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Gulf Coast Communities and the Fabrication and Shipbuilding Industry: A Comparative Community Study

Volume I: Historical Overview and Statistical Model

U.S. Department of the Interior
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

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Volume I: Historical Overview and Statistical Model

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LIST OF ACRONYMS

AAPA	American Association of Port Authorities
ABC	Associated Builders and Contractors
ABS	American Bureau of Shipping
ABSD	advanced base sectional drydock
ADDSCO	Alabama Drydock and Shipbuilding Company
AEWR	Adverse Effect Wage Rate
AFL-CIO	American Federation of Labor-Congress of Industrial Organizations
AHTS	anchor handling tug supply vessel
AIDT	Alabama Industrial Development Training
AmFELS	American Far East Levingston Shipbuilding
ASIB	Active Shipbuilding Industrial Base
ATC	Applied Technology Center [founded in 1976 as the Pascagoula Vocational Technical Center]
BEA	Bureau of Economic Analysis, U.S. Department of Commerce
BIP	Border Industrialization Program
BISD	Brownsville Independent School District
BLS	Bureau of Labor Statistics, U.S. Department of Labor
BOE	barrels of oil equivalent
BOEM	Bureau of Ocean Energy Management, U.S. Department of the Interior
BP	formerly British Petroleum
BRAC	Base Realignment and Closure Program, U.S. Navy
BXA	Bureau of Export Administration
CAA	Community Action Agency
CBI	Chicago Bridge and Iron
CCAD	Corpus Christi Army Depot
CCMPO	Corpus Christi Metropolitan Planning Organization
CDBG	Community Development Block Grant, a program of the U.S. Department of Housing and Urban Development
CDP	Census Designated Place
CEDS	Community Economic Development Scheme
CISD	Consolidated Independent School District
CLEAR	Consolidated Land, Energy, and Aquatic Resources Act of 2010
CMC	Chet Morrison Contractors
CNC	computer numerically controlled
COLA	cost of living adjustment
COO	Chief Operating Officer
CPI	Consumer Price Index
DOC	Department of Corrections
DOE	Department of Energy
DOL	Department of Labor
DP	dynamic positioning
DPC	Defense Plant Corporation
DWT	dead weight ton

E&P	exploration and production
EADS	European Aeronautic Defence and Space Company
ECO	Edison Chouest Offshore
EDA	Economic Development Administration, U.S. Department of Commerce
EEZ	Exclusive Economic Zone
EPA	Environmental Protection Agency
ESL	English as a Second Language
ETPM	Entrepose Pour les Travaux Petroliers et Maritimes [Entrepose for Petroleum and Maritime Works]; ETPM-USA is this French company's U.S. subsidiary
FEMA	Federal Emergency Management Agency, U.S. Department of Homeland Security
FEPC	Fair Employment Practices Committee
FERC	Federal Energy Regulatory Commission
FPS	floating production system
FPSO	floating production storage and offloading
FSV	Fast Supply Vessel
FTZ	Foreign Trade Zone
GAP	Growth and Prosperity Act of 2000 [State of Mississippi]
GED	General Education Certificate or Certification
GO Zone	Gulf Opportunity Zone [created by the Gulf Opportunity Zone Act of 2005]
GPS	Global Positioning System
GSSC	Gulf State Shipbuilder's Consortium
H-2B	Type of U.S. non-immigrant visa
HR	Human Resources
HUD	Department of Housing and Urban Development
IADC	International Association of Drilling Contractors
ICAF	Industrial College of the Armed Forces
ICE	Immigration and Customs Enforcement, U.S. Department of Homeland Security
IMCA	International Marine Contractors Association
INA	Immigration and Nationality Act of 1952
ISD	Independent School District
ITF	International Transportation Federation
IUMSWA	Industrial Union of Marine and Shipbuilding Workers
JCEDF	Jackson County [Mississippi] Economic Development Foundation
LASH	Lighter Aboard Ships
LCT	Landing Craft Tank
LCVP	Landing Craft Vehicle Personnel carrier
LDS	Latter-Day Saints
LHWC	Longshoreman's and Harbor Workers Compensation
LHWCA	Longshore and Harbor Workers' Compensation Act of 1927
LLC	Limited Liability Company

LMA	Labor Market Area
LMPC	Lower Mississippi Port Cluster
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
LPG	liquefied petroleum gas
MARAD	Maritime Administration, U.S. Department of Transportation
MBFC	Mississippi Business Finance Corporation
MDA	Mississippi Development Authority
MDOC	Mississippi Department of Corrections
MEP	Manufacturing Extension Partnership [affiliated with the Mississippi Technical Alliance]
MGCCC	Mississippi Gulf Coast Community College
MMEIA	Mississippi Major Economic Impact Authority
MMS	Minerals Management Service, U.S. Department of the Interior [now the Bureau of Ocean Energy Management]
MODU	mobile offshore drilling units
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
MSB	major shipbuilding base
NAFTA	North American Free Trade Agreement
NAICS	North American Industry Classification System
NAS	North American Shipbuilding
NASA	National Aeronautics and Space Administration
NCCER	National Center for Construction Education and Research
NED	National Economic Development
NIOSH	National Institute for Occupational Safety and Health
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOIA	National Ocean Industries Association
NSRP	National Shipbuilding Research Program
OCLSA	Outer Continental Shelf Lands Act of 1953
OCS	Outer Continental Shelf
OES	Occupational Employment Statistics
OHS	occupational health and safety
OJT	on the job training
OMB	Office of Management and Budget
OPA	Oil Pollution Act of 1990
OSHA	Occupational Safety and Health Administration, U.S. Department of Labor; also the Occupational Safety and Health Act of 1970
OSV	offshore service vessel
OTA	Office of Technology Assessment, U.S. Congress
P&G	Principles and Guidelines, Water Resource Council

RO-RO	Roll-on/Roll-off vessels
ROV	remotely-operated [underwater] vehicle
SCIA	South Central Industrial Association
SCPDC	South Central Planning and Development Commission
SD	School District
SHARP	Safety and Health Achievement Recognition Program [administered by OSHA]
SIC	Standard Industrial Classification
SLEC	South Louisiana Economic Council
TDI	Texas Drydock, Inc.
TEDA	Terrebonne Economic Development Association
TEU	twenty-foot equivalent unit
TLP	tension leg platform
TOPS	Tuition Opportunity Program for Students [state-funded Louisiana scholarship program]
TSA	Transportation Security Administration
TSTC	Texas State Technical College
TWC	Texas Workforce Commission
TWIC	Transportation Worker Identification Credential
ULCC	ultra large crude carrier
USACE	U.S. Army Corps of Engineers
USCIS	U.S. Citizenship and Immigration Services
USEPA	U.S. Environmental Protection Agency
USW	United Steel Workers
UTB-TSC	University of Texas at Brownsville and Texas Southmost College
VLCC	very large crude carrier
VPP	Voluntary Protection Program [administered by OSHA]
WC	Workers' Compensation system [federal insurance fund]
WIA	Workforce Investment Act of 1998
WIN	Workforce Investment Network
WIRED	Workforce Innovations in Regional Economic Development [a U.S. Department of Labor program]
WRDA	Water Resources Development Act of 1986
YFD	yard floating drydock

PREFACE

The fabrication and shipbuilding enterprises in the Gulf of Mexico are unique. Though some date back more than a century, and others were established to support wartime expansion, many were born as a local response to the development of offshore petroleum in the Gulf and still rely on that niche market. Like the offshore industry that it serves, shipbuilding and fabrication for this market has evolved into an international industry, bucking a general decades-long trend in the United States of steady decline of heavy industries in the face of globalization.

At the same time, the shipbuilding and fabrication industries concentrate specific offshore petroleum industry-related social and economic effects in particular towns and cities along the Gulf Coast. They are responsible for the lion's share of the employment generated by the offshore oil and gas industry and, for decades, have anchored and stimulated the growth of many coastal communities. Consequently, they have shaped the physical attributes, populations, and fiscal, social, and economic systems of these communities.

This study was designed to describe the shipbuilding and fabrication industries in the Gulf of Mexico region, their geographic distribution, variation in their size and function, their trends and dynamics, the services they provide, and their labor demands and how they meet them. It brought together historical, demographic, and ethnographic data collection and analyses to define the industry and explore the evolution of specific sites where petroleum-related shipbuilding and fabrication occurs, changes over time and space, and economic linkages.

This report focuses on the local significance of these industries, noting their similarities and differences in relation to the U.S. and global shipbuilding industry, and on their specific consequences to the region. Historical data provide a broad view and make it possible to track changes in the industries and their impacts. Demographic data address key community socioeconomic variables such as population size, age, household income, racial and ethnic composition, educational attainment, housing, employment, and earnings and, where possible, link those to the industries. Ethnographic data reveal community perspectives on the industries and provide local specificity. Together these data offer a look at the interactions between the communities and the fabrication and shipbuilding industries, identifying and analyzing the benefits, such as job creation, and the burdens, such as infrastructure demand, that these industries have placed on their host communities.

This study was conducted between 2006 and 2009 and led by researchers from the University of Houston Center for Public History and the University of Arizona Bureau of Applied Research in Anthropology. It brought together historians, a political scientist, an economist, and anthropologists. The historians, led by Dr. Tyler Priest of the University of Houston, included Dr. Jason Theriot, Jamie Christy, Dr. Sonia Hernandez, and Dr. Paul Wilson. They were supported by Dr. Joshua Stockley, a political scientist, and Dr. John Lajaunie, an economist, both of whom were at Nicholls State University in Thibodaux, Louisiana when the study began. The anthropologists were led by Drs. Diane Austin and Tom McGuire of the University of Arizona and included graduate students Jacob Campbell, Rebecca Crosthwait, Ben McMahan, Lauren Penney, Victoria Phaneuf, Preetam Prakash, Lucero Radonic, and Sarah Raskin. They were assisted in the field by undergraduates Irene Angelov, Terez Banks, and Heather Gallivan, and were supported by Kevin Bulletts, Britny Delp, Samantha Herr, Gigi Owen, Monica Voge, and Dr. Drexel Woodson.

The first volume of this report provides a historical overview of Gulf Coast shipbuilding and fabrication. It then presents a model designed to explore the statistical relationships among various economic and social measures for each of the seven communities highlighted in the study and, specifically, to determine whether the selected variables measure the relationship between the fabrication industry and the well-being of the community. It examines whether a statistical model can consistently capture the impact of these industry segments in such a way as to support a forward-looking forecast of the potential impact of changes in the industries on the study communities.

The second volume is devoted to detailed descriptions of the seven communities selected for this study. From east to west, these include: (1) south Mobile County, Alabama; (2) southeast Jackson County, Mississippi; (3) Lafourche and Terrebonne Parishes, Louisiana; (4) east St. Mary Parish, Louisiana; (5) Port Arthur and Orange, within the Golden Triangle of southeast Texas; (6) Corpus Christi and Ingleside, within the Coastal Bend of Texas; and (7) Brownsville and Port Isabel of Cameron County, Texas. The descriptions include past growth and development, community organization and infrastructure, and economic and social conditions that existed in 2007 and 2008. Each description discusses community-specific dynamics related to fabrication and shipbuilding and their relationship to offshore petroleum development. The community descriptions also address workforce issues, examining recruitment, education and training, and retention. The community descriptions are supplemented by appendices containing detailed demographic data and discussions of those data.

The third and final volume presents a series of analytical chapters addressing the geography of the industry; labor issues; business startup and organization; the configuration of jobs and responsibilities on a yard; community, economic, and workforce development; risk; and the effects of hurricanes on the industry. These chapters draw primarily from the rich ethnographic data gathered during this study to explore common themes that cut across the industries and study communities (see also Preface to Volume III).

This study has been framed by disasters. It was initially conceived in 2005 but was put on hold when the devastation caused by Hurricanes Katrina and Rita affected people and organizations across the Gulf Coast, disrupting the operations of the Gulf of Mexico regional office of what was then the U.S. Minerals Management Service (now the Bureau of Ocean Energy Management) as well as the University of Houston and Nicholls State University. Fieldwork began in 2007 and was underway in 2008 when Hurricanes Dolly, Gustav, and Ike struck the Gulf Coast, ensuring that none of the communities that were the focus of this research were spared. Fieldwork for the study was completed in 2009 and the report was being completed when, on April 20, 2010, the *Deepwater Horizon* drilling rig exploded in the Gulf of Mexico, about 40 miles southeast of the Louisiana coast. The study's principal investigators and several of the graduate students went to work almost immediately to gather data about the impacts of that disaster on Gulf Coast communities and to share information and perspectives on the region and the industry with those seeking to understand the disaster, its causes, and its effects. Work on this report was resumed in late 2011. Though efforts were made to update sections of the community profiles, it was not possible to revisit all the study communities and participants or to gather 2010 census data and redo the demographic analyses; that work will remain for a future study.

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Special thanks to the men and women who work in fabrication and shipbuilding across the Gulf of Mexico region. These individuals perform difficult and sometimes dangerous tasks, often in extreme heat and under considerable time pressures, to ensure the readiness of the rigs, platforms, and vessels needed to extract and transport oil and gas from the U.S. outer continental shelf, as well as the myriad other tasks to which the vessels they construct are assigned. This study would not have been possible without the participation of hundreds of individuals in the fabrication and shipbuilding industry and in the seven study communities who willingly shared their time, knowledge, and perspectives with members of the research team. Because most of them were promised anonymity, we cannot identify them by name. However, their contributions have been critical to the success of this effort.

In addition, we thank the business managers of our respective institutions. Maria Rodriguez of the Bureau of Applied Research in Anthropology at the University of Arizona ensured that contracts were issued, travel was authorized, and the ethnography team had the resources it needed to complete our work. Lorena Lopez of the Department of History at the University of Houston helped manage resources for the entire study, keeping the UH team on pace and coordinating the subcontract with BARA and the contracts with consultants.

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K. Brownsville-Port Isabel	Joshua Stockley and John Lajaunie

1. THE HISTORY OF GULF COAST SHIPBUILDING AND OFFSHORE FABRICATION

1.1. INTRODUCTION

1.1.1. General Description of Shipbuilding and Fabrication

Shipbuilding and fabrication, the subjects of this study, are, among other things, two distinct but overlapping segments of the larger offshore industry. They are distinct in that, both within the offshore industry and more broadly, these segments are geared toward different markets and respond to different economic indicators.[1] They overlap in that, as the two primary “onshore” industries servicing offshore oil and gas, they consume many of the same materials, tap the same labor markets, and interact in the same communities. Some firms even fabricate both platforms and ships/boats. Both shipbuilding and fabrication for the offshore industry emerged from, and in close relationship to, pre-existing shipbuilding and oil and gas industries on the Gulf Coast. After World War II, they continued to be affected by national and global developments in shipbuilding and oil and gas, but they also evolved as a local response to the growth of offshore petroleum in the Gulf. Due to the extent and character of the offshore oil and gas industry in the Gulf of Mexico, centers of industrial activity have not been directly tied to particular offshore projects or developments. Other factors, such as access to transportation, workforce geography, and economic incentives have determined where fabrication and shipyards located. They have become specialized industries that are not well described in industry or government publications. Yet they are the most significant sector in outer continental shelf (OCS) program-related employment. Also, like the offshore businesses that they serve, the Gulf’s shipbuilding and fabrication businesses have expanded internationally, bucking a general decades-long trend in the U.S. of steady decline of heavy industries in the face of globalization.

The principal reason these two industries are difficult to describe is that they encompass numerous and changing subsets of businesses and companies. Both are included in the U.S. Census of Manufactures (historically taken every five years). Prior to 1997, they were covered under the Standard Industrial Classification (SIC) code 3731, “Ship Building and Repair,” which encompasses “establishments primarily engaged in building and repairing ships, barges, and lighters, whether self-propelled or towed by other craft . . . [and] the conversion and alteration of ships, the manufacture of offshore oil and gas, well drilling and production platforms (whether or not self-propelled).” However, mobile drilling vessels were not broken out as a sub-category of the product group, “self-propelled ships, nonmilitary,” until 1972, at least 20 years after the first generation of mobile offshore drilling units (MODUs) were launched.[2] In 1997, the SIC codes were replaced by the North American Industrial Classification (NAIC) system, under which these sectors are now categorized as “Ship Building and Repairing,” NAIC 336611.

The Maritime Administration (MARAD) of the U.S. Department of Transportation breaks down U.S. shipbuilders into first-tier, second-tier, and third-tier facilities. First-tier shipyards have at least one shipbuilding position consisting of an inclined way and a launching platform and are capable of constructing, drydocking, or topside repairing vessels 122 meters in length or

[1] Other marine contractor segments of the offshore oil and gas industry include drilling, diving, supply, surveying, remotely operated vehicles (ROVs), and such, and are represented by organizations such as the International Marine Contractors Association (IMCA), the International Association of Drilling Contractors (IADC), the Offshore Marine Services Association, and the National Ocean Industries Association (NOIA).

[2] The American Bureau of Shipping (ABS) provided the first classification for a MODU in 1958.

more. There are only six first-tier facilities, or major shipbuilding bases (MSBs), still in operation. Three are owned by General Dynamics and three by Northrup Grumman (two of Northrup's are on the Gulf Coast—New Orleans, formerly Avondale, and Pascagoula, formerly Ingalls). Second-tier yards include small or medium-sized facilities and engage primarily in the construction and repair of smaller vessels (under 122 meters), most of which are used on the inland and coastal waterways as well as in foreign markets. According to ShipbuildingHistory.com, a database of active and formerly active shipyards, there are 14 active second-tier facilities remaining, and 10 of those are Gulf Coast yards. There are six second-tier yards, all on the Gulf Coast (two in Florida), which have become primarily repair yards, not actively engaged in new construction. The third tier consists of hundreds of small shipbuilders and boat builders, as well as the facilities that design, develop, produce, and maintain subsystems and components required to support the shipbuilding industry. ShipbuildingHistory.com counts 321 small shipbuilders and boat builders, 78 of which are active today. There 19 are active boatbuilders and barge builders with significant construction records, 8 of which are located on the Gulf Coast, and 58 other active yards, 33 of which produce for Gulf of Mexico business (Colton Company 2011).

The offshore fabrication business is technically included in the Census of Manufactures, but it is still difficult to identify and classify, both historically and currently. The Census started including different aspects of this business in its survey long after they were established. Not until 1967 did the Census include "drilling platforms" as a separate category under the product group, "nonpropelled ships." Again, like MODUs, this came 20 years after the wave of platform installations began in the Gulf. Even then, these categories provide only an unfocused snapshot of this industry every five years. The fabrication business varies along different dimensions, including size of operation, degree of specialization, company ownership and control, extent of work for foreign clients, and overseas operations. Plus, recent decades have witnessed wave after wave of company failures, mergers, and consolidations, and an increasing trend toward specialization in platform fabrication. No two fabrication yards perform the exact same kind of work—jackets, decks, living quarters, hookup services, interconnection piping. Even the largest do not have the facilities for all facets of a project. So they rely on smaller, specialized yards, shops, and subcontractors. In 2000, Mustang Engineering did a survey of 51 yards on the Gulf Coast—only nine had single piece fabrication capacity of more than 10,000 short tons. Only those nine had a workforce of more than 1,000. Most yards have much smaller workforces. When additional labor is required, the yards attract skilled workers from their petrochemical, refining, and of industries in their area. More recently, workers have been brought in on H-2B guestworker visas.

1.1.2. Relationship between Gulf Coast Oil and Gas and Shipbuilding and Fabrication

The Gulf Coast region emerged as one of the four major shipbuilding regions in the United States, along with the Atlantic Coast, Pacific Coast, and Great Lakes. Perhaps the least studied of all these regions, the Gulf Coast nevertheless has a maritime legacy that dates back to the early settlement of communities along the banks of many rivers and tributaries that connect the fertile inland plains to the sea. Shipbuilding developed as both a business venture to meet a demand and as a means of survival. Skills, knowledge, technology, and waterfront property had been passed down from generation to generation, and company to company. By the early 20th century, the U.S. Army Corps of Engineers became heavily involved with improvement projects to open the

Gulf Coast waterways to commercial trade, thus creating coastal ports and expanding regional economies in ways that were beneficial to shipbuilders and their investors. During World War II, when the United States undertook the largest naval construction effort by any nation in history, many Gulf Coast shipyards expanded dramatically, hiring tens of thousands of workers to build hundreds of vessels for the U.S. military, and swelling the populations of the communities in which they were located. Many of the original shipyards remained active after the war, even as military orders shrank. Retaining an active, skilled workforce and the requisite infrastructure, some yards transitioned to building offshore drilling vessels. At the same time, other shipbuilders and construction companies converted their yards, or built entirely new ones, to fabricate steel platforms and pipelines.

During the last half of the 20th century, the Gulf Coast South emerged as the hydrocarbon energy corridor of the United States. The development of the oil and gas industry and its movement offshore has been integral to the modern history of the states bordering the northern Gulf of Mexico. The economy of this region, composed of the southern portions of Texas, Louisiana, Mississippi, and Alabama, was once defined by large-scale cotton, sugar cane, and timber operations, along with smaller-scale fishing and trapping along the coast. By World War II, the Gulf Coast had emerged as the nation's primary producer and refiner of petroleum. For the rest of the 20th century, the industrial landscape of these states was dominated by petroleum and the products and chemicals derived from this natural resource.

The Spindletop, Texas, gusher in January of 1901 marked the beginnings of the oil and gas industry on the Gulf Coast. "The coastal region from southwest of Houston to south of Lake Charles, Louisiana, quickly attracted the capital, expertise, and workforce needed to develop this newfound resource, whose importance in national and international markets made the region a magnet for outside investment" (Pratt 2007: 26). Over the next few decades, these investors financed the exploration of salt domes in the coastal zone across Texas and Louisiana and discovered many more fields. By the late 1920s and into the 1930s, the waterways of southern Louisiana rivaled Texas fields in oil and gas production. Petroleum interests built refineries, laid pipelines, and erected tank storage. Local shipyards constructed the barges, tugboats, and oil tankers needed for transporting petroleum and petroleum products through the region's waterways.

The regional social and economic impact of offshore oil and gas development in the Gulf of Mexico has been unique. Unlike most petroleum provinces in which discoveries have been concentrated in a short span of one to three decades, substantial discoveries have been made in the Gulf basin for the past *nine* decades. In contrast to other major petroleum provinces of the world where hydrocarbons are clustered in a small number of world-class "giant" fields (fields with a known recovery of more than 500 million barrels of oil equivalent [boe]), the Gulf basin has yielded thousands of smaller fields of less than 50 million boe, as well as "large" fields of 50 to 500 million boe and giant fields. As oil and gas operations in the United States increasingly moved offshore in the Gulf of Mexico, major shipbuilding and offshore fabrication operations grew and spread along the coast, providing mobility for exploratory drilling and fixed structures for oil and gas production in open water.

