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Abstract

Hurricane Katrina caused the greatest damage of any hurricane in American history. We look at the rebuilding effort in New Orleans through the lens of two other disasters that occurred in 1992: Hurricane Andrew in Miami and the Rodney King riots in Los Angeles. The rebuilding effort in New Orleans shares similarities with both events, combining the impact of a hurricane on infrastructure and private businesses, and the prospect of an uneven recovery biased against racial minorities and the economically disadvantaged. Using the experience of the King riots, our concern is that the rebuilding effort will be modest at best and slow to develop in poorer areas. There is the prospect of long lasting negative effects on income in poor neighborhoods. In wealthier areas, the pecuniary incentive for private business and citizens to rebuild is stronger, and in some cases the rebuilding effort can cause net income *gains* in response to a natural disaster of the scale of Hurricane Andrew. Based on these events, we recommend targeting a disproportionate amount of federal transfers towards poorer areas to stimulate growth.

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Introduction

Hurricane Katrina, which swept into New Orleans and the Gulf Coast on August 29, 2005, caused far and away the largest damages in real dollar terms of any hurricane in U.S. history, with uninsured losses topping $100 billion (Bloomberg News, 2005) and insured losses estimated at $34.4 billion (Powell, 2005). Its final death toll also places it among the worst natural disasters ever suffered by the United States. New Orleans was particularly hard hit by the storm, as flood waters remained for weeks after Katrina while levies were repaired. Many wonder how long, if ever, it will take the economy of New Orleans to recover from this cataclysmic event. This paper offers partial answers by examining post-Katrina New Orleans through the lens of two disasters that struck major American cities thirteen years ago: Hurricane Andrew, which hit Miami in August 1992, and the Rodney King riots, which took place in Los Angeles in late April and early May 1992. In addition, we use the contrasting experiences of Los Angeles and Miami to identify the types of policies that are likely to be successful in rebuilding the New Orleans economy.

These two particular events are chosen for several reasons. First, each represents a highly significant event in each city's economic history. Until Katrina, Hurricane Andrew was the most expensive natural disaster in U.S. history with insured losses topping $15.5 billion in nominal terms and total property losses exceeding $26 billion (National Weather Service, 2005). Similarly, the King riots, which resulted in 53 deaths, 10,000 arrests, 2,300 injuries, more than 1,000 destroyed buildings, and an estimated cost to the city of $1 billion in damages, are widely considered the worst civil disturbances the U.S. has seen in modern years (Matheson and Baade, 2004).

The two cities, however, took markedly different paths to recovery following the disasters, and that is of particular importance to this paper. The initial devastation wrought by Hurricane Andrew was followed by a surge in economic activity in the south Florida area as residents and businesses returned flush with private and public insurance payments earmarked for rebuilding. Los Angeles, on the other hand, despite the anticipation that 500 private corporations would invest more than $1 billion in the riot torn areas of South Central Los Angeles, failed to restore its economy in the short run. The private group launched to encourage private redevelopment funding, in fact, only brought in $400 million in corporate investment from 1992 to 1999 with much of that money going to areas that were among the least affected by the riots (Matheson and Baade, 2004). Economic activity in Los Angeles following the riots took at least 10 years to return to its previous levels, if indeed full recovery ever occurred.

The next section of the paper reviews existing literature on the economic impact of natural disasters on local economies. This is followed by empirical analyses of the economic aftermaths of Hurricane Andrew and the Rodney King riots that demonstrate the contrasting natures of the two events. This is followed by a discussion of Hurricane Katrina which poses the question of which path New Orleans will follow in the years subsequent to the disaster. In addition, policy recommendations are made that may aid in helping New Orleans to achieve the better of the two outcomes.

Review of Natural Disaster Impact Studies

Scholars have devoted modest attention to assessing the economic impact on local, regional, and national economies that have experienced natural disasters. Given the substantial

economic disruption that these catastrophes can create, it is surprising that there is a paucity of literature on the subject. Pelling (2002) offered this explanation for the scarcity of studies on the economic consequences of natural disasters:

> Given the far-reaching consequences of disaster shocks with a natural trigger it is perhaps surprising that disaster studies have held a relatively marginal place in development theory and practice until very recently. Disaster shocks have consistently been interpreted as exceptional events operating outside of 'normal' development theory and practice. As a result disaster vulnerability has not been integrated into development planning.

There are important reasons to accelerate the study of the economic impact of natural disasters, in particular hurricanes, on the United States. First, scientific evidence indicates both the number and severity of hurricanes is rising, and this increased incidence is attributable to natural cycles and perhaps global warming. In addition, population and income growth along the Atlantic and Gulf Coasts has put an increasing number of people and a rising value of property at risk. Unfortunately these two trends suggest increasing economic disruptions from storms in coming years. Further research on the aftermath of hurricanes can aid in current and future economic recovery efforts by applying lessons learned from the past.

The social and economic devastation wrought by Katrina has clear implications for government policy. Costs associated with this storm have exceeded anything previously experienced, and a more precise rendering of those costs are essential to sound economic decision making. Significant social costs in terms of race and class relations are incurred beyond those relating to persons and property that are immediately obvious following a disaster. Katrina sent the unmistakable message that storms of category 5 intensity stretch social institutions and infrastructure beyond their ability to cope, and new coping strategies and mechanisms must be developed to minimize the direct physical damage and loss of life as well as the indirect social

damage, which may dwarf the direct costs inflicted by these severe storms. Storms of unprecedented ferocity and frequency necessitate modification and reinforcement of social institutions to prevent the breach of not only physical levies but social levies as well. This paper does not identify what a breach in social levies means for the economic recovery period. Rather, it is the contention of this report that the revival from storms such as Katrina may well be protracted and impaired not only as a result of the extensive physical damage, but through rupturing those social institutions that serve an essential function in providing for the recovery from a natural catastrophe.

