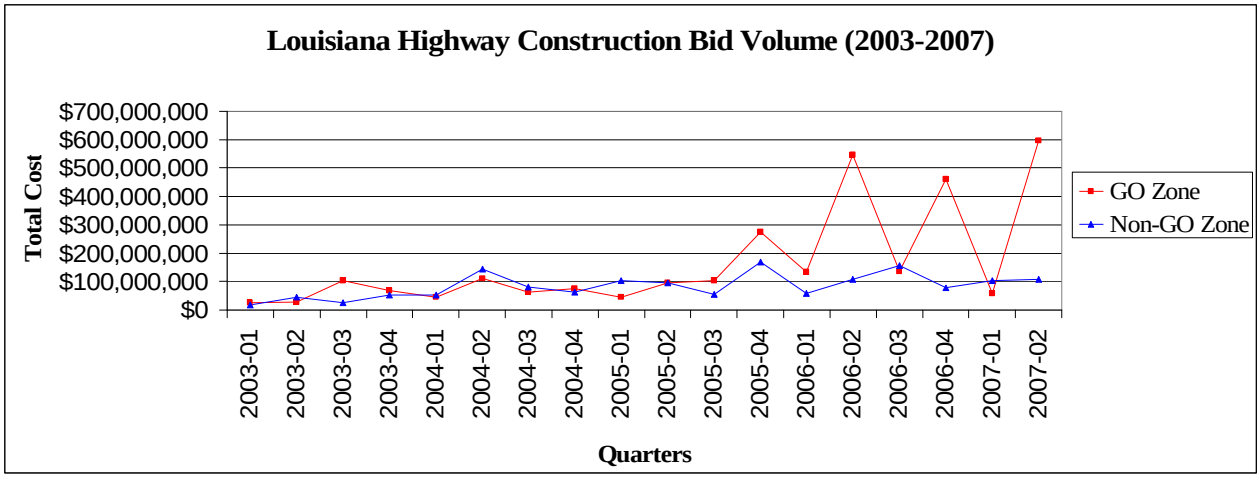

FIGURE 6 Louisiana Highway Construction Bid Volume (2003-2007).

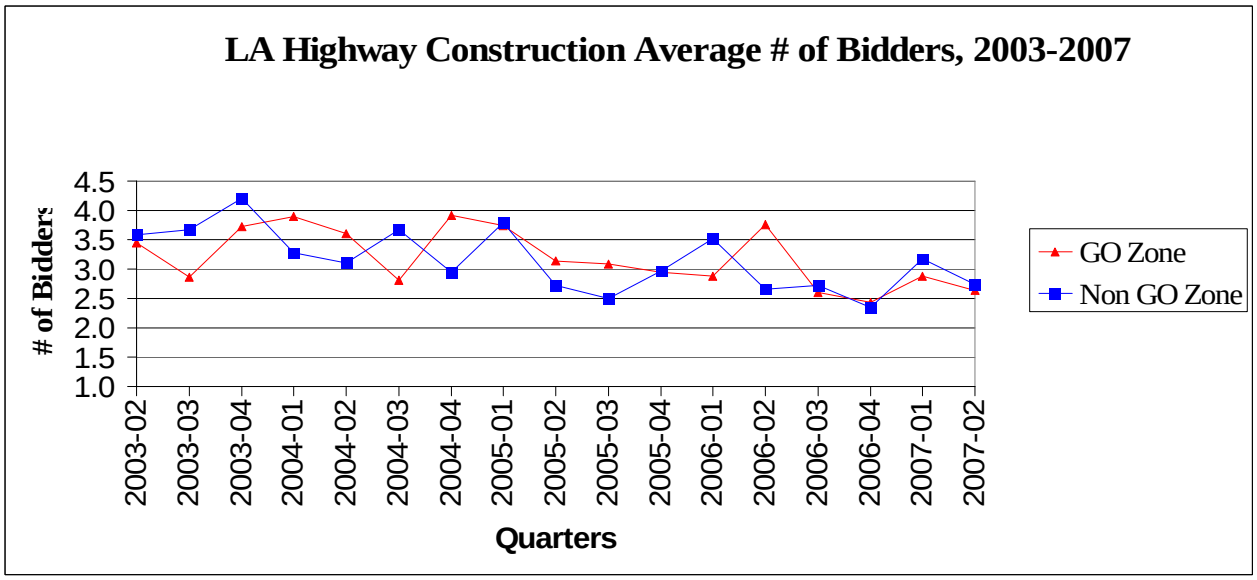

FIGURE 7 Louisiana Highway Construction Average Number of Bidders (2003-2007).

The impact of bid volume and number of bidders on construction cost can be verified by observing their impact on the LHCI value. Table 3 shows the observed correlation between the LHCI and bid volume and number of bidders by zone. For the GO Zone area, there is a clear positive correlation between bid volume and LHCI as expected, suggesting that as more work is offered to contractors, the price increases. This is consistent with the results from other studies (Wilmot and Cheng, 2003). However, the data does not show the same trend for the Non GO Zone areas. Looking at the data it is apparent that this result is more a product of the fact that bid volume varies so little in 2003-2007 that its impact on LHCI values in that time period could not be discerned.

The correlation between LHCI and number of bidders is negative in both the GO and non-GO Zone areas, showing that a decrease in competition is associated with an increase in cost. Thus, the general decrease in the number of bidders in Louisiana is probably responsible for at least a part of the increase in construction costs in the state.

TABLE 3 Correlation Between LHCI and Bid Volume and Number of Bidders

	GO Zone	Non-GO Zone
Bid Volume	0.50	-0.07
Number of Bidders	-0.34	-0.58

5 CONCLUSIONS

The LHCI trends showed Hurricane Katrina and Rita had a significant influence on Louisiana's highway construction cost. Construction costs in areas affected by the hurricane increased 51% immediately following the storms, while costs in other parts of the state actually reduced. However, this trend was relatively short-lived (approximately two quarters) with construction costs tending to converge in the state shortly thereafter, and to stabilize at an increase of about 25% above prices pre Hurricane Katrina and Rita. This indicates that the market is playing its role as typically seen in a demand-supply relationship.

The cost indices show some significant fluctuations, which is the nature of the construction industry. Another reason is the small sample of bid items in some quarters, however, aggregating the data to longer time intervals results in a loss of information in short term trends. This can be observed in the smoother statewide index than that for geographically more detailed areas.

Increased bid volume and the drop in the number of competitors per project after hurricane Katrina and Rita are two contributors to the increase in costs observed in this study. However, a general increase in highway construction costs has been evident nationwide since 2003. In Louisiana, this is reflected in the increase in costs in the Non GO Zone areas which has also shown an increase in costs since that time. Thus, in investigating the impact of hurricanes Katrina and Rita on highway construction costs in the state, only the difference between construction costs in the GO and Non GO Zones should be considered. In that respect, what the data has shown is that while the market was disrupted immediately following the storms and bid prices were higher in affected areas for several quarters, market principles asserted themselves and the market stabilized into equilibrium over a period of approximately two years in which time construction prices once again became consistent across the state.

This study provides valuable information for decision makers under future emergency/recovery situations. The findings suggest that agencies may want to postpone major projects until after the relatively short-lived price hike that follows a major disaster such as that incurred by hurricanes Katrina and Rita.

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