Offshore oil and gas first emerged as an *industry* in the Gulf region during the late 1940s and early 1950s. As oil and gas firms developed their offshore leases, they stimulated the growth of unique kinds of businesses, contracting relationships, and technologies. But this new industry also built upon a preexisting base of petroleum infrastructure and tapped into the region's engineering and construction experience, especially in shipbuilding and repair. Entire communities—ports, depots, labor camps, administrative centers, in addition to shipyards and fabrication yards—were mobilized behind various aspects of the offshore enterprise. The offshore industry evolved into a vast complex of companies, facilities, people, and infrastructure located predominantly in the Gulf Coast states, but which also increasingly extended into other parts of the United States and other places around the world. Since the 1940s, some 5,500 platforms have been installed in the U.S. Gulf of Mexico. At the turn of the 21st century, more than 3,600 fixed structures remained in place and produced oil and gas in water depths ranging to 8,000 feet off of the coastlines of Texas, Louisiana, Mississippi, and Alabama. The Gulf of Mexico accounted for close to one-third of total U.S. oil and gas production, and this percentage was rising.

In the anatomy of the offshore oil and gas industry, the exploration and production (E&P) functions of the oil and gas companies were the central nervous system. Historically, these operations were headquartered in various parts of the country, primarily New York City, Tulsa, Dallas, and Houston, and most companies had important regional offices or divisions in New Orleans, Morgan City, or Lafayette, Louisiana. More recently, operators active in the Gulf have centralized most of their E&P offices in Houston and closed offices elsewhere. The oil downturn of the late 1990s and the devastating hurricanes of 2003-2005 hastened this trend. As administrative functions have been consolidated in Houston, the fabrication corridor, by contrast, sprawls ever wider along 1,000 miles of the Gulf of Mexico shoreline. Since the earliest days of the offshore business, companies have contracted out for nearly all the onshore and marine services needed to find and produce oil and gas offshore: geophysical surveying, drilling, well completion, platform construction and installation, pipeline laying and hookup, and transportation of crews and supplies. Specialized fabrication yards and facilities multiplied along the extensive Intracoastal Waterway system from the coastal bend of Texas to Mobile, Alabama to provide the platforms, pipelines, and other infrastructure for this growing industry.

The following overview traces the history of the major shipbuilding and fabrication communities on the Gulf Coast within the larger national and international context of shipbuilding and repair. The community profiles in the larger study examine the industrial histories of cities that border the northern Gulf of Mexico and that have one or more important shipbuilding and ship repair, platform fabrication, or offshore-support industries. Moving from west to east, the communities analyzed are: Brownsville, Corpus Christi/Ingleside (the Coastal Bend), and Beaumont-Port Arthur-Orange (the oil industry's original "Golden Triangle") in Texas; Morgan City/Amelia and Lafourche/Terrebonne/New Orleans in Louisiana; Pascagoula/Moss Point in Mississippi; and Mobile/Bayou La Batre in Alabama. Houston-Galveston, Texas historically had important shipbuilding and offshore fabrication operations, and R.G. LeTourneau launched numerous offshore vessels from its yards in Vicksburg, Mississippi and Longview, Texas. Although not officially part of the study, shipbuilders from these communities are included in this overview because of their historical significance. This overview leaves the specific historical details of most companies and yards to the profiles or appendices and focuses instead on the large-scale changes over time and space in shipbuilding and fabrication.

The full impact of the oil fields on the Gulf Coast communities can best be viewed from looking at and analyzing the patterns of change across five major time periods: 1) Shipbuilding, pre-1914; 2) Shipbuilding, 1914-1945; 3); Shipbuilding and Offshore Fabrication, 1945-1970; 4) Shipbuilding and Offshore Fabrication, 1970-1986; and 5) Shipbuilding and Offshore Fabrication, 1986-2005. The first two time periods correspond to distinctive eras in the development of United States shipbuilding before the emergence of the offshore industry. The last three periods correspond to distinctive eras in the development of the oil and offshore industries, which shaped shipbuilding and fabrication on the Gulf Coast. Developments since 2005 will be covered in Volume II.

1.2. SHIPBUILDING TO 1914

Shipbuilding is one of the oldest industries in the United States, dating back to the first settlements. From 1607 to 1880, wooden ship construction characterized the industry. From its birth as a nation in the late 18th century through the convulsions of a civil war in the mid-19th century, the United States was a formidable maritime power. The locus of this power remained on the Atlantic Coast, but maritime trade also increasingly shaped the development of the Gulf Coast. During the first half of the 19th century, American ships, built with unique and fast designs, competed favorably with ships built anywhere in the world. After the Civil War, American shipbuilding contracted, as iron and metal began to displace wood and British shipping prevailed on the high seas. The industry's revival began in the 1880s, driven by the U.S. government's commitment to build a modern Navy and the introduction of metal ship construction, which, by World War I, largely overtook the wooden ship business. After the war, U.S. shipbuilding was weighed down by organization and financial problems stemming from an oversupply of ships, until the Merchant Marine Act of 1936 reorganized the industry as a business with a special public interest.

Writing in 1948, shipbuilding historian, John Hutchins, identified six historical periods (sub-periods, in this summary) each for the wooden and metal ship industries in the United States. The first period of wooden ship construction was during the colonial era (1607-1776),when the industry developed in British North America primarily on the basis of cheap timber. The second period came after the revolution (1789-1829), when foreign markets were closed, but cheap timber, low construction costs, and the combination of American continental expansion and economic growth created a large domestic market for ships. Discriminatory tonnage duties on non-U.S.-built vessels and the reservation of U.S. coastwise trade to U.S.-built vessels also underpinned the growth of U.S. shipbuilding. The third period (1830-1865) witnessed the assertion of new technical leadership by U.S. shipbuilders in the art of wooden ships --- the clipper, the Atlantic packet, the cotton ship, and wooden-paddle steamships—followed by a sharp collapse in 1857 brought on by the financial panic of that year. During the fourth period (1866-1879), stiff competition from foreign builders of iron sailing vessels and steamships precipitated a decline in American wooden shipbuilding. The fifth period (1880-1913) saw the disappearance of deep-sea full-rigged ships due to high domestic timber costs and competition from steamships constructed abroad. Finally, in the sixth period (1914-1921), government contracts and wartime freights led to a brief revival in schooner and steamer construction, followed by a quick collapse after the war (Hutchins 1948).

The first period of metal ship construction (1822-1865) involved experimentation in Great Britain and the United States, with American builders unable to compete with their British counterparts or even with domestic wooden shipbuilders. In the second period (1866-1879), mail subsidies encouraged deep-sea iron steamship construction on both sides of the Atlantic, which drove the wooden steamship out the coastwise trade. In the third period (1880-1913), the industry developed "mainly on the foundations of steel construction, large naval contracts, and the rising requirements of the protected coastwise trade for modern tonnage" (Hutchins, 1948: 15). The fourth period (1914-1921) of metal ship construction witnessed tenfold increase in construction as a new naval program based on prefabricated designs ramped up production for the war. During the fifth period (1922-1940) the industry suffered from high costs, an oversupply of ships, and naval disarmament, a depression alleviated somewhat after the Maritime Commission's building program in the late 1930s. In the sixth period (1941-1945), massive naval and merchant ship orders for World War II generated construction activity beyond anything ever seen in the past (Hutchins 1948).

Labor shortages were the rule for the first 200 years of U. S. shipbuilding history. In the first century, shipyards did not produce the large quantities of ships or experience the concentration of capital, management, and labor that define them at present. Early colonial law made enticing or using forced labor in shipyards illegal, and many of the colonies, from Massachusetts to Pennsylvania, chartered companies to supervise their shipbuilding and ensure that only residents entered the trade. Ship carpenters of the period, like workers in other occupations, demanded and obtained closed shops. Laborers in the more populous regions organized to improve hours, wages, and working conditions and to control local labor practices. Nevertheless, the industry was spread widely across the nation's seaboards and waterways, and communication and transportation were slow and unreliable, making organization on a national scale difficult (Powell 1948: 271-272).

National labor unions began to form around 1860, but their activities were confined locally. As iron and then steel started to replace wood as the principal material of construction, which called for more skilled tradesmen in ship construction, union organization, especially through the American Federation of Labor (A.F.L.), became more common in the industry. The A.F.L., particularly in areas such as the San Francisco Bay region, came to dominate shipbuilding and the small and widely-dispersed companies became unionized, some accepting a closed shop and allowing the collection of dues. Unionization in the larger shipyards, by contrast, was minimal. Yard foremen ran the employment offices and handled the hiring and firing of workers. They maintained daily contact with laborers and enforced standards of discipline. Yard managers, under company officers, supervised the foremen in matters of trade wages and labor policies. Workers formed employee welfare organizations and committees to address individual employee problems. This situation persisted until World War I (Powell 1948: 272).

Prior to World War I, the Gulf Coast experienced significant growth in shipbuilding, but at fluctuating levels generally lower than along the Atlantic and, later, Pacific coasts. During the second period of wooden ship construction (1789-1829), settlement and commerce in the trans-Mississippi west elevated the importance of New Orleans as national and international port. Federal legislation in 1789 and 1790 levied discriminatory tonnage duties on non-U.S. built vessels and reserved U.S. coastwise trade to U.S.-built vessels. An 1817 act strengthened this protection by limiting coastwise trade to U.S.-flag, U.S.-owned, and U.S.-built vessels, which stimulated the industry on the Gulf Coast (Whitehurst 1986: 33). Ship construction there took place along most coastal areas with access to navigable water. During the antebellum period, Louisiana built several hundred schooners. Meanwhile, as boatbuilding technology advanced, shrimping and oyster fishing developed south of the Atchafalaya Basin in the shallow lakes and bays that connect to the Gulf waters. By 1840, New Orleans had grown to become the second largest port in the nation, and Algiers, a small community across the river, was the key ship repair center on the Gulf Coast.

Pascagoula and Mobile also became major seaports for the export of agricultural commodities. Behind New Orleans, Mobile erected the second largest port on the Gulf. For the better part of the 19th century, several million bales of cotton moved through Mobile annually on steamboats and flatboats. A bustling coastal trade emerged along the shores of the Gulf, in particular between Mobile, New Orleans, and Galveston Island, which also used its natural seaport to export growing volumes of cotton. In 1834, the Houston-Galveston region saw the construction of its first steamship vessel, and others were subsequently built to service the booming cotton trade. With the dredging of the east bank of its river in the 1830s, Pascagoula also reinforced the ties between the regional economy, especially lumbering operations, and Gulf of Mexico commerce. Shipbuilding and timber emerged as interconnected enterprises in southern Mississippi. Likewise, in the Sabine Pass area of East Texas, early shipyards employed many former sawmill workers with carpentry skills. During the first half of the 19th century, the lowlands stretching from Texas to Florida supplied increasing amounts of live oak as frame timber for larger ships in both southern and northern yards. Live oak far surpassed white oak in durability, but the high cost of procurement and relative scarcity of this wood precluded its use by 1860 (Hutchins 1948: 16).

The Civil War gave a brief boost to Gulf Coast shipbuilding. New Orleans-Algiers contributed the largest number of warships to the Confederate States Navy. Louisiana launched seven privateers and built, converted, or outfitted 35 naval vessels (Piston 1988: 167-168). Mobile made headlines for being the place where the *H.L. Hunley*, the first submarine to sink an enemy ship, was built, and in August 1864, as the site of a key naval battle. Near the end of the Civil War, the Confederate Navy opened a shipyard near Baytown, east of Houston. Still, the war marked the high point for U.S. shipping and shipbuilding in the 19th century. As vessels became casualties of war, American shippers turned to foreign registry to reduce the risk of capture and high insurance premiums. After the war, as the world's merchant fleets moved to iron steamships, the relative cost advantage enjoyed by U.S. shipbuilders, which was due to the widespread availability of low-cost wood, evaporated. High import duties on iron and steel plate, along with higher prevailing wages in the United States, prevented American shipbuilders from competing with the British in the global steamship market. As a result, American shipping and shipbuilding "sank from a position of preeminence to near international insignificance" (Walters 2000: 419).

British shipping took the lead in establishing regular cargo service to world ports. English shipowners dominated the exclusive shipping cartels, or international shipping "conferences," which organized the world trading routes through deferred rebates, revenue pooling, and predatory pricing (Cafruny 1995). American merchant marine policy was a reflection of the general American aversion to involvement in European affairs and laissez-faire approach to business at home. Consequently, American cargo trade relied on foreign-built ships and foreign-flag services. As shipbuilding was largely left to the British, national shipyards shrank and operated at minimal capacity (Hutchins 1954; Clark 1986). The United States ordered no modern warships and trailed far behind European nations in naval technology and speed of construction (Walters 2000). During the second half of the 19th century, the extension of railroads across the United States took business away from commercial riverboats and undercut coastal maritime trade (Piston 1988).

Shipping along the Gulf Coast was still dominated by wooden sailing craft long after the introduction of steamships. The industry endured a steady decline in demand for vessels. Many shipbuilders went out of business, changed hands, or barely survived. The southern lumber industry produced fewer and fewer ship timbers. But prospects for shipbuilding did not disappear. Coastwise trade was still protected from foreign competition, and southern politicians managed to capture government funds for river and harbor dredging. In 1873, the federal government passed a Rivers and Harbors Act that appropriated funds for a survey to "connect the inland waters along the margin of the Gulf of Mexico from Donaldson, Louisiana to the Rio Grande River in Texas by cuts and canals." This was the start of the great Gulf Intracoastal Waterway. However, funding for the creation of this 1,000-mile navigation channel, which would ultimately extend from Apalachee Bay, Florida to the U.S.-Mexican border, would not come until after World War I, and its completion would not be achieved until after World War II (Alperin 1983). The controversial Rivers and Harbors Act of 1882, passed in the wake of the disastrous flood in the lower Mississippi River valley, first dedicated substantial federal money to enhancing water outlets for commerce on the Gulf Coast. Considered "pure pork barrel" legislation by President Chester Arthur, whose veto of the bill was overridden by Congress, the act put the U.S. Army Corps of Engineers to work on opening the region's waterways. Both Pascagoula and Mobile had their harbors and ship channels enlarged. In 1897, the U.S. Congress increased appropriations for widening and deepening the waterway connecting Galveston Bay to Houston. A turning point in Houston's history came in 1910 when local citizens partnered with the federal government to fund a major channel enlargement program that culminated in 1914 with the opening of the deep water Port of Houston. The growth of the new oil industry helped pushed Houston ahead of Galveston in what had historically been a highly competitive race for commercial business (Farrar 1926; Sibley 1968). The completion of federally funded ship channels in the Golden Triangle region before and after World War I rounded out efforts by the Gulf region's Washington politicians to harvest federal money for augmenting the region's coastal waterways.

During the 1890s, U.S. foreign policymakers and business leaders began to break out of their continental isolation and seek economic supremacy in world affairs. "Like their European counterparts, American capitalists and conservative politicos embraced the overproduction theory and the belief that a permanent industrial surplus . . . required them to monopolize the home market through protective tariffs and expand the foreign market through participation in the so-called new imperialism" (McCormick 1989: 18). The drive to build a new, modern American Navy would accomplish both objectives. Between 1890 and 1909, Congress funded the construction of steel-hulled, steam-powered warships. By inserting the phrase, "domestic manufacture" into the earliest Navy laws, Congress "guaranteed that, unlike the Russian and Japanese navies, which were rebuilding at the same time and which relied heavily on foreign purchases, almost all American ships would be built in American shipyards" (Walters 2000: 419). At the same time it protected shipbuilding, Congress removed protection on the materials used by the industry. In 1890 and 1894, it removed import duties on steel plate and iron for shipbuilders. With the Panama Canal Act of 1912, it removed duties on all shipbuilding materials used to construct vessels for U.S. registry. Protected and supported ship construction at home would help project American power into markets abroad.

The post-1890 Navy orders created many large new corporations in the shipbuilding business. At first, the only yards capable of building steel ships were located along the lower Delaware River (the "American Clyde") between Philadelphia and Wilmington. Naval construction did not involve the southern Atlantic Coast and Gulf Coast, and included the Pacific Coast in only a limited way, to insure defense of the coastline. During the 1910-1919 period, the tonnage launched increased three-fold over earlier decades, and five private yards came to dominate U.S. shipbuilding: Bethlehem Steel at Fore River (later renamed Bethlehem Quincy) in Massachusetts and the company's Union Iron Works in San Francisco; William Cramp & Sons, just south of Philadelphia; New York Shipbuilding, across the Delaware River from Cramp in Camden, New Jersey; and Newport News in Virginia (Walters 2000: 421).

1.3. SHIPBUILDING, 1914-1945

1.3.1. Gulf Coast Shipbuilding, 1914-1919

On the eve of World War I, American merchant shipping lagged far behind the growing arsenal of warships. In 1914, the United States had less than 5% of the merchant shipping tonnage in the world (Clark 1955 105). The European war, especially after the devastating German submarine attacks on merchant shipping in 1916, prompted a massive U.S. government program to spur merchant shipbuilding and thus complete the transformation of U.S. maritime policy from economic liberalism to autarchy (Clark 1954: 125). This fundamental shift in the political economy of shipbuilding incorporated the Gulf Coast to a much greater degree than ever before in the national organization of the industry.

In 1916, the U.S. Congress responded to the shipping crisis by passing the Shipping Act, the first comprehensive regulatory law for the shipping industry in U.S. history. The act created the United States Shipping Board to regulate carriers and promote a merchant marine. The program was slow in starting and plagued by bureaucratic infighting over awards and material allocations. After the United States formally entered the war in 1917, the Shipping Board chartered the Emergency Fleet Corporation to steer the effort. "It involved the construction of new shipyards, the enlargement of old ones, the building of villages and houses, the procurement of materials, the development of new labor resources in all branches, and the administration and financial control of the largest industrial operation in the United States." The Emergency Fleet Corporation nearly doubled the size of the industry from one in 1917 consisting of 42 yards with 154 ways for steel ships, and 23 yards with 102 ways for wooden ships, to one in 1919 comprised of 72 yards with 461 ways for steel ships, and 94 yards with 473 ways for wooden ships (Hutchins 1948: 52).

Gulf Coast lumber interests, organized under the Southern Pine Association, aggressively lobbied the Shipping Board to fund the construction of a fleet of wooden ships. Southern lumber companies, whose German and North Atlantic markets had been disrupted by the war, claimed they could provide enough lumber to build a "thousand ships" without overextending the mills. John Kirby, a Houston lumber and oil baron, served as a regional advisor to the Emergency Fleet Corporation. Kirby used his political connections to his advantage and established the Houston Shipbuilding and Dry Dock Company, which received orders from Emergency Fleet (Levengood 2001: 23-24). In mid-1917, the Shipping Board accepted bids for the construction of 100 ships built from yellow pine, which would come largely from Texas, Louisiana, and Mississippi. More orders followed the next year. The mills, railroads, and shipbuilders had a difficult time responding to the unprecedented number of orders for large dimensional timbers. The problems of mobilization were immense, from the expansion of yards, to the procurement of labor, to the organization of transportation, to the endless political wrangling in Washington. Frantic construction produced ships of varying quality. They typically lacked power, were difficult to maneuver, or had leaky hulls (Clark 1986).

Shipyards in Texas, Louisiana, Mississippi, and Alabama contracted for more than 300 hulls, barges, and cargo ships, mostly made from wood. The armistice in November 1918 caught the program at its peak, and the government cancelled a large number of contracts. About 620 of the 2,312 vessels built around the country during the war were wood (Hutchins 1948: 53). Many of these "ships to nowhere," as one historian calls the program, were not delivered until the early

1920s, and a large number of them never entered service. Many of the hulls not finished into ships were either scrapped or turned into barges. One consequence of the program was the massive clearance of piney woods along the Gulf Coast. In 1918, the rate of cutting reached 51,000 acres a day, or approximately 81 square miles. All told, three-quarters of a billion board feet of prime virgin pine went into the construction of shipyards, cargo ships, barges, hulls, docks, and workers' housing (Clark 1986).

The great increase in shipbuilding orders beginning in 1916 created severe labor shortages, drawing a huge influx of workers into the industry. The number of workers employed nationally in yards building for the Emergency Fleet Corporation increased from approximately 90,000 in October 1917 to 381,000 by the end of 1918. The majority of the 285,000 men who rushed to work in the new shipyards were inexperienced. Some had been builders or engaged in similar occupations but most were not acquainted with the shipbuilding industry in any way (Douglas and Wolfe, 1919: 145-149; Powell, 1948: 273). Approximately 10% of total workers were African-Americans, most working in unskilled jobs, and about 80% of them were employed in the South and Middle Atlantic states (Northrup 1943: 160).

During the war, organized labor first achieved recognition in shipbuilding. At the outset, shipyard owners did not recognize collective bargaining and refused to respond to organizations of workers. Employees resented owners who reaped huge profits by selling vessels to the U.S. Shipping Board while paying low wages. Their situation was aggravated by the rapidly-increasing cost of living. In August 1917, an agreement between the Emergency Fleet Corporation and the Metal Trades Department of the American Federal of Labor (AFL) established a Shipbuilding Labor Adjustment Board, which was charged with fixing wages and working conditions for shipyard workers and referring all disputes over wages, hours, or labor conditions to a Board of Arbitration. The Metal Trades Department represented craft unions, such as the Pipefitters, Boilermakers, Machinists and Iron Workers, who joined together through local councils to sign agreements with shipbuilders. Membership in these shipbuilding unions grew rapidly after 1917, "in part because of government support but even more from a massive strike wave initiated by workers themselves" (Palmer 1998: 5). By 1919, the Metal Trades had secured collective bargaining agreements with most the nation's major shipyards (Northrup 1943: 161).

Union representation, however, had limited strength and did not improve the position of all shipbuilding workers. Only a few shipyards, all on the Pacific Coast, included closed shop provisions. The Metal Trades unions either formally or informally excluded African-Americans, on whom shipbuilders relied heavily to meet production quotas. In some shipyards during the war, African-Americans sometimes organized into unions unaffiliated with the AFL, but in most cases they had no representation at the yard or on the Adjustment Board. As a result, the Board allowed wages in Gulf Coast and southern yards to be fixed "in conformity with established local custom," with separate wage rates for "laborers" (whites) and "common laborers" (African-Americans) (Northrup 1943: 161).

1.3.2. U.S. Shipbuilding and Maritime Policy, 1919-1945

The post-World War I challenge for U.S. maritime policy was disposing of the giant taxpayer-funded merchant fleet. The Merchant Marine Act of 1920, commonly known as the Jones Act, gave the U.S. Shipping Board broad powers to sell off the fleet to private shipping firms, using revenues to create a construction loan fund with mortgage guarantees. Rejecting proposals for a government-owned merchant fleet, Congress intended for the law to support private shipbuilding and ship repair and a trained merchant marine with sufficient manpower and assets to respond to future national emergencies. The Jones Act would live on to shape the evolution of the offshore oil and gas industry in important ways. Article 27, in particular, strengthened nationalistic requirements for coastwise shipping, stipulating that all merchandise transported by water between U.S. points had to travel in vessels built in the United States, crewed by U.S. mariners, and owned by U.S. citizens.

Meanwhile, the movement for establishing a coastal inland navigation system steadily gained strength. The growth of the region's oil industry after the Spindletop discovery in 1901 and the demonstrated value of water transportation during the war, combined with lobbying by the civic leaders of the Intracoastal Canal Association of Louisiana and Texas, compelled Congress to approve funds for the construction of an intracoastal waterway. The Rivers and Harbors Act of 1925 appropriated $9 million for a nine-by-100-foot waterway running from New Orleans to Galveston and authorized a preliminary survey east to the Apalachicola River in Florida. Five years later, in 1930, another River and Harbors Act contained the first appropriations for the waterway east of the Mississippi River, extending it to Pensacola Bay. As work on the main channel progressed into the 1930s, Congress authorized the construction of floodgates, locks, and tributaries to the main channel, which reshaped the region's environment (Alperin 1983).