Current literature on the economic impact of hurricanes does not reach a consensus on whether the net effect of a catastrophe is positive or negative in the long run, or whether any such economic effects are transitory or permanent. Most studies suggest that major storms cause temporary disruptions in economic activity followed by a short-term boom period as the region engages in rebuilding efforts (West and Lenze, 1994). For example, in summarizing the impact of Hurricane Hugo, Gillespie (1991) concludes:

> There was a loss of 6,800 jobs in tourism and trade immediately following the storm. Most of the negative impact on employment directly attributable to Hugo was short-lived. Although many businesses were closed by the storm, most of them were back in business by early spring. The positive impact on the construction industry of Hugo building was enormous, adding over 8,000 jobs by the spring, which more than offset the brief loss of jobs in the tourism and trade sectors (p. 2).

Burrus, et al. (2002) observes that the literature supports the proposition that the short-term substantial destruction wrought by a hurricane the size of Andrew is reduced by rebuilding efforts financed by external sources.

> Long-run migration effects aside, these studies indicated that the short- to medium-run impact of high-intensity of storm damage on regional economic

> activity is ameliorated by reconstruction-related local spending (financed largely from extraregional sources, such as insurance claim payments and federal disaster funds (p. 118).

However, Guimares, et al. (1993), who uses a multi-sector regional econometric model, finds different results:

> …we found that the income gains were neutral overall, despite a major surge in construction, retail, and other sectors. In one of the most affected sectors of South Carolina, agriculture and forestry, the income gain remained below the unreimbursed wealth loss. Thus, we maintain that catastrophe was not a positive economic force.

West and Lenza (1994), however, note the difficulties associated with regional econometric modeling when applied to natural disasters. The economic multipliers used in models such as Bureau of Economic Analysis' Regional Industrial Multiplier System (RIMS II) (and other multiplier models) are based upon inter-industry relationships within regions based upon an economic area's normal production patterns. Following major disasters, however, the economy within a region may be anything but normal, and therefore, these same inter-industry relationships may not hold. Since there is no reason to believe that the usual economic multipliers are the same following disasters, any economic analyses based upon these multipliers may, therefore, be highly inaccurate (Matheson, 2004).

Previous studies have also found that the paths to recovery differ according to the size of the storm. This is not unexpected considering the level of destruction varies directly with the hurricane's strength. It is worth noting, however, that frequent "low-intensity" hurricanes can still generate substantial damage. Burrus, et al. (2002) observes:

> Low-intensity hurricane strikes have substantial impacts on local economies. We find that the impact of a low-intensity hurricane is, on average, between 0.80 and

> 1.23% of annual regional output. If a region's average annual rate of growth is 4%, these potential impacts amount to approximately one-fifth to one-third of an average year's growth (p. 124).

Business interruptions, particularly in the tourist industry, typically occur with each storm, regardless of the storm's strength when it hits land. Thus, the impact on tourism of high- and low-intensity storms may be comparable in some situations. Burrus, et al. (2002) also suggests that the frequency of hurricanes is important in determining their economic impact. For example, parts of the country that experience a greater incidence of low-intensity storms may be more economically vulnerable than areas that suffer from high-intensity, but infrequent, storms.

Finally, there is some support that the cumulative effect of storms within a relatively short period of time is not additive. In studying the employment effects of hurricanes that affected Wilmington, North Carolina, Ewing and Kruse (2001) conclude that the economic impact of hurricanes is transitory and further observe:

> There may be a limit to the gains and losses associated with hurricanes that is based on the number of hurricanes that hit an area as well as the timing of the hurricanes. For instance, Bertha had a significant impact on the Wilmington economy whereas Bonnie that was similar in strength did not. Wilmington had not been hit by a hurricane for several years prior to Bertha and then experienced a total of five hurricanes in less than five years.
>
> In many respects, Hurricane Bertha was unremarkable when compared with the other four hurricanes that followed her. However, as the first, Bertha triggered a flurry of activity that appears to have reduced the adverse impact of the larger storms that followed (p. 14).

It is important to keep these observations in mind in assessing the economic damage of past events and of Hurricane Katrina.

An Empirical Examination of Hurricane Andrew and the Rodney King Riots

The first step in determining an economic impact of a major event is to identify variables vital to making such an assessment. In order to maximize the chance that the economic effects of a natural or manmade disaster can be isolated, i.e., to minimize statistical "noise," it is crucial to find data as specific to the area in which the disaster occurred and as high-frequency as possible. California provides quarterly data on taxable sales for individual cities and counties, while Florida provides monthly taxable sales data for individual counties. Taxable sales are a good indicator of economic well-being as they are strongly correlated with many measures of economic activity such as personal income or gross domestic (city) product. In addition, both Florida's monthly data and California's quarterly data provide a sufficient number of observations before and after their respective incidents to permit meaningful statistical analysis. The California data are available from the first quarter of 1987 through the third quarter of 2004 providing five years of data before and twelve years of data following the riots. The Florida data are available from the first month of 1980 through the middle of 2005.

