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Abstract

In 2010, the Gulf Coast experienced the largest oil spill, the greatest mobilization of spill response resources, and the first Gulf-wide deepwater drilling moratorium in U.S. history. Taking advantage of the unexpected nature of the spill and drilling moratorium, I estimate the net effects of these events on Gulf Coast employment and wages. Despite predictions of major job losses in Louisiana – resulting from the spill and the drilling moratorium – I find that Louisiana coastal parishes, and oil-intensive parishes in particular, experienced a net increase in employment and wages. In contrast, Gulf Coast Florida counties, especially those south of the Panhandle, experienced a decline in employment. Analysis of accommodation industry employment and wage, business establishment count, sales tax, and commercial air arrival data likewise show positive economic activity impacts in the oil-intensive coastal parishes of Louisiana and reduced economic activity along the Non-Panhandle Florida Gulf Coast.

JEL Codes: J30, J64, Q40

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1 Introduction

On April 20, 2010, the Transocean *Deepwater Horizon* suffered a catastrophic blowout while drilling in a BP lease in the Gulf of Mexico's Macondo Prospect that resulted in the largest oil spill in U.S. history. Due to the ongoing spill and concerns about the safety of offshore oil drilling, the U.S. Department of the Interior suspended offshore deep water oil and gas drilling operations on May 27, 2010, in what became known as the offshore drilling moratorium. The media portrayed the impacts of these events on local employment, with closed fisheries, idle rigs, as well as boats skimming oil and workers cleaning oiled beaches.

This paper examines the net impact of the oil spill, spill response, and the drilling moratorium on employment and wages in the Gulf Coast. The spill and moratorium represented unexpected events in the Gulf Coast region. Coastal counties and parishes in this region were expected to bear the vast majority of the effects of these two events, while inland areas were expected to be largely unaffected. The moratorium was expected to affect Louisiana – with significant support of the offshore drilling industry – but not, for example, Florida, which had no active drilling off of its coastline. The timing and magnitude of the spill response varied across the states over the course of the spill as well.

These characteristics of the spill, spill response, and moratorium motivate an event study difference-in-differences strategy to estimate the impacts of these events on the local labor markets. In this framework, the spill, spill response, and moratorium are considered exogenous events that "treat" the coastal counties, as defined by their hydrologic characteristics by the National Oceanic and Atmospheric Administration, in the Gulf region. Given the surprise nature of these events, they can credibly be characterized as exogenous and hence the pre-event period should not include anticipatory behavior in the Gulf economy. I categorized five Louisiana "oil parishes" identified by the U.S. government as most active in support of offshore drilling activities for "treatment" by the drilling moratorium.

To estimate the net effects of these events on employment and wages, I use monthly county/parish-level data (quarterly data for wages) from the Quarterly Census of Employment and Wages (QCEW). Figure 1 illustrates graphically the employment levels in the Louisiana oil parishes, the non-oil coastal parishes of Louisiana, counties on the Florida Gulf Coast, and the control (inland) counties in the Gulf States and identifies the dates of the spill and the drilling moratorium. To facilitate comparisons over 2010, I have indexed total employment for these four groups of counties such that they each equal 1.0 in January 2010. Employment growth among these four groups follows a nearly identical trajectory through April 2010 and then a significant divergence occurs. Florida Gulf Coast counties experience a significant drop in employment from May through July and then begin to experience employment growth immediately after the capping of the well (July 15). The non-oil parishes on the Louisiana coast track quite closely the employment path of the inland counties throughout the spill. In contrast, the Louisiana oil parishes had effectively flat employment throughout the spill and moratorium and avoided the decline in employment that affected these other Gulf Coast regions during May, June, and July of 2010.

In statistical analysis based on 2010 data, I find that the net employment effect of the spill, spill response, and moratorium is a fairly precise zero for most parts of the Gulf Coast during 2010. In particular, the coastal counties of Texas, Mississippi, and the Florida Panhandle all experienced net job impacts that cannot be statistically distinguished from zero. Three Gulf Coast sub-regions experienced statistically significant changes in employment. I find that the most oil-intensive parishes in Louisiana witnessed a 1.2% increase in employment (95% confidence interval, 0.4 to 2.0%), and the Alabama coastal counties experienced a 1.3% increase in employment as well. In contrast, the Non-Panhandle Florida counties on the Gulf Coast experienced a 2.7% decrease in employment (95% confidence interval, -1.9 to -3.5%).

Complementing these employment impacts, I find that the Louisiana oil parishes experienced a statistically significant increase in the average wage of about 2%. Likewise, the Alabama coastal counties enjoyed higher wages of about 4 to 6% during the spill. The rest of the Gulf Coast counties and parishes experienced economically small and statistically insignificant impacts on wages.

I undertook an array of robustness checks of the base econometric model. First, I accounted for seasonality in labor markets by extending the panels to cover the 2008-2010 period and I permitted seasonality (month fixed effects) to vary by coastal regions and by states in some specifications. Second, I employed a modified definition of coastal counties/parishes. Third, I substituted U.S. non-Gulf State counties as controls for the inland Gulf State counties and parishes. Finally, I omitted Texas observations, since the state was effectively "up current" from the spill and largely unaffected by the spill events. The adverse employment impacts in the Non-Panhandle Florida coastal counties hold across nearly all robustness checks. The results for Louisiana parishes are mixed across the robustness checks, with non-oil parishes experiencing statistically significant positive employment impacts when accounting for seasonality and with some variations in geographic controls. The Louisiana oil parishes typically have either statistically significant 1-2% employment increases or smaller estimates that cannot be statistically distinguished from zero. The positive and statistically significant wage impacts in the Louisiana oil parishes and the Alabama hold across virtually all robustness checks.

I conducted a variety of external validity checks. First, I implemented the employment and wage models for the mining support industry – expected to be impacted by the drilling moratorium – and the accommodation industry – expected to be impacted by the spill and spill response. There is some mixed evidence of statistical declines in mining support employment in the Louisiana oil parishes and Alabama coastal counties, but no evidence of adverse impacts on wages in this industry. The Non-Panhandle Florida coast experienced statistically significant declines in accommodation industry employment and wages. Second, I estimated the impacts of the spill on the number of business establishments, and found statistically significant increases of 1-5% for Louisiana oil parishes and non-oil Louisiana coastal parishes across an array of specifications, while Alabama, Mississippi, and all of Gulf Coast Florida experienced statistically significant declines in the count of establishments. Third, I investigated worker migration using IRS tax statistics, but found no statistically significant impacts of these events on net migration. Fourth, I analyzed parish-specific sales tax data for Louisiana and found a statistically significant increase of 11% in sales tax revenues in the Louisiana oil parishes. Fifth, I investigated quarterly air travel passenger arrivals by airport in the Gulf Coast states, which provides some evidence of lower air passenger arrivals in Florida Gulf Coast airports than other airports during this time. I also provide evidence of the magnitude of the spill response, the positive impact of initial compensation claims on employment, and the very small take-up of benefits available through the rig worker assistance fund to further illustrate the net labor market impacts of these events.

The next section synthesizes the relevant literature on local labor market shocks and describes the predicted labor market impacts reported in the media during the spill and moratorium in 2010. The third section outlines the empirical strategy. Section four presents the empirical results for the base models for employment and wages, followed by an extensive array of robustness and external validity checks. The final section concludes.

2 Predicted Labor Market Impacts of the Spill and Drilling Moratorium

2.1 Local Labor Market Shocks

The local labor markets literature highlights the expected outcomes of an adverse shock to labor demand – such as the shutting down of a fishery due to an oil spill or a drilling moratorium. A negative demand shock should decrease wages and increase unemployment and, with time, result in out-migration of workers, who seek better wages elsewhere (Blanchard et al., 1992). The impact on firms could be mixed, with the initial demand shock causing some firm exit, but the wage readjustment process leading to in-migration of firms that seek out low-cost labor and eventually mitigate some of the impact of the negative shock. Due to the dynamics of migrating workers and firms, Topel (1986) finds that a transitory shock is likely to have a more pronounced impact on wages than a permanent shock.

A positive demand shock – such as a large spill clean-up effort – should increase wages, reduce unemployment, and result in net in-migration of workers. The positive shock to economic activity could result in short-run firm entry, although higher wages could discourage long-run entry. In light of worker migration, the increase in employment under a positive labor demand shock could reflect more jobs for residents and/or more jobs for migrants.[1] Enrico (2011)'s assessment of the local labor market literature notes that empirical evidence on this question is mixed.

While the theoretical and empirical literature have been motivated by and focused on a wide array of local labor market shocks, of particular relevance to the analysis in this paper is the impact of Hurricane Katrina, one of the most destructive and deadly hurricanes to strike the Gulf Coast, on the region's labor markets. In the months following the storm, payroll employment fell by more than one-third in New Orleans (Groen and Polivka, 2008). The number of business establishments in Orleans Parish fell nearly 20% in the two years after the hurricane (Vigdor, 2008). Yet, in contrast to the oil spill, which primarily shocked demand, Katrina adversely impacted labor supply and demand. Vigdor (2008) notes that the higher wages and relatively low unemployment a year after the storm suggests that the reduction in labor supply dominated the decline

[1] During the 2010 oil spill, some Gulf Coast political leaders complained that spill response jobs went to non-residents.

in labor demand. In analysis of individual income tax return data, Deryugina et al. (2014) find that the gap in wage earnings between Katrina victims and the control group had closed by 2007, and non-employment differences had likewise closed by 2009. In light of these findings, in the regression models that control for seasonality presented below, I focus on panels over the 2008-2010 period (as opposed to longer panels) to minimize "Katrina effects" in my statistical models.

Since theory cannot unambiguously resolve the net effect of simultaneous positive and negative demand shocks in a local labor market, I focus on an empirical analysis of the impact of the spill, spill response, and moratorium on the Gulf Coast labor markets. If the adverse shocks (spill and moratorium) dominate the positive shock (spill response), then I would expect a decline in employment and wages, as well as out-migration and, in the short run, fewer business establishments. Before turning to the empirical framework and analysis, I present some evidence of the potential scope of adverse labor market impacts predicted in spring and summer 2010 during the spill and drilling moratorium.

2.2 Predicted Labor Market Impacts of the Spill

In the weeks after the *Deepwater Horizon* sank to the bottom of the Gulf of Mexico, analysts and politicians began to predict the potential employment impacts of the spill. In May 2010, the Atlanta Federal Reserve Bank identified about 130,000 jobs at risk from the spill in the forestry/fishing, arts/entertainment/recreation, and accommodation and food services industries in the Gulf States (Chriszt and Hammill, 2010). An economist at the University of Central Florida estimated that 39,000 (195,000) jobs could be lost in Florida if the spill caused a 10% (50%) decline in tourism (Harrington, 2010). The spill adversely impacted local employment through the closing of state and federal Gulf fisheries and by discouraging some tourists from vacationing on the Gulf Coast that summer (Aldy, 2011).