Despite the Jones Act and progress on the Gulf Intracoastal Waterway, demand for newly-constructed ships remained depressed for years. Military orders had evaporated and the huge government fleet loomed over the market. Although large numbers of ships became technically obsolete in the 1920s, they could still be sold cheaply and eventually, in the 1930s, at close to scrap value. The Merchant Marine Act 1928 attempted to alleviate the problems in the industry by introducing a 10-year contract mail subsidy to shipping lines and more generous construction loans. However, the act did little to stimulate new construction. The financial crisis of the early 1930s and the restrictions on ocean traffic by higher tariffs, quotas, and exchange controls prolonged the stagnation in the shipbuilding and shipping industries. "The result was a severe and chronic over-supply of tonnage, and severe pressure on liner and charter rates. In some countries ship scrapping subsidies were given along with building subsidies" (Hutchins 1948: 57).

The severe postwar decline in shipbuilding had a dramatic impact on workers in the industry. National employment in the "ship and boatbuilding industry, according to the 1930 Census, had declined to 93,437, one-fourth of where it stood at the end of 1918. Massive layoffs destroyed trade union membership, and the high unemployment of the postwar depression of 1920-1921 further eroded union power. The decline in membership, intra-union conflicts, and anti-union offensives by shipyard employers practically eliminated organized labor from the industry. The AFL Metals Trade unions "collapsed in a wave of desperate and futile localized strikes" (Palmer 1998: 16). By 1930, only Bethlehem and Newport News had recognized unions (Northrup 1943: 162).

Beginning in 1933, government orders for war and merchant ships revived U.S. shipbuilding. As a result of a U.S. Senate subcommittee investigation into rampant corruption and abuse in the subsidy program, Congress overhauled the regulation of shipping and shipbuilding by passing the Merchant Marine Act of 1936. The new act, sometimes referred to as the "Magna Charta" of the American maritime industry, was a landmark piece of legislation. It created a new Maritime Commission to replace the World War I-era Shipping Board and inaugurated the largest and most ambitious cargo ship construction program in history. In sum, it "recognized in law what the shipping industry had been in fact—a business having a special public interest which justified both aid and close regulation on a public utility basis" (Hutchins 1954: 116).

The Merchant Marine Act authorized government subsidies, through the Maritime Commission, to U.S. shipbuilding and ship operations. Title V of the act provided for government payments in the form of a "construction differential subsidy" (CDS) to make up for the difference in U.S. and foreign costs in building ships for U.S. foreign trade. Title VI provided for a similar "operating-differential subsidy" (ODS) for U.S. shipping firms. The two provisions were closely connected, since the act mandated that U.S. ships in foreign trade receiving an ODS be built in U.S. shipyards (Hutchins 1954). Title XI of the Merchant Marine Act, passed in 1938, provided for federal mortgage insurance for shipbuilding. In the event of default, the federal government would repay the outstanding balance of a loan from a private lender. Unlike Title V and VI, the Title XI program did not have a significant effect on shipbuilding at first, as mortgagees were required to foreclose on a defaulted mortgage, insurance payments took long to mature, and the program did not cover financing during the construction period (Cook 1973). Later revisions to Title XI, however, would become crucial to the financing of offshore drilling rigs and other vessels supporting offshore operations (see below).

From 1939 through the end of World War II, the Maritime Commission funded and administered the most gargantuan shipbuilding effort in world history, amounting to 5,777 vessels totaling 56.3 million deadweight tons (Fischer 1949: 41-43). During 1936-1947, the Commission disbursed more than $14 billion in construction funds, most of it between 1942 and 1946 (Lane1951: 716). In addition to C-type cargo ships, many of which were converted to Navy auxiliary ships, the Commission funded the construction of Liberty ships, Victory ships, T2 tankers, and other "military type" vessels, such as Landing Ship Tanks (LST), patrol frigates, troop transports, and submarine chasers. Most were built with non-military uses in mind to serve as cargo, passenger, or combination ships after the transition to a peacetime economy (Lane 1951).

Shipbuilding during wartime incorporated technological innovations that developed the industry's capabilities. Most of the merchant ship construction during the war was performed in yards designed for maximum prefabrication and assembly and for assembly line production. Yards adopted high-speed electric tools, expanded facilities for making large forgings and castings, and increased their crane capacities. Electric-arc welding reduced the production cost for building steel hulls and did away with heavy, expensive machinery for riveting. This slashed the time required for all hull work. Yard organizations, from recruiting and housing labor to programming orders from subcontractors, also developed new sophistication. Assisted by government financing, shipyards on every coast upgraded and reorganized their facilities and equipment (Hutchins 1948).

U.S. defense planners targeted southern shipyards to build Merchant Marine and Navy ships. The Gulf Coast's central location relative to both the Pacific and Atlantic coasts, its relative security compared to the Atlantic Coast, and the need to stimulate the south's still-weakened post-depression economy raised the region's strategic importance for the war effort (Lane 1951: 48-50; Levengood 2001: 25). In contrast to World War I, when nearly all the ships built in Gulf Coast yards were made of wood, the yards had to transition to producing steel ships. Although Navy building was still concentrated in yards on the rivers and estuaries of the Northeast coast—Boston, New York Bay, the Delaware River, and Chesapeake Bay, and Maritime Commission expenditures were largest around San Francisco Bay and near the mouth of the Columbia River System, Navy and merchant construction on the Gulf Coast was relatively greater than ever before (Lane, 1951: 9, 59, 153). Yet, the Gulf's relative inexperience in large-scale steel ship construction posed special problems for the Maritime Commission's program. According to the War Administration's historical report on shipbuilding:

> On the East coast the biggest yards were managed directly or indirectly by strong experienced companies—Bethlehem, Newport News, Federal, and Sun. No need to teach them shipbuilding! In the Gulf, however, nearly all the yards were new and having difficulties; skilled labor and management were hard to find. More than in the other regions, the yards in the Gulf looked to the Maritime Commission's regional office for guidance (Lane 1951: 690-691).

The federal shipbuilding program ultimately disbursed $1.8 billion in Maritime Commission contracts and $1.7 billion in Navy contracts to the Gulf Coast. Shipyards along the Gulf from Brownsville, Texas, to Mobile, Alabama, worked around the clock welding, fitting, and riveting, while local communities and economies exploded with the massive influx of new workers who often migrated great distances to find jobs in the expanding yards. At the end of the war, 57 major private shipyards were in operation—23 on the East Coast, 22 on the West Coast, and 12 on the Gulf Coast. California, Oregon, Maryland, and Pennsylvania produced the largest number and highest gross tonnage of steel self-propelled merchant ships over 2,000 gross tons each. But Alabama, Louisiana, and Texas led the second tier of shipbuilding states, each producing between 1.5 and 2 million gross tons (Smith and Brown 1948: 95).

The wartime emergency sped up the expansion and lengthening of the main channel of the Gulf Intracoastal Waterway, laying the foundation for the growth of the shipbuilding and maritime economy along the Gulf Coast. In 1942, the extension of the waterway to Corpus Christi was completed. That same year, faced with the plea of bolstering national defense as German U-boats began attacking ships in the Caribbean and the Gulf of Mexico, Congress approved the widening and deepening of the entire waterway to 12-by-125 feet from Apalachee Bay to "the vicinity of the Mexican border." The legislation not only authorized the last western segment, from Corpus Christi to Brownsville, which was completed in 1949, but provided for an improved connection at New Orleans between the waterway's eastern and western halves. Prior to this time, westbound barges had to pass through Lake Pontchartrain and pay a toll on the state-owned Inner Harbor Navigation Canal (Industrial Canal) to reach the Mississippi River. The act initiated the construction of a new eastern approach to New Orleans via a land cut through the marsh from the Rigolets to a point on the canal. The federal government then leased the part of the state-owned canal that connected to the Mississippi River, providing a diversion for westbound barges, cutting off 30 miles and eliminating their need to pass through Lake Pontchartrain and under five drawbridges. The operation of this portion of the Industrial Canal toll-free by the federal government was "the vital link between east and west in a continuous federal Gulf Intracoastal Waterway" (Alperin 1983: 34).

The wartime shipbuilding program transformed parts of coastal Alabama and Mississippi. Mobile and Pascagoula were relatively small compared to established cities like New Orleans or Houston, and they had a difficult time accommodating and housing the large inflow of workers. For several years, these places experienced overcrowding, soaring rents, and the deterioration of housing conditions. But the yards in both places managed to increase production. In the Mobile area, Alabama Drydock and Shipbuilding Company (ADDSCO) ramped up from a struggling operation with 1,000 irregularly employed workers before the war to a major war production facility by the end of the war that built tankers and refitted combat vessels. In 1945, ADDSCO employed 30,000 people, approximately 7,000 of which were African-Americans (Nelson 1993: 952). In 1940, Waterman Steamship's Gulf Shipbuilding Corporation began launching cargo vessels, minesweepers, and destroyers and had more than 10,000 workers by the end of 1942 (Nelson 1993: 958). The war completed the change in Mobile's status from a local port to a hub of international commerce. In Pascagoula, Ingalls Shipbuilding arrived in 1938 to take advantage of the new Merchant Marine program and launched an average of one ship per month during the war with a workforce that reached 9,000 by 1945. Before the end of the war, Ingalls prepared for peacetime operations. Company plans included a resumption of the yard's original purpose, the construction of large government vessels. Most Maritime Commission-delivered ships in the immediate post-war years came from Ingalls, whose Pascagoula yard became the South's preeminent shipbuilder (Couch 1964).

The New Orleans-area shipyards dominated wartime shipbuilding in Louisiana. In 1942, the Maritime Commission selected New Orleans as one of its four regional headquarters. The Navy maintained its shipyard at Algiers and two steel and two timber floating drydocks at New Orleans. The Todd-Johnson shipyard expanded its facility and repaired or serviced thousands of military vessels (Mitchell and Linen 1981: 148-159). Equitable Equipment launched dozens of ocean-going tugs. Avondale Marine Ways opened a yard upriver from New Orleans in 1938 and constructed tugboats, tankers, and cargo ships for the war effort. At Morgan City, the U.S. Navy contracted with Chicago Bridge and Iron Company to build ships and floating drydocks (Piston 1988: 170-171). The Delta Shipbuilding Company and Higgins Industries, founded by the bold entrepreneur, Andrew Jackson Higgins, produced most of the landing craft and Liberty ships along the Gulf Coast. During the war, Higgins Industries was the largest maritime employer in the state's history. Operating three plants with 25,000 personnel, Higgins completed 1,000 vessels per month at its peak. While Henry Kaiser receives most of the credit for introducing mass production to shipbuilding during the war, Higgins was actually the first to take assembly line techniques and apply them to shipyard production, developing a four-line, 44 way yard where large ships were assembled from prefabricated units welded in place as the vessels moved from stage to stage. To ensure a steady supply of components, he integrated backward into manufacturing pumps, engines, and other ship parts (Peebles 1980: 141; Heitman 1990: 156). General Dwight D. Eisenhower later credited Higgins for his D-Day success, describing Andrew Higgins, as "the man who won the war" (quoted in Piston 1988: 172).

World War II established Texas as a shipbuilding state for the first time. Before 1914, little shipbuilding activity could be found in the state, due to its lack of deepwater harbors and ports. During World War I, a few shipyards produced wooden cargo ships, but most of them closed after the war. After 1941, Texas contributed immensely to the war program, employing close to 100,000 people and producing 1,521 ships, boats, and craft. The Brownsville Shipbuilding Corporation and U.S. Navy facilities at the Port of Brownsville built deck barges, subchasers, and inshore tugs (Rozeff 2009). In the Golden Triangle area, Consolidated Steel Corp. opened new yards in the region to build hundreds of Navy ships and tank barges, while older, local firms, such as Weaver Shipyard, built wooden minesweepers and steel submarine chasers for the Navy. Gulfport, Pennsylvania Shipyard, and Levingston Shipyard also built hundreds of merchant and Navy vessels (Colton Company 2011).

As a result of the shipbuilding program, three new large firms opened operations in the Houston Ship Channel area: Houston Shipbuilding Corporation, a subsidiary of Todd Shipyard Corporation, San Jacinto Shipbuilders, which shut down in the middle of the war due to financial problems, and the East Texas construction company, Brown & Root, which used its political connections to obtain contracts for building hundreds of U.S. Navy vessels, even though the company had never built a single ship (Mitchell and Linen 1981: 136-137, 148-151; Levengood 2001: 27-29).

The largest company, Houston Shipbuilding Corporation, a subsidiary of Todd Shipyard, built a facility on the most unlikely of locations on the channel, Irish Bend Island. One of the nation's oldest shipbuilders, Todd first moved to the Texas Gulf Coast in 1934 when it opened a drydock, tanker-repair yard in Galveston at Pelican Island. When the Irish Bend shipyard opened in 1942, only a handful of its workers had prior shipbuilding experience. With government contracts in hand, the company established its own in-house training facility, dubbed the "Irish Bend University," to train enough people to speed up construction. Additionally, Todd hired thousands of newly trained craftsmen and women through numerous training programs in the area, such as Houston Independent School District's vocational schools, National Youth Association training center, Houston School of Shipbuilding, and Bell School of Welding. The shipyard built 228 Liberty Ships and 10 T-1 tankers for the U.S. government. At its peak, the yard employed 22,000 workers, 10% of whom were women. In 1944, Todd purchased Gray's Iron Works in Galveston and installed a massive drydock for large naval vessel repairs during and after the war (Levengood 2001; Mitchell and Linen 1981: 148-151).

Brothers Herman and George Brown started Brown Shipbuilding Company after taking over contracts from the financially troubled Platzer Shipyard. They then purchased a large track of land along Greens Bayou where they operated two shipyards with access to the Gulf of Mexico via the ship channel and employed as many as 25,000 workers. Additionally, the company installed a 3,000-ton drydock in 1943 and became the first yard at the Port of Houston to provide repair facilities for ocean going vessels. In 1945, the Brown shipyard added a massive 11,500-ton drydock for large Navy ship repairs (Pratt and Castaneda 1999: 77).

The huge convergence of workers from rural areas across the South into shipbuilding centers strengthened organized labor's ability to recruit members and establish agreements with various yards. Following the 1935 National Labor Relations Act (Wagner Act), which protected workers' right to organize and bargain collectively, the Metal Trades Department of the AFL came to agreements with shipyards across the country. The Industrial Union of Marine and Shipbuilding Workers of America (IUMSWA), officially founded in Quincy, Massachusetts in 1934 and affiliated with the Congress of Industrial Organizations (CIO) starting in 1936, also organized many of the larger yards, especially in the Northeast. The IUMSWA eschewed the organization of workers along craft lines, which meant a separate union for each shipyard trade. Instead, it followed the CIO's strategy of industrial unionism, organizing all workers regardless of their trade. Unlike the more conservative Metal Trades, the IUMSWA did not practice racial exclusion; its constitution opposed ethnic, racial, religious, and political discrimination. In practice, however, especially in the South, this principle was difficult for the union to uphold. Charging that Metal Trades unions had long denied workers a voice, mismanaged funds, and misled and divided the membership, the IUMSWA promised to represent the broader interests of shipbuilding labor (Palmer 1998: 1-13).

The IUMSWA's aggressive organizing drives attracted a membership of 50,000 workers by 1940 and more than 200,000 toward the end of World War II (Palmer 1998: 182). The union's chief victories were in Northeast shipyards, but it made concerted efforts to organize yards on the Gulf Coast beginning in 1937. Organizers focused on the big yards in Mobile, New Orleans, Beaumont, and Galveston. But they achieved success only at ADDSCO in Mobile and the Todd-

Johnson shipyard in New Orleans. The Metal Trades organized most of the other big yards—Gulf Shipbuilding in Mobile, Ingalls Shipbuilding in Pascagoula, Delta Shipbuilding and Higgins in New Orleans, Pennsylvania Shipyards in Beaumont, and the Todd-Galveston Dry Docks. IUMSWA organizers observed that the Metal Trades often worked "hand in hand" with employers to prevent industrial organizing. "The men are for the Industrial Union," wrote one organizer about the Todd Shipyard in Galveston, "but are afraid of their jobs as usual" (Hamilton 1937).

The Metal Trades and employers worked together to divide workers and enforce segregated workplaces. By 1940, the number of African-Americans employed in shipbuilding in the states of Alabama, Mississippi, Louisiana, and Texas averaged about 20%, compared to a national average of 6.4% (Obadele-Starks 2000: 103). Although the Metal Trades unions officially condemned racial discrimination, they excluded African-Americans from skilled jobs and even forced the demotion of African-Americans at shipyards where they had previously held skilled positions. The Metal Trades opposed hiring new African-American workers into skilled occupations, refused them access to company training schools, and channeled them into segregated "auxiliaries." The Fair Employment Practices Committee (FEPC), created in 1941 by a presidential executive to prevent discrimination in defense industries, made little headway in southern and Gulf Coast shipyards to enforce the directive. The Metal Trades Council at the Houston Todd shipyards assigned blacks to unskilled positions, such as rolling wheelbarrows and picking up scrap iron, and ignored their requests for fair treatment, even imposing a fee on African-Americans who requested pay increases or job upgrades (Obadele-Starks 2000: 104). Ingalls Shipyards hired 1,000 African-Americans, more than 10% of the company's workforce, but relegated them to unskilled labor or paid them unskilled wage rates in the rare instance they were assigned to skilled positions (Nelson 1993: 958). Gulf Shipbuilding in Mobile resisted hiring African-Americans at all, finding it "simpler not to hire them in the first place" than to face pressures to upgrade them to skilled positions which would lead to "additional difficulties" (Nelson 1993: 960). Likewise, the Levingston Shipyard in Orange employed 2,000 white workers, but no African-Americans, in order to avoid "an unfavorable worker reaction" between the races (Obadele-Starks 2000: 106). Both Brown Shipbuilding in Houston and Todd Dry Docks in Galveston rigidly segregated minority groups into unskilled work and openly defied FEPC mandates to correct the situation (Obadele-Starks 2000: 108-109). Higgins Industries offered a plan to comply with FEPC standards, announcing in 1942 to train whites and African-Americans on a 50-50 basis, but in separate schools and for separate assembly lines, both of which would have white foremen and supervisors (Strahan 1994: 100). Throughout the war, African-American workers complained of unequal working conditions at Higgins (Chamberlain 2003: 146).

In May 1943, racial tensions in Mobile led to violence. ADDSCO responded to a FEPC directive and upgraded 12 African-Americans to welding positions, which provoked rioting by an estimated 4,000 enraged white workers wielding hammers, bricks, and crowbars. Nobody was killed, but at least 50 African-Americans were injured before U.S. Army troops from nearby Brookley Field arrived to restore order. Most of the rioters were not long-time skilled white workers in the yard, but recent migrants, men and women, from the rural Deep South, who were competing with African Americans for skilled jobs. The CIO local union, IUMSWA, found itself in a difficult position at the ADDSCO yard. Although strongly committed to racial equality, the IUMSWA worried about the survival of their organization in southern shipyards, which depended on the allegiance of white workers. The post-riot accord between ADDSCO, the

FEPC, and the IUMSWA local resulted in separate segregated shipways where skilled African-Americans could work under the supervision of white foremen. In implementing this system, however, the IUMSWA lost support from both white and African-American workers. An interracial union, even one that was segregated, drove off many whites, and limiting access by African-Americans to skilled jobs distanced the union from the emerging civil rights movement (Nelson 1993).

A similar eruption in Beaumont happened a month after the ADDSCO riot. Escalating racial strife at the Pennsylvania Shipyards boiled over when an accusation about the rape of the wife of a white shipyard worker by an African-American provoked nearly 3,000 white workers to march into the black section of town and loot stores, burn automobiles, and attack African-American residents. As in Mobile, competition for skilled jobs, or at least the possibility of it, had been the underlying cause of racial tension. Meetings between the FEPC, the company, and Metal Trades union officials "exposed the racist labor practices that each group allowed to persist but failed to produce an adequate remedy for the racial hostilities permeating the industry" (Obadele-Starks 2000: 107).

The failure of industrial unionism to take hold on the Gulf Coast and the dominance of the Metal Trades in the larger shipyards had long-term implications for shipbuilding in the region. The craft organization of the yards arguably presented greater obstacles to technological change than industrial organization. If workers had been organized into one, large industrial union, they might have been less defensive about preserving privileged types of work and more adaptable to mass production techniques that were the wave of the future in commercial shipbuilding. Admitting racial minorities into skilled positions in the yards, as well as retaining women who were largely dismissed when the war ended, would have created a broader social base of workers to draw on in times of tight labor markets, even with the large decline in shipbuilding employment in the postwar period. In general, as historian John Heitman concludes in his examination of Higgins during the war, shipbuilding in the Gulf became the "story of a region dominated by strong individuals rather than by dynamic organizations and an infrastructure of institutions that possess the inherent ability to sustain economic growth from generation to generation" (Heitman 1990: 159).

1.4. SHIPBUILDING AND OFFSHORE FABRICATION, 1945-1970

The rise of an industry to build drilling vessels, boats, and platforms for the newly developing offshore industry in the Gulf of Mexico after World War II emerged in part from the shipbuilding industry that had grown up during the war, but was also distinct from it. Major shipbuilders saw a sharp decline in orders after the war and faced new overseas competition for merchant ships. They continued to operate mainly on account of U.S. government orders for military ships and subsidies. Some large shipbuilders and construction firms diversified into fabricating steel jackets and decks for fixed drilling/production platforms. The disposal of surplus World War II vessels provided the initial equipment to get these and other service companies started offshore. As the industry grew and moved into deeper water, more specialized equipment was needed, leading many shipbuilders, large and small, into the business of building various kinds of barges, launches, tug boats, supply boats, crew boats, and work boats to service platforms in open waters. In the mid-1950s, when a premium was placed on achieving mobility in drilling, larger shipyards started taking orders to build mobile offshore drillings units (MODUs)—submersible, jack-up and semi-submersible vessels—which became a lucrative business during the offshore boom years of the 1960s and 1970s. The growth of shipbuilding and fabrication for offshore oil development during the 15 years following the end of the war thus was an important mitigating factor in the sharp decline in employment and income for the shipbuilding industry as a whole in the United States.

1.4.1. Shipbuilding, 1945-1970

U.S. maritime supremacy did not last long after the end of World War II. Between 1945 and 1970, the number of major U.S. shipyards declined from 57 to 13. Employment and business income dropped by about 90% (Mack-Forlist 1970: 16). Most of this decline happened immediately after the war, but shipbuilders never regained much ground. In addition to the cessation of wartime demand for sea transport, the other problem afflicting the industry was increasing competition from gradually recovering Japanese and European shipyards, along with the industries that supplied them. The production methods of most U.S. shipyards quickly became outmoded, their costs relatively high, and their labor productivity inferior. Widely fluctuating demand and employment created extreme instability for the industry. The effects were high labor turnover and the inability of shipbuilders to make long-range capital investments. Four bursts of orders, largely for tanker construction, interrupted the long, steady decline in U.S. shipbuilding. These orders came in the late 1940s; during the Korean War, 1950-1953; after the Suez Crisis of 1956; and during the Maritime Administration's cargo replacement program beginning in 1967. Despite these bursts in demand, many yards continued to operate only with sustained government assistance.