Since the gross personal income of Los Angeles County in 1992 exceeded $200 billion in nominal terms and that of Miami/Fort Lauderdale/West Palm Beach metropolitan statistical (MSA) area in 1992 was nearly $100 billion, even the effects of a major economic event such as Hurricane Andrew or the King riots can be obscured by the normal economic fluctuations of these large, diverse economies. Many factors including the local, regional and national business cycle, state and federal government policies, monetary policy and inflation, international factors, consumer and business confidence, wealth effects, and a host of other ingredients influence taxable sales. The next step is to separate the impact of Hurricane Andrew and the Rodney King

riots from these other factors.

One method for filtering much of the "noise" is to analyze the change in taxable sales in an area affected by an event compared to that of an otherwise similar area that did not feel the effects of the event. To this end, the taxable sales in the City of Los Angeles are calculated as a percent of the taxable sales in the rest of the County of Los Angeles. Since it is reasonable to assume that many economic, seasonal, political, and demographic factors will affect the economies of the County and the City of Los Angeles in a similar way, this method serves to account for the economic impact of all the variables that the city and county have in common. The city/county ratio, therefore, is influenced only by economic events that are unique to one area or the other. While some rioting occurred in areas peripheral to the City of Los Angeles (most notably in the City of Inglewood), the vast majority of the destruction occurred within the Los Angeles City limits so that the riots, if significant, should affect the city/county taxable sales ratio. Figure 1 plots this ratio over the period of the sample, and the data exhibit an acceleration of the decline of the City of Los Angeles' taxable sales as a percentage of those of the county.

Similarly, the taxable sales ratio for the Miami MSA, which includes Miami-Dade, Broward, and Palm Beach counties, is calculated as a percent of the taxable sales for the rest of the state. Figure 2 plots the south Florida taxable sales ratio (adjusted for seasonality) over the period of the sample. Even a cursory glance at Figure 2 reveals a reduction in taxable sales around the time of Hurricane Andrew followed by a substantial spike in taxable sales immediately afterwards.

In order to examine the impact of the Rodney King riots and Hurricane Andrew on taxable sales in their respective cities, we use intervention analysis on an ARIMA model as

outlined in Box and Tiao (1975). In addition to its previous use in analyzing the impact of the King riots (Matheson and Baade, 2004), others have employed similar techniques to analyze a wide array of economic problems ranging from the impact of the U.S. bombing of Libya in 1986 on terrorist activity (Enders, et al., 1990) to the effects of the most recent players' strikes on Major League Baseball attendance (Schmidt and Berri, 2002). Intervention analysis provides a formal test for the change in the mean of a series as a result of an exogenous shock at a specific point in time.

The general intervention ARIMA(P,D,Q) model for the taxable sales ratio is

$$y_t^* = \beta_0 + \sum_{p=1}^{P} \Phi_p \, y_{t-p}^* + \sum_{q=0}^{Q} \Theta_q \, \varepsilon_{t-q} + \beta_1 z_t \qquad (1)$$

where y_t^* is the first-differenced taxable sales ratio in time period t, P is the number of lagged values of y_t^* in the model known as the autoregressive (AR) dimension of the model, ε_t is an error term, Q is the number of lagged values of the error term representing the moving average (MA) dimension of the model, and z_t is an independent variable representing the effect of the Rodney King riots. D is the number of times y_t (as well as any independent intervention variables) is differenced to create y_t^*. The model can be modified to include a quarterly or monthly seasonal component. These seasonal variables are statistically insignificant at any reasonable confidence level and therefore are dropped from the Los Angeles data. Seasonal variables, however, are statistically significant in the south Florida model. These variables are included in the estimation, but they are removed from the results for brevity.

Augmented Dickey-Fuller tests on the taxable sales ratio for both time series indicates that the original data series follow non-stationary paths which can be transformed into stationary

series through first-differencing, so that D in both ARIMA models is set equal to one. Next, we determine the autoregressive and moving average dimensions of the models through estimation and diagnostic testing. Trial and error reveals that the Los Angeles data is best described by a model with two lagged dependent variables and no moving average term, so that P is equal to 2, and Q is equal to 0. The maximum likelihood estimation (MLE) results for this model are shown as equation 1 in Table 1. The one result of note is that the constant term is negative and significant indicating that taxable sales in the City of Los Angeles have been falling in comparison to those in the County of Los Angeles over the sample frame.

To determine the effect of the riots, a dummy variable, z, is entered for the model. The exact format of this dummy depends on whether the effects of the riots on taxable sales are temporary or permanent as well as the nature of any recovery from the riots. Since the original time series did not follow a stationary path one should not necessarily expect that the taxable sales ratio would return to its previous level following a shock to the economy. Non-stationarity does not preclude, however, instances where a shift in one direction is countered by a later movement in the opposite direction. Since private and government agencies committed themselves to repairing the damage, one would expect a rapid recovery in the ratio to its previous levels, or, to borrow a term from development models, a recovery to the steady state. If recovery did occur, realized growth rates in the ratio should, therefore, be higher than predicted by the model over subsequent periods.

Box and Tiao (1975) suggest multiple intervention and response possibilities. The MLE results shown in Table 1, equation 2, demonstrate one extreme where the riots can be seen as a pure pulse function with the riots causing only a single-period decline with a complete recovery

in the following period as in Figure 3b. In a first differenced model, z = 1 in 92.2, z = -1 in 92.3 and z = 0 elsewhere. On the other extreme, the event can be seen as pure step event causing a one-period decrease to a permanently lower level as shown in Figure 3a. In this model where the taxable sales are first differenced, the intervention variable, z, takes a value of 1 in the in the second quarter of 1992 and a value of 0 in all other periods. The MLE results for this model, as seen in Table 1, equation 3, clearly show that this pure step model displays a much better fit than a pure pulse model shown in equation 2, which suggests the effects of the riots have persisted beyond the quarter they occurred. The dummy variable for the pure pulse model is negative but not statistically significant while the dummy variable for the pure step model is not only negative but also highly statistically significant. This indicates that something during the second quarter of 1992, most likely the riots, had a long-lasting negative impact on the economy of the City of L.A. while leaving the economy of the County of L.A. relatively unscathed. The coefficient on the z variable in equation 3 shows that the taxable sales ratio in the city fell by 1.29 percentage points. Based on taxable sales in the city and the rest of the county of $5.94 billion and $12.96 billion, respectively, a 1.29 percentage point drop in the city-county ratio corresponds to $166 million drop in taxable sales in the City of Los Angeles during the quarter of the Rodney King riots with losses continuing into the future.