Some early evidence suggested that regional tourism, especially in Florida, would bear adverse impacts from the spill. Oxford Economics (2010) presented information reflecting tourist travel intentions to the Gulf Coast in summer 2010. First, they reported on consumer webpage views for TripAdvisor, which is the world's most popular travel website. Gulf coast destinations of Clearwater, Destin, Gulf Shores, Fort Myers Beach, Key Largo, Panama City Beach, and Pensacola each had changes in TripAdvisor page views in June 2010 relative to June 2009 ranging between -25% and -52%, while Atlantic coast destinations, such as Daytona Beach, Hilton Head, Miami, Myrtle Beach, and West Palm Beach experienced changes in page views ranging between -4 and +17%. Oxford Economics also reported that a June 2010 survey found that 10% of households intending to travel to the Gulf Coast for vacation had changed their plans as a result of the oil spill. Oxford Economics (2010) estimated a reduction in tourism revenues by 12% in the first year after the beginning of the spill.

2.3 Predicted Labor Market Impacts of the Drilling Moratorium

Within a week of the U.S. government's announcement of the May 27 drilling moratorium, representatives of the oil and gas industry highlighted potentially large employment losses (see Table 1). The Louisiana Mid-Continent Oil and Gas Association identified potential job losses in excess of 30,000 (Louisiana Workforce Commission, 2010). In June, several economists at Louisiana State University independently estimated moratorium-related job losses in the range of 10,000 – 20,000 for the state of Louisiana (Dismukes, 2010; Mason, 2010; Richardson, 2010). The U.S. government also employed regional multiplier models in two analyses: an internal Department of Interior assessment in July reportedly estimated job losses in excess of 23,000 (Power and Eaton, 2010) while an interagency working group report published in September estimated job losses in the 8,000 – 12,000 range (U.S. Department of Commerce, 2010).

Senator Mary Landrieu of Louisiana stated that the moratorium "could cost more jobs than the spill itself" (Condon, 2010). John Hofmeister, the former CEO of Shell, stated that "50,000 people could lose their jobs" (Desel, 2010). The head of one Florida-based investment firm wrote in his oil spill blog that "an extended moratorium… will cost up to 200,000 higher-paying jobs in the oil drilling and service business and that the employment multiplier of 4.7 will put the total job loss at nearly 1 million permanent employment shrinkage over the next few years" (Kotok, 2010).

The pre-spill employment data can put these moratorium job loss estimates in context. First, about 9,000 rig workers worked on projects in the Gulf of Mexico covered by the moratorium (U.S. Department of Commerce, 2010). The total number of workers – onshore and offshore – in the oil and gas industry and in support services to oil and gas extraction in the Gulf States in April 2010 numbered about 110,000 (BLS, nd).

3 Empirical Strategy

The *Deepwater Horizon* oil spill and the offshore drilling moratorium were two unprecedented and unexpected events. With an estimated release of about 5 million barrels of oil over nearly three months, the *Deepwater Horizon* spill was some 50 times larger than the second biggest spill in U.S. history, the 1969 Santa Barbara spill (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011). The scope of the *Deepwater Horizon* spill likewise triggered an unprecedented spill response.

The May 27, 2010 offshore drilling moratorium was also an unexpected event. In 2009, a bipartisan energy bill passed the Senate Energy and Natural Resources Committee that would have opened up the eastern Gulf of Mexico to drilling (American Clean Energy Leadership Act, S. 1462). In March 2010, President Obama announced a new offshore leasing plan that would also make available more of the Gulf to offshore drilling. Prior to the spill, political momentum pointed toward more Gulf of Mexico offshore drilling, not the potential for restricted access and drilling activities. A search of GoogleNews, shows no media articles calling for a moratorium on drilling throughout the Gulf of Mexico before May 27, 2010.

The economic impacts of the spill, spill response, and moratorium varied within and among the Gulf States. Figure 2 illustrates the coastal and inland counties for each of the five Gulf States as well as the location of the *Deepwater Horizon* oil spill. Coastal counties and parishes in this region bore the vast majority of the effects of these events, while inland areas were largely unaffected. The moratorium was expected to affect select Louisiana parishes – with significant support of the offshore drilling industry – but not Florida, which had no active drilling off of its coastline.

The timing and magnitude of the spill response varied across the states over the course of the spill as well. The spill began with the *Deepwater Horizon* explosion on April 20 and the sinking of the rig on April 22. Soon after the rig collapsed to the bottom of the Gulf of Mexico, remote robots captured video of oil leaking from the well. Throughout May, BP undertook an array of efforts to contain the well without immediate success, and by the end of the month it appeared very likely that the spill would not be stopped until a relief well – requiring at least three months – intercepted the leaking well some 17,000 feet below sea level. On May 27, the Department of the Interior issued a six-month suspension order for deepwater drilling, commonly referred to as the offshore drilling moratorium. On July 15, the leak was capped. On September 19, the relief well officially killed the well. Nearly a month later on October 12, the Department lifted the drilling moratorium.

These spatial and temporal characteristics of the spill and moratorium motivate the empirical framework. I use a difference-in-differences strategy to estimate the impacts of the spill, spill response, and moratorium on employment and wages. In this framework, the spill, spill response, and moratorium are considered exogenous events that "treat" coastal counties in the Gulf region (see Table 2). Given the surprise nature of these events, they can credibly be characterized as exogenous and hence the pre-event period should not include anticipatory behavior in the Gulf economy (i.e., relocating fishing vessels to the Atlantic coast in anticipation of the spill or relocating drilling rigs to another region in anticipation of the moratorium). Expectations that oil could impact any part of the Gulf Coast – as evident with the discussion above on online Florida tourism searches and clearly indicated in contemporaneous media coverage of the spill – suggests that all Gulf state coastal counties and parishes should be considered "treated" by the spill. Coastline incidence of oil ranged from Cameron Parish, the western-most coastal parish in Louisiana to Wakulla County, on the eastern edge of the Florida Panhandle.[2] Spill response activities focused on these coastlines and nearby waters (as well in the immediate vicinity of the *Deepwater Horizon*), although some spill response efforts originated in Texas as well. Very little spill response activities occurred in the Non-Panhandle Florida coastal counties.

I employ the National Oceanic and Atmospheric Administration's definition of Gulf of Mexico coastal counties and parishes for Alabama, Florida, Louisiana, Mississippi, and Texas (National Oceanic and Atmospheric Administration, nd). These counties are assumed to be "treated" by the spill for May through July 2010. In addition, I isolate the five Louisiana parishes identified by the U.S. government as most active in support of offshore drilling activities – Iberia, Lafayette, Lafourche, St. Mary's, and Terrebonne (Interagency Economic Report 2010).[3] These are assumed to be treated by the moratorium for June

[2] Refer to the Environmental Response Management Application (ERMA) Deepwater Gulf Response website for geographic data on the oil spill: http://gomex.erma.noaa.gov/erma.html#/x=-89.37870&y=29.14486&z=6&layers=23036+5723+23566+24402+2725+4155+2174, last accessed Augsut 3, 2014.

[3] Dismukes (2010) estimates that nearly three-quarters of the economic impacts of the moratorium would be borne by these five parishes in his multiplier analysis for Louisiana.

through October 2010.[4] For the "control" group, I employ all non-coastal counties and parishes in these five states. Table 3 presents summary statistics on the number of coastal and inland counties by Gulf State as well as average employment, weekly wage, and establishment counts.

Formally, I specify the following regression equations:

$$ln(y_{it}) = \alpha_i + \delta_t + \beta 1[spill]_t 1[coastal]_i + \varepsilon_{it} \tag{1}$$

$$ln(y_{it}) = \alpha_i + \delta_t + \beta 1[spill]_t 1[nonoil - coast]_i + \gamma 1[mor]_t 1[oil]_i + \varepsilon_{it} \tag{2}$$

$$ln(y_{it}) = \alpha_i + \delta_t + \sum_{j=1}^{6} \beta 1[spill]_t 1[nonoil - coast]_i 1[region]_j + \gamma 1[mor]_t 1[oil]_i + \varepsilon_{it} \tag{3}$$

in which y represents one of two labor market outcomes: (a) total employment for county i in month t, and (b) average weekly wage in 2010 dollars for county i in quarter t;[5] α represents county fixed effects, δ represents month-year (quarter-year) fixed effects in the employment (wage) specifications; the indicator functions $1[spill]$ and $1[mor]$ take the value of 1 for the months May through July (oil spill duration) and for the months June through October (moratorium duration), respectively;[6] the indicator functions $1[coastal]$, $1[oil]$, $1[nonoil - coast]$ take the value of 1 for NOAA-classified Gulf Coast counties and parishes, the five Louisiana "oil" parishes of Iberia, Lafayette, Lafourche, Saint Marys, and Terrebonne, and all coastal counties and parishes except for the five oil parishes, respectively; and the indicator function $1[region]$ takes the value of 1 for each of these six regions: Alabama, Panhandle Florida, Non-Panhandle Florida, Louisiana, Mississippi, and Texas. I estimate the base models with data for January through October 2010 (I test for sensitivity to panel length and seasonal controls in the robustness checks). The standard errors are clus-

[4] The appendix table lists Gulf Coast counties within each treatment category.

[5] I also employ the quarterly-based specification for establishment count analyses in the robustness checks below.

[6] For the wage and establishment count analyses, these indicators take the value of 1 for 2010 quarter 3. The spill began in week four of the second quarter, and the moratorium began in week nine of the second quarter. Given this timing and the likely lag for wage adjustment, I specify the wage and establishment count models such that the net treatment of spill, response, and moratorium are assumed to occur in 2010q3.

tered by county/parish to account for potential serial correlation in the data (Bertrand et al., 2004).

To implement this model, I employ QCEW monthly county/parish-level employment and quarterly county/parish-level wage data (BLS, nd). The BLS and state employment security agencies compile monthly employment and quarterly wage and establishment data for workers covered by various unemployment insurance programs, and hence is effectively a measure of employment provided by employers. It does not include data on the self-employed, proprietors, armed forces, domestic workers, and railroad workers. This dataset only permits an investigation of employment levels; it does not include data on labor force participation, unemployment, or unemployment rates.[7] In addition, the QCEW provides employment and wage data, for some counties and parishes in this region, by sector and industry, and I use these data to investigate industry-specific labor market impacts in the robustness checks.