After the war, ship disposal was the first priority for U.S. maritime policy. The termination of the emergency shipbuilding programs at the end of the war left the United States again with too many merchant vessels for peacetime needs. In 1944, Congress passed the Surplus Property Act to manage the disposal of surplus war equipment. The act created the Surplus Property Administration, which later became the War Assets Administration. In 1946, Congress passed the Merchant Ship Sales Act to speed the sale of ships at fixed prices. The price formula for disposing of the surplus called for 50% of the prewar domestic cost for each class of ship (87.5% for tankers), with various adjustments and allowances that would not drop prices below a floor of 35% of domestic war cost (50% for tankers). U.S. ship operators received preference in purchasing ships offered for sale. Vessels were also loaned to nations recovering from the war, deployed to carry relief cargoes, or enlisted in the Marshall Plan rebuilding effort for Western Europe. Ships not disposed of in this way were placed into the National Defense Reserve Fleet (NDRF). This program enabled American shipping industry to restock and renew its fleets, and it helped hasten economic recovery in Europe (Hutchins 1954: 119).

Foreign owners could also purchase cargo ships if the owner agreed to fly the American flag on those ships. A few, especially those from Greece such as Stavros Niarchos and Aristotle Onassis, took advantage of the program, especially during the Korean War. After the war, they pleaded guilty to concealing foreign ownership of companies that purchased surplus vessels on terms as favorable as those given to U.S. citizens, and then not flying them under the U.S. flag. They paid multi-million-dollar fines and agreed for the next ten years to build a substantial number of new ships in U.S. yards, which led to major new construction business for Bethlehem Steel and Newport News shipyards (Gray 2008: 203).

During the 1950s, the U.S. shipbuilding industry shrank and stagnated, despite continued government subsidies and support. The overhang of wartime vessels meant little demand for new commercial construction in the United States, even with the continued subsidy programs. By 1950, private-sector shipyards had scaled back operations to the bone and had little new work.

That year, the Maritime Commission was divided into a U.S. Federal Maritime Commission, to regulate shipping trades and routes, and a United States Maritime Administration (MARAD), which contained a National Shipping Authority (NSA) responsible for administering the construction and operating subsidy programs, along with maintaining the NDRF and U.S. Merchant Marine Academy (Hutchins 1954: 120-122; Vambery 1968). In 1951, MARAD initiated the "Mariner" program, contracting with seven shipbuilders to build 35 newly designed cargo ships, which breathed some life into U.S. shipbuilding for a few years. The Korean War also stimulated repair work and a large amount of naval construction, but little new merchant ship construction (Colton and Huntzinger 2002: 8). In the mid-1950s, Congress expanded the Federal Ship Financing Guarantee Program (Title XI of the Merchant Marine Act), singling out for special treatment vessels need to provide essential national transportation services, such as Great Lakes and passenger vessels (Cook 1973). Various cargo reservation programs—such as the Cargo Preference Act of 1954 and the Agricultural Trade Development and Assistance Act of 1954, both of which specified that certain amounts of U.S. government-generated cargoes travel in privately-owned U.S. flag commercial ships—indirectly induced orders for U.S.-built ships (Whitehurst 1986: 38-42). But because there was no requirement that ships carrying preference cargoes be American-built, the inducement was not large (Gibson and Donovan 2001 175).

American shipping lines simply could not keep up with foreign-flag competition, and American shipbuilders played a diminishing role in the rapidly growing global shipbuilding industry. The orders that came in during the post-war years reflected two trends in ship fabrication. First, ships began to be built with much larger dimensions and chief among these huge new vessels were tankers involved in moving oil from the Middle East. Second, the construction of other kinds of ships became increasingly specialized. American shipbuilders led in both movements. During the 1950s, American yards specialized in "jumboizing" T-2 tankers for coastal trades—a process by which ships are cut in half and a section is inserted to lengthen the vessel. They also developed Roll-on/Roll-off vessels, lighter aboard ship vessels, and Liquefied Natural Gas (LNG) carriers (Gray 2008: 203-204; Whitehurst 1986: 2-3, 28). Still, the advantages of foreign registration, such as lower registration fees and taxes, independence from U.S. Navy approval of designs[3], and exemption from U.S. laws and regulations, especially pertaining to labor rights, enticed ship owners away from the U.S. flag. Meanwhile, U.S. shipbuilders saw their orders, especially for ever larger ocean-going vessels, shrink. This happened during a period when there actually was an acute shortage of shipping worldwide. The Suez Crisis of 1956 magnified the shortage, fueling ship construction, especially oil tankers, in Japan and other developing nations. After Suez, the world tanker fleet grew by almost 400%, and the average size of tankers nearly tripled to 58,000 dead weight tons (DWT). Portugal, Bahrain, the U.A.E., and Singapore built large ship repair yards to service the new fleets of tankers. "Because the large tanker is one of the simplest and most labor-intensive types of merchant ship to build, its dominance of new ship construction contracts between 1957 and 1973 fueled the development of shipbuilding in less developed countries" (Colton and Huntzinger 2002: 16). Other nations that expanded their shipbuilding industries during this period included Spain and Yugoslavia in Western Europe, Poland in Eastern Europe, and Brazil and India, which both heavily subsidized their shipyards to build up their national-flag fleets.

[3] Citizens of the United States could apply for a cost differential subsidy for the construction or reconditioning of vessels if the work were done in the United States and the ships operated under the U.S. flag, and if the subsidy was shown to be essential for servicing international trade routes. However, designs had to be approved by the Navy, which could suggest modifications to make ships potentially convertible for military use.

The seller's market in the global shipping and shipbuilding industries persisted until the late 1950s, when a major economic recession in the United States and the overbuilding of tankers created a sharp downturn in global shipbuilding. World shipbuilding output fell from an annual 9 million gross tons in 1958 to 8 million gross tons in 1961 (Stopford 1997: 466). By the mid-1960s, the quick recovery of economic growth in industrialized nations and the accompanying expansion of world seaborne trade created a flood of orders for new construction, initiating a steady and unprecedented increase in shipbuilding capacity around the world. In the late 1950s, some yards received U.S. government mandated work from Greek ship owners as restitution for fraudulent purchases of war surplus ships (see above). Some orders came in for U.S. flag liners and then container ships, pioneered by American trucking entrepreneur, Malcolm McLean, in 1956. By 1966, however, the U.S. shipbuilders were receiving only 1.7% of world's new construction orders of 1,000 gross tons or more, which placed the United States twelfth among the principal shipbuilding countries of the world. Japan was first with 34.8% of new construction. It was producing seven to eight times as many vessels and 20 times the gross tonnage as the United States (Vambery 1968: 86-87).

Organized labor remained relatively robust in large U.S. shipyards, though diminished compared to its position during the war. The IUMSWA suffered major loses in membership during demobilization, dropping to 25,000 by 1950, as naval production shifted away from the Northeast, where the IUMSWA was concentrated, and internal divisions over communist presence in the union eliminated some of the union's key leaders (Palmer 1998: 232-233). The Metal Trades, on the other hand, remained strong, especially on the Gulf Coast. According to the IUMSWA organizer in Beaumont, the Metal Trades council in that city controlled all hiring at Bethlehem Steel's yard, which the IUMSWA regarded as the most valuable, as it was key to unionizing all of Bethlehem's yards on the Atlantic and Gulf Coasts and would be a base from which to organize other yards in Texas (Hansen 1950a; Hansen 1950b). But the IUMSWA made no further gains. The Metal Trades Department became the dominance presence at the large shipyards on the Gulf Coast. Only Avondale Marine Ways (which became Avondale Shipyards after it was acquired by Ogden Corporation in 1959) remained non-union, mainly by paying a relatively higher wages than other yards in the area and firing workers suspected of union activity (New York Times 1964; Hansen 1950c). In a 1968 National Labor Relations Board case, for example, the U.S. Fifth Circuit Court of Appeals found that Avondale had unlawfully discharged four employees after learning of their identities as union committeemen during an organizing campaign between March 1964 and June 1965 (Avondale Shipyards v. National Labor Relations Board 1968).

During the 1950s, African Americans made small gains in finding shipbuilding work. In 1960, they remained a relatively high percentage of shipbuilding labor force in Alabama (29%) and Louisiana (15.6%), but not in Texas (5.8%) and Mississippi (9.2%), where shipyard jobs were the preserve of white privilege. Along the entire Gulf, African-Americans employed in shipbuilding were still largely consigned to unskilled positions (Rubin 1970: 61). The passage of the 1964 Civil Rights Act and government pressures to carry out affirmative action plans eventually, but gradually, forced Gulf Coast yards to modify their discriminatory labor practices. In 1969, a group of African-American workers brought suit against the American Marine Corporation, a New Orleans builder of offshore supply boats (see below), charging a pattern of widespread discrimination in hiring and advancement. The U.S. District Court in New Orleans sided with the plaintiffs, finding that the shipyard had an extreme scarcity of skilled African-American workers and ordered that the plaintiffs be reinstated and earnings adjusted for all black workers who performed similar work as whites but who had not advanced to higher paying jobs during the same length of service (Rubin 1970: 111-113). Also in 1969, a compliance review conducted by the MARAD found that Avondale had been "placing most new black employees in low-level positions with little opportunity for advancement and it promoted black workers at a slower rate than whites" (Wall Street Journal 1977). Avondale later agree to pay back wages for 425 current and 700 former employees. Another barrier to African-American employment in skilled shipyard jobs fell in 1970, when Ingalls Shipyards, as a condition for signing a new destroyer contract, was required to identify and indemnify as an "affected class" African-American workers who had suffered past discrimination. Union cooperation was essential to this agreement. At the time, it marked "the most significant affirmative action cooperation of the Boilermakers and other members of the Metal Trades Council in shipyards" (Rubin 1970: 115).

There were many factors working against the global competitiveness of U.S. shipbuilding, but high labor costs and low labor productivity were among the most obvious. Unionized workers in major U.S. yards earned much more than their foreign counterparts, and so labor costs were higher.[4] Large shipbuilders and ship operators continued to give in to demands of labor for significant increases in base pay, partly because the high-wage contracts would be shouldered by the government. The subsidy system made up the difference between American and foreign costs, and this differential that would rise with increased wages (Powell 1948: 292-293; Roland, Bolster, and Keyssar 2007: 328). The craft orientation in the yards also hindered productivity. It produced disputes over job demarcation, made planning and scheduling more difficult, and prevented labor market flexibility. Technological changes directed at increasing productivity were subject to difficult and time-consuming negotiation (U.S. Congress, Office of Technology Assessment 1983: 109). U.S. shipyards therefore became excessively labor intensive. Limitations on the pool of skilled workers due to union and employer-enforced racial segregation during the 1950s and 1960s also constrained the ability of the industry to tap skilled labor during times of tight labor markets. Too often, they had to ramp up employment with unskilled labor. This situation affected not only the large unionized yards, but non-unionized yards as well. On the Gulf Coast, the regional labor market included the many small and medium-sized shipyards, as well as the fabrication yards, producing for the offshore oil and gas industry. As a 1970 study of African-Americans in shipbuilding observed: "Characteristic of this type of economy is the increasing inability to maintain a given level of skilled employment, and therefore productivity, within a particular industry or plant, especially if that industry happens to be declining or, at best, remaining stagnant" (Rubin 1970, 110)

Organized labor was not the only, or even most important, contributor to low productivity and declining competitiveness of U.S. shipbuilding. Management decisions, public policy, and the timing and characteristics of international competition were all salient factors. Japanese shipbuilders incorporated the most advanced technology and methodology in new yards established after the war, and they did so with direct government intervention and help, indirectly funded by vast helpings of American reconstruction aid and offshore military procurement (Borden 1984). Japan's Programmed Shipbuilding Scheme, begun in the 1950s, allocated capital resources in a way to even out the notoriously cyclical trends in shipbuilding orders. The larger Japanese shipyards also developed close relationships with smaller shipyards, thereby increasing coordination and reducing domestic competition between shipbuilding firms (Chida and Davies

[4] According to the 1964 Annual Report of the Shipbuilders Council of America, average hourly shipyard labor costs were: USA $3.00, Japan $0.73, United Kingdom $0.96, Sweden $1.69, and West Germany $1.08. Cited in Vambery, 1968: 91.

1990; Bunker and Ciccantell 2007: 55-82). As they developed, Japanese yards continued to innovate, replacing labor with machines in hull construction and fitting-out departments, rationalizing the designing of ships, and introducing 'section' or 'block' building and welding. In the process, Japanese shipbuilders pioneered the standardization of designs and captured growing economies of scale (Chida and Davies 1990: 91).

A close steelmaking-shipbuilding nexus underpinned the expansion of shipbuilding in Japan and other advanced nations. By the mid-1960s, steelmakers in Western Europe and Japan had rebuilt and expanded their steel industries using more advanced and cost-efficient technologies and capitalizing on the growth in world iron ore and mineral production to supply their new plants, many of which were located at deepwater ports to take advantage of new large-bulk ore carriers. The U.S. Cold War remilitarization of West Germany during the 1950s resurrected German shipbuilding and allowed the reestablishment of close corporatist alliances with the Ruhr Valley steel industry that had existed during and prior to Nazi rule (Wend 2001). By 1966, West Germany had risen to become the third largest merchant shipbuilding nation in the world. Meanwhile, Japanese steel and shipbuilding became tightly linked industries, financially and geographically. Japan's Maritime Industrial Development Area (MIDA) program, started in the early 1950s, used reclaimed land to integrate greenfield port, steel, and shipbuilding operations. One important result was the cost reduction of steel plate used in steelmaking, making Japanese ship exports competitive with those from any other country in the world (Chida and Davies 1990: 108-09).

Major U.S. shipbuilders fell far behind foreign rivals. They remained wedded to older methods, using drydocks, ways, buildings, and equipment left over from World War II or before. These facilities had relatively high maintenance costs and relied on less efficient techniques. They did not have automatic cargo-handling equipment. Machine tools were inadequate to diversified manufacturing. The federal government's long depreciation schedules for subsidized vessels did not permit speedy recovery of invested capital, thus encouraging the maintenance of antiquated fleets rather than replacement of equipment with rapidly-changing technology. Although government aid and planning fueled the growth of shipbuilding in West Germany and Japan, shipbuilders in those nations were less insulated from global market forces than their counterparts in the United States (Vambery 1968).

American shipbuilders increasingly relied on a single buyer—the U.S. government, in the form of the U.S. Navy and MARAD. The Navy closed its three shipyards in Boston, Brooklyn, and San Francisco and began a wholesale modernization of its fleet through a five-year plan (1963-1968) to build 250 new ships, directing more and more work to private-sector shipyards. The dependence on the federal government, however, had long-run consequences for U.S. shipbuilders. To maintain shipyards around the country, the government spread orders among several yards, rather than giving a single yard the complete contract for a specific ship. This practice "put shipbuilders in the position of contractors, building small numbers of ships to individual specifications, rather than manufacturers producing large quantities of identical items" (Beazer 1972: 3). Design functions were separated from production functions and carried out by independent naval architects and marine engineers. As a result, there was little standardization in hull construction, machinery, and outfitting. Along with fluctuating demand, these procurement policies made U.S. yards risk averse and disinclined to make long-range capital investments. Thus they became more labor-intensive and less innovative than firms in comparable industries. The capital-labor ratio of U.S. shipbuilding and repair was consistently much lower than that in foreign shipbuilding and repair and U.S. manufacturing in general (Beazer 1972: 5-15).

1.4.2. Fabrication of Boats, Platforms, and Drilling Vessels for the Offshore Industry, 1945-1970

One area of growth for merchant shipbuilders during this general era of decline for U.S. shipbuilding was the construction of vessels for the emerging offshore oil and gas industry. This part of the shipbuilding business was driven by on-demand, tailored specifications. What were considered liabilities for competing in the international shipbuilding market—the lack of standardization and the separation of design functions from production functions – amounted to an advantage in the offshore vessel market. These yards also avoided the long-run problems encountered by the major yards in dealing with the government as a major customer, "with endless change orders, much bureaucracy with cost-plus contracting, which virtually ensures very high final cost and late delivery" (Gray 2008: 207). By the late 1960s, the Gulf Coast marine construction industry, with many firms, large and small, located across Texas, Louisiana, Mississippi, and Alabama, had moved aggressively to compete for the growing demand for offshore workboats, supply boats, construction barges, drilling vessels, and platforms. With lean management and their own "builder-friendly" designs, the so-called "shade tree" yards prospered in the Gulf of Mexico offshore market and became competitive with comparable-sized yards overseas.

Prior to World War II, the Gulf Coast oil and gas industry mainly worked the inland oil fields and the marshes, swamps, bayous, and protected bays of coastal Louisiana and Texas. By the late 1930s, however, the development of the "submersible barge" drilling vessel had greatly increased shallow water exploration in the Gulf (McBride 1935). In 1938, the first open-water platform was installed off the Louisiana coast. Morgan City, Louisiana fabricators built a platform supported by hundreds of wooden piles at the Creole field, a mile from shore in less than 30 feet of water. Workers were carried from onshore base of operations at Cameron to the platform and back each day on chartered shrimp boats (Alcorn 1938).The Creole platform gave the Gulf Coast oil construction industry a preview of coming attractions, but the war intervened to delay progress following this successful demonstration. Not until 1947 did a joint venture directed by Kerr-McKee and Phillips Petroleum install the first out-of-sight land platform, the Kermac 16, near Morgan City, Louisiana. This marked a new phase in the evolution of the oil and gas industry and offshore rigs began to dot the waters of the Gulf from Texas to Alabama. Port cities and small towns along the Gulf Coast quickly became strategic locations of support for the offshore industry. Two companies in particular—Brown & Root of Houston and J. Ray McDermott of New Orleans—became synonymous with the fabrication and installation of fixed offshore production platforms. Both had high-level political connections—Brown & Root with Lyndon Johnson of Texas, and McDermott with Earl and Russell Long of Louisiana—which they deftly used to their advantage in obtaining the government contracts essential to any successful construction business.

Brown & Root's first project was for Humble Oil (now ExxonMobil) in Galveston Bay. In the initial years, the industry was confined to shallow and protected waters. As a result, fabrication contractors created land-like structures from which to drill, including drilling barges and platforms supported by piles. In 1938, Brown & Root constructed their first project in the open ocean, building a trestle out to a platform a mile from shore of High Island, Texas. During the war, the Brown brothers focused most of their attention on shipbuilding and other wartime contracts. The Browns built vessels through another company, but the experience enabled the brothers to more easily adapt surplus boats to the needs of the industry when it began to expand again (Pratt, Priest, and Castaneda 1997).

J. Ray McDermott was founded in 1923 by father and son team J. Ray and R. Thomas McDermott. The company started as a contractor for building wooden derricks for oil wells in East Texas. Unlike the Brown brothers, McDermott stayed focused on the oil industry in the early years, expanding geographically across Texas and Louisiana. McDermott's experience working in the swamplands of Louisiana positioned the company as a leader in "marine" construction when oil companies moved into open water. In 1937, McDermott began constructing fixed platforms in the marshes, supplied by plank roadways supported by piles, similar to the early offshore attempts. In 1947, McDermott entered the offshore oil business when it constructed a wood-piled platform in 20 feet of water in the Gulf of Mexico.

The wooden-pile platforms built by Brown & Root and McDermott had problems with corrosion and stability, which led to the introduction of stronger, more durable steel pilings and structures. Brown & Root erected Kerr-McGee's pioneering Kermac 16 platform by driving 16 steel pilings more than 100 feet into the ocean floor. At the same time, McDermott used a somewhat different approach in building a self-contained platform for Superior Oil. Instead of "stickbuilding" the support structure on location, McDermott prefabricated a steel frame structure, described variously as "jacket" or "template," onshore, and then towed it to the drilling site. The advantages of this approach were easier installation, stronger underwater bracing, and lower costs from onshore fabrication (Pratt, Priest, and Castaneda 1997).

The two other competitors in offshore fabrication that emerged at this time on the Gulf Coast were Chicago Bridge & Iron and Raymond Concrete and Pile. Based in Oakbrook, Illinois, Chicago Bridge & Iron (CB&I) built landing ship tanks at Morgan City during World War II, but shut down the yard at war's end. In the early 1960s, CB&I opened fabrication yard in Pascagoula, but did not really step up platform fabrication until the 1970s. Raymond Concrete and Pile, formed in 1923, specialized in pre-stressed concrete piles at a yard in Madisonville, Louisiana and became best known for building the 24-mile causeway over Lake Ponchartrain in 1955. Raymond eventually expanded into offshore fabrication. In the mid-1970s, Raymond developed yards in Houma and Morgan City, creating Raymond Offshore Constructors and Raymond Fabricators that operated as subsidiaries of Raymond International (Pratt, Priest, and Castaneda 1997: 101; Oil & Gas Journal 1978). Still, the competition from these companies presented little threat to Brown & Root and J. Ray McDermott's dominance of platform fabrication and pipelaying in the Gulf.

Oil companies' push into the Gulf of Mexico required an armada of marine service vessels. Having faced supply problems and vessel shortages before the war, offshore operators took advantage of the cheap availability of surplus war vessels from the War Assets Administration to fill this need. Oil companies and drilling contractors initially acquired vessels to convert to tenders for holding supplies, equipment, and workers. They purchased surplus YF Navy barges, designed for Pacific theater supply transport, and converted them into tenders capable of housing 40 workers along with water, fuel, oil, mud, and equipment. Both Brown & Root and J. Ray McDermott also converted YF barges into the first derrick barges for offshore construction (Pratt, Priest, and Castaneda 1997: 24). Because of limited overall space and impossibility of converting YF barge to self-propelled vessels, other companies turned to LSTs (Landing Ship Tanks). With standard dimensions of 50 x 327 feet, converted LSTs were self-propelled, could accommodate up to 75 men, and had ample space for storage of drilling water and fuel oil in ballast tanks in the double bottoms of the ship. Before 1955, 90% of the wells drilled in the Gulf were from relatively small steel platforms supported by tenders, most of which were converted war surplus vessels (Penney 2008: 57; Stine 1955).

Other kinds of surplus vessels contributed early offshore oil operations. LCTs (Landing Craft Tanks), amphibious assault ships designed to land tanks on beachheads, served as work boats. They also were self-propelled and capable of carrying heavy equipment of all types and long strings of well casing. Kerr-McGee converted several LCTs into supply boats and replaced the high-speed gasoline burning engines with slower but more fuel-efficient diesel engines (Penney 2008: 57). One leading oil service company, Halliburton, owned a fleet of 15 major vessels in the Gulf of Mexico, in which five of them were converted LCTs. YMSs, surplus wooden hull vessels, were used to transport crews, drilling materials, and heavy equipment (McGee 1954; Craig 1955). Shell Oil and other companies even deployed surplus LSMs (Landing Ship Mediums) as floating breakwaters around shallow water platforms (Priest 2007: 49; Penney 2008: 56).