Another possible response to the riots would include an immediate negative impact followed by a gradual return to the original level over a number of periods that so that z = 1 in 92.2, z = -1/n in the subsequent n periods, and z = 0 elsewhere (corresponding to Figure 3c. in the undifferenced data), or z = 0 prior to 92.2, z = 1 in 92.2, $z = -(1/\alpha)^n$ for all periods subsequent to 92.2 (corresponding to Figure 3d. in the undifferenced data). Alternatively, the response could

be an immediate negative impact followed by a return to a level that is either higher or lower than that existing before the riots as in Figures 3e. and 3f.

Without a detailed *a priori* expectation of the effects of the riots on economic activity, one is simply left to the task of examining multiple models for fit. Models similar to Figures 3d. and 3f. showed poor model fit under nearly all values of α. This is not surprising as there is little indication from media reports of a rapid reconstruction and recovery. For comparison, the MLE results for a model with $\alpha = 2$ and full recovery is shown in Table 1, equation 4.

The linear recovery models as in Figures 3c. and 3e. provide more interesting results. The MLE results for the linear, full recovery models are shown in Table 1 as equations 5 and 6 for post-riot periods of 5 years and the entire sample (12.5 years) respectively. The relatively poor fit of the 5-year model (compared to the pure step model) suggests that recovery did not come quickly. This confirms the general impression of people in riot-struck areas. A Los Angeles Times poll taken 5 years after the riots revealed that 35 percent of respondents in areas affected by the violence reported that some businesses in their neighborhoods had still not reopened 5 years after the fact (Los Angeles Times, 1997).

In comparison, the model in equation 6 which assumes full recovery over the entire sample displays a slightly better fit than the pure step model, indicating that after 12-and-a-half years, the city's economy may have finally returned to its previous levels. This recovery model also slightly outperforms any of the linear models that provide for only partial recovery and any models that provide for full recovery over a shorter time period. Overall, the results indicate that, at best, the City of Los Angeles has only just recovered from the riots that occurred over 12 years ago, and the model fits between equation 3 (no recovery) and equation 6 (12.5-year linear

full recovery) are also close enough to permit one to conceivably take an even more pessimistic view and suggest that the economy has yet to recover entirely. The results in Table 1, equation 6 point to $5.56 billion in lost taxable sales over the entire 12-year post-riot history of L.A. City. The results in Table 1, equation 3, which assume that recovery from the riots has never occurred, produce $14.34 billion and counting in lost taxable sales.

Miami, on the other hand, presents an entirely different story. The Miami data is best described by a model with two lagged dependent variables and a moving average term lagged for 1 year, so that P is equal to 2, and Q is equal to 12, but Q does not include MA terms for lagged periods 1 through 11. The maximum likelihood estimation (MLE) results for this model are shown as equation 1 in Table 2. Monthly dummy variables are included in the model to account for seasonal variations in Miami's taxable sales versus the rest of the state but the resulting coefficients are omitted from the table. Since seasonal dummy variables have been included, the sign on the constant term can not be interpreted in the same manner as in the Los Angeles model.

To determine the effect of the hurricane, a dummy variable for August 1992, z(HA), is entered into the model. A cursory examination of taxable sales following August 1992, however, clearly shows a recovery in taxable sales in the month immediately following Hurricane Andrew so a second intervention dummy variable, z(RCV2), is entered for September 1992. The MLE results for a model with a single month of heightened taxable sales following the hurricane are recorded in Table 2 as equation 2. The dummy variable for z(HA) is negative and significant in indicating that something, most likely Hurricane Andrew, had a large negative impact on the south Florida economy in August 1992, while leaving the rest of Florida's economy relatively unscathed. The coefficient on the z(HA) variable shows that the taxable sales ratio in the MSA

fell by 5.32 percentage points. Based on taxable sales in the MSA and the rest of the state of $3.08 billion and $7.67 billion, respectively, a 5.32 percentage point drop in the ratio corresponds to a drop in taxable sales in the city of $408 million in the month of August. The sign and magnitude of the coefficient for the z(RCV2) recovery variable, however, shows that taxable sales recovered in the month immediately following the hurricane. Specifically, taxable sales in the month after the hurricane are by 1.49 percentage points above pre-hurricane levels, which means after one month Miami recovered about $114 million, or nearly 30 percent, of the loss caused by Hurricane Andrew.

The next step is to determine how long the bump in taxable sales persisted after Hurricane Andrew and in what manner did this "recovery effect" wear off. As is the case with the Rodney King riots, the taxable sales ratio following the initial drop and subsequent recovery could take several paths. Taxable sales could remain permanently high following a hurricane, an unlikely scenario. Alternatively, taxable sales could gradually return to their previous levels following a concave function where $z = 0$ prior to 92.08, $z = 1$ in 92.09, $z = -(1/\alpha)^n$ for all periods subsequent to 92.09 (corresponding to the inverse of Figure 3d. in the undifferenced data) or a linear function where $z = 1$ in 92.08, $z = -1/n$ in the subsequent n periods, and $z = 0$ elsewhere (corresponding to the inverse of Figure 3c. in the undifferenced data).