4 Results

4.1 2010 Panel Analyses of Employment and Wages

Table 4 presents the employment results for estimating equations 1-3. Equation 1, which permits an examination of a common treatment of the spill, spill response, and moratorium on all coastal counties and parishes, shows fairly precise zero impacts for the Gulf Coast counties. The estimated coefficient cannot be distinguished from zero and the 95% confidence interval ranges from about a 7/10 of 1% decline to a 1/10 of 1% increase in employment.

The model in column 2 allows for differential impacts for the five oil-intensive parishes of Louisiana and for the rest of the Gulf Coast counties. This model effectively focuses on the treatment of spill, spill response, and moratorium on the oil-intensive parishes and the treatment of spill and spill response on the rest of the Gulf Coast region, which had little economic activity that could be impacted by the offshore drilling moratorium. Not surprisingly, the non-oil Gulf Coast counties show similar impacts as the entire Gulf Coast in column 1 results. The oil parishes exhibit a statistically significant employment increase of 1.2%.

[7] While the Current Population Survey's Local Area Unemployment Statistics (LAUS) provides such information at the county-by-month level, the LAUS data are imputed for most counties and months, in contrast to the QCEW count data.

The model in column 3 provides even greater flexibility in estimating the impacts of treatment by the spill, spill response, and moratorium by allowing for effects to vary by state and sub-state region, including the Louisiana oil parishes. The results in column 3 illustrate a statistically significant 1.2% employment gain in the Louisiana oil parishes, a statistically significant 1.3% employment gain in Alabama coastal counties, and a statistically significant 2.7% employment decline in Non-Panhandle Florida Gulf Coast counties. Based on average 2009 employment levels in these three regions, these statistically significant estimated impacts translate into about 3,000 more jobs in the oil parishes, 3,000 more jobs in the Alabama coastal counties, and 50,000 fewer jobs in the Florida coastal counties reflecting the net effects of the spill, spill response, and moratorium.

Table 4, columns 4 – 6, present the results for impacts of these events on the average weekly wage. As evident above in the discussion of employment, the average treatment effect for the Gulf Coast counties as a whole is not statistically different from zero (the 95% confidence interval is about +/- 1 %) (column 4). The Louisiana oil parishes experience a statistically significant increase in wages of about 2% (columns 5 and 6). Likewise, the Alabama coastal counties appear to have higher wages, with a statistically significant estimate of about 4% (column 6). The non-oil Louisiana coastal parishes experience a statistically significant 2.5% decline in wages. Both Florida regions, Texas, and Mississippi experience small and statistically insignificant wage impacts during the oil spill. Given the evident variation in employment and wage outcomes by state and sub-state region, I focus on model (3) in the subsequent robustness checks.

4.2 Robustness: Seasonality

To address the concern that the results presented above reflect regular seasonal variations in labor markets, I expanded the analyses to include a longer panel (2008-2010) and allowed for month (quarter) fixed effects to vary between coastal and non-coastal regions as well as by state. Table 5 presents the employment impacts for these seasonality robustness checks and includes the model from column 3 in Table 4 for reference.

While the oil parishes exhibit a statistically significant employment increase of 1 – 2% in the 2010 panels (columns 1, 3, and 5), the longer panels show fairly precise zeroes for the oil parishes (columns 2, 4, and 6). These results highlight a question for this kind of analysis (and is common to all reducedform difference-in-differences empirical models) – when should the panel start? The panel could start as early as January 1990 (given the construction of the public domain QCEW dataset) or as late as April 2010. A longer panel provides more power to estimate parameters, but if omitted time-varying factors affect a subset of counties or parishes, then lengthening the panel could affect the estimation of county/parish fixed effects and the treatment effects. For example, Hurricane Katrina and post-hurricane rebuilding differentially impacted counties and parishes in 2005 and subsequent years. In addition, the increase in oil prices over 2003-2008, including the sharp run-up in spring and summer of 2008, could have spurred greater drilling activity and associated support activity employment in the oil parishes than in 2010. A longer panel, however, permits the estimation of seasonal trends in employment that may explain some of the variation evident in a 2010-only panel. I report panel results for 2008-2010 – long enough to control for seasonality but post-Katrina and after the local labor market had begun to converge to a new normal, at least as described in the literature reviewed above in section 2.[8]

Alabama coastal counties enjoy a statistically significant employment increase of 1.3 to 2.0% in the 2010 panel (columns 1, 3, and 5), but small, positive, statistically insignificant effects in the 2008-2010 panel. Non-Panhandle Florida Gulf Coast counties experience a statistically significant employment decline of 1.7 – 2.7% in four of the six specifications presented in Table 5 (columns 1, 3, 5, and 6). With longer panels, Texas coastal counties appear to experience statistically significant employment gains ranging between 1.5 and 2.0% for the 2008-2010 panel.

Table 6 presents the seasonality robustness checks for the wage impacts. In five of the six specifications, Louisiana oil parish wages are statistically significant and higher than control wages by 2 – 3%. Likewise, in five of the six specifications, Alabama coastal county wages are about 4 – 6% higher and statistically significant. In 2008-2010 panels, Texas coastal county wages are 1.4 – 1.9% higher. The statistically significant decline in non-oil Louisiana coastal parish wages only holds for two models with the 2010 panel. The two Florida regions and Mississippi experience small and statistically insignificant wage impacts during the oil spill.

[8] I have also estimated these models with 2007-2010 and 2009-2010 panels, which yield very similar results to the 2008-2010 panel models.

4.3 Robustness: National Controls

The primary empirical strategy in this paper rests on the assumption that the non-coastal counties and parishes in the Gulf Coast region are not impacted by the spill, spill response, or moratorium and thus can serve as controls in the regressions. Given the close proximity many of these counties and parishes have to the treated coastal region, there may be a risk that the controls are affected by changes in economic activity in the treatment region. For example, if a worker lost her job in a treatment county and relocated to a control county where she took on a new job, then we would have a case in which the employment status of the individual is unchanged but this empirical framework would estimate a delta of -2 for employment (for treatment employment minus control employment during the treatment period). In a similar way, if a worker quits a job in a control county so he can move to a treatment county and participate in spill response, then this approach would again show a change in employment (in this case a delta of +2) despite the fact that the employment status for the worker in question is unchanged.

To address this possible concern, I run the base regressions with a modified sample. I exclude all control counties and parishes in the Gulf States and I add all non-Gulf State counties in the United States. Thus, I use the non-Gulf Coast region as the control group for the treatment of the spill and moratorium on the Gulf Coast counties and parishes. This also permits an illustration of how employment trends in the Gulf Coast region compared with the rest of the nation during these events.

Table 7, columns 1 and 2, shows the results for employing national controls for employment outcomes. In both panels, the Florida coastal regions have a statistically significant lower employment of 2 to 4%. Neither the Louisiana oil parishes nor the Alabama coastal counties show employment impacts statistically different from zero in each of the panels. While the non-oil Louisiana oil parishes and coastal counties of Mississippi and Texas appear to have statistically lower employment in the 2010 panel on the order of 1 to 1.5%, these results do not hold up in the 2008-2010 panel.

Table 8, columns 1 and 2, presents the results for wage impacts using the national sample. The Louisiana oil parishes have statistically significant higher wages ranging between 2.5 – 3.2%. Likewise, Alabama has statistically higher wages in the 5 – 6% range. There is some evidence of statistically higher wages in Texas – up to 2% – in the 2008-2010 panel. None of the other regions have wage impacts statistically different from zero.

4.4 Robustness: Omit Texas

Texas counties represent about 48% of the sample in the Gulf State statistical analyses. Texas may not have experienced much of an impact from the oil spill, since the spill occurred southeast of the boot of Louisiana and the vast majority of the oil moved to the east and north from the leaking well. To address the concern that the Texas counties – coastal and inland – may not be appropriate for inclusion in these statistical analyses, I have run the base regressions with a four-state Gulf sample that omits coastal and inland counties of Texas.

Table 7, columns 3 and 4, shows the results for the model runs with this modified sample. As before, the Louisiana oil parishes and the Alabama coastal counties have statistically higher employment in the 2010 panel, but not in the 2008-2010 panel. The non-oil Louisiana parishes have statistically higher employment, ranging from about 0.7% to 2.2% in the 2010 and 2008-2010 panels, respectively. The Non-Panhandle Florida coastal counties have statistically lower employment of about 2.3% in the 2010 panel, although this effect falls and is not significant in the 2008-2010 panel. Overall, these results are fairly similar to those specifications that include Texas counties in the regression model.

Excluding the Texas observations does not qualitatively alter the estimated wage impacts of the spill, response, and moratorium (Table 8, columns 3 and 4). Louisiana oil parish wages experience a statistically significant 2.2% increase, and the Alabama counties enjoy statistically significant increases of 4 – 6% across these panels as well. There is limited evidence of a statistically significant decline in the non-oil Louisiana coastal parish wages, as illustrated in the 2010 panel. None of the other state-specific coastal wage impacts are statistically different from zero in this "Omit Texas" framework.

4.5 Robustness: Definition of Coastal

The base regressions employ the NOAA definition of a coastal county or parish in the Gulf States. I have also employed a more narrow definition that requires a county or parish to meaningfully border the Gulf of Mexico. In these analyses, I have dropped what I now define as "buffer" counties and parishes – those that NOAA identifies as coastal but do not have meaningful coastline. This reduces the sample from 534 to 444 counties and it also eliminates those counties that may have experienced relatively weak "treatment," when compared to those counties with significant coastline, and relatively stronger "treatment," when compared to those counties further inland.

The Louisiana parishes – oil-intensive and non-oil – have statistically higher employment in the 2010 panel but not in the 2008-2010 panel (Table 7, columns 5 and 6). Alabama coastal counties (in this case, Baldwin and Mobile) have statistically higher employment of 1.9% to 2.7% across the panels, while Non-Panhandle Florida coastal counties have statistically lower employment of more than 3% in the two panels. These results illustrate the robustness of the adverse employment impacts to Florida and potentially highlight the positive employment impacts to the two Alabama counties sitting on the Gulf Coast.

For wage effects under this alternative definition of coastal counties and parishes (Table 8, columns 5 and 6), the oil-intensive Louisiana parishes have statistically significant higher wages of about 2% in the panels. Coastal counties in Non-Panhandle Florida appear to experience a statistically significant decline of about 1.4 to 2.3% in these panels. In addition, Alabama appears to benefit on the order of 1.5 – 2.0% in the average wage. There is no statistically significant impact of the spill on non-oil Louisiana coastal parishes in this framework.