By the mid-1950s, after a temporary resolution of litigation over the tidelands dispute, which had suspended offshore operations in 1954-1956, surplus war vessels were no longer as cheap and easily available for conversion to offshore oil operations. Many of the small boat-chartering companies had gone out of business during the suspension of operations. Furthermore, converted surplus vessels were not sufficiently durable and seaworthy for operations in the deeper and rougher waters contemplated by offshore operators. They were too lightly built and unsuitably subdivided and arranged. When their high-speed gasoline engines were replaced by slower diesel engines, their hulls were inefficient at lower speeds (Macy 1957).

Gradually, older surplus boats yielded to purpose-built crew, supply, and work boats that were safer, faster, and more efficient. The new boats had heavy steel-plated hulls and were equipped with multiple diesel engines. Such hulls worked well for supply boats, but were less desirable for crew boats. They slowed down the crew boats, increased the amount of fuel needed for a trip, and lengthened the time it took to get a crew out to a platform and back. In order to improve the speed and reliability of these boats, shipbuilders began using lighter, thinner steel-plated hulls. However, once it became apparent that these lighter steel hulls corroded easily in the saltwater, a few shipbuilders turned to aluminum, a much lighter metal, which lasted longer than steel (Alderdice 1969).

The surge in exploration and development also called for new construction of other kinds of vessels, such as tugs, barges, and towboats. Seismic surveying, previously performed from shrimp boats and oyster luggers, now demanded specially designed boats. Orders for all kinds of new vessels generated a booming business for shipbuilders, large and small alike. One industry observer wrote in 1957: “At the present time, the demand for crew and supply boats is so high that they are being built by a wide variety of shipbuilders ranging from large first class yards to the ‘shade tree’ fabricators. Due to duplication in production, boats from the larger yards have come down in cost to something not too much higher than the river bank yards, and the quality of the work is usually well worth any difference. However, there are as many of the small yards, even with little marine experience, doing good work as there are yards doing bad or marginal quality work” (Macy 1957: 19).

Several of the major shipbuilders on the Gulf Coast entered the boatbuilding business for offshore contractors. During the 1950s and 1960s, Ingalls Shipbuilding in Pascagoula, Mississippi mainly built ships for the U.S. Navy, but it supplemented that work at times with contracts for submersibles and offshore supply vessels. Other large yards launched numerous barges with relatively simple and standardized designs. In the last four months of 1955, ADDSCO built 26 deck barges for Humble Oil, as it geared up for offshore developments, and continued to build barges for operators and oil service companies into the 1960s (Ingalls Shipbuilding 2009; Atlantic Marine Alabama 2009).

Facing a decline in government contracts, Avondale Marine Ways of New Orleans expanded its repair business to the Harvey Canal, which links the Mississippi River to the Intracoastal Waterway. It diversified by building a wide variety of boats—shrimp boats, tuna clippers, passenger vessels, and various types of barges and workboats for the oil industry. Avondale built its first drilling barge in 1946 and its first submersible drilling barge in 1951. Its list of customers was as varied as its fabricated structures. During the Korean War, most Avondale-built ships were for the U.S. armed forces. The sheer number of vessels constructed by the yard was staggering: in 1953, in addition to building 23 civilian vessels, the company delivered approximately 150 landing craft to the Navy and Army. After the cessation of hostilities, it returned to its specialty in constructing numerous drilling, deck, and tank barges for petroleum service companies (Avondale Shipyards 2009).

The medium-sized yards took an increasing share of the offshore supply vessel business, which involved specialized designs and customized production. In the early 1950s, L.F. Alexander Shipyards in New Orleans built the first mobile submersible vessels designed for open water, the *Breton Rig 20* for Barnsdall Oil Company, the *Mr. Charlie* and *John Hayward* for Alden "Doc" Laborde's Offshore Drilling and Exploration Company (ODECO), and the *Offshore No. 53* for The Offshore Company. In 1955, L. F. Alexander launched *Ebb Tide*, the first purpose build offshore service vessel (OSV) for Tidewater Marine. Founded in New Orleans in 1956 by Doc and John Laborde, Tidewater was the world's first company devoted exclusively to supply offshore industry. In its first 10 years, the company went from owning a single vessel to a fleet of over 200. In 1955, Les Durant, naval architect and rig designer, acquired L.F. Alexander and renamed it American Marine Corporation. Into the late 1970s, American Marine built dozens of offshore supply boats for Tidewater and other companies. Burton Construction & Shipbuilding was the other principal maker of offshore supply vessels. From the 1950s to the early 1980s, at a 60-acre facility occupying 2,000 feet of frontage on Port Arthur's Intracoastal Canal, Burton built more than 200 offshore utility vessels for customers such as Zapata Marine, Otto Candies, and Tidewater Marine, among many others. In the early 1960s, Harold Halter opened Halter Marine shipyard in New Orleans on the Industrial Canal and built several boats for the oil and gas industry, including anchor-handling tugs, towboats, and supply vessels. Halter expanded by purchasing the old Barker Barge Line shipyard in Lockport and began building workboats there in the late 1960s.

Small, family-run shipyards, which were especially prevalent in South Louisiana, found a substantial niche in the construction of smaller vessels for the offshore market. Vessel construction initially occurred in backyards and along the banks of the bayous by craftsman using basic equipment and whatever material was available. Ropes hanging from trees did the work of cranes. Some small yards came and went through the years while others persisted, sometimes changing names and even locations several times. Despite their limitations, the small yards yielded a significant number of talented boat builders. Some provided the training grounds for new builders while others served as an outlet for talented craftsmen who tired of the conditions at the large yards or were seeking opportunities for greater personal investment. Conrad Shipyards out of Morgan City, for example, specialized in building deck barges, freight barges, and tank barges for offshore and inland work. No shipbuilder in south Louisiana built more barges than Conrad. The company also maintained drydocks for a prosperous repair business, about half of which involved repairs on vessels serving the oil industry.

In the 1950s, boat-building companies proliferated in Lafourche Parish. Noah Bourgeois of Thibodaux established St. Charles Steel Works on Bayou Lafourche to build fishing vessels and tugboats. Allied Shipyard in Larose transitioned from building shrimp boats to building workboats and barges. Beginning in 1952, boat builder Nolty Theriot of Golden Meadow designed and built his "Theriot tugs" at a small yard in the woods along Bayou Lafourche. In Lockport, the Barker Barge Line began building barges and tugboats for the Gulf oil industry. Donald Bollinger opened Bollinger Machine Shop and Shipyard on Bayou Lafourche near Lockport, initially building and repairing wooden shrimp and oyster boats, but eventually shifted to steel construction and specializing in workboats and supply boats. Grand Isle Shipyard, founded in 1948 to repair commercial fishing vessels, transitioned into repairing wooden luggers that serviced oil rigs. Other long-time family-run businesses that grew into significant operations that serviced the offshore industry during this period included the Cheramie Brothers of Golden Meadow, Cenac Towing Company of Houma, and Edson Chouest of Galliano (For details on all the companies discussed in the last three paragraphs, see Lafourche-Terrebonne Community Profile, Volume II).

Offshore fabrication and shipbuilding also flourished in Terrebonne Parish. Especially along the bayous, as the demand for OSVs increased, many individuals designed and built their own boats, and some of these also constructed vessels for others. Local skills and experience were preserved as yards were passed from one individual to another and as the craftsmen opened new yards elsewhere. Access to the Gulf of Mexico became a key necessity, and throughout the 1960s and 1970s a number of shipbuilding firms such as Universal Iron Works, Main Iron Works, Delta Shipbuilding, Delta Fabrication, Raymond Industries, and Houma Marine Fabricators opened or expanded their operations on or near the Houma Navigation Canal (see Lafourche and Terrebonne Community Profile, Chapter 4, Volume III).

Local technical and infrastructural assistance helped offshore construction and support business grow. Private and public vocational-technical programs, such as those offered by the South Lafourche Technical School, were developed to meet the enormous demands for specialized labor throughout the offshore petroleum industry. The Lafourche Parish Port Commission formed in 1960 to develop Port Fourchon, Louisiana's southernmost port. Port Fourchon initially served as a base for numerous workboats and fishing vessels plying Gulf waters. In Houma, the 30-mile Houma Navigation Canal, completed in 1961 and maintained by the Army Corps of Engineers, linked the Intracoastal Waterway south to Terrebonne Bay in the Gulf of Mexico (see Lafourche and Terrebonne Community Profile, Chapter 4, Volume II).

During the 1950s, McDermott and Brown & Root expanded the scale of their platform fabrication business. Throughout the 1950s and 1960s, the two companies repeatedly bested each other's record for constructing the platform in the deepest water. From its base at Greens Bayou in Houston, Brown & Root offered services for the complete job of engineering, fabricating, and erecting drilling platforms, both self-contained and tender-supported. By 1966, Brown & Root (which was acquired in 1962 by the oil services giant, Halliburton) had completed 315 platforms with a total value of nearly $180 million (Pratt, Priest, and Castaneda 1997: 56, 71). In 1955, J. Ray McDermott, opened a new fabrication yard in Amelia, Louisiana exclusively to build offshore steel structures. It eventually grew to become the world's largest offshore fabrication facility. Located along Bayou Boeuf and initially named Bayou Boeuf Fabricators, it officially became McDermott Fabricators in 1958. The following year, McDermott expanded its Amelia operation with the purchase of Dupont Fabricators and the creation of a marine department to repair company equipment. That department quickly evolved into McDermott Shipbuilding

(Offshore 1958a). During the 1960s, both Brown & Root and McDermott introduced ever-larger crane-mounted barges and purpose-built pipelaying barges to tackle larger projects in deeper waters. Pipelaying became the most lucrative part of the offshore construction business, and the part most dominated by the two companies, because, as it turned out, they colluded closely in this activity to fix prices and divide markets (see below).

The major drawback to tender-supported platforms was their relative immobility—should a drilled hole prove to be dry, a fixed platform would either have to be scrapped where it stood or else taken apart then transported to and reconstructed at another site, a process that was both costly and time-consuming. For these reasons, platforms were suitable for bringing in production, but too expensive for wildcat exploration. Beginning in the early 1950s, naval architects, marine engineers, and shipbuilders began responding to demands from operators for more mobility in exploratory drilling by experimenting with new designs for submersibles, "jack-ups," and "drillships." In the early 1960s, "semi-submersibles" made their appearance. These four basic types of vessels were eventually classed together by the American Bureau of Shipping (ABS) in 1958 as mobile offshore drilling units (MODUs).

Initially, oil companies bought and owned the new mobile drilling vessels. Costs for building these large, specialized vessels were high, and investing in them was risky. In case of a downturn in the industry, there was no alternative use for a customized rig. Banks refused to finance their construction, and insurance rates were almost prohibitively high. Oil companies were "uncomfortable with the fact that drilling vessels sometimes logged long periods of idle time, waiting on seismic interpretation, well log analysis, or location of another project. On the other hand, these owner-operators were reluctant to lease drilling units to competitors, especially after they went through the trouble of training the drilling crews" (Offshore 1997). A few independent designers, such as Doc Laborde, convinced investors to shoulder the risks and obtained long-term contracts from operators. These deals eventually justified bank financing. In 1959-1960, after recovery from the 1958 recession and the announcement of several federal offshore lease sales, numerous independent drilling contractors had obtained the requisite contracts and financing that enabled them to begin building their fleets. For the next decade, they submitted a steady stream of orders to Gulf Cost shipbuilders for vessels.

Most of these orders were for jack-ups. Submersibles were limited to shallow water. Drillships were limited to coring; they did not yet have the stability to drill deep for hydrocarbons. The other "floating" concept was the semi-submersible, which was still coming off the drawing board. These would be more expensive vessels designed for extreme water depths. Jack-ups, by contrast, allowed for drilling in the 75- to 150-foot depth range while maintaining footing on the seabed. These units elevated their platforms out the water by extending, or jacking, long cylindrical or truss-frame legs to the bottom. Despite a number of early mishaps and capsizings, jack-ups designs had improved to a point where drilling contractors and operators could rely on them (Priest 2007: 69-71).

The leading builders in the jack-up market were Bethlehem Steel and R.G. LeTourneau. In 1947, Bethlehem Steel entered the Gulf Coast shipbuilding market by opening a major facility in Beaumont. It bought out Beaumont Shipbuilding & Dry Dock Co. and Pennsylvania Shipyards, and began designing and building vessels to work in the Gulf of Mexico, including tankers, derrick barges, and mobile drilling vessels. The shipyard boasted a massive 15,000-ton floating drydock for doing repair work. Moreover, Bethlehem had a facility in Corsicana, Texas—the Bethlehem Supply Division—that manufactured several drilling rig components and tools, such as drill works, rotary tables, and crown blocks. Bethlehem pioneered many firsts in the industry, including the first oil-well drilling barge (1949) and largest non-propelled barge (1958). The firm also built one of the first mobile jack-ups, *Mr. Gus* (1954). Modeled after Colonel Leon B. Delong's self-elevating platforms used for troop and supply landings in World War II, Bethlehem's jack-up rig *Mr. Gus* was the first mobile drilling rig capable of operating in water depths up to 100 feet (New York Times 1954). R.G. LeTourneau began his career in California where he founded R.G. LeTourneau, Inc. in 1929 as a contractor, engineer, and manufacturer of earthmoving equipment. LeTourneau built manufacturing plants in Peoria, Illinois (1935), Toccoa, Georgia (1938), Rydalmere, Australia (1941), Vicksburg, Mississippi (1942), and Longview, Texas (1945). LeTourneau's Vicksburg facility opened in 1942 to build defense hardware for the war. It produced 155 mm shells, scrapers, bulldozers, and cranes. The company also received important defense contracts during the war for sheepfoot rollers, rooters, and two-wheel tractors. Ultimately, LeTourneau supplied 70% of all heavy earthmoving equipment used by the Allies (LeTourneau 1967).

In the early 1950s, when offshore drilling was mostly confined to non-mobile platforms embedded in the seafloor with permanent pilings, R. G. LeTourneau, well-known for designing and constructing all-wheel electric drives for heavy-duty machinery, had a plan for a vessel that could safely drill for oil and gas offshore. His company performed a series of engineering studies of hurricane winds, tidal waves, and other conditions prevalent in open water and designed a mobile self-elevating offshore drilling platform. The oil companies of the period were interested in this type of platform but George Bush's Zapata Offshore Company of Houston, Texas, was the only one willing to help finance LeTourneau's $3 million unproven project (Offshore 1974).

Construction on the jack-up type vessel, named *Scorpion*, began in late 1954 at LeTourneau's Vicksburg facility on the Mississippi River. Launched in late 1955, *Scorpion* was a large, shallow-draft barge, outfitted with three electro-mechanically-operated lattice-type legs. The vessel went to work off the coast of Port Aransas, Texas, and drilled its first well for the Standard Oil Company of Texas. It then moved to another spot off the coast of Galveston, Texas, and then into the deeper waters of the Gulf of Mexico. *Scorpion* set a record in June of 1956 for traveling nearly one mile under tow from one well site to another to begin drilling at the new location within eight and one-half hours. *Scorpion* revolutionized offshore oil and gas exploration by reducing the costs of setting an offshore oil well into operation. By 1959, LeTourneau had built nine similar offshore drilling vessels for service around the world (Offshore 1957b; Offshore 1960).

Levingston Shipbuilding in Orange, Texas distinguished itself from its competition on the Gulf Coast by offering construction services for all types of offshore drilling vessels, a strategy that placed the company in a position to become an important technical innovator. The company, whose history dated back to the Civil War, when it converted river steamers to gunboats for the Confederate Navy, had been a major builder of ocean tugs for the Navy during World War II. After the war, Levingston specialized in building a wide variety of barges for the petroleum industry: drilling barges, tank barges, deck barges, derrick barges, pipelay barges, and purpose-built tenders (Offshore 1955; Offshore 1957a; Offshore 1958b). But, in the 1960s, it also built every kind of MODU. In 1962, the Orange yard delivered the world's first drilling catamaran, the $1.5 million *C.P. Baker*, to Reading & Bates Offshore Drilling (Offshore 1962). In 1966, after building a second catamaran for Reading & Bates, Levingston launched the enormous *Blue Water No. 3*, the world's first purpose-built semi-submersible, capable of drilling in 1,000 feet of water (Offshore 1966). Two years, later, it produced a sister semi-submersible for Santa Fe, the *Blue Water 4*. At the same time, the company began dabbling in the design of self-propelled drilling ships, initiating an important business partnership with Global Marine Drilling, which purchased eight of Levingston's multimillion-dollar drill ships over the next two decades (Levingston Shipbuilding 2009).

Avondale's offshore business continued to grow. In 1959, New York's Ogden Corporation bought the company for $14 million and changed the name to Avondale Shipyards. In 1963, the company expanded to Westwego with a yard to build and repair small ships, and to Morgan City with an Offshore Division to fabricate steel platforms for oil exploration. That year, Avondale completed two record-breaking vessels for the offshore industry. In January, the yard launched Kerr McGee's *Rig 54*, the world's largest (and, at $6.25 million, the most expensive to that date) submersible drilling barge, capable of operations in waters up to 175-ft deep. Six months later, Avondale built for ODECO the offshore industry's first floating steel drilling island, a $5 million V-shaped rig (Offshore 1963). Even while setting these milestones in the offshore industry, Avondale continued as a leading producer of Navy ships and all types of ocean-going vessels. During 1961-1964, the company doubled the size of its workforce, from 2,500 to 5,000, and ran up a $238 million backlog in orders (Offshore 1965a; New York Times 1964).

The offshore rig-building boom continued through the 1960s. During that decade, Bethlehem Steel built 11 jack-ups at the Beaumont yard, largely for Storm Drilling, Transworld Drilling, and Marlin Drilling companies. LeTourneau built 26 jack-up vessels for water depths ranging out to 300 feet. Nearly completed jack-up rigs were transported from Vicksburg to a yard on the Sabine Pass for final assembly, after which the jack-up was christened and launched. In 1965, Penrod signed an agreement with LeTourneau for four new jack-ups, two of which were capable of operations in 300-foot water, one for 200-foot water, while the remaining platform was intended for 150-feet (Offshore 1965b). In 1967-1968, the construction of mobile offshore drilling units on the Gulf Coast surpassed all records. Over a 13-month span, 40 mobile units were completed. Eight of these were conventional jackups, three were self-propelled jackups, 10 were submersible drilling barges, 12 were drillships, and seven were small workover rigs (Offshore 1968).

1.5. SHIPBUILDING AND OFFSHORE FABRICATION, 1970-1986

The decade of the 1970s ushered in a major transition for the world economy, the world shipbuilding industry, and offshore oil in the Gulf of Mexico. Nearly 25 years of robust economic growth on a global scale came to halt after a series of shocks to the system. The Vietnam War sapped the U.S. economy, leading to balance-of-payments problems and the collapse of the Bretton Woods international monetary arrangements. In 1973, the Arab oil embargo compounded economic instability and fueled general price inflation. Increased competition and overcapacity produced stagnation in global manufacturing and a steep global recession in 1974-1975.

In shipbuilding, South Korea, Taiwan, China, and Eastern European countries became major international competitors, which led to a cutback in shipbuilding capacity in other established shipbuilding nations. Due to a number of exceptional factors, U.S. merchant shipbuilding surged in the 1970s, only to collapse in the 1980s as subsidies ended and demand evaporated. Global economic stagnation caused a decline in seaborne trade, driving shipyard output to historic lows by the mid-1980s. In the United States, a wave of defense orders, thanks to an expanding military budget in response to escalating Cold War tensions, propped up some of the larger shipyards amidst the sagging market for commercial vessels.

For shipyards and fabrications supplying the offshore industry in the Gulf of Mexico, the 1970s were boom years. Rising oil prices resulting from the OPEC embargo sent operators scrambling for offshore leases. Orders for drilling vessels and boats of all kinds soared. Fabrication yards could not keep up with demands for platforms and equipment. Large yards opened in the Coastal Bend and Brownsville areas of Texas to build mammoth-sized structures and vessels for deeper water. Smaller yards also sprouted up in South Louisiana and elsewhere. A second oil price shock in 1979, after a revolution in Iran cut off oil exports, kept oil prices, and thus demand for offshore services and equipment, running high. During the offshore boom, the communities that provided the local work force and supported the growing industry became highly dependent on the fortunes of offshore oil.

Then the oil and shipbuilding booms turned to bust. The collapse of oil prices and the decline of the rig market in the mid-1980s devastated the Gulf Coast, leaving many companies and individuals in financial ruin. The industry depression waylaid all segments of the oil field service sector, forcing many of these interests to downsize or shut down completely. Many skilled workers lost their jobs, relocated, or moved into a different line of work. For a period in the 1970s, U.S. shipyards, especially those along the Gulf Coast, had bucked the trend of decline in world shipbuilding, but by the mid-1980s, they were reinforcing it.

1.5.1. Shipbuilding, 1970-1986

The tremendous expansion of world shipbuilding capacity started in the 1960s reached a peak in the mid-1970s. From a production of 8 million gross tons in 1961, shipbuilders around the world produced 36 million gross tons in 1975, more in a single year than the entire tonnage produced between the two world wars. With huge state subsidies and long-term shipping charters from steel mills, Japanese shipyards built larger and larger bulk carriers, tankers, and eventually offshore drilling vessels. After the steep recession of 1974-1975, however, the market was plagued by 50-100% overcapacity. The contraction in seaborne trade, especially in crude oil after the embargo, slashed demand for new ships and tankers. “The collapse in demand was so sudden and so severe that many new ships that were already under construction went straight from the shipbuilder into long-term lay-up in the fjords of Norway or the harbors of Greece and Southeast Asia, and a few went to the ‘breakers’ without ever carrying a cargo” (Colton and Huntzinger 2002: 19).

During this period of collapsing demand, the large-scale entry of South Korea into the shipbuilding market aggravated the problems of overcapacity. Closely following the Japanese model, the Korean government’s series of five-year plans, particularly the Third and Fourth Five-Year plans (1971-1976, 1977-1981), directed and financed intensive industrialization and coordinated a close relationship between the “generative sectors” of steelmaking and shipbuilding. The government nurtured the growth of Hyundai Heavy Industry (HHI), which in 1973 opened the world’s largest state-of-the-art shipyard at Ulsan Bay, by granting the firm a temporary monopoly over structural steel, ordering that all Korea’s crude oil imports be carried by Hyundai’s newly created merchant marine, and extending substantial subsidies for infrastructure and overseas credit. During the world market downturn, Korean government support also helped HHI to import shipbuilding technology from Japan and Western Europe and to develop new technologies by branching out to produce smaller high-value ships and offshore structures and diversifying into steel and industrial plants. Daewoo and Samsung followed on HHI’s success by opening shipyard operations, respectively, at Okpo in 1978 and at Koje in 1979 (Shin and Ciccantell 2009: 13-16). With labor costs running about one-fourth those of the

Japanese, the Koreans could compete with even the most efficient shipbuilding nation in the world (Colton and Huntzinger 2002: 21).