Again, without a detailed *a priori* expectation of the effects of the hurricane on economic activity, one is simply left to the task of examining multiple models for fit. As in the case of Los Angeles, models similar to Figures 3d. and 3f. showed poor model fit under nearly all values of α. For comparison, the MLE results for a model with $\alpha = 2$ and full recovery is shown in Table 2, equation 3.

The linear return models as in Figures 3c. and 3e. provide more interesting results. The MLE results for a linear, full return model over an 18 month period, the return period which showed the best model fit, are shown in Table 2, equation 4. The coefficients on z(HA) and z(RCV2) show that taxable sales in south Florida fell by 2.99 percentage points in the immediate aftermath of Andrew, but quickly rebounded to a level 5.53 percentage points above the usual level by the following month, after which they returned to their previous levels over the succeeding 18 months.

An even more detailed examination of taxable sales following Hurricane Andrew suggests that it may have taken several months following the hurricane for recovery spending to hit its peak. Table 2, equation 5 shows the regression results for a final model including a third intervention variable, z(RCV1), which takes an undifferenced value of 0.7 in the month immediately after Andrew, 0.85 two months after the hurricane, and 1 a full three months after the event. z(RCV2) assumes a linear decline in taxable sales down to previous levels over the following 15 months for an 18-month total period in elevated taxable sales as in equation 4.

The results in Table 2, equation 5 provide the best model fit and point to an immediate drop in taxable sales of $198 million during the month of Hurricane Andrew. In the following months, however, south Florida residents, flush with cash from insurance settlements and subsidized government loans and grants, returned to the area and began to purchase goods to replace those destroyed by the storm and to rebuild homes and businesses. Spending reached its post-Andrew peak within 3 months and the bump in economic activity persisted for fully 18-months. In total, south Florida enjoyed an increase in spending over the subsequent year and a half that totaled $3.81 billion.

Predicting the Recovery from Hurricane Katrina

In light of the two contrasting results in the previous section, it is time to turn attention to the aftermath of Hurricane Katrina and the path to recovery in New Orleans. In many ways Hurricane Katrina is a hybrid of these two previous events combining the damaging physical effects of a natural disaster like Hurricane Andrew with the devastating social disruption of the Rodney King riots. A crucial policy question is to answer what private citizens and government can do to ensure that New Orleans follows the positive path to recovery taken by Miami and not the dead end that occurred in Los Angeles. In order to predict how such factors might influence the recovery of New Orleans it is important to identify the differences between the events in Miami and Los Angeles that affected their recovery or lack thereof.

The first primary difference between Hurricane Andrew and the Rodney King riots is the economic and racial demography of the areas affected by each event. The areas affected by the Rodney King riots were much poorer than those areas that were unaffected by the riots or areas affected by Hurricane Andrew in Miami. For example, in the nine Census tracts surrounding the intersection of Florence and Normandie, the infamous epicenter of the riots where white truck driver Reginald Denny was beaten by a mob during the first few hours of the riots, the average poverty rate was just over 30 percent in 1990. This compares to a poverty rate for the entire County of Los Angeles MSA of just under 18 percent and 18 percent for the Miami MSA. Assuming there are lower returns to investment in poorer neighborhoods, then private businesses will be slow to rebuild in these areas. Similarly, residents have less reason to return to damaged or destroyed homes in poor areas due to poor economic and employment prospects.

New Orleans is among the poorest large metropolitan areas in the country and specific areas within the city are poorer still. The lower Ninth Ward area of New Orleans, which is one of the neighborhoods that flooded in the wake of Hurricane Katrina, was over 98 percent African American and had poverty rates over 36 percent in 2000. While wealthier areas of the city such as the French Quarter will undoubtedly undergo an economic resurgence, the experience of Los Angeles suggests that without specific attention to rebuilding and reconstruction in the poorest neighborhoods of New Orleans, economic activity in these areas is unlikely to rebound.

Important racial aspects also differentiate the post-disaster experiences of Los Angeles and Miami. The areas suffering the most damage in the Rodney King riots were predominantly in African American neighborhoods. Only 43 percent of white respondents in a Los Angeles Times poll reported that the riots directly affected their neighborhoods compared to 83 percent of African-Americans questioned. In this way New Orleans imitates Los Angeles. The vast majority of residents trapped within the city as floodwaters rose following Katrina were black, as poor African Americans in the city had little access to transportation that would have allowed them to escape the storm.

Recovery from the riots was even more racially skewed. Five years after the riots, 37 percent of black respondents reported living in neighborhoods where businesses had been damaged in the riots and had not yet reopened compared with less than 10 percent of whites. While the recovery efforts from Katrina are only just beginning, there is already evidence of racial disagreement regarding to initial response. In a Gallup Poll taken immediately after Katrina, roughly 60 percent of blacks thought that the federal government was slow is responding to the crisis within the city because the victims were poor and black as compared to

only about 20 percent of whites who help similar views (CNN, 2005). Such underlying racial disharmony may make rebuilding in New Orleans as difficult as is proved to be in Los Angeles.