4.6 External Validity: Industry-Specific Impacts

To complement the analyses of total employment and wages, I have also estimated equation 3 with industry-specific data for the support activities for mining (NAICS 213, which includes drilling oil and gas wells NAICS 213111) and accommodation (NAICS 721) industries. These industry-specific analyses permit further investigation of the impacts of the spill, spill response, and moratorium on directly affected industries. While additional industries, such as fishing (NAICS 1141), water transportation (NAICS 483), oil and gas drilling (NAICS 211) would certainly be of interest for this kind of analysis, the censoring of the public domain county-level employment data renders these panels much too small (3, 20, and 62 counties, respectively, out of 534 in the region). Table 9 presents the estimated employment and wage impacts for the support activities for mining and accommodation industries. As a result of data censoring, the models for support activities for mining industry exclude Florida counties.

For the mining support industry, the Louisiana oil parishes, Alabama coastal counties, and Mississippi coastal counties appear to experience a statistically significant decline in employment based on the 2010 panel, but this is robust to extending the panel to 2008-2010 only for Alabama, which suffers an 11% decline. In contrast, non-oil Louisiana parishes experience a 14% increase in mining support employment in the longer panel. Louisiana oil parishes and Alabama coastal counties also experience a decline in the wage in the mining support industry based on the 2010 panel, although this effect falls to a statistical zero for each region in the longer panel. Mississippi coastal counties have a statistically significant 1.6–3.3% increase in mining support wages in the two panels.

For the accommodation industry, the Louisiana oil parishes have a statistically significant increase of nearly 5% in employment, while the non-Panhandle Florida counties (-4.7%), Mississippi coastal counties (-4.8%), and Texas coastal counties (-2.7%) experience statistically significant declines in employment in the 2010 panel. These results hold only for the non-Panhandle Florida counties in the 2008-2010 panel, which shows a 3.7% decline in accommodation employment in these counties. For this industry, again, only the non-Panhandle Florida counties show a statistically significant decline in wages, ranging from -3.6 to -6.2% in the two panels, although there is weak evidence that the Louisiana oil parishes enjoyed a 4.2 to 4.7% increase in the accommodation industry wage (statistically significant at the 10% level in each panel).

4.7 External Validity: Establishment Count

The QCEW provides quarterly counts on the number of business establishments in each county. I employ equation (3) and replicate the specifications as reported in Table 6 on wages with the natural logarithm of the establishment count as the dependent variable. Table 10 presents the results for these specifications with quarter, quarter-by-coastal, and quarter-by-state fixed effects (in addition to county fixed effects) for 2010 and 2008-2010 panels. As in the wage regressions, the third quarter of 2010 is considered the "treated" quarter in these statistical analyses.

In all specifications, non-oil Louisiana coastal parishes experience statistically significant increases in the establishment count, ranging from about 0.5 to 4%. In all but one specification, the Louisiana oil parishes likewise experience statistically significant increases of about 1 to 4%. In all specifications, Panhandle Florida and Non-Panhandle Florida experience statistically significant declines in establishment count of about 1 to 2% in the former and about 2 to 4% in the latter. In a majority of specifications, Alabama and Mississippi coastal counties also experience statistically significant declines in establishment count, 3 and 1%, respectively.

The net positive impacts of these events on Louisiana business establishments is consistent with the zero to positive impacts on employment and wages for the two Louisiana regions in nearly all specifications. Likewise, the adverse impact on Non-Panhandle Florida coastal business establishments squares with the finding of a decline in employment across virtually all statistical models.

4.8 External Validity: Migration

The standard models of local labor markets suggest that a negative (positive) shock that decreases (increases) wages will result in out-migration (in-migration). To investigate the potential impacts of the spill, spill response, and drilling moratorium on migration, I use annual migration data provided by the U.S. Internal Revenue Service (nd) to estimate a version of equation 3. In particular, I estimate this regression model with an array of migration dependent variables: net migration (scaled by the non-migration population), the natural logarithm of in-migration, and the natural logarithm of out-migration. Net migration reflects the net effect of total in-county migration and total out-county migration for a given year. Given the annual nature of the data, I consider the 2010 data for the various coastal counties and parishes as treated, and run the models with 2009-2010, 2008-2010, and 2007-2010 panels. I also run these models with various assumptions about fixed effects: using year, year-by-state, and year-by-coastal fixed effects (and all with county fixed effects) in various model runs.

The net migration models consistently show – across panel lengths and various assumptions over fixed effects – no statistically significant impact of the spill, spill response, and moratorium on net migration flows in coastal counties and parishes in the Gulf States. For the in-migration and out-migration models, there is no evidence that any region, in any specification, experienced a statistically significant increase in either in-migration or out-migration. There is some evidence that Louisiana oil parishes and non-oil Louisiana parishes experienced statistically significant declines in in-migration and out-migration. In almost all specifications, the Florida Panhandle and Non-Panhandle Florida counties experienced statistically significant declines in in-migration and out-migration, with the Non-Panhandle counties having the largest declines (as much as -9%) of any region. The reductions in both in- and out-migration may reflect uncertainty over the duration and persistence of these events on the local labor markets.

4.9 External Validity: Sales Tax Revenue

To further corroborate the labor market findings for Louisiana and Florida, I separately analyze these states' parish-/county-level sales tax data.[9] The State of Louisiana reports sales tax revenues by parish for the state general sales tax on an annual basis for fiscal years that run from July to June. The state sales tax rate was 4% over the sample period and across all parishes.[10] The revenue data are for fiscal years ending in June of a given calendar year (Louisiana Department of Revenue, 2010, 2011). For this analysis, I conduct a standard difference-in-differences analysis that allows for comparisons across two time periods: (1) July 2009 – June 2010, and (2) July 2010 – June 2011; and comparisons across three groups: (1) non-oil Louisiana coastal parishes, (2) oil parishes, and (3) inland (control) parishes. Specifically, I estimate the following regression:

$$ln(rev_{it}) = \alpha_i + \delta_t + \beta 1[2010/2011]_t 1[nonoil - coast]_i + \gamma 1[2010/2011]_t 1[oil]_i + \varepsilon_{it} \quad (4)$$

in which rev represents total sales tax revenue for parish i in year t; α represents county fixed effects; δ represents the fixed effect for the 2010/2011 year (the 2009/2010 year fixed effect is omitted); the indicator function 1[2010/2011] takes the value of 1 for the 2010/2011 tax revenue year; and the other indicator functions were defined above.

The oil parishes experienced an increase in sales tax revenues for the July 2010 – June 2011 period relative to the previous twelve months. This increase in tax revenues differs statistically from the non-oil coastal parishes and the inland parishes, each of which experienced no meaningful change in the level of revenues.[11] The difference-in-differences estimator using parish-level data to

[9] This analysis focuses on Louisiana and Florida because of the distinctive impacts of the spill, response, and moratorium on these two states and the availability of public use sales tax data.

[10] Technically, the 4% state general sales tax consists of a 3.97% state sales tax and a 0.03% Louisiana Tourism Promotion District sales tax. The revenue data presented covers only the state sales tax; it does not include parish or city-established sales tax revenues.

[11] A Wald test of the hypothesis that $\hat{\beta} = \hat{\gamma}$ is rejected at the 1% level, and $\hat{\gamma}$ is statistically significant at the 1% level.

compare the before and after time periods yields a statistically significant 11% increase in sales tax revenue for the oil parishes relative to the inland parishes.

The State of Florida reports county sales tax data on a monthly basis.[12] I use gross sales subject to the state sales tax in a specification similar to (4):

$$ln(sales_{it}) = \alpha_i + \delta_t + \beta 1[spill]_t 1[pan]_i + \gamma 1[spill]_t 1[nonpan]_i + \varepsilon_{it} \quad (5)$$

in which *sales* represents gross sales subject to the state sales tax for county i in month t; α represents county fixed effects; δ represents month and year fixed effects; and the other indicator functions were defined above. Given the seasonal nature of Florida tourism, I estimate equation (5) with a 2010 sample (January to July) and January 2009 – July 2010 and January 2008 – July 2010 samples. The Panhandle counties experienced a 12-15% increase in gross sales relative to the non-Gulf Florida counties during the spill months, and this impact is statistically different from zero at the 1% level in all three sample periods. In contrast, Non-Panhandle Gulf coast counties experienced relatively small and statistically insignificant sales increases (1.5-2.6%) during the spill. Wald tests of the hypothesis that the coefficient estimates on the Panhandle and Non-Panhandle indicator variables are equal are rejected at the 1% significance level in all three sample periods.

4.10 External Validity: Commercial Air Travel

The labor market impacts presented above suggest that tourism may have been adversely impacted by the oil spill, especially in Florida. To further investigate these impacts, I employ data compiled by the U.S. Bureau of Transportation Statistics (nd), which tracks commercial air travel, including number of passenger arrivals by airport by quarter. According to the BTS, there were 115 airports in the five Gulf States receiving commercial air passengers in the second quarter of 2010. For this analysis, I limit the sample of airports to those with at least 50,000 passenger arrivals per quarter, which corresponds to about four daily arrivals of a Boeing 737-sized aircraft. This restriction drops a number of military installations that occasionally receive civilian arrivals and very small airports. The resulting sample includes 32 airports that received more

[12] I accessed Florida county-by-month sales tax data from http://dor.myflorida.com/dor/taxes/colls_from_7_2003.html on August 12, 2012.

than 97% of all commercial air passengers in these five states in the second quarter of 2010. Coastal counties and parishes host 15 of these airports.

To evaluate the potential impacts of the oil spill on commercial air travel, I estimate the following regressions:

$$ln(pass_{it}) + \alpha_i + \delta_t + \beta 1[spill]_t 1[coastal]_i + \varepsilon_{it} \quad (6)$$

$$ln(pass_{it}) + \alpha_i + \delta_t + \beta 1[spill]_t 1[FLcoast]_i + \gamma 1[spill]_t 1[nonFLcoast]_i + \varepsilon_{it} \quad (7)$$

in which *pass* represents the total number of arrivals for airport i in quarter t; α represents airport fixed effects; δ represents quarter-year fixed effects; the indicator function $1[spill]$ takes the value of 1 for the third quarter of 2010; the indicator functions $1[coastal]$, $1[FLcoast]$, and $1[nonFLcoast]$ take the value of 1 for airports in NOAA-classified Gulf Coast counties and parishes, airports in Florida coastal counties, and airports in non-Florida Gulf Coast counties, respectively. I estimate the models with varying lengths of panels, ranging from 2008:Q1 through 2010:Q3 to only the first three quarters of the 2010 calendar year. The standard errors are clustered by airport.

For the specifications of equation 5, there is a modest but statistically insignificant reduction (-6%) in commercial air travel passengers for the oil spill quarter. By estimating differential impacts for Florida versus non-Florida coastal airports (equation 6), there is some weak evidence that Florida airports are adversely impacted by the oil spill. With the 2010 panel, I estimate a 17% decline in Florida coastal airport passenger arrivals, although this estimate cannot be statistically distinguished from zero. Using the 2007-2010, panel I estimate a similar 15% decline that is statistically different from zero at the 10% level.