The late-1970s witnessed "a three-way battle between Japan, Korea, and Western Europe for a share of the diminishing volume of orders" (Stopford 1997: 467). In this battle, Western Europe lost. Threatened by widespread bankruptcies, European shipbuilders could compete only with public assistance and subsidies for financing or directly for production. Great Britain, the nation that had once dominated shipbuilding and shipping on the high seas, forced its shipbuilding industry to reorganize and then, in 1977, proceeded with outright nationalization. The resulting bureaucratic morass and hemorrhaging of public funds forced the British government, in the mid- to late-1980s, to return shipyards to the private sector with targeted financial assistance. The new companies, however, were undercapitalized and inadequately supported. In general, during the 1980s, shipbuilding activity in Western Europe shriveled up. "Every shipbuilding nation had been forced to support its shipyards, financially, at great expense compared to the number of jobs maintained" (Colton and Huntzinger 2002: 19). Rather than continue subsidizing a dying industry, some nations, such as Sweden, abandoned the fight. Sweden had entered shipbuilding only after World War II and had invested heavily enough to achieve third place in the world rankings, behind Japan and West Germany. It allocated more than 40% of all government industrial assistance to its shipbuilders. But in 1981-1982, burdened by huge and escalating budget deficits, Sweden dramatically reduced financial assistance to industry and thus the props that kept it alive (Nilsson 1991: 149-151).

Although increasingly uncompetitive in the global market, U.S. builders of merchant ships in the 1970s experienced brief but vigorous revival thanks to major alterations to the Merchant Marine Act. After his election in 1968, President Richard Nixon appointed a President's Commission on American shipbuilding to recommend changes in U.S. shipbuilding policy. Acting on the commission's recommendations, Nixon and MARAD proposed several amendments to the Merchant Marine Act of 1936, which Congress passed in 1970. Calling for a ten-year program to construction 300 merchant ships in U.S. shipyards, the amendments reduced the level of CDS and ODS subsidies, but also extended them to tankers and dry bulk carriers. Payments for construction subsidies were paid directly to shipbuilders rather than channeled through ship owners as before (Gibson and Donovan 2001: 200-201).

Most importantly for shipbuilders servicing the offshore industry, the amended act expanded the Capital Construction Fund (CCF) created under the Merchant Marine Act of 1936. The original CCF allowed subsidized ship owners operating in essential foreign trades to defer payment of federal income taxes on profits set aside in a fund used later to finance the purchase, construction, or repair of a vessel. The CCF basically enabled ship owners to acquire or build vessels using before-tax, rather than after-tax, dollars. The amount of money accumulated by deferring tax on income when used to pay for a vessel, in effect, served as an interest free loan from the federal government. The 1970 amendments broadened the CCF to U.S.-built vessels operating in both domestic (Great Lakes and non-contiguous) and foreign trades (Cook 2007). This meant that boats and drilling vessels built for the offshore industry now qualified, resulting in a huge boon to construction on the Gulf Coast (see below).

Another policy innovation pertaining to the Merchant Marine Act provided an additional and major stimulus to the construction of drilling rigs and boats deployed in support of offshore operations. Vessel operators on the Gulf Coast were having difficulty securing long-term financing to construct large enough fleets to meet booming demand in the Gulf of Mexico and North Sea. In 1972, based on an application from ODECO to contract for the construction of the

Zephyr 1 semi-submersible at Bethlehem Steel's yard in Beaumont, MARAD's chief counsel issued an opinion approving the extension of Title XI guarantee authority to drilling vessels, barges, and workboats (Cook 2011). Title XI allowed vessel owners to issue bonds to finance most of the vessel's cost with a U.S. Treasury guarantee of principal and interest. This enabled financing for vessel construction with interest rates a half-point below normal, a relatively low down payment, and 25 years for the borrower to pay off the debt as opposed to the normal 10-12 year term (Cook 2011). The Federal Ship Financing Act of 1972 rewrote the language of the Title XI program, simplifying the documentation and substituting the terminology "loan guarantee" for "mortgage insurance" to make the program more palatable to investment banks (Cook 1973).

Together, the Merchant Marine Act Amendments of 1970, the expansion of Title XI, and the Federal Ship Financing Act produced the largest peacetime private shipbuilding program in U.S. history. Between 1970 and 1975, U.S. shipbuilders spent more than $1 billion on capital improvements to their yards, producing about 77 commercial vessels (1,000 gross tons or more) per year. The end of the decade was even better. During 1977-1979, U.S. shipyards launched vessels totaling more than 1 million gross tons each year, which marked the peak tonnage in U.S. history (Roland, Bolster, and Keyssar 2007: 443). The new federal programs not only stimulated more subsidized shipbuilding, which constituted about 40% of all U.S.-built merchant ships, but it also encouraged the construction and repair of Jones Act vessels, those engaged strictly in coastwise and inland domestic trade (Louis Berger Group 2004: 52). New orders for large tankers to transport oil production from Alaska's giant Prudhoe Bay field, for barges working inland waterways, and for offshore drilling vessels and supply boats created a boom in Jones Act shipbuilding. By the mid-1970s, U.S. shipyards "had so much commercial work that . . . the Navy could not find enough interested shipbuilders to build all the ships for which funds had been appropriated" (Colton and Huntzinger 2002: 17).

Booming business hid a crucial underlying problem for the major U.S. shipbuilders. They were becoming highly segmented, not universally healthy or strong, as it might have been tempting to conclude from watching an increase in merchant ships of every type being launched in the mid-1970s. At the high end of this segmented market were technologically complex naval vessels, followed by technologically complex commercial vessels. Farther down were naval fleet auxiliaries and containerships, and at the low end were single-commodity bulk vessels such as oil tankers and ore carriers. As a rule, U.S. shipyards were more competitive in building more technological complex vessels. The Navy built a large number of them in series on five-year building programs. U.S. shipbuilders initially took the lead in containerships, roll-on/roll-off (RO-RO) vessels, lighter aboard ships (LASH), and LNG carriers, in addition to offshore drilling vessels (Whitehurst 1986: 28). But these were built in smaller numbers, based on orders from a wide variety of shipping firms, each with different design requirements, limited numbers of vessels, and with different delivery dates (Whitehurst 1986: 103-104). Over time, the higher construction costs and longer delivery time for U.S. yards in building these vessels allowed foreign yards to erode U.S. dominance in these markets. This meant that the U.S. industry in general was still dependent on government subsidies and naval construction for its survival.

High labor intensiveness remained a weakness for U.S. shipbuilding. In the early 1980s, the United States reported 51 major shipbuilding/repair yards with some 94,736 workers. The total number of employees in each yard ranged from 35 to 28,112. The average quantity of laborers was 1,857 and the median was 326. Total private sector shipyard employment increased during the early 1980s, but the higher numbers were solely due to a boost in orders from the Navy.

Employment in commercial work, in contrast, dropped from 19,317 in 1980 to 7,926 in 1984 (Whitehurst 1986: 92-94). In the mid-1980s, with the exception of Avondale Corporation in New Orleans, all yards in the Active Shipbuilding Industrial Base (ASIB) were unionized, and over 90% of all those working in these facilities belonged to a union. The U.S. Maritime Administration defined the ASIB as major yards that had the capability of fulfilling contracts for constructing naval and/or large merchant ships. Gulf Coast yards included in the ASIB were: ADDSCO, Avondale, Halter Marine, Ingalls, and Todd Shipyards-Galveston. Yards in the ASIB were a subset of what MARAD defined as a "first tier" group of facilities or major shipbuilding base (MSB), capable of building or repairing vessels 122 meters in length or more. The principal unions, in terms of quantity of membership, representing the shipyard workers were: Industrial Union of Marine and Shipbuilding Workers (IUMSWA); International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers, and Helpers of the AFL-CIO's Metal Trades Council; and the United Steel Workers (USW). In 1982, the Metal Trades had 36,727 members nationally, compared to 12,971 for the IUMSWA and 19,668 for the USW. On the Gulf Coast, the Metal Trades had contracts with Bethlehem Steel, Ingalls Shipbuilding, Todd-Galveston, and Halter Marine (U.S. Congress, Office of Technology Assessment 1983: 106). The IUMSWA's only contract was with ADDSCO, and that ended in 1989. Most Gulf Coast shipyards, it should be noted, fell under the classification of a "second-tier" facility engaging primarily in the construction or repair of small vessels. Nearly all of them were non-union, so the total number of unionized yards and workers in the Gulf was very small.

In the early 1980s, the U.S. shipbuilding and repair industry crashed. The first big blow came in 1981 with the elimination of Construction Differential Subsidies. After an Office of Management and Budget (OMB) review of U.S. maritime policy, which concluded that public assistance to maritime industries could not be justified on national security grounds, incoming President Ronald Reagan terminated MARAD funding for construction and operating subsidies for foreign-trade ships and Title XI guarantees for the financing of U.S.-flag ships built in U.S. shipyards. The Reagan administration moved the MARAD from the Department of Commerce to the Department of Transportation, and the maritime administrator lost the title of assistant secretary for Maritime Affairs. The responsibility for formulating maritime policy moved to the secretary of transportation. Furthermore, budgetary restrictions that the Office of Management and Budget placed on the various branches of the administration would constrain maritime policy proposals. Under this new arrangement, the administration did not have to seek annual appropriations to pay for the authorized programs (Gibson and Donovan 2001 257).

A succession of other developments combined to undercut demand further and weigh on the industry. Completed construction of the Alaska-trade tanker fleet reduced orders for Jones Act shipbuilding. A high interest-rate policy pursued by the U.S. Federal Reserve to combat inflation both exposed builders who had overextended themselves through debt and brought about the most severe economic recession in the post-World War II era, drying up demand for heavy manufactured goods across the board (Colton and Huntzinger 2002: 22). Overbuilding of inland waterway fleets, drilling rigs, and OSVs, encouraged by generous federal support, forced many operators into default, halting construction in this sector. Finally, the collapse in oil prices after 1982 brought new orders for drilling vessels and supply boats to a screeching halt (see below).

The numbers behind the decline in U.S. merchant shipbuilding were startling. Total gross tonnage went from an average of more than 1 million tons per year in the late 1970s to an average of just over 200,000 ton per year during the entire decade of the 1980s. The total in 1989 was a mere 4,000 tons. Construction of commercial vessels (1,000 gross tons or more) at first tier shipyards averaged a total of eight ships per year into the early 1990s. Total employment dropped from 150,000 workers in 1979 to 72,000 workers in the early 1990s. In this time, 45 shipyards closed, leaving only 17 yards capable of building ocean-going ships. Shipbuilders that survived relied increasingly on the naval building program under Reagan's expanded defense budget. By 1990, 95% of all business in for major U.S. shipbuilders came from Navy construction, overhaul and repair (Colton and Huntzinger 2002: 22).

1.5.2. Fabrication of Boats, Platforms, and Drilling Vessels for the Offshore Industry, 1970-1986

The character of shipbuilding and offshore fabrication on the Gulf Coast differed from shipbuilding elsewhere in the United States. The 1970s ushered in extraordinary demand for new construction of drilling vessels, crew boats, supply boats, and workboats. Activity surged at major and minor shipyards, and at fabrication yards both large and small. Most Gulf Coast shipyards were second-tier facilities, as defined by MARAD. They depended on the private sector, rather than the federal government, for contracts. Consequently, the shipbuilding and fabrication industries along the Gulf rode the volatile swings in the oil and gas business cycle. The upside of these swings produced dynamic growth, high wages, and profits, but the downside could be equally painful and disruptive.

Skyrocketing oil prices in the 1970s and an aggressive federal leasing system generated huge demand for new equipment and technology in the Gulf. Orders for boats and platforms piled up, creating backlogs of 18-24 months or more for large items like drilling rigs, platforms, and larger vessels (Oil & Gas Journal 1978; Times-Picayune 1981). Persistent labor and materials shortages resulted. Gulf Coast shipbuilding and fabrication tended to rely more heavily on non-unionized and flexible sources of labor. But competition for labor with other industries in the region, such as offshore operations, refining and petrochemicals, which were also booming in the 1970s, often drew workers away from shipyards and fabrication yards. The construction of the super port terminal, the Louisiana Offshore Oil Port (LOOP), added to the building frenzy.

Shipbuilders and fabricators ramped up production in response to demand. New companies entered the market. New yards were opened. Many investors, taking advantage of the tax break for new vessel construction provided by the CCF and Title XI loan guarantees, poured money into the offshore boat business. A steady increase in demand for fishing vessels and shrimp boats supplemented the construction of oilfield vessels. Residents from many walks of life acquired sufficient resources to build their own boats or have them built for them. In 1972, 97 shipbuilders in Louisiana employed 16,000 workers with an annual payroll of $34 million. Four years later, those figures rose to 142 firms with 19,700 employees and a $250 million payroll (Acadiana Profile 1979). In 1981, the Louisiana Labor Department estimated that 23,800 people were employed in ship and boat building and repair, representing one-fourth of all durable-goods manufacturing jobs in Louisiana (Times-Picayune 1981). Few people recognized at the time, however, that shipbuilding and fabrication on the Gulf Coast was creating tremendous overcapacity for the offshore market.

The demand for drilling vessels, both domestically and internationally, prompted the major builders to open new yards in the Gulf and overseas. In 1970, the three major Gulf Coast builders of MODUs—LeTourneau, Levingston, and Bethlehem Steel—were already booked with contracts. In 1971, offshore operators deployed 13 MODUs, the majority of them for deep water, and issued orders for more. By the end of the year, 48 new units were being built at a total investment of around $630 million. This number was an all-time high for the industry. Still, rig shortages loomed. Yards had difficulty recruiting experienced labor, especially welders, fast enough to keep from delaying already tight construction schedules (Offshore 1972c). For the rest of the decade, the supply of MODUs lagged behind demand, permitting drilling contractors to quintuple the day rates they charged to offshore operators. To handle the giant increase in business, all three major builders opened new yards on the Gulf Coast. Within the same time period in the early 1970s, all three also opened yards in Singapore to take advantage of new international demand for drilling rigs.

Levingston Shipyards participated in the earliest efforts to create a shipbuilding industry in Singapore. In 1965, this island city-state on the southern tip of the Malay Peninsula became an independent republic after a long history as a British colony and a short period as a member of the Malaysian federation. In 1967, a group of investors formed Far East Shipbuilding Industries Limited (FESL) to undertake all types of maritime construction projects. In 1970, FESL signed a management agreement with Levingston Shipbuilding and renamed itself Far East Levingston Shipbuilding (FELS). Meanwhile, the Swan Hunter Group, an internationally renowned British shipbuilder, formed the Keppel Shipyard to take over the dockyard department of the Port of Singapore. In 1971, Keppel acquired a 40% stake in FELS. For the next several years, Keppel-FELS specialized in building barges and tugs (in 1990, Keppel-FELS returned to the Gulf by acquiring a controlling stake in the Allison-McDermid yard in Brownsville—see Brownsville/Port Isabel Community Profile).

R.G. LeTourneau was close behind Levingston in opening a 32-acre waterfront yard in the Jurong Industrial District of Singapore. But LeTourneau had larger ambitions—to fabricate offshore drilling vessels. At the time, company president, Richard H. LeTourneau, explained that his company's sales and marketing department had determined that the Indian Ocean and Southwest Pacific showed strong oil potentials. Rig transportation from the Gulf of Mexico to Asian waters involved high cost and risk, and the government of Singapore offered to subsidize utilities and supplement manpower with cheap labor (Offshore 1970). During the 1970s and early 1980s, LeTourneau would build 29 jack-up vessels at its Jurong yard (LeTourneau Technologies 2009).

In 1972, Bethlehem opened a shipyard in Singapore, Bethlehem Singapore Private Limited, to build jack-up rigs for the growing offshore market in Asia. Bethlehem held a 70% interest in the 79-acre facility, which was built on a tract of British naval property. Bethlehem in Beaumont supplied the designs, the management team, and many of the components for the jack-ups built overseas (Wall Street Journal 1970). In the 1970s and early 1980s, Bethlehem built at least 14 jack-ups at its Singapore yard (Colton Company 2011).

Over time, shipyards in Singapore, led by Keppel-FELS, would become the world leaders in the construction of MODUs. In the 1970s, however, most of the action was still in the Gulf Coast shipyards, where the leaders continued to be Bethlehem Steel and LeTourneau. During the height of the boom, Bethlehem Steel employed more than 3,000 workers in the Golden Triangle area, mainly building jack-ups (see Port Arthur/Ingleside Community Profile, Chapter 5, Volume II). During 1970-1984, the company's Beaumont yard built 48 jack-up vessels and seven semi-submersibles. LeTourneau kept pace. In 1971, Marathon Manufacturing Company, a producer of electric-chemical and fabricated metal products, acquired a controlling interest in LeTourneau, which had a $200 million backlog of orders and letters of intent for more, and announced that the newly merged company would lease 114 acres and 2,000 feet of frontage at the Brownsville Ship Channel to expand the capacity of its Gulf Marine Division to build mobile drilling vessels (see Brownsville/Port Isabel Community Profile, Chapter 8, Volume II). The yard would employ some 3,000 workers, most of them welders. The Brownsville Navigation District issued $6 million in revenue bonds to help finance the new shipyard facilities (Offshore 1972a; Rozeff 2009). In 1972, Marathon-LeTourneau expanded further by taking over the Upper Clyde Shipyard in Clydebank, Scotland. The British government pitched in an estimated $240 million in support to seal the deal (Offshore 1972b). Throughout the 1970s and into the early 1980s, all four of Marathon-LeTourneau's yards—Vicksburg, Singapore, Brownsville, and Clyde—hummed with activity. The Vicksburg yard produced 46 jack-up vessels, while Brownsville turned out 24 jack-ups and four modern semi-submersibles (Colton Company 20011.

During the boom years, four other Gulf Coast shipyards accounted for the rest of the big orders. Avondale's big ticket was semi-submersibles. In 1972, the yard earned praise as the builder of the world's first self-propelled semisubmersible, the $20 million *Ocean Victory* built for ODECO, who had become an important customer for Avondale. The shipyard went on to build 12 semi-submersibles, in addition to a variety of barges, supply vessels, LNG carriers, and crude oil and petroleum product carriers. Further east in Mobile, ADDSCO constructed seven semi-submersibles. Levingston lived up to its reputation for versatility, building two semi-submersibles, five drillships, 11 jack-ups, and numerous drill barges, tank barges, and derrick barges. For most of the 1970s, Ingalls Shipbuilding was busy with orders from the U.S. Navy for assault ships and destroyers, but in the early 1980s, the company took on more work for the offshore drilling industry, building 13 jack-ups and four semi-submersibles (Avondale Shipyards 2009; Atlantic Marine Alabama 2009; Levingston Shipbuilding 2009; Ingalls Shipbuilding 2009).

Hidden in the stream of giant drilling vessels and barges pouring out of Gulf Coast yards was the spectacular increase in supply and work boat construction, most of it taking place in Louisiana. Throughout the 1970s, oil companies complained about shortages of boats and licensed crew personnel to service their operations. South Louisiana responded, making a name for itself as the "Work Boat Capital of the World" (Acadiana Profile 1979). By the end of the 1970s, the Halter shipbuilding group had expanded to five shipyards in Louisiana and five others in Mississippi and Florida, employing at total of 2,550 people. It had become the largest manufacturer of onshore push boats and offshore workboats on the Gulf Coast, as well as a world leader in supply boats, doing $200 million worth of business in 1979 (Times-Picayune 1981). In Lafourche Parish, Bollinger Shipyards grew steadily, expanding to Larose along the Intracoastal Waterway, and delivering tugs, push boats, barges, and offshore supply boats as well as ship repair services. In 1974, Edison Chouest opened North American Shipbuilding to build and repair tugs and supply boats for the ever-expanding Chouest fleet. A report in the mid-1970s noted that some 6,700 workboats plied the Gulf waters, and shipyards in Louisiana produced nearly a billion dollars in workboats annually. In 1974 alone, according to the Harbor and Terminal District in Morgan City, workboats made more than 100 trips daily through the Atchafalaya Bay. By one account, there were 550 major vessels—supply boats, tug/supplies, tug/utility, lay barges and so on—in the Gulf at any one time, plus scores of smaller vessels. In 1978, Conrad Shipyards out of Morgan City expanded with a 3,600-square-foot indoor-construction facility, 150 feet of additional bulk-headed waterfront along the Atchafalaya, and additional automatic welding equipment. Increasingly, South Louisiana boat yards also built vessels deployed for offshore work in the North Sea, the Middle East, and Southeast Asia (Acadiana Profile 1979; Times-Picayune 1981).

After oil companies spent lavishly to purchase a large number of leases at federal Gulf of Mexico auctions in 1970 and 1972, fabrication yards bulged with platforms and tankers under construction, and orders for new platforms quickly became backlogged. New companies entered or expanded their platform-construction business. ETPM-USA, a Houston-based subsidiary of the French company, Entrepose-TM pour les Travaux Petroliers Maritimes, opened a 150-acre fabrication yard near Aransas Pass, Texas (following Brown & Root and McDermott—see below). Chicago Bridge & Iron purchased a yard at Ingleside, Texas to take on new platform orders. And Raymond International built a new 437-acre yard near Houma, Louisiana and purchased the Morgan City yard of Dupont Fabricators (Oil & Gas Journal 1978).

Brown & Root and J. Ray McDermott, however, were the major beneficiaries of the platform-building boom, solidifying their dominance of the large-scale engineering and construction segment of the industry. This segment of offshore contracting generated the biggest profits. For fiscal 1978, according to a study by Arthur Little, McDermott recorded profits of $159 million on revenue of $1.3 billion, and Halliburton's operating income traceable to marine engineering and construction (Brown & Root) was $217 million on revenues of $1.05 billion. By buying up competitors and their equipment as well as expanding on their own, these two giants controlled the vast majority of the world market for these services—McDermott's 40% and Halliburton-Brown & Root's 38%, compared to the 13% controlled by foreign companies and 9% controlled by other American companies. In the offshore construction and installation business, Brown & Root owned and operated 41 barges, and McDermott had 31, compared to one of their strongest U.S. competitors, Santa Fe International, which owned three (Wall Street Journal 1978).

As oil operators moved into deeper water in the Gulf of Mexico—to 300 feet by the late 1960s and aiming toward 1,000 feet after the 1973 price shock—the requirements for fabricating steel jackets for those depths exceeded the capacity of existing yards, even for the two largest on the Gulf Coast, Brown & Root's Greens Bayou and McDermott's Morgan City-Bayou Boeuf facility. McDermott acquired a yard in New Iberia, Louisiana, and in 1975 expanded facilities there and at Morgan City-Bayou Boeuf. But these expansions were still insufficient. In 1975, McDermott contracted with Shell Oil to build a 1,000-piece structure to develop the company's Cognac field, only it had to be constructed in three pieces and mated on site in the water. Shell and McDermott had to resort to this risky and challenging procedure because there was not a yard or an installation barge big enough to handle such a structure made in one piece (Priest 2007: 191-201). Anticipating more platform orders for this depth, Brown & Root and McDermott searched for sites that could serve as a major assembly point but within a reasonable distance to their main yards in Houston and Morgan City. They found the location at Harbor Island, Texas, located about one-half mile from the open Gulf waters on the main channel leading into Corpus Christi Bay. It was protected from heavy waves by Mustang Island and San Jose Island, and close to the Gulf Intracoastal Canal. In 1975, both companies purchased land on the island and developed fabrication yards that opened the next year (Pratt, Priest, and Castaneda 1997: 78-81).