Another primary difference between the riots and Hurricane Andrew is the extent of human casualties. While Hurricane Andrew caused massive physical damage, the human toll was relatively light with only 26 deaths directly attributed to the storm. The King riots, on the other hand, caused far less property damage but resulted in 53 deaths and 2,300 injuries. It is reasonable to presume that neighborhood safety will be a factor as people decide whether to invest in a rebuilding effort. In Miami, many may believe that technological fixes are available that can minimize the extent of any future damages even thought the area cannot avoid being in the path of future storms, For example, stricter building standards enacted in the wake of Hurricane Andrew may reduce property damage by up to one-third from a similar storm in the future (Stark, 2002).

Hurricane Katrina has been blamed for over 1,000 deaths in the Gulf Coast region, making it the deadliest natural disaster in the United States in over 75 years. Unless authorities can convince former residents that future hurricanes no longer pose such a danger to human life, many residents are unlikely to take the risk by returning to the region.

A final difference is the government response to each event. Since natural disasters comprise the overwhelming majority of officially declared federal disasters, there is little ability to analyze any systematic bias on the part of FEMA against human induced problems. However, a cursory examination of FEMA's response to the King riots versus other major catastrophes suggests that the agency seems to be far more willing to expend money on major natural

disasters than on major social disruptions. The Federal Emergency Management Agency allocated just $148 million to rebuilding efforts in Los Angeles while dedicating $1.70 billion to Miami just four months later. Even more startling is the $7.24 billion in FEMA payments received by Los Angeles following the 1994 Northridge earthquake. It comes as no surprise, therefore, that taxable sales in California registered no dip as a result of this damaging earthquake. It is reasonable to presume that the minimal federal response to the Rodney King riots, especially when compared to the lavish aid packages received by some cities in other circumstances, was at least in part responsible for the affected areas' slow or non-existent recovery from the turmoil.

Conclusions

Hurricane Katrina was a storm of unprecedented ferocity. By virtually any measure, the damage wrought dwarfs any past storms or the Rodney King riots. Early estimates for uninsured losses caused by Katrina are at least $100 billion, or approximately five times that of Hurricane Andrew (Bloomberg, 2005), and insured losses are estimated at $34.4 billion, which exceeds Andrew's inflation-adjusted insured losses of $20.8 billion (Powell, 2005). For this reason, it cannot be assumed that the transition back to normalcy will be as quick as has happened following disasters in the past.

There are lessons to be learned, however, from recovery efforts in past disasters. While everyone is hopeful that New Orleans will follow the path towards rapid revitalization taken by Miami in the wake of Hurricane Andrew, the failure of Los Angeles' economy to recover following the Rodney King riots suggests an uneven recovery biased against racial minorities

and the economically disadvantaged. Our concern is that the rebuilding effort will be modest at best and slow to develop in poorer areas. There is also the real prospect of long lasting negative effects on income in poor neighborhoods. In wealthier areas, the pecuniary incentive for private business and citizens to rebuild is stronger, and in some cases the rebuilding effort can cause net income *gains* in response to a natural disaster as was the case with Hurricane Andrew in Miami.

Based on the past events in Miami and Los Angeles we make two specific recommendations to promote economic recovery in New Orleans. First, citizens must be convinced that the natural and man-made barriers against future hurricanes are sufficient to allow the city to weather future storms. Without such guarantees, displaced residents, both rich and poor, have little incentive to return to the city. Second, while private investment dollars and insurance settlements are likely to result in the reconstruction of the wealthier and economically vibrant areas of the city such as the French Quarter, it is clear public money will be necessary to rebuild significant portions of the city, especially those areas where private money is slow to return. To this end, we recommend targeting a disproportionate amount of federal transfers towards poorer areas and areas with significant minority populations in order to stimulate growth. In addition, effort must be directed to rebuilding and strengthening social institutions as the clear undercurrents of social and economic unrest revealed in New Orleans in the aftermath of Hurricane Katrina suggest that rebuilding efforts will be far more difficult than simply repairing damaged physical infrastructure.