4.11 External Validity: Spill Response Labor Mobilization

The unprecedented mobilization of spill response resources – including more than 800 specialized skimmers, 120 aircraft, 8,000 vessels, and nearly 50,000 responders (Aldy, 2011) – provided employment opportunities that could counter the potential adverse effects of the spill and the moratorium. While many of these responders represented workers relocating temporarily to address the spill, some were local displaced workers. For example, fishermen who faced closed state and federal fisheries during the spill could participate in the Vessels of Opportunity program. Through this program BP paid \$1,200 - \$3,000 per day per vessel for skimming, booming, and related response operations (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011). Between April and July 2010, the U.S. Coast Guard expended nearly \$600 million on spill response, with more than \$100 million each for personnel and cutters as well as more than \$250 million for other federal, state, and local government clean-up efforts (National Pollution Funds Center, 2013).[13]

4.12 External Validity: BP Clean-up Expenditures and Economic Damage Compensation

The clean-up activities and compensation for economic damages provided by BP could counter at least some of the impacts of lost income on economic activity. BP's expenditures in the Gulf States for damage compensation and clean-up were quite significant. By June 1, 2010, BP reported spending nearly a billion dollars for clean-up, and the clean-up tab increased to more than \$3 billion by July 5. On September 17, BP reported clean-up spending of nearly \$10 billion. BP reported compensation for damage claims of \$40 million through June 1, \$147 million through July 5, and nearly \$400 million through August 23, when BP turned over the claims process to the independent Gulf Coast Claims Facility (GCCF) created as a part of the June 16 agreement with the White House (Aldy, 2011). On September 21, 2010, the GCCF reported paying out nearly \$300 million in its first month in operation, with 36% and 29% of the funds to Louisiana and Florida claimants, respectively (GCCF, 2010). Fishing industry claims represented about \$120 million followed by nearly \$75 million in claims from food, beverage, and lodging industries. By May 2012, the GCCF had paid out about \$6.5 billion in claims, with the food, beverage, and lodging industry claims in excess of \$1 billion representing the largest industry category. By then, Florida's claims amounted to a 38% share of all fund payments, followed by Louisiana's share of 28% (GCCF, 2012).

The compensation payments for oil-spill related damages are similar to some forms of targeted fiscal stimulus. Drawing from Feyrer and Sacerdote (2011), I estimate the relationship between compensation claims and the change in

[13]The Coast Guard sought and received compensation for these clean-up and spill response expenditures from BP, the responsible party as specified under the Oil Pollution Act.

employment using county-specific claims data from the September 2010 GCCF report:

$$\Delta\left(\frac{employment}{population}\right)_i = \alpha + \beta\left(\frac{compensation}{population}\right)_i + \theta_j + \varepsilon_i \tag{8}$$

in which the dependent variable is the difference in the ratio of employment to total county population over September 2009 – September 2010 (using a 12-month difference to control for seasonality), the key variable of interest is the ratio of compensation claims to total county population in September 2010, and θ represents state fixed effects to control for state-specific drivers of employment. With compensation per capita measured in \$100,000 per person, my estimated $\hat{\beta}$ of 2.93 (with a robust standard error of 0.42) suggests an implicit fiscal multiplier of about \$34,000 per job, which is relatively small given the fiscal multiplier literature (see Council of Economic Advisers, 2014). This approach suffers from an obvious endogeneity problem: compensation claims are larger in counties suffering greater economic damages from the spill.[14] Such an endogeneity problem, however, should bias the coefficient estimate down and increase the dollars per job implicit multiplier. My model likely suffers from another source of endogeneity: counties suffering significant economic damages from the spill also experienced a significant influx of spill response resources and activities, as detailed above. While this model is not statistically identified, the apparent bias is consistent with various factors increasing employment in some of the worst hit parts of the spill, especially in Louisiana and Alabama.[15]

4.13 External Validity: Rig Worker Assistance Fund

On June 16, 2010, as a part of a larger agreement, the White House and BP agreed that BP would set aside \$100 million for a Rig Workers Assistance Fund (RWAF) to benefit any rig workers laid off as a result of the drilling moratorium. BP allocated the \$100 million to the Baton Rouge Area Foundation, which was responsible for designing and implementing the assistance fund. The RWAF made grants, ranging from \$3,000 to \$30,000, available to individuals who had

[14] Feyrer and Sacerdote employ political instruments based on the seniority of Congressional delegations in their stimulus analyses. There is no obvious analog to the oil spill.

[15] The average county-level per capita compensation payments are comparable across the Alabama coast, Florida panhandle, and Louisiana coast (oil and non-oil parishes). Payments are about a factor of three lower in the Mississippi coast, and an order of magnitude lower in the Non-Panhandle Florida gulf coast counties and the Texas coast. Inland compensation payments are, on average, three orders of magnitude smaller.

been working on deepwater drilling rigs as of May 6, 2010 and had lost their jobs. The RWAF took a first round of applications in September 2010 and paid out grants totaling $5.6 million to 347 workers. To put these claims for lost jobs in context, 347 rig workers would staff less than two deepwater drilling rigs like the *Deepwater Horizon*.

The RWAF opened a second round in the Spring of 2011 to provide grants to those individuals who lost their jobs in a position that supported deepwater drilling rigs, such as shipyard workers, caterers, drilling support operations, etc. In this second round, the RWAF paid out about $5.8 million to 408 workers. These relatively modest claims for displaced rig support workers are consistent with the evidence that few rigs left the Gulf of Mexico: only five of the 46 rigs operating on April 20, 2010 had left the region as of September 10, 2010 (U.S. Department of Commerce, 2010). Anecdotal evidence indicates that "oil companies used the enforced suspension to service and upgrade their drilling equipment, keeping shipyards and service companies busy" (Broder and Krauss, 2010).

5 Conclusions

The April 20, 2010 explosion on the *Deepwater Horizon* drilling rig precipitated several economic shocks to the Gulf Coast region: an unprecedented U.S. oil spill, an unprecedented mobilization of spill response resources, and an unprecedented moratorium on deepwater drilling. This paper has investigated the impact of these shocks on employment and wages in the Gulf Coast region.

Non-Panhandle Florida gulf coast employment fell during the oil spill, as evident across panels and various robustness checks. The analysis for the accommodations industry provides additional evidence of the adverse impact of the spill on Non-Panhandle Florida coastal employment in a tourism-oriented industry. The evaluation of commercial air passenger arrivals also suggests evidence of a decline in tourism in the Florida coast as a result of the spill. A casual comparison of the Florida Panhandle – treated by the spill and spill response – to the Non-Panhandle Florida coast – treated by only the spill – could imply a positive employment impact of 1 to 2% of total employment associated with spill response.

The analysis of employment shows little adverse impact in Louisiana, the state closest to the leaking well in the Macondo Prospect of the Gulf of Mexico.

The various statistical models illustrate either statistically significant increases in employment in the oil parishes (2010 panel) and the non-oil coastal parishes (2008-2010 panel) or small effects (point estimates $< |0.5\%|$) that are statistically indistinguishable from zero. Figure 3 presents the estimated employment impacts for each coastal region based on the 2010 panel model (Table 5, column 1; left graph) and the 2008-2010 panel model (Table 5, column 2; right graph). These graphs show the significant adverse impacts in the Non-Panhandle Florida coastal counties in contrast with the rest of the Gulf Coast region. The Louisiana oil parishes also enjoyed a statistically significant increase in the average wage across all panels and virtually all robustness checks, and the oil parishes and non-oil Louisiana parishes alike experienced a statistically significant increase in the number of business establishments. Complementary analyses of sales tax revenues in Louisiana indicate that the oil parishes enjoyed greater levels of economic activity during the spill, spill response, and moratorium than non-oil coastal parishes and inland parishes in Louisiana. In aggregate, this evidence suggests a net positive labor market shock to the oil parishes and a net zero to positive shock to the non-oil Louisiana coastal parishes during the period of the spill and moratorium.[16]

The results of these statistical analyses for the Louisiana parishes differ significantly from the predictions made with various state and regional multiplier models employed to assess the impacts of the drilling moratorium. A number of analysts quickly undertook multiplier analysis of the moratorium after its announcement. None of these analysts employed their modeling tools to evaluate the employment and economic activity impacts of the spill itself or the spill response. Figure 4 presents the estimated combined employment impacts for all Louisiana coastal parishes (oil parishes and the non-oil parishes) based on the estimated 2010 and 2008-2010 panel models (Table 5, columns 1 and 2). The net effect of the spill, spill response, and drilling moratorium resulted in a statistically significant increase of about 6,400 – 20,000 in coastal Louisiana employment relative to the counterfactual. All of the predicted negative im-

[16]A casual comparison of the oil parishes (treated by spill, spill response, and moratorium) to the non-oil Louisiana coastal parishes (treated by spill and spill response) would result in an inconclusive assessment of the incremental impact of the moratorium. In some statistical models, the comparison would suggest that the drilling moratorium increased jobs and other models would yield the opposite conclusion. In virtually all wage models, the comparison would suggest a net positive impact of the moratorium on labor compensation. The more likely outcome is that the intensity of spill response activity centered more on the oil parishes than non-oil parishes and the moratorium, as evident in the limited take-up of benefits available through the Rig Worker Assistance Fund, had little economic impact.

pacts on employment from the published 2010 analyses fall outside the 95% confidence intervals of these models. The estimated employment losses in the ex ante multiplier models, in comparison to employment gains in the ex post statistical analysis – and for that matter, simple graphical analysis in Figure 1 – suggests several shortcomings of the multiplier tools. First, the ceteris paribus assumption made in the drilling moratorium multiplier analyses did not appropriately represent the economic environment in the Gulf Coast region during the summer of 2010. Everything else was not equal; a significant influx of spill response resources provided a source of income and employment for at least some of those displaced by the spill and the moratorium. Second, these multiplier models operated as if a significant number of drilling rigs would relocate to other regions and layoff a significant number of workers. This did not pan out, perhaps in part resulting from the uncertainty about future government regulation – including the length of the moratorium – in the Gulf of Mexico.