In the late 1970s, several landmark platforms were towed out of these yards and set near the 1,000-foot depth mark pioneered by Cognac. McDermott constructed Union Oil's *Cerveza* platform in water nearly deep as the Cognac structure, only in one piece, which reduced costs dramatically. Brown & Root built a 700-foot structure for Chevron's Garden Banks field, and a 650-foot jacket for ARCO. Then the company accomplished another industry record when it built a 1,000-foot tall "guyed tower" platform for Exxon's Lena prospect. Brown & Root won this significant fabrication contract in April of 1981 and planning for the fabrication of the *Lena* jacket centered on having it ready for launch before the 1983 hurricane season. Some of the parts for this project were prefabricated at Brown & Root's Green Bayou shipyard near Houston and then moved 200 miles south to Harbor Island for final assembly. Both companies geared up their Harbor Island facilities for what they expected would be a stream of deepwater platform projects made possible by steadily rising crude oil prices (Pratt, Priest, and Castaneda 1997: 83-90).

During the boom years of the 1970s, fabricators all along the Gulf Coast scrambled to keep up with orders from offshore operators and drilling and service companies. Not only did fabrication increase in scale, it developed new sophistication, specialization, and scope. Shipbuilders like Avondale diversified into specialized aspects of fabrication and equipment installation. The company created an Industrial Division to perform diverse kinds of jobs. "In addition to topside repairs," wrote the *Houston Post* in 1977, "they specialize in steel fabrication such as dredge pontoons, deck fittings, main condensers for ships, caisson piers for bridges and fabrication of any design; construction of marine closures, quick-acting hatches, dogged manholes, watertight sliding doors, BuShips closures and closures of any specific design" (Houston Post 1977).

Although the 1970s boom spread prosperity all along the Gulf Coast, union efforts to organize for a greater share of this prosperity continued to meet stiff employer resistance. Avondale remained vigilant against union organizing at its yard. In 1975, J. Ray McDermott refused to bargain with a NLRB-certified union of divers, tenders, and rack operators organized under the International Association of Professional Divers and affiliated with the AFL United Brotherhood of Carpenters and Joiners. The case went to the Fifth Circuit Court, which found the company's actions to be unlawful and upheld the union as the bargaining agent for the divers (J. Ray McDermott vs. National Labor Relations Board 1978). In 1977, the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of American attempted to unionize workers at Marathon LeTourneau's 1,200-person division in Longview, Texas, which manufactured and repaired heavy machinery. Marathon-LeTourneau's reaction to these efforts led to another case that went to the Fifth Circuit, where the court upheld an NLRB decision finding that the company committed unfair labor practices involving the "interrogation of employees, threats of discharge for union activity, interference with the wearing of union paraphernalia, and discriminatory enforcement of rules concerning distribution of literature and solicitation of employees" (Marathon LeTourneau Company, Longview Division vs. National Labor Relations Board 1983).

In 1979, ADDSCO initiated a campaign against the last stronghold of the IUMSWA on the Gulf Coast. That year, the company divided its Mobile yard. One part remained under the ADDSCO name and performed ship repair. The other part, organized as a new company called Alabama Maritime Corporation (AMC), handled new construction. The AMC union contract paid lower wages and benefits, undermining in the IUMSWA local and eventually leading to the decertification of the union at AMC. In 1989, ADDSCO closed the union ship repair yard, announcing it would take a $4.2 million surplus from the workers' pension plan. It then continued to operate the AMC yard. The president of the local union complained that the ADDSCO closing was not a real shutdown. "It is just going to transfer work from its union shop to its non-union subsidiary" (Labor Notes 1989). The ADDSCO closing was part of a larger anti-union offensive in the 1980s that weakened organized labor across the country. The IUMSWA experienced a 50% decline in membership during that decade. Resulting financial troubles drove the union to merge with the International Association of Machinists in 1988 (Palmer 1998: 234).

Despite the great boom of the 1970s, several of the major players in Gulf Coast shipbuilding and fabrication experienced financial and legal problems that were magnified when oil prices, and thus demand for their services, dropped in the early 1980s. In mid-1972, Levingston announced that it would have to report a net loss on its investments for the previous year, a fact which it attributed to cost overruns on several major contracts (Wall Street Journal 1972). In 1976, Ashland Oil acquired Levingston, but the oil company never had a clear strategy for the shipyard. Levingston continued building drilling vessels, completing a total of 16 between 1975 and 1982, and even expanded its interests onto the East Coast with the acquisition of Sun Company's shipbuilding facilities in Chester, Pennsylvania. However, in 1982, Ashland relinquished control of the company to Levingston's president, Ed Paden. Three years later, as a result of the downturn in the offshore oil market, the troubled Levingston closed its yard in Orange (New York Times 1984).

Avondale Shipyards suffered a succession of business and legal problems. In 1964, a federal judge enjoined the yard for violating shipbuilding safety regulations after explosions killed one employee and wounded another (New York Times 1964). In the 1970s, Avondale experienced several years of costly delays in fulfilling a $310 million contract for the construction of three LNG carriers for El Paso Natural Gas. In 1979, one of the LNG carriers developed a mysterious and potentially dangerous crack in its hull insulation during sea trials. Meanwhile, Avondale launched a multimillion-dollar claim against the U.S. Navy, with each side blaming the other for delays and cost overruns, although this did not prevent Avondale from acquiring defense-related contracts well into the 1980s (States-Item 1978a; States-Item 1978b). Then, in the late 1970s, Avondale Shipyards began laying off employees after a decline in commercial shipping orders. At the same time, Avondale came under intense scrutiny after reports of widespread thievery and pay-offs in the yard. A number of Avondale employees, both low-level and high, along with suppliers ultimately pleaded guilty to embezzlement, mail fraud, and extortion (Wall Street Journal 1984).

Other firms also found their reputations tarnished through criminal convictions. In 1980, Bethlehem Steel was fined $325,000 for admitting in a U.S. District Court in Manhattan that it had paid more than $400,000 in bribes to shipowners' representatives between 1972 and 1976. The bribes were used to steer ships needing repairs into Bethlehem's eight shipyards. For years, the company had been padding bills and skimming profits from shipyard work and channeling the money to a dummy corporation in Switzerland, incorporated in 1961 for use as a secret fund to pay bribes (Wall Street Journal 1980).

In perhaps the most sensational case, a federal grand jury in 1977 indicted Brown & Root for collusion and price fixing with J. Ray McDermott. During the years 1960-1976, the case revealed, these two companies had conspired to rig their bids to offshore operators by splitting up the work between them, mainly in pipelaying. One of the companies would agree to submit an astronomically high bid on the project, which the other company would underbid, but still at a very profitable level. The roles would then be reversed on the next project to come along. The indictment resulted from a lawsuit filed by the Ingram Company, which had been shut out of the market and had come up with enough evidence of wrongdoing to file a case in federal court in New Orleans. Both companies pleaded no contest and were fined $1 million each. A week after the grand jury's subpoena was issued, Brown & Root's president, Foster Parker, was found dead of an apparent suicide. Brown & Root later paid $90 million to settle civil suits over the price fixing (Wall Street Journal 1978; Briody 2005: 172-173). Six executives, three from each company, were convicted and given probated sentences. One of the convicted Brown & Root executives wrote in his memoir that the arrangement with McDermott "permitted us to receive contracts with an average profit mark-up of 25%, versus the 12½% we would have earned under legal contract bidding," with Brown & Root's marine pipeline work averaging annually a profit of $12 million on $55 million in revenues (Ward 1996: 100). McDermott also settled dozens of civil suits and, in a separate 1978 case, pleaded guilty to racketeering for under-the-table payments to a former vice president of Tenneco in exchange for contracts from that company (Wall Street Journal 1978).

In the wake of these legal problems, business weakened and then collapsed for Gulf Coast shipbuilders and fabricators. In 1982, as oil prices softened, money for drilling in the Gulf of Mexico dried up. The flow of investment into shipbuilding and fabrication slowed. High interest rates imposed by the Federal Reserve to fight inflation shrank the credit available to finance new drilling and exploration. The reduction in the highest marginal tax rate for capital gains from 70% to 50% made tax shelters, including those in oil and gas and vessel construction (see above) less attractive to investors (New York Times 1982). Then, in 1985-1986, oil prices dropped sharply, as OPEC and non-OPEC producers saturated the global market with crude. Expensive offshore projects in the Gulf of Mexico were canceled or shelved. Mobile drilling vessel construction fell sharply. There were 25 rigs under construction at the end of 1986, compared to 42 the year before. The year of the crash, only two orders were placed. 12 new units were finished, but only five of these rigs had drilling contracts. The remaining seven were delivered only to sit idle. The total number of drilling rigs in the U.S. (onshore and offshore) shrank from 2,452 in 1985 to 900 in 1987, with vessels costing $35 million when they were built selling at under $1 million. In 1986, the utilization rate for tug/supply vessels in the Gulf of Mexico alone fell from 76% to 36%. The drastic decrease in value and lack of orders put offshore fabrication yards in jeopardy, and many firms were forced out of business (Offshore 1987).

A full-blown depression had emerged in the oil industry, which challenged the viability of shipyards all along the Gulf Coast. Shipyards that grew up with the oil industry faced brutal struggles to survive. In 1985, an estimated 8,000 Louisiana shipyard workers lost their jobs. "Idle rigs are parked at ports and in bay all along the Gulf Coast," wrote one reporter in 1986. "And scores of offshore workboats wait quietly in the back bayous of Louisiana for jobs that industry sources believe will be a long time coming—if ever" (Fletcher 1986: 9E). Conventional supply, tug, and barge vessels were sold into use as cargo, fishing, and other types of boats. Some were employed for container transport, Drug Enforcement Administration work, or naval towing. While this proved to be an effective means for riding out the depression, not all vessels were well-suited for conversion and many builders went out of business or were forced to consolidate, downsize, or move to locations where they could drastically cut costs. In this manner, the market shook out the least competitive companies, and the workboat sector remained quiet until the late 1980s and early 1990s, when oil exploration and development in "deepwater" created a surge in workboat evolution to accommodate this new field of interest (Hart's E & P 2002; Offshore 1987).

The oil collapse also devastated offshore fabricators. Despite its completion of several platforms during the 1980s, McDermott's labor force shrunk, and it closed its New Iberia shipyard. McDermott would not realize a profit until the beginning of next decade. Brown & Root, likewise, saw its marine construction and pipelaying business dry up. During 1983-1987 the company released two-thirds of its marine engineers, liquidated its fleet of pipelaying and construction vessels, and sold off its Greens Bayou yard in pieces (Pratt, Priest, and Castaneda 1997).

The oil depression brought down other sectors of the economy, such as real estate and banking. One report noted that every job lost in the oil field meant two additional jobs lost outside of the industry (Acadiana Profile 1985: 40-44). Once-flourishing coastal communities entered a period of economic decline, as tax revenues from companies serving the oil industry fell drastically. Unemployed oil field workers either transitioned into new professions, such as carpentry, or they simply migrated out of southern Louisiana in the hopes of finding better opportunities.

1.6. SHIPBUILDING AND OFFSHORE FABRICATION, 1986-2010

1.6.1. Shipbuilding, 1986-2010

Out of the economic and financial wreckage of the 1980s, world shipbuilding capacity shifted increasingly to Southeast Asia. The output of European countries shrank, and several, including Sweden, ceased making merchant ships. While American industry across the board lost international market share over this period, the construction of large, oceangoing commercial ships experienced an especially rapid collapse. During the 1970s, approximately 20 merchant vessels were built every year in private U.S. yards. In the decade following 1984, 10 or fewer ships were built every year and no vessels at all were ordered between 1989 and 1991 (National Research Council and Committee on National Needs in Maritime Technology, 1996). By 1992, 37% of new construction was in Japan, 27% in South Korea, 7% in China and Taiwan, and more than 12% in six EU countries (Denmark, France, Germany, Italy, Spain, and the U.K.). None of the new vessels under construction at that stage were being fabricated in the United States (Lovett 1996; 312; Stopford 2009: 620). During the 1990s, the United States and other nations continued to lose market share. Western Europe saw its share decline from 33% to 18%, while South Korea's portion rose to 29%. China secured an increasing share of the market, but Japan still led the world with over 39% of the world's shipbuilding contracts. Japan, together with Korea, held two-thirds of total production, firmly establishing the Far East as the centre of world shipbuilding (Gibson and Donovan 2001 269). Shipyard employment in the United States peaked in 1981 at 180,000. Employment dropped sharply in 1982 after funding for ODS and CDS ceased and declined steadily, reaching 95,000 in 1998 (U.S. Department of Commerce 2001: xv).

Increasingly, ship owners shifted the registration of ships from the U.S. flag to open registries or "flags of convenience" (FOCs), which reinforced the decline of American shipbuilding. Open registries were first introduced in the 1930s, when American oil companies transferred the registration of oil tankers to Panama to avoid U.S. neutrality laws. After World War II, when the steady stream of relief supplies to Europe slowed, many American freighters could not get cargoes while operating under the restrictions that accompanied U.S. registry, so they transferred to foreign registry. In 1948, former U.S. secretary of state, Edward Stettinius, with support from Standard Oil of New Jersey, set up the first open ship registry in Liberia, named Liberian Services, Inc. Open registries, available to noncitizens in return for a registration fee and an annual payment based on the tonnage of the ship, allowed for lower operating costs and offered maximum operating flexibility. There was no tax on income and no nationality requirements for the crews. Ships could be built and repaired anywhere in the world, and they experienced little government inspection and oversight. Many of the former colonial nations set up "open registries" that did not restrict the nationality of the officers and crew employed and did not tax the income of ships or their crews (Gibson and Donovan 2001 208-209). The Liberian registry, administered by Stettinius's Liberian Services and its successor, International Registries, Inc. (IRI), for years was the most popular registry for oil company vessels. During the late 1980s, the Liberian civil war drove IRI to establish a new open registry in the Marshall

Islands, which, by the early 2000s, became the most popular flag for owners of offshore drilling vessels (Carlisle 1982; DeSombre 2006).

Naval shipbuilding increased significantly during the Reagan administration's defense expansion and quest to acquire a 600-ship Navy. Shipbuilding outside the Gulf Coast region became almost completely dependent on naval contracts. By 1998, defense revenues as a percentage of total revenues were 65% in the Pacific region, 80% in the South Atlantic region, and 90% in the North Atlantic region (U.S. Department of Commerce 2001: 17). Great Lakes and inland shipbuilding had a higher percentage of commercial to defense revenues, but total revenues in these regions were almost negligible compared to coastal shipbuilding. During the 1990s, thanks to deepwater offshore developments (see below), the Gulf Coast was the only major shipbuilding region that saw growth in commercial shipbuilding. By 1998, the region had a 50-50 ratio of commercial to defense revenues and accounted for 55% of the national industry's commercial revenues. With little overall commercial work to supplement naval construction on a national scale, competition for Navy contracts was so intense that it "effectively drove at least three major long-established shipbuilders—General Dynamics (Quincy, MA), Sun Shipbuilding (Chester, PA), and Bethlehem Steel (Sparrows Point, MD)—out of business, leaving the work concentrated in only six shipyards, none of which were making any money from building merchant ships" (Colton and Huntzinger, 2002: 22).

By the late 1980s, U.S. shipyards were continuing to lose ground in merchant shipbuilding to their East Asian competitors. They had been almost a decade behind those competitors in investing in advance steel preparation, fabrication, and assembly, and in introducing such facilities when large tanker/carrier orders diminished and when U.S. government support for upgrading the merchant fleet receded. Japanese and Korean shipbuilders had more advanced materials handling facilities, had adopted computer-assisted design/manufacturing systems, pursued extensive licensing and technology transfer agreements, and used more fully automated processes in assembly fitting and erection. U.S. yards, by contrast, made little effort to exchange and acquire technology and relied on more labor-intensive approaches to ship outfitting. They used poorer quality steel and coating work, "a fact that was dramatically obvious walking under the distorted and flimsy bottom structure with awful welding on the *Exxon Valdez* after her grounding in 1989" (Gray 2008: 209). According to a 1983 Office of Technology Assessment study, "ships constructed in U.S. yards were designed with more attention to Government specification than to cost-effective commercial production techniques" (U.S. Congress, Office of Technology Assessment 1983: 102). American shipbuilders had long cited their own high labor costs as a factor leading to its lack of competitiveness in the world market. However, hourly pay in American shipyards—although not labor productivity—was no higher than in Great Britain and Japan, and was well below the Scandinavian countries, the Netherlands, and Germany (Gibson and Donovan 2001 269).

With the cost of building a ship in the United States nearly double average world costs, increasing direct U.S. subsidies to meet the difference was not possible. Unable to make their case based on labor cost differentials, shipbuilders switched tactics to focus on the shipbuilding subsidies in foreign nations. In 1989, the Shipbuilders Council of America (SCA) filed a petition under the 1974 Fair Trade Act claiming that Norway, Germany, Japan, and Korea were undercutting the competitiveness of American shipbuilders by providing subsidies to their yards. That year, U.S. officials initiated multilateral negotiations with other shipbuilding nations through the Organization for Economic Cooperation and Development (OECD), including South Korea, to eliminate all government subsidies and allow shipyards to compete without government interference. After five years of negotiation, the countries concluded an agreement in 1994 that eliminated most subsidies for vessel construction and repair, provided compensation for injurious pricing, and created a mechanism for settling disputes (Congressional Research Service 1998).

Although U.S. shipbuilders instigated the diplomacy to eliminate subsidies, they split over ratifying the agreement. The six largest U.S. shipbuilders withdrew from the Shipbuilders Council and opposed ratification, arguing that foreign shipbuilders would continue to receive aid through "loopholes" in the agreement. They also pointed out that Jones Act vessels and military reserve vessel were not adequately protected, and that some major shipbuilding nations like China were not bound by the agreement. They also realized that even with the elimination of subsidies, there was no way they could compete with East Asian yards. In 1992, the U.S. International Trade Commission examined the shipbuilders' complaints and found that the difference between U.S. domestic and world shipbuilding costs was nearly 96%. American shipyard costs were so high that the elimination of foreign subsidies would still not make U.S. shipbuilders competitive. If all foreign subsidies were ended, the commission concluded, world shipbuilding costs would rise only 5.9% (U.S. International Trade Commission 1992).

In the face of impending military cutbacks, first-tier shipbuilders needed federal subsidies to compete in commercial shipbuilding. With the end of the Cold War, the U.S. military expenditures were reduced, and the U.S. Navy abandoned its goal of a 600-ship fleet. In 1993, President Bill Clinton introduced a five-point initiative to make U.S. shipbuilding more competitive in international markets, calling for a "level playing field" for foreign and domestic subsidies, alliances among customers and suppliers to develop manufacturing and information technologies, reduced government regulation, executive-branch assistance with international marketing, and the expansion of Title XI loan guarantees to finance exports to foreign owners as well for U.S. flag vessels. Parts of this plan were incorporated into the National Defense Authorization Act of 1993, which included a new technological assistance program called MARITECH and an expansion of Title XI as proposed. To prevent a replay of the 1980s, the new Title XI program included a contingency account to cover defaults and new checks on the financial stability of applicants. Large shipbuilders seized on Title XI as vital for maintaining commercial orders. The OECD agreement, they feared, implied an eventual phase-out of Title XI (Congressional Research Service 1998: 5).

Second-tier shipyards, represented by the Shipbuilders Council, supported the OECD agreement. They recognized that the chance of returning to construction subsidies was unlikely, so the best strategy to aid U.S. shipyards was to set rules to limit other nations' subsidies. Title XI would only help U.S. shipbuilders temporarily, they argued, because other nations froze support to their yards when the agreement was signed. But in the event of a failed agreement, these nations would return to subsidizing their yards and erase the benefit of Title XI. The U.S. Congress refused to ratify the agreement, insisting on modifications that would provide more protection to U.S. shipyards. Furthermore, the U.S. enacted legislation in 1996 that removed the 23 year-old ban on the sale of Alaskan oil to foreign buyers, provided that the oil was transported in ships built and registered in the United States. OECD nations and European ship owners were infuriated by the protectionist nature of the requirements (Gibson and Donovan 2001 292). Negotiations were restarted in 2002, but were terminated in 2010 over disagreements on creating a pricing mechanism. Meanwhile, the new Title XI program did spur a modest revival in commercial shipbuilding, but not a huge resurgence. Ill-fated projects such as Newport News's "Double Eagle" tankers and a wave of defaults beginning in 1998 undermined Title XI's political support, leading to reduced funding during the George W. Bush administration (U.S. Department of Commerce 2001; Cook 2011; Gray 2008).

In the late 1990s, the decline in defense orders and failed resurgence of commercial building prompted a consolidation among first-tier facilities. Shipyards specializing in naval construction had entered into partnerships and joint ventures with "defense system integrator" companies, who then acquired American shipyards to upgrade their maritime capabilities. In 1999, Litton Industries, which had owned Ingalls Shipbuilding since 1961, acquired Avondale, whose ownership had been reorganized several times since 1985. Litton agreed not to fight the New Orleans Metal Trades Department's drive for unionization, which had stemmed from long-standing grievances over unsafe working conditions and a disputed election from 1993. In late 1999, an arbitrator certified the Metal Trades Department as the yards collective bargaining agent.[5] Litton then united Avondale and Ingalls to form Litton Ship System (LSS). In 2001, Northrop Grumman purchased Litton and Newport News, consolidating control over three of the nation's largest shipbuilders.[6] Meanwhile, beginning in the late 1990s, General Dynamics brought together the three other major shipbuilders, Bath Iron Works (Bath, ME), NASSCO (San Diego, CA), and Electric Boat Company (Groton, CT). These six first-tier shipbuilding yards, controlled by the two companies, General Dynamics and Northrup Grumman, came to be known as the "Big Six."

When the decline in defense expenditures stabilized around 1995, the industry began to recover. Revenues, profits, and investments increased steadily in the late 1990s for the Big Six. These yards accounted for two-thirds of the industry's revenues and 76% of the industry's total profits. Investments increased from $218 million to $378 million annually (U.S. Department of Commerce 2001: 52). But these numbers masked the underlying, long-term weakness of first-tier shipbuilding. Most of their business still came from Navy contracts, which provided cost-plus profits and scheduled progress payments for work accomplished, both of which reduced incentives to improving efficiency. Striving to ensure competition in ship procurement, the Navy fostered excess capacity among shipbuilders, which raised overhead costs. Overall, the U.S. shipbuilding and repair industry continued to have higher overhead, labor, and material costs than international competitors. While productivity improved during the 1990s, productivity in the leading shipbuilding nations improved at an even faster rate (Colton and Huntzinger 2002: 24-25).

Shortages of skilled labor began to plague the industry severely. Aging workers, high turnover, and competition from other manufacturing industries disrupted shipbuilders' ability to maintain an optimally-sized and well-trained workforce. The Gulf Coast employed 36% of the nation's shipbuilding labor, but during the deepwater boom, this region still had the greatest shortage of skilled tradesmen (see below). As a U.S. Department of Commerce national security assessment observed in 2001: "without steady growth or stability in the industry, yards are forced to layoff workers during poor economic periods and to recruit and train workers as work volume is restored. Each cycle of the industry erodes the labor force, sending a portion of its workforce to more stable industry and replacing them with unskilled labor" (U.S. Department of Commerce 2001: 38).