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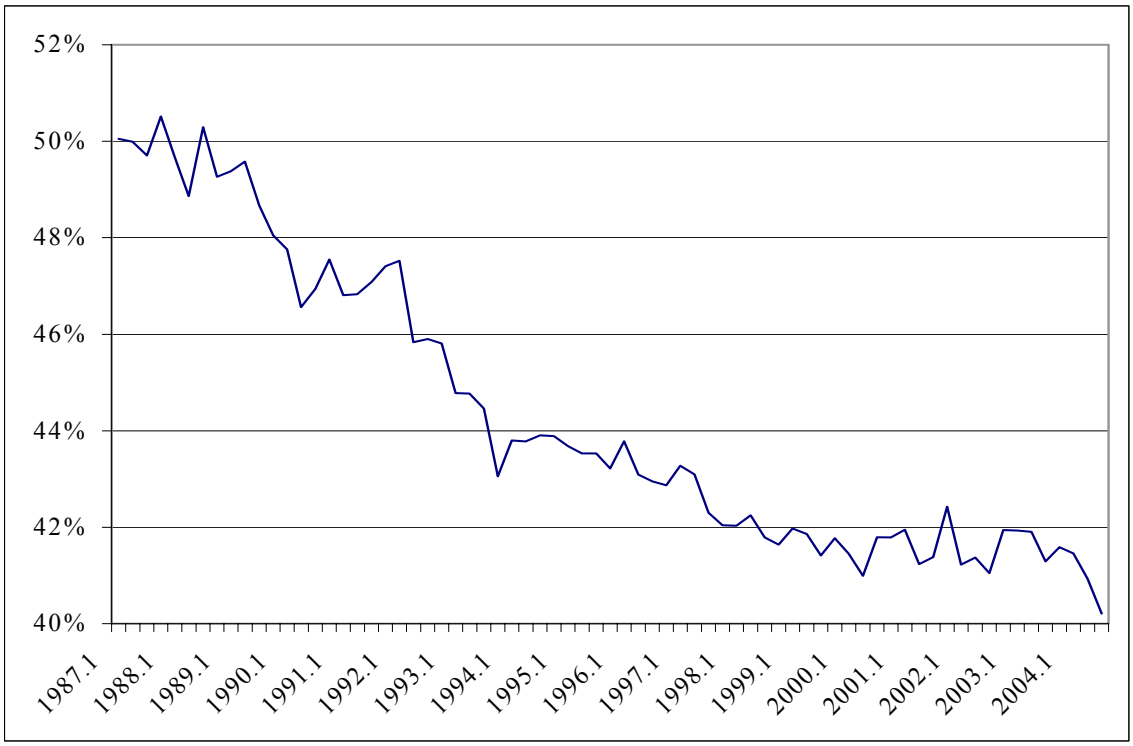
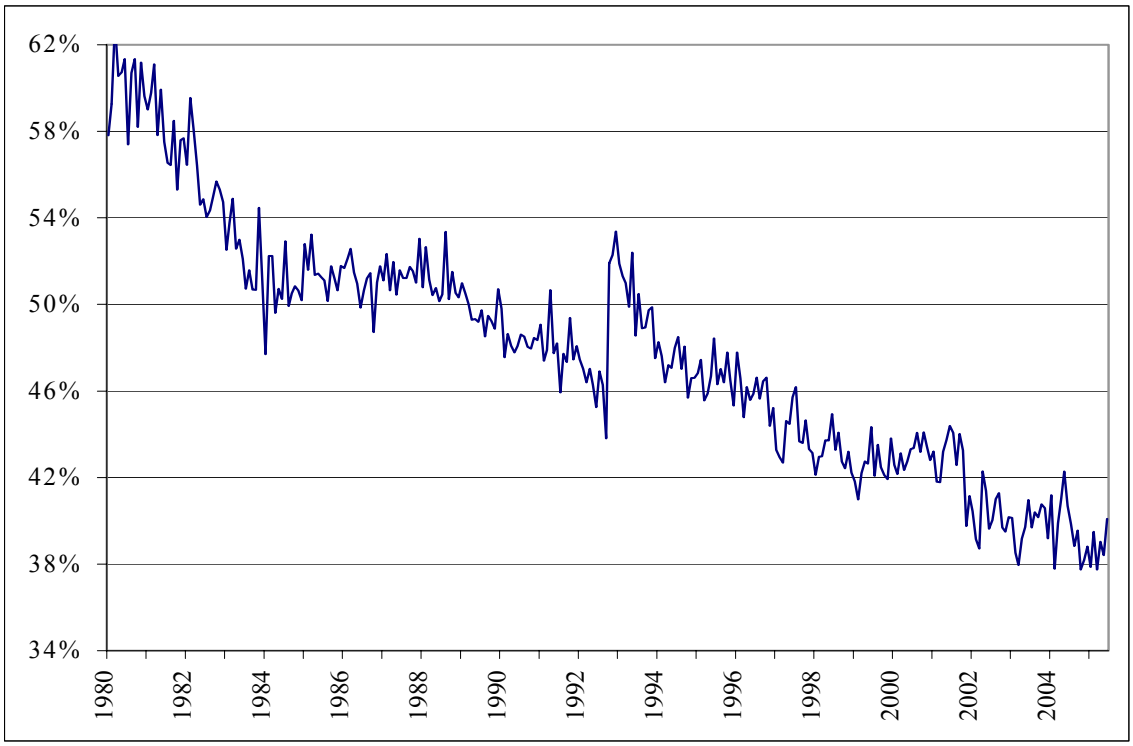
Figure 1: Taxable Sales Ratio for Los Angeles City versus Los Angeles County



Ratio of taxable sales in the City of Los Angeles to the remainder of the County of Los Angeles. Note that while significant downturns in the ratio are common, they are generally accompanied by immediate reversals. This is reflected by the negative coefficients on the one- and two-period lagged dependent variables in the regression results. The exception is the 1992 period of the Rodney King riots.

Figure 2: Taxable Sales Ratio for Miami MSA versus state of Florida



Ratio of taxable sales in the three counties of the Miami MSA (Broward, Dade, and Palm Beach) to the remainder of the state of Florida.