These results yield several policy implications. First, a significant pulse of resources in spill response appears to offset much of the adverse impacts of the spill. This is not a determination that the optimal level of spill response was pursued, but to simply note that the spill response delivers an array of immediate and longer-term economic and environmental benefits. In other words, spill response represents a kind of economic stimulus that creates employment opportunities, not unlike conventional fiscal stimulus. Second, the ambiguity about the length of the drilling moratorium may have mitigated some of the adverse impacts of the drilling moratorium. Throughout what was originally billed as a 6-month moratorium, Department of the Interior officials noted that it could end early (and in fact, the moratorium ended more than one month early). This uncertainty may have created an incentive for rig owners to wait, not unlike how uncertainty associated with an irreversible investment can create value in waiting for new information. Third, multiplier analyses that do not characterize the complexity and temporal attributes of an economic shock may be uninformative and potentially biased for policy deliberations. To be fair, multiplier models provide analysts with a tool to conduct ex ante analysis premised on a few assumptions about the economic environment that is, by definition, not available through ex post statistical analysis of employment and wage data. Just as scientific models of the fate of oil spilled from the Macondo Prospect would deliver misleading predictions if they failed to account for skimming, dispersant applications, deepwater containment, boom deployment, and other means of mitigating the effects of the spill, economic models that, by assumption, fail to account for the economic and employment impacts of response activities would also produce misleading predictions. Finally, the net positive labor market impacts in the regions exposed to the most substantial clean-up activity and the net negative labor market impacts in those regions with the least clean-up activity illustrate how a rapid, significant infusion of resources in response to a labor market shock, such as a natural or human-caused disaster, can mitigate the shock's adverse impacts to labor income and participation.

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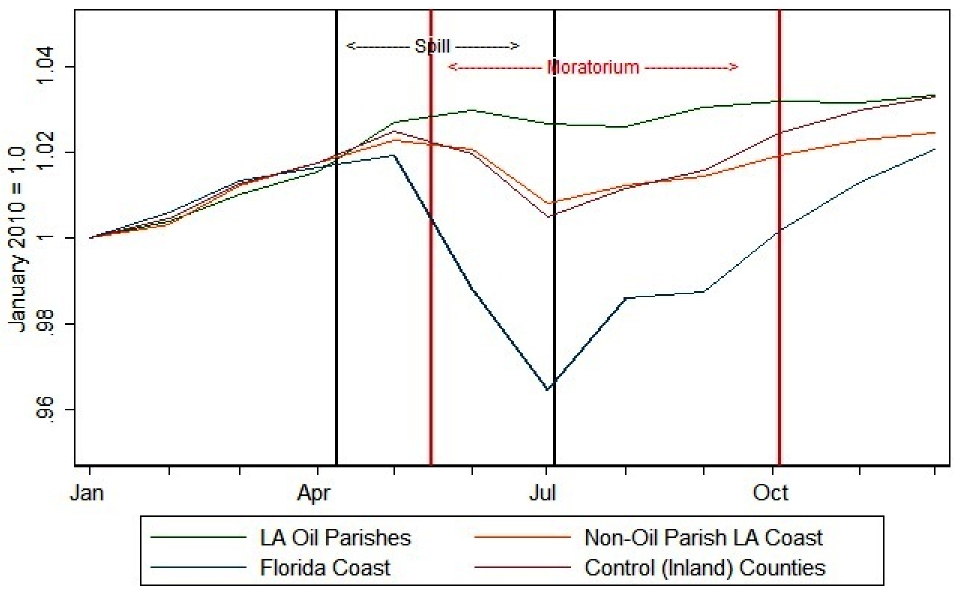
Figures and Tables

Figure 1: 2010 Employment for Oil Parishes, Non-Oil Louisiana Coastal Parishes, Florida Coastal Counties, Control (Inland) Counties



Source: Constructed by author using QCEW employment data for total covered employment across all industries.

Figure 2: Gulf Coast Region, Coastal Counties and Parishes, and the Louisiana Oil Parishes

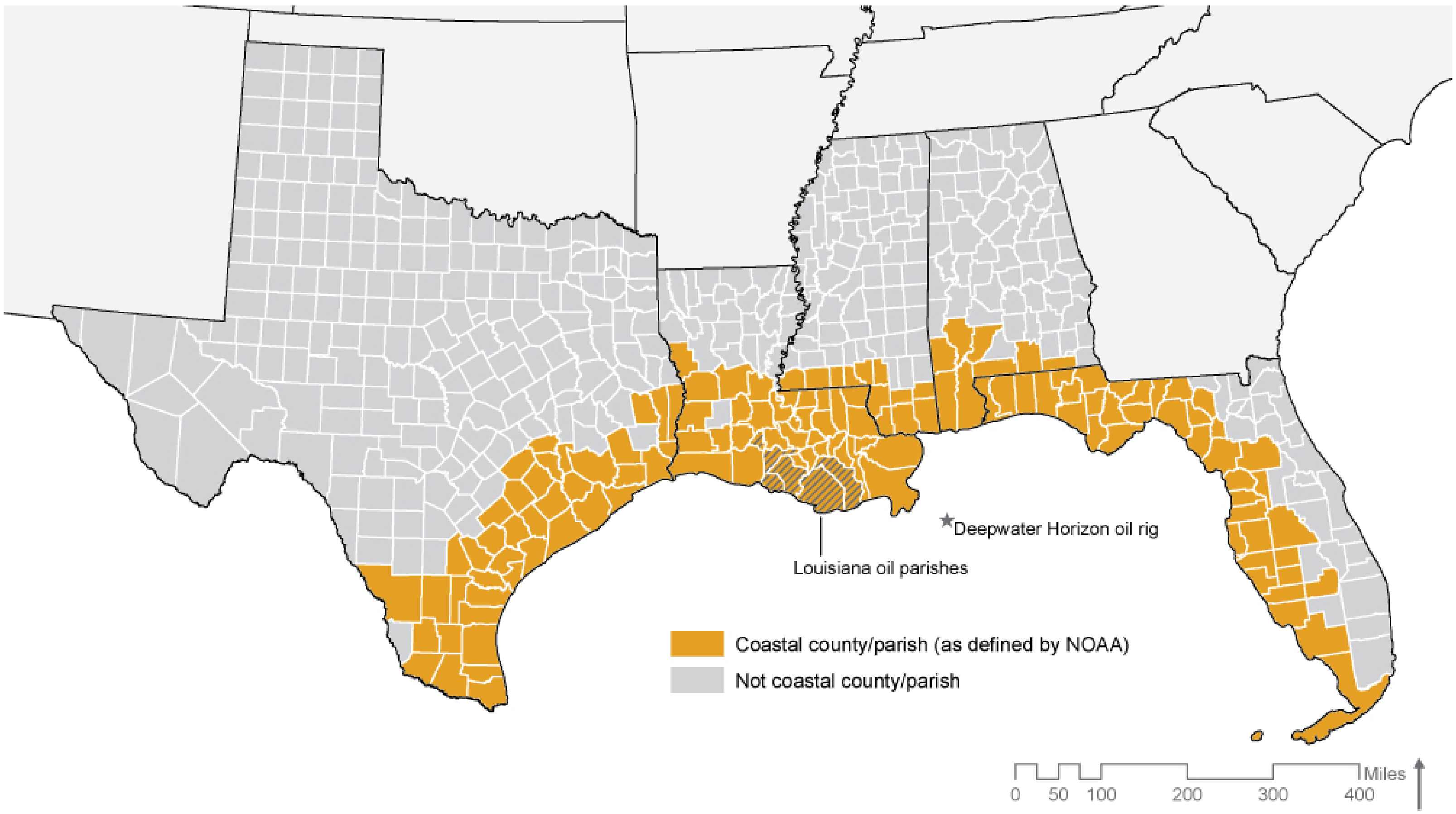
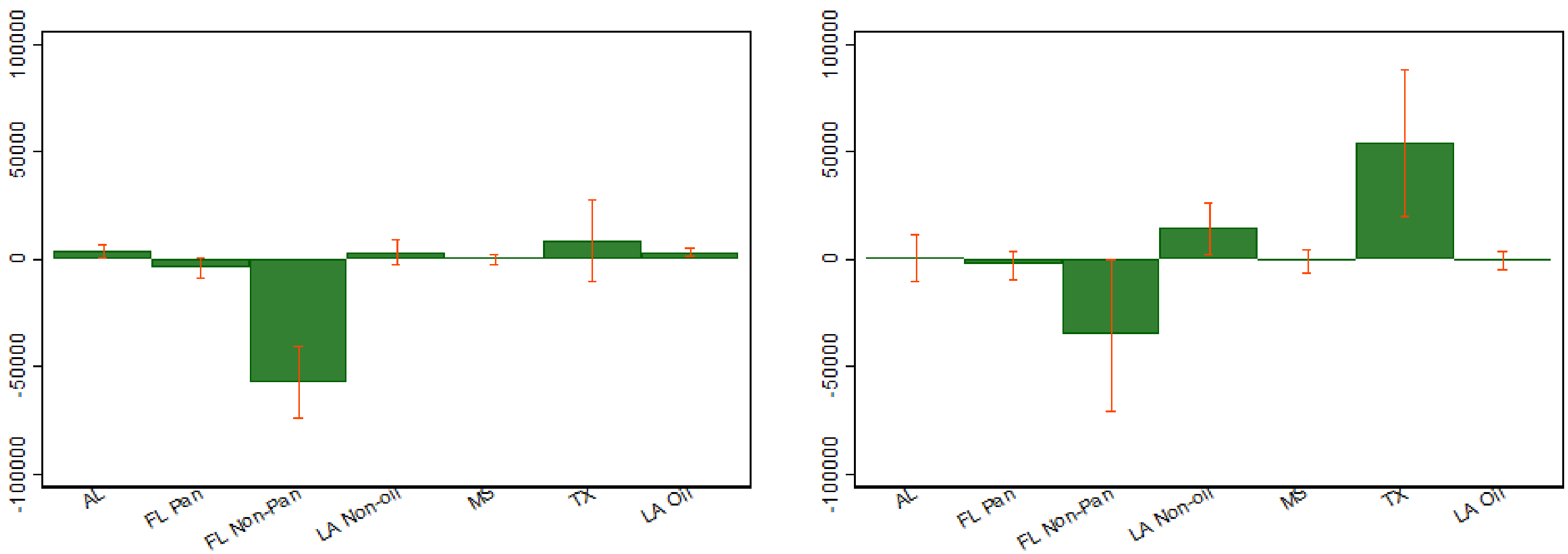
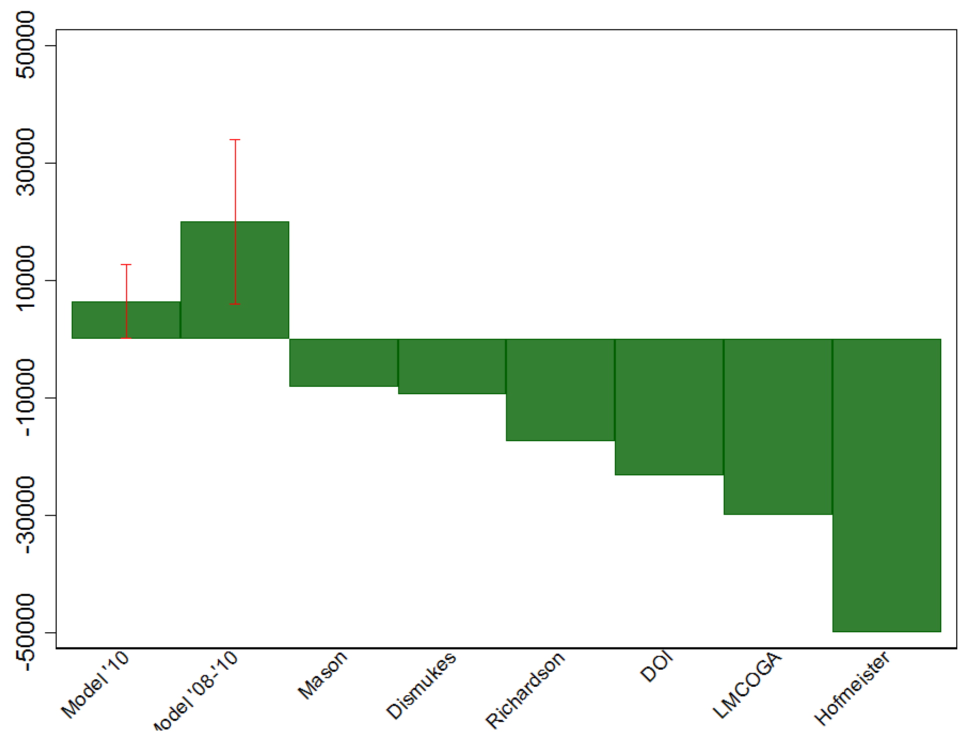


Figure 3: Estimated Employment Impacts by Coastal Region



Notes: The employment estimates are based on the 2010 panel model presented in Table 5 column 1 (left) and the 2008-2010 panel model presented in Table 5 column 2 (right) and average 2009 employment. The 95% confidence intervals are presented as error bars.

Figure 4: Estimated Louisiana Employment Impacts in Statistical Models and Ex Ante Predicted Employment Impacts from 2010



Notes: The Model '10 and Model '08-'10 estimates are based on the estimated combined employment impact for non-oil Louisiana coastal parishes and Louisiana oil parishes for the 2010 panel and 2008-2010 models presented in Table 5, columns 1 and 2, respectively, and average 2009 employment. The 95% confidence intervals are presented as error bars for these two statistical model estimates. Confidence intervals or other representations of the distribution around the central estimates are not available from the sources published in 2010.

Table 1: Ex Ante Estimates of the Employment Impacts of the Offshore Drilling Moratorium

Estimated Job Loss	Region	Source
8,169	Gulf States	Mason (2010)
9,462	Louisiana	Dismukes (2010)
17,464	Louisiana	Richardson (2010)
23,247	Not Specified	Department of the Interior (DOI; Power and Eaton (2010))
30,000	Louisiana	Louisiana Mid-Continent Oil and Gas Association (LMCOGA)
50,000	Not Specified	Quoted by John Hofmeister, former CEO, Shell (Desel (2010))
200,000-1,000,000	Not Specified	Kotok (2010)

Table 2: Treatment by 2010 Spill-Related Exogenous Shocks

Region	Oil Spill	Spill Response	Offshore Drilling Moratorium
Alabama Coastal Counties	X	X	
Florida Panhandle Coastal Counties	X	X	
Florida Non-Panhandle Coastal Counties	X		
Louisiana Oil Parishes	X	X	X
Louisiana Non-Oil Coastal Parishes	X	X	
Mississippi Coastal Counties	X	X	
Texas Coastal Counties	X	X	
Gulf Coast Inland Counties			

Table 3: Number of Counties and Average County Employment, Wages, and Establishments in 2009, Gulf States

	Number of Counties		Employment (1000s)		Weekly Wage (2010$)		Establishments (1000s)	
Region	Coastal	Inland	Coastal	Inland	Coastal	Inland	Coastal	Inland
Gulf Coast States	139	395	57	36	693	648	3.7	2.4
			(182)	(121)	(139)	(138)	(9.6)	(7.9)
Alabama	8	59	34	26	681	655	2.4	1.6
			(53)	(51)	(134)	(121)	(3.2)	(2.8)
Florida	40	27*	66	163	645	720	5.3	13.7
			(111)	(243)	(87)	(145)	(8.1)	(20.4)
Panhandle	18		29		630		2.1	
			(42)		(72)		(2.7)	
Non-Panhandle	22		95		657		7.9	
			(139)		(96)		(9.9)	
Louisiana	38	26	39	14	772	634	2.6	1.0
			(57)	(25)	(153)	(146)	(3.6)	(1.6)
Oil Parish	5		56		850		3.6	
			(39)		(36)		(2.8)	
Non-Oil Parish	33		36		760		2.4	
			(59)		(161)		(3.7)	
Mississippi	12	70	18	12	618	585	1.1	0.8
			(24)	(18)	(127)	(92)	(1.2)	(1.2)
Texas	41	213	81	32	692	658	4.2	1.8
			(308)	(128)	(138)	(145)	(15.2)	(6.4)

Source: BLS (nd).

Notes: Standard deviations presented in parentheses. * Some "inland" Florida counties refer to those on the Atlantic coast.

Table 4: Estimated Employment and Wage Impacts, All Industries, Gulf Coast States, 2010

Region	(1) ln(employment)	(2) ln(employment)	(3) ln(employment)	(4) ln(wage)	(5) ln(wage)	(6) ln(wage)
Gulf Coast	-0.0032			-0.0016		
	(0.0020)			(0.0051)		
Gulf Coast ex Oil Parishes		-0.0034			-0.0024	
		(0.0021)			(0.0052)	
Oil Parishes		0.012***	0.012***		0.021***	0.020***
		(0.0040)	(0.0040)		(0.0044)	(0.0043)
LA Coast ex Oil Parishes			0.0026			-0.025**
			(0.0025)			(0.012)
AL Coast			0.013**			0.038**
			(0.0061)			(0.016)
FL Panhandle Coast			-0.0075			-0.0013
			(0.0048)			(0.0011)
FL Non-Panhandle Coast			-0.027***			-0.0079
			(0.0040)			(0.012)
MS Coast			-0.0016			-0.015
			(0.0054)			(0.016)
TX Coast			0.0026			-0.0022
			(0.0029)			(0.0066)
Sample Period	2010	2010	2010	2010	2010	2010
N(counties)	534	534	534	534	534	534
N	5,340	5,340	5,340	1,602	1,602	1,602

Notes: Robust standard errors clustered by county. All models include fixed effects by county and month (or quarter). ***, **, * denote statistical significance at the 1, 5, and 10% levels.

Table 5: Estimated Employment Impacts, All Industries, Gulf Coast States, Seasonality Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Region	ln(employment)	ln(employment)	ln(employment)	ln(employment)	ln(employment)	ln(employment)
Oil Parishes	0.012***	-0.0021	0.022***	0.0030	0.010***	-0.0050
	(0.0040)	(0.0074)	(0.0048)	(0.0076)	(0.0038)	(0.0074)
LA Coast ex Oil Parishes	0.0026	0.012**	0.0064**	0.016***	0.0045*	0.011**
	(0.0025)	(0.0051)	(0.0030)	(0.0055)	(0.0023)	(0.0050)
AL Coast	0.013**	0.0022	0.017***	0.0061	0.020***	0.0026
	(0.0061)	(0.021)	(0.0063)	(0.021)	(0.0060)	(0.020)
FL Panhandle Coast	-0.0075	-0.0056	-0.0036	-0.0011	-0.0032	-0.0052
	(0.0048)	(0.0065)	(0.0051)	(0.0066)	(0.0047)	(0.0065)
FL Non-Panhandle Coast	-0.027***	-0.017*	-0.023***	-0.013	-0.023***	-0.017**
	(0.0040)	(0.0086)	(0.0043)	(0.0090)	(0.0039)	(0.0085)
MS Coast	-0.0016	-0.0053	0.0022	-0.0014	-0.0020	-0.0064
	(0.0054)	(0.013)	(0.0056)	(0.0013)	(0.0053)	(0.0013)
TX Coast	0.0026	0.016***	0.0064*	0.020***	-0.00012	0.015***
	(0.0029)	(0.0053)	(0.0035)	(0.0057)	(0.0030)	(0.0053)
Sample Period	2010	2008-2010	2010	2008-2010	2008-2010	2008-2010
Seasonal Effects	Month		Month-by-Coastal		Month-by-State	
N	5,340	18,156	5,340	18,156	5,340	18,156

Notes: Robust standard errors clustered by county. All models include fixed effects by county and month (2010 panel) or county, month, and year (2008-2010 panel). Each sample includes 534 counties/parishes. ***, **, * denote statistical significance at the 1, 5, and 10% levels.

Table 6: Estimated Wage Impacts, All Industries, Gulf Coast States, Seasonality Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Region	ln(wage)	ln(wage)	ln(wage)	ln(wage)	ln(wage)	ln(wage)
Oil Parishes	0.020***	0.020**	0.0083	0.025***	0.030***	0.020**
	(0.0043)	(0.0087)	(0.0095)	(0.0088)	(0.0040)	(0.0087)
LA Coast ex Oil Parishes	-0.025**	-0.0032	-0.038***	-0.0020	-0.0097	-0.0036
	(0.012)	(0.0083)	(0.013)	(0.0081)	(0.012)	(0.0083)
AL Coast	0.038**	0.058***	0.026	0.063***	0.060***	0.054***
	(0.016)	(0.012)	(0.018)	(0.012)	(0.015)	(0.012)
FL Panhandle Coast	-0.0013	0.0031	-0.013	0.0080	0.015	0.0010
	(0.0011)	(0.0083)	(0.014)	(0.0081)	(0.011)	(0.0083)
FL Non-Panhandle Coast	-0.0079	-0.0014	-0.020	0.0034	0.0083	-0.0035
	(0.012)	(0.0073)	(0.014)	(0.0068)	(0.011)	(0.0073)
MS Coast	-0.015	-0.0051	-0.027	-0.00026	-0.011	-0.00029
	(0.016)	(0.014)	(0.018)	(0.014)	(0.016)	(0.014)
TX Coast	-0.0022	0.014***	-0.014	0.019***	-0.0040	0.018***
	(0.0066)	(0.0051)	(0.010)	(0.0051)	(0.0070)	(0.0059)
Sample Period	2010	2008-2010	2010	2008-2010	2008-2010	2008-2010
Seasonal Effects	Quarter		Quarter-by-Coastal		Quarter-by-State	
N	1,602	5,874	1,602	5,874	1,602	5,874

Notes: Robust standard errors clustered by county. All models include fixed effects by county and month (2010 panel) or county, month, and year (2008-2010 panel). Each sample includes 534 counties/parishes. ***, **, * denote statistical significance at the 1, 5, and 10% levels.