Figure 3: Various Impulse-Response Possibilities

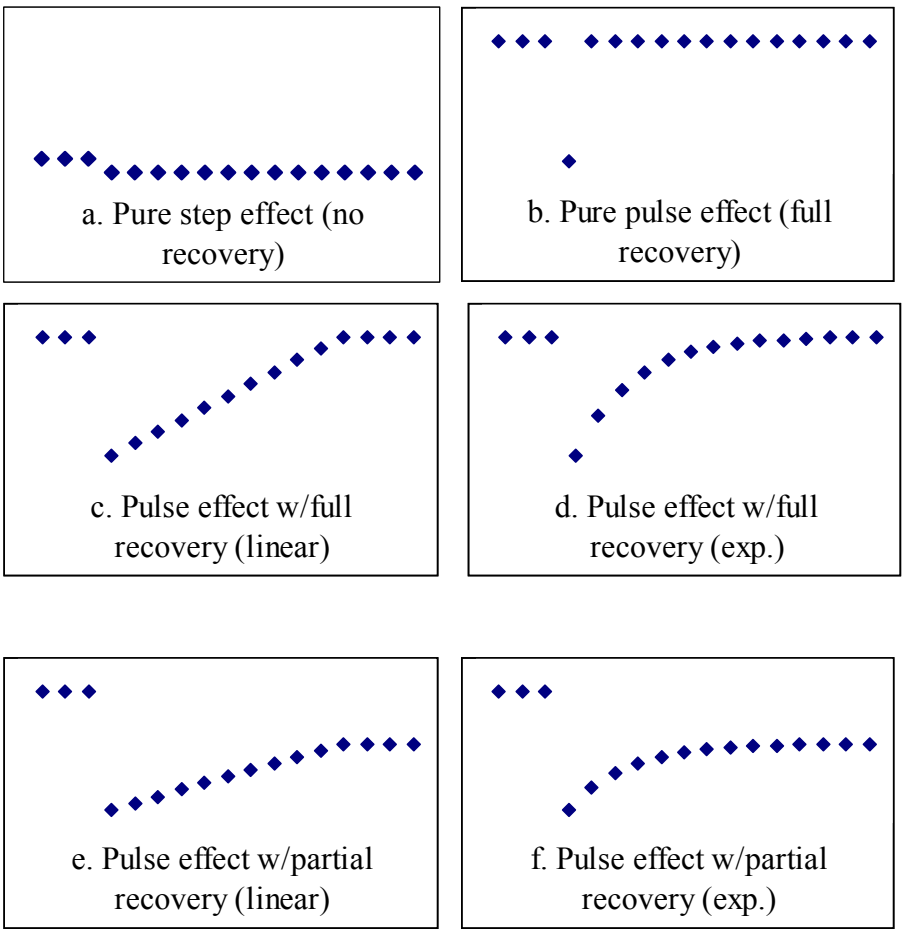


Table 1: *(Sample 1987.1 - 2004.3) intervention analysis*: Rodney King riots

Dependent variable: $y_t^* = \Delta$(taxable sales ratio)

Equation	Constant	AR(1)	AR(2)	z(Intervention)	Diagnostics
1	-.00136**	-.393**	-.280*	-	log L = 267.862
	(-3.58)	(-2.91)	(-2.22)		SSE = .001938
2	-.00137**	-.358**	-.240*	-.0063	log L = 268.859
	(-3.49)	(-3.02)	(-2.00)	(-1.43)	SSE = .001885
3	-.00118**	-.403**	-.276*	-.0129**	log L = 271.680
	(-3.23)	(-3.47)	(-2.38)	(-2.82)	SSE = .001737
4	-.00136**	-.358**	-.235*	-.0089	log L = 269.402
	(-3.50)	(-3.02)	(-1.96)	(-1.77)	SSE = .001856
5	-.00136**	-.389**	-.265*	-.0113**	log L = 270.921
	(-3.71)	(-3.32)	(-2.24)	(-2.49)	SSE = .001776
6	-.00136**	-.405**	-.278*	-.0127**	log L = 271.728
	(-3.81)	(-3.48)	(-2.40)	(-2.84)	SSE = .001735

Notes: All taxable sales ratios have been first-differenced.

The coefficients are reported with their associated t-statistic for the null hypothesis that the estimated value is equal to zero. ** and * represent statistical significance at the 1%, 5% significance levels respectively.

1: no riot variable
2: riot variable in 1992.2 only
3: riot variable from 1992.2 to end of sample frame
4: riot variable with convex recovery (1/t) from 1992.2 to end of sample
5: riot variable with 5-year linear recovery from 1992.2 to 1997.1, inclusive
6: riot variable with linear recovery from 1992.2 to end of sample frame

Table 2: *(Sample 1980.01 - 2005.06) intervention analysis*: Hurricane Andrew
Dependent variable: $y_t^* = \Delta$(taxable sales ratio)

Equation	Constant	AR(1)	AR(2)	MA(12)	z(HA)	z(R2)	z(R1)	Diagnostics
1	.00853*	-.582**	-.278**	.174**				log L = 895.538
	(-2.45)	(-10.43)	(-4.97)	(3.07)				SE = .05035
2	.00854**	-.594**	-.272**	-.164**	-.0532**		.0149	log L = 909.851
	(-2.58)	(-10.45)	(-4.83)	(2.90)	(-4.94)		(1.37)	SSE = .045972
3	.00864**	-.616**	-.296**	.150**	-.0449**		.0388**	log L = 914.163
	(-2.64)	(-10.87)	(-5.26)	(2.70)	(-4.06)		(3.28)	SSE = .044713
4	.00866**	-.650**	-.331**	.163**	-.0299**		.0553**	log L = 922.643
	(-2.64)	(-11.72)	(-5.98)	(2.97)	(-2.67)		(5.45)	SSE = .042351
5	.00906**	-.656**	-.334**	.179**	-.0258*	0.0662**	.0527**	log L = 924.521
	(2.72)	(-11.87)	(-6.03)	(3.25)	(-2.29)	(4.31)	(4.31)	SSE = .041849

Notes: All taxable sales ratios have been first-differenced. Dummy variables for

The coefficients are reported with their associated t-statistic for the null hypothesis that the estimated value is equal to zero. ** and * represent statistical significance at the 1%, 5% significance levels respectively.
1: no Andrew variable
2: Andrew variable in 9/1992, recovery variable in 10/1992
3: Andrew variable in 9/1992, convex recovery decline (1/t) from 10/1992 to end of sample frame
4: Andrew variable in 9/1992, linear recovery decline from 10/1992 to 4/1994
5: Andrew variable in 9/1992, convex ramp over three months, and linear recovery decline variable from 1/1993 to 4/1994