Table 7: Estimated Employment Impacts, All Industries, Gulf Coast States, Geographic Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Region	ln(employment)	ln(employment)	ln(employment)	ln(employment)	ln(employment)	ln(employment)
Oil Parishes	-0.0048	-0.010	0.022**	0.010	0.0097*	-0.0032
	(0.0039)	(0.0072)	(0.0044)	(0.0076)	(0.0040)	(0.0075)
LA Coast ex Oil Parishes	-0.0090**	0.0043	0.0072**	0.022**	0.014**	0.029
	(0.0024)	(0.0049)	(0.028)	(0.050)	(0.0050)	(0.019)
AL Coast	0.0016	-0.0060	0.018**	0.013	0.027*	0.019**
	(0.0061)	(0.021)	(0.0062)	(0.020)	(0.013)	(0.0065)
FL Panhandle Coast	-0.019**	-0.013*	-0.0029	0.0055	0.00090	0.00039
	(0.0048)	(0.0064)	(0.0050)	(0.0065)	(0.0058)	(0.010)
FL Non-Panhandle Coast	-0.039**	-0.024**	-0.023**	-0.0061	-0.031**	-0.032**
	(0.0040)	(0.0086)	(0.0042)	(0.0085)	(0.0053)	(0.0072)
MS Coast	-0.013*	-0.013	0.0029	0.0052	0.0084	0.017
	(0.0053)	(0.013)	(0.055)	(0.013)	(0.082)	(0.015)
TX Coast	-0.0091**	0.0085	–	–	-0.00036	0.019
	(0.0029)	(0.0052)	(0.)	(0.)	(0.0044)	(0.013)
Sample Period	2010	2008-2010	2010	2008-2010	2008-2010	2008-2010
Sample Region	National		Gulf States excluding TX		Gulf States excluding buffer counties	
N(counties)	2,865	2,865	280	280	444	444
N	28,650	97,410	2,800	9,520	4,440	15,096

Notes: Robust standard errors clustered by county. All models include fixed effects by county and month (2010 panel) or county, month, and year (2008-2010 panel). ***, **, * denote statistical significance at the 1, 5, and 10% levels.

Table 8: Estimated Wage Impacts, All Industries, Gulf Coast States, Geographic Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Region	ln(wage)	ln(wage)	ln(wage)	ln(wage)	ln(wage)	ln(wage)
Oil Parishes	0.032***	0.025***	0.022***	0.022**	0.020***	0.019***
	(0.0035)	(0.0085)	(0.0049)	(0.0088)	(0.0044)	(0.0088)
LA Coast ex Oil Parishes	-0.022*	-0.0048	-0.036***	-0.0066	-0.034	-0.037
	(0.012)	(0.082)	(0.012)	(0.0082)	(0.029)	(0.032)
AL Coast	0.050***	0.063***	0.040**	0.061***	0.020*	0.019**
	(0.015)	(0.012)	(0.016)	(0.012)	(0.011)	(0.0087)
FL Panhandle Coast	0.010	0.0079	0.00044	0.0053	-0.0053	-0.0011
	(0.011)	(0.0082)	(0.012)	(0.0082)	(0.011)	(0.011)
FL Non-Panhandle Coast	0.0036	0.0033	-0.0061	0.00071	-0.023***	-0.014***
	(0.011)	(0.0071)	(0.012)	(0.0073)	(0.0060)	(0.0052)
MS Coast	-0.0033	-0.00039	-0.013	-0.0030	-0.015***	-0.0096
	(0.016)	(0.014)	(0.016)	(0.014)	(0.0052)	(0.0072)
TX Coast	0.0092	0.0419***	–	–	-0.012	0.012
	(0.061)	(0.0050)	(0.)	(0.)	(0.013)	(0.010)
Sample Period	2010	2008-2010	2010	2008-2010	2008-2010	2008-2010
Sample Region	National		Gulf States excluding TX		Gulf States excluding buffer counties	
N(counties)	2,867	2,867	280	280	444	444
N	8,601	31,537	840	3,080	1,332	4,884

Notes: Robust standard errors clustered by county. All models include fixed effects by county and quarter (2010 panel) or county, quarter, and year (2008-2010 panel). ***, **, * denote statistical significance at the 1, 5, and 10% levels.

Table 9: Estimated Industry-Specific Employment and Wage Impacts, Gulf Coast States

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Region	Mining Support 213		Accommodation 721		Mining Support 213		Accommodation 721	
	ln(employment)				ln(wage)			
Oil Parishes	-0.063***	0.0014	0.048**	0.017	-0.047*	-0.0030	0.015	0.042*
	(0.0017)	(0.039)	(0.024)	(0.037)	(0.027)	(0.020)	(0.035)	(0.024)
LA Coast ex Oil Parishes	0.013	0.14**	0.014	0.0078	-0.048	-0.0023	-0.020	0.022
	(0.014)	(0.0062)	(0.017)	(0.038)	(0.033)	(0.034)	(0.023)	(0.019)
AL Coast	-0.11***	-0.11***	0.026	0.052	-0.18***	-0.0022	0.12	0.12
	(0.0060)	(0.018)	(0.040)	(0.043)	(0.015)	(0.014)	(0.10)	(0.073)
FL Panhandle Coast	–	–	0.0089	0.034	–	–	0.036	0.030
			(0.022)	(0.037)			(0.040)	(0.027)
FL Non-Panhandle Coast	–	–	-0.047***	-0.037**	–	–	-0.062***	-0.036***
			(0.012)	(0.017)			(0.021)	(0.011)
MS Coast	-0.072***	0.0025	-0.048***	0.0012	0.033**	0.016***	-0.0081	0.011
	(0.0050)	(0.018)	(0.016)	(0.042)	(0.015)	(0.012)	(0.077)	(0.030)
TX Coast	0.014*	-0.032	-0.027**	-0.052	-0.017	0.082***	-0.0034	0.024
	(0.0083)	(0.028)	(0.013)	(0.034)	(0.027)	(0.027)	(0.042)	(0.041)
Sample Period	2010	2008-2010	2010	2008-2010	2010	2008-2010	2010	2008-2010
N(counties)	118	118	247	247	118	118	223	223
N	1,180	4,012	2,470	8,398	354	1,298	669	2,453

Notes: Robust standard errors clustered by county. All models include fixed effects by county and month (quarter) (2010 panel) or county, month (quarter), and year (2008-2010 panel). ***, **, * denote statistical significance at the 1, 5, and 10% levels.

Table 10: Estimated Establishment Impacts, All Industries, Gulf Coast States, Seasonality Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Region	ln(establishments)	ln(establishments)	ln(establishments)	ln(establishments)	ln(establishments)	ln(establishments)
Oil Parishes	0.0080***	0.039***	0.0020	0.038***	0.0087***	0.040***
	(0.0018)	(0.0036)	(0.0025)	(0.0036)	(0.0017)	(0.0036)
LA Coast ex Oil Parishes	0.0097***	0.040***	0.0054***	0.041***	0.011***	0.040***
	(0.0022)	(0.0037)	(0.0020)	(0.0037)	(0.0021)	(0.0037)
AL Coast	-0.0017	-0.030***	-0.0076***	-0.031***	0.00073	-0.029***
	(0.0022)	(0.0050)	(0.0029)	(0.0050)	(0.0020)	(0.0050)
FL Panhandle Coast	-0.0099***	-0.021***	-0.016***	-0.021***	-0.0083***	-0.020***
	(0.0032)	(0.0048)	(0.0036)	(0.0051)	(0.0031)	(0.0048)
FL Non-Panhandle Coast	-0.019***	-0.037***	-0.025***	-0.037***	-0.018***	-0.036***
	(0.0045)	(0.0070)	(0.0047)	(0.0070)	(0.0044)	(0.0069)
MS Coast	-0.00014	-0.011**	-0.0061*	-0.012**	-0.00027	-0.011**
	(0.0027)	(0.0051)	(0.0032)	(0.0052)	(0.0028)	(0.0051)
TX Coast	0.00064	0.0090*	-0.0053*	0.0083	-0.00032	0.0083
	(0.0026)	(0.0052)	(0.0030)	(0.0053)	(0.0027)	(0.0052)
Sample Period	2010	2008-2010	2010	2008-2010	2008-2010	2008-2010
Seasonal Effects	Quarter		Quarter-by-Coastal		Quarter-by-State	
N	1,602	5,874	1,602	5,874	1,602	5,874

Notes: Robust standard errors clustered by county. All models include fixed effects by county and quarter (2010 panel) or county, quarter, and year (2008-2010 panel). Each sample includes 534 counties/parishes. ***, **, * denote statistical significance at the 1, 5, and 10% levels.

Table A.1: Counties by Treatment Region

Region	Counties/Parishes by FIPS Code
Alabama Coast	1003*, 1025, 1039, 1053, 1061, 1097*, 1099, 1129
Florida Panhandle Coast	12005*, 12013, 12033*, 12037*, 12039, 12045*, 12059, 12063, 12065*, 12073, 12077, 12079, 12091*, 12113*, 12123*, 12129*, 12131*, 12133
Florida Non-Panhandle Coast	12015*, 12017*, 12021*, 12027, 12029*, 12041, 12043, 12049, 12053*, 12057, 12067, 12071*, 12075*, 12081*, 12083, 12087*, 12101*, 12103*, 12105, 12115*, 12119, 12121
Louisiana Oil Parishes	22045*, 22055*, 22057*, 22101*, 22109*
Louisiana Non-Oil Coast	22001, 22005, 22007, 22009, 22011, 22019, 22023*, 22033, 22037, 22039, 22047, 22051*, 22053, 22063, 22071, 22075*, 22077, 22079, 22085,22089, 22091, 22093, 22095, 22097, 22099, 22103, 22105, 22113*, 22115, 22117, 22121, 22125
Mississippi Coast	28005, 28039, 28045, 28047*, 28059*, 28073, 28091, 28109, 28113, 28131, 28147, 28157
Texas Coast	48007*, 48015, 48025, 48039*, 48047, 48057*, 48061*, 48071*, 48089, 48123, 48131, 48149, 48157, 48167*, 48175, 48201, 48215, 48239, 48241, 48245*, 48247, 48249, 48261*, 48273*, 48285, 48291, 48297, 48321*, 48351, 48355*, 48361, 48391, 48409*, 48427, 48457, 48469, 48473, 48477, 48479, 48481, 48489*

Notes: * refer to counties classified as coastal under the more narrow definition of coastal in the robustness checks.