By the 2000s, first-tier yards had not made the adjustment to replacing reduced Navy orders with efficient and competitive commercial ship production. Commercial jobs in these yards

[5] For details on this development, see (Ragen 2001).

[6] In March 2011, Northrup Grumman spun off Newport News, Avondale, Ingalls as Huntington Ingalls Industries.

commonly suffered from cost overruns, delivery delays, and poor workmanship. Ingalls efforts to move into the construction of drilling vessels and modern cruise ships, for example, were a dismal failure (Times-Picayune 2000a). Renewed pressures on first-tier shipbuilders from declining commercial orders and growing overcapacity forced a new round of downsizing. In August 2005, Northrup Grumman Ship Systems reduced its Gulf Coast work force by 1,900 workers. The company laid off 900 laborers at Avondale and Ingalls, and another 1,000 jobs were lost through attrition. When, in 2010, Northrup Grumman announced the closing of the Avondale yard, it marked the culmination of a long historical trend. “Last week's announcement that Avondale Shipyard will end a 75-year tradition of shipbuilding in 2013 may have stunned the region and the company's 5,000 employees,” wrote the *Times-Picayune*, “but maritime experts describe it as the foreseeable outcome of the long, public decline of major American shipyards and their later dependence on a single, specialized customer in the U.S. Navy” (Times-Picayune 2010).

1.6.2. Fabrication of Boats, Platforms, and Drilling Vessels for the Offshore Industry, 1986-2010

After suffering a decade of downturn in the oil market, the marine construction industry along the Gulf Coast restructured and experienced renewed growth. Many firms had closed their yards or been acquired by other companies. Smaller businesses had simply disappeared. Most of the companies that survived did so by diversifying into new areas, such as repair and refurbishing offshore rigs and workboats, recreational and pleasure boat fabrication, Coast Guard and defense contracts, and construction for international markets. Morgan City’s Conrad Shipyard, for example, increased its repair work and aggressively bid on new construction jobs in other industries, becoming a primary builder of drydocks for ship repairers in the United States and abroad (Conrad Shipyard nd).

More importantly, the 1990s ushered in a new era of exploration and production in the deepwater Gulf of Mexico, and many shipyards and fabricators geared up to support this push into the offshore frontier. Designers and shipbuilders revolutionized the workboats of the 1990s to handle more loads, in heavy seas, at greater distances, and at quicker speeds. Installation services for large floating production facilities became big business for Gulf Coast companies with the requisite technological capabilities. Aging platform infrastructure in the shallower waters of the continental shelf also created a specialized market for platform removal and decommissioning. Shipbuilding and fabrication for the offshore industry continued to be challenged by sharps swings in the oil-driven business cycle, and the economic benefits to the region from the deepwater boom never equaled the prosperity generated in the 1960s and 1970s. Still, Gulf Coast shipbuilding and fabrication stood out as the only dynamic commercial segment in the larger shipbuilding and repair industry in the United States.

The one area of shipbuilding and fabrication that largely disappeared from the Gulf in the 1980s and did not return was the construction of large drilling vessels. The oilfield recession in the 1980s led companies constructing these vessels to search for ways to cut costs. They downsized their yards in the United States and laid off workers in large numbers, especially those with special skills who earned the higher wages. In addition, they turned to overseas yards, especially in the Far East, with lower operating and labor costs. Over time, the construction of all three major types of MODUs—drillships, semi-submersibles, and jack-ups —migrated away from the United States. South Korea has been the largest maker of drillships for the current world fleet, with Samsung Heavy Industries’ Koje Shipyard turning out most of them. Only 36 of the current world fleet of 186 semi-submersible drilling vessels were built in the United States, and only three of the 58 built since 1985 came out of U.S. shipyards. U.S. shipyards produced 151 of the current world fleet of 451 jack-up vessels, but only 23 of the 112 built since 1985. By the 2000s, a few jack-ups continued to be built at Vicksburg and Brownsville. Rowan Companies, which acquired the old LeTourneau from Marathon, opened a yard in Sabine Pass in 1994 and began repairing offshore rigs and outfitting new jack-ups built by the LeTourneau yards at Vicksburg and Longview (Rodengen 1998: 176). Most new construction drilling vessels, however, came from Singapore and China (Colton Company 2011). Once the pioneers in the design and construction of all three kinds of MODUs, Gulf Coast shipyards surrendered most of this work to foreign competitors (ICF International, U.S. EPA 2007: 3-96).

Beginning in the 1980s, many Gulf Coast shipyards and fabrication yards fell silent. Levingston shuttered its Orange yard in 1985 (see above). Bethlehem sold its Beaumont yard in 1989 to Dallas-based Trinity Industries, which operated the yard as a shipbuilder and repairer until 1994, when it converted operations there to railcar construction (see Port Arthur/Ingleside Community Profile, Chapter 6, Volume II). In 1989, after labor unrest following the closure of its ship repair yard and mishaps that damaged its drydock, ADDSCO in Mobile sold its yard to boat builder Atlantic Marine (see South Mobile Community Profile, Chapter 2, Volume II). Marathon-LeTourneau closed its Brownsville yard in 1988, although it would be leased out and later purchased by Keppel Fels (see Brownsville-Port Isabel Community Profile). Smaller yards all along the Gulf Coast shut down or changed hands several times. Major fabricators also closed yards, reduced their workforces, and shrank. Brown & Root sold off part of Greens Bayou yard in Houston and mothballed its Harbor Island yard near Ingleside, Texas. Chicago Bridge & Iron gave up its yards at Ingleside. J. Ray McDermott restructured and downsized, closing yards and facilities, and relying on government contracts and the profits of its power generation subsidiary, Babcock & Wilcox, the nation’s leading boilermaker, to carry it through the downturn (Times-Picayune 1998a).

Many companies saw opportunity in the fire sale of assets during the downturn. Tied-up workboats sold for pennies on the dollar, making them affordable vessels for conversion to more economically viable uses. Equipment and property of bankrupt companies were auctioned at bargain prices, enabling new ventures to emerge and prosper during the oilfield resurgence in the Gulf in the 1990s. Prices for land, equipment, shipyards, and drydocks dropped precipitously. Prior to purchasing Bethlehem Steel’s Beaumont yard, Trinity Industries had acquired Halter Marine and its many yards in Louisiana and Mississippi. In the Houma area, Chet Morrison gradually acquired assets at various auctions and assembled a management team from the Houma area to build a business that grew into platform fabrication, pipeline construction, and decommissioning work. In Orange, Texas, Don Covington, the last president of Levingston Shipbuilding, started Texas Drydock, Inc. (TDI), to do rig repairs and conversions (see Port Arthur/Orange Community Profile, Chapter 6, Volume II). Bollinger Shipyards, buoyed through the downturn of the 1980s by lucrative deals to build cutters for the Coast Guard and patrol boats for the Navy, began picking up distressed yards in southern Louisiana (including McDermott Shipubilding’s Morgan City yard) and southeastern Texas. In the 1990s, it then turned to building vessels for the offshore industry to supplement its government work (Times-Picayune 2002). Global Industries, a small diving company based in Harvey, Louisiana, was another company that dug deep for funds to purchase discounted assets during the 1980s, positioning itself as a leading pipelaying and offshore construction company for the deepwater boom of the 1990s (Global Industries 1999).

One of the most important developments in the 1980s revival of offshore fabrication on the Gulf was the formation of a major new offshore fabricator at Ingleside, Texas. Peter Kiewit Sons, an Omaha-based construction company, moved into the offshore construction business in the early 1980s by acquiring ETPM yard (today known as the Aransas Pass yard or the Gulf Marine Fabricators "north yard"), where the company established Gulf Marine Fabricators as a subsidiary. The company then took over Chicago Bridge and Iron's facility at Ingleside Point (also known as Baker Port or today the "south yard"), and joined with Kaiser Steel in 1985 as Bullwinkle Contractors to build the tallest fixed platform ever constructed, Shell Oil's Bullwinkle. This project made Gulf Marine one of the largest industrial enterprises in the area. The 1985 designation of the Port of Corpus Christi as a foreign trade zone, which exempted duties on imported goods until the finished product enters the U.S. market, was also a major factor in the decision to build the huge platform in the United States rather than overseas. In 1991, Kiewit's Gulf Marine entered into a joint venture with the Norwegian company, Aker Maritime, to become Aker Gulf Maritime, which would take on some of the major construction work for the early tension-leg platforms in deepwater (see Corpus Christi/Ingleside Community Profile, Chapter 7, Volume II).

In the late 1980s and early 1990s, the drilling business in the Gulf reawakened. The introduction of area-wide leasing by the Minerals Management Service (MMS) in 1983 encouraged some companies to acquire large portfolios of leases in deepwater (1,000 feet of water or deeper). The MMS provided an additional stimulus in 1987, when it lowered the minimum bid for a deepwater tract from $900,000 to $150,000, allowing companies to lock up entire basins for 10 years for only a couple million dollars. During the next five years, oil companies acquired 1,500 tracts in deepwater. In 1989, Shell Oil announced a major discovery in 2,860 feet of water at its Auger prospect, in the Garden Banks area 136 miles off the Louisiana coast. In the early 1990s, new discoveries in the "subsalt" generated renewed interest in both shallow and deepwater. Then in 1994, Shell brought in prolific production from its first wells at Auger, establishing the commercial viability of deepwater turbidite sandstone reservoirs. The next year, Congress passed the Deepwater Royalty Relief Act, exempting a certain percentage of deepwater production from federal royalties. Suddenly, the deepwater Gulf was the hottest oil play in the world, despite persistently low oil prices. Beginning with Auger, Shell Oil launched one massive tension-leg platform (TLP) after another. Other exploration and production companies rushed to purchase deepwater leases, and newly developing offshore technologies found commercial applications (Priest 2007; National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling 2011: 36-43).

The deepwater boom of the mid-1990s reversed the sagging fortunes for many Gulf Coast shipbuilders and fabricators. Most immediately, new kinds of boats and equipment were required for deepwater developments. Larger and faster workboats had to be built to reach platforms farther on the horizon. Rigs operating in deeper water required greater anchor line, which weighs more and increases the demand for power. New anchor-handling tugs were therefore needed to carry more cargo, and increased deck capacity was required to accommodate the greater weight of anchor chain, mud and additional supplies. New types of mooring for deep water, such as taut-leg systems and buoyancy tanks, also required different kinds of handling equipment, and horsepower requirements from customers increased. Ships operating in the North Sea's typical 330-ft waters were no longer up to par for the newer deepwater regions, which necessitated larger and more sophisticated vessels that could perform offshore services (Bradbury 2002: 1-2).

As they geared up for new business, shipbuilders on the Gulf Coast found themselves short of skilled labor. Downsizing during the downturn had expelled experienced workers from the industry, and years of slack hiring skipped over an entire generation. Shipyards advertised widely in newspapers, on the radio, and on highway billboards for welders, shipfitters, and other skilled workers. They paid bounties to employees who found successful job candidates (Times-Picayune 1995). “To recruit labor,” reported the *Times-Picayune* in 1996, “yards are competing with offshore platform fabricators, such as J. Ray McDermott S.A. in Morgan City and Gulf Island Fabricators Inc. in Houma, and with offshore boat operators and a myriad of oil-service companies (Times-Picayune 1996a). Shipyards, state officials, and vocational and technical schools scrambled to channel people into training programs, but ramping up workers in the yards lagged well behind production schedules. In 1996-1997, Louisiana shipbuilders responded to the shortage by importing approximately 3,000 foreign workers on temporary H-2B work visas to fill welder, shipfitter, and electrician positions. Workers came predominantly from India and Mexico. Many were recruited to Avondale shipyards, which created major controversy. American-born workers there who were battling the company in court over a contested union election in 1993 complained that Avondale helped manufacture the shortage by refusing to hire workers who identified themselves with the local union. In mid-1997, the U.S. Department of Labor determined that the visas had been issued in error. The imported workers did not qualify because their jobs lasted for the duration of shipbuilding contracts, which could be three years or more, whereas H-2B visas were designed for seasonal workers whose jobs would last no more than a year. In 1998, after pressure from Louisiana politicians, the Department of Labor approved 715 new H-2B visas (500 for Edison Chouest’s North American Shipbuilding in Larose, 100 for Avondale, and 115 for Quality Shipyards in Houma) for workers hired as welding trainers for the legally mandated one-year term (Times-Picayune 1997a; Times-Picayune 1998c). The H-2B visa controversy would reappear in 2005-2006, after companies sought foreign workers again to address severe labor shortages following the 2005 hurricanes (see Chapter 2, Volume III).

In addition to addressing labor shortages, government policy also helped the offshore supply vessel industry expand its fleet. In the late 1990s, new government regulations broadened the definition of an offshore supply vessel (OSV) to enable the construction and operation of ships technically more sophisticated to meet the demands of complex deepwater field developments. The Coast Guard Reauthorization Act of 1996 raised the maximum tonnage requirements for OSVs from 500 gross tons to 6,000 gross tons, which gave builders more flexibility to operate larger vessels for deepwater (Gulf Coast Mariners Association 2006). In 2001, the U.S. Coast Guard relaxed requirements for “multi-service certification,” so that OSVs built to certain criteria could be certified to carry freight, tow vessels, or engage in other industrial activities, in addition to offshore supply. This policy allowed for the construction of much more versatile OSVs (U.S. Coast Guard 2001). By the early 2000s, the substitution of the terms “support” or “service” for “supply” expanded the definition of OSVs to include not only traditional supply boats, but also anchor handling tug/supply ships, well stimulation ships, standby ships, and even ships built to carry hazardous substances, fight fires, or recover oil. The sophisticated OSVs built in this era came equipped with onboard computers, GPS systems, radar, autopilot, jet propulsion, dynamic positioning, and Z-drive technologies to meet the demands of deepwater operations. Boatbuilders such as Breaux’s Bay Craft in Loreauville, Louisiana turned out an increasing number of large, speedy, all-aluminum crewboats, yet another kind of OSV, for service companies such as Edison Chouest (American Ship Review 2006-2007: 61-65).

Beginning in the mid-1990s, shipbuilders and fabricators all along the Gulf Coast expanded aggressively. In 1991, Keppel Fels (now Keppel Offshore & Marine) purchased Marathon Le Tourneau's old Brownsville shipyard, renamed it Keppel AMFELS, and began building barges and jack-up rigs. In 1996, the company leased from the Port of Brownsville a floating drydock with a capacity for lifting 30,000 tons. The drydock, the largest in the state of Texas, provided the shipyard with a full range of repair, refurbish, and upgrade work for offshore rigs operating in the Gulf of Mexico (Chilton 1997: 138). Trinity Industries, which went public as the Halter Marine Group in 1996, "rapidly gobbled up chunks of capacity on the Gulf Coast" (Marine Log 1999). In 1997, Halter Marine acquired Texas Drydock, Inc. (TDI), becoming TDI-Halter. By 1998, TDI-Halter comprised 26 small- and medium-sized shipyards, employed 9,200 people, and had a backlog of orders valued at $1 billion (Marine Log 1999). That year, however, deepwater drilling in the Gulf slowed, as oil prices sank to historic lows and some companies were stung by expensive dry holes. A wave of mergers in the drilling industry left many companies focused on reorganization rather than drilling. TDI-Halter saw contracts for OSVs dry up and losses mount on the construction of drilling vessels. Stock prices for oil service companies plunged. TDI-Halter sought salvation in merger with Friede Goldman, a Mississippi-based designer and builder of semi-submersibles that had just gone public. The new company, Friede Goldman Halter (FGH), based in Gulfport, Mississippi, became the second largest employer in the state. However, construction delays and cost overruns on two complex drilling vessels, combined with a plunging stock price and Halter Marine's debt, proved too burdensome for FGH, forcing it to file for Chapter 11 bankruptcy in April 2001 (Daily Deal 2002).

Out of FGH's bankruptcy liquidation arose three shipbuilding enterprises that would become major players in the resurgence of the deepwater construction market after 2000. Signal International, led by president Dick Marler, was created in 2002 through the purchase of two former Halter shipyards in Pascagoula and four former Texas Drydock yards in Port Arthur/Orange. Signal developed a diverse business strategy focused on rig overhaul, repair, upgrade and conversion, as well as heavy fabrication, such as hull components for floating production systems (Offshore 2006). In 2002 Bollinger Shipyards also swooped down to acquire five ship-repair yards (Halter Gulf Repair, New Orleans; Gretna Machine & Iron Works, Gretna, Louisiana; Halter Calcasieu, Carlyss, Louisiana; Bludworth Bond-Houston, Houston, Texas; and Bludworth Bond-Texas City, Texas City, Texas) from FGH for $80 million, increasing Bollinger's stable of shipyards to 14 and transforming the company "from small fry to one of the biggest fish in the shipbuilding ocean" (Times-Picayune 2002). Bollinger had expanded more prudently than Halter Marine and Friede Goldman, forgoing a public stock offering in 1998 after drilling had slowed in the Gulf. It was thus in a better position to ride the wave of new business when the deepwater market picked up again, supplemented by new Coast Guard and government contracts (Times-Picayune 2002). Bollinger attempted to enlarge its shipbuilding presence further on the Gulf Coast, but was thwarted in 2002 by the entry of a new competitor. Singapore Technologies Engineering (ST Engg), through its subsidiary, Vision Technologies Kinetics (VT), bested Bollinger in a fierce bidding war to acquire the Halter Marine Division and the seven remaining southern Mississippi yards owned by the bankrupt FGH. VT Halter Marine, as the new company was named, became Bollinger's chief competitor in constructing a range of OSVs, barges, tugs, and other kinds of commercial and defense vessels (Straits Times 2002).

The 1990s deepwater boom transformed the fabrication business in the Gulf. Discoveries in water depths ranging out to 5,000 feet required advanced technologies such as floating production facilities (TLPs, spars, semi-submersible), subsea wells, and deepwater pipelines.

Building and installing such facilities and equipment entailed tremendous financial investment, technological sophistication, and risk. Furthermore, the exorbitant costs of developing deepwater fields led to added pressure from operators for quick and efficient fabrication, and fast-track schedules for early production. “For many fabrication yards, these new technologies and floating structures represent a more precise, higher risk, and significantly larger projects than they have had in the past, with a complexity requiring added involvement from engineering firms, vendors, and component specialists” (Hunt and Gary 2000).

Gulf Coast fabricators alone could not meet this challenge. Fabrication yards had the capabilities to make specialized components, such as separators, heater/treater skids, living quarters, jackets, decks and topsides modules. Some had facilities large enough to fabricate sizeable structures and superstructures, but few possessed complete capabilities to handle all facets of deepwater projects. Even the most expansive yards farmed out different parts of the construction to specialized subcontractors. A 2000 study found some 51 yards with water frontage and direct access to the Gulf that fabricated fixed or floating offshore oil and gas structures and related equipment. Of these facilities, only nine had single-piece fabrication capabilities of more than 10,000 short tons, and only 12 could make structures destined for more than 1,000 feet of water (Hunt and Gary 2000).

In view of the practical constraints on Gulf Coast fabrication in an era of globalized manufacturing, it is not surprising that significant aspects of fabrication moved overseas. Where once fixed platforms for the Gulf were assembled on the coast and most of the materials were produced in the region or at least in the United States, many of the components that went into TLPs, spars, and other floating production facilities came from Europe or East Asia. In developing its TLPs, Shell Oil contracted separately for hull construction, topsides construction, and installation/integration services. The giant, ship-sized, hull components for most deepwater production facilities were constructed overseas. Belleli S.p.A. of Italy built the hulls for the Auger, Mars, Ram-Powell, and Ursa TLPs in the Bay of Taranto and then towed them more than 6,000 miles across the Atlantic Ocean into the Gulf. Hull construction on subsequent projects then migrated to South Korea. Daewoo built the hull for the Brutus TLP, and Hyundai Heavy Industries built the substructure for BP-Shell’s Na Kika semi-submersible production facility. The Finnish company, CSO Aker Rauma Offshore, built Kerr-McGee’s spar facilities and ExxonMobil’s deep draft caisson vessel (DDVC) for its Hoover/Diana project at a yard in Pori, Finland (Priest 2007: 243-264; Rainey 2002; Thibodeaux, Vardeman, and Kindel 2002; Arthur and Meier 2001).

The leading Gulf Coast firms, meanwhile, fabricated decks and topsides and provided installation/integration services. But even in these areas, fabrication became a globalized business. J. Ray McDermott fabricated the deck modules for the Shell TLPs at its yard in Amelia, Louisiana. Topside facilities on the TLPs were built by various companies on the Gulf Coast, including McDermott, Kiewit Offshore Services, Aker Gulf Marine, and AMFELS. Contractors around the world, however, also contributed. Mooring equipment tended to be constructed overseas. Facility installation and integration, as well as the installation of pipelines, increasingly involved globally-oriented companies based outside the United States, such as the Dutch firm, Heerema Marine Contractors, and the French firm, Coflexip-Stena Offshore, which was acquired by Technip in 2000 to become Technip Offshore Contractors (Rainey 2002; Thibodeaux, Vardeman, and Kindel 2002; Arthur and Meier 2001).

Many Gulf Coast fabricators expanded during the deepwater boom and established thriving businesses throughout the region. Chet Morrison Fabricators, Kiewit Offshore Services, and

Grand Isle Shipyards were notable among the medium-sized fabricators with a Gulf of Mexico focus. Grand Isle developed four fabrication yards in Louisiana, one in Mobile, Alabama, and one in Odessa, Texas. Chet Morrison even opened yards in Veracruz, Mexico and Trinidad, still with a Gulf focus but giving the company international capabilities. In 2001, Kiewit sold its interest in Aker Gulf Marine, created Kiewit Offshore Services, and built a new facility in Ingleside, where it continued to attract major deepwater business, as well as defense-contracting work (Marine Log 2005). As in earlier eras, however, two companies emerged as the dominant offshore fabricators: J. Ray McDermott, the holdover from those eras, and Gulf Island Fabrication, a more recent company created through the combination of yards in South Louisiana and Coastal Bend, Texas.

McDermott relied on its deep experience in offshore engineering and construction and its fleet of powerful offshore equipment to garner a large share of the deepwater fabrication market in the Gulf. During the 1980s, McDermott had diversified away from marine construction, which had become the most volatile part of its business. In 1983, McDermott International became the parent of J. Ray McDermott, the marine construction company. By 1990, J. Ray McDermott represented only about 25% of McDermott International's business, most of which was in power generation through its Babcock & Wilcox subsidiary. In the mid-1990s, however, a downturn in domestic power generation and the resurgence of deepwater reversed the prospects for McDermott's core businesses. In 1995, J. Ray McDermott acquired Offshore Pipelines, giving the combined company, which retained the name J. Ray McDermott (61% owned by McDermott International), a strong position at the beginning of a new cycle of offshore development and the inside track as the fabricator for Shell Oil's TLP decks (Financial World 1995; Forbes 1996; Funding Universe 2011). "The sheltered construction bays at the McDermott yard [in Amelia, Louisiana], which total the size of eight football fields, are filled with gray modules for these projects," wrote the *Times-Picayune* in 1996 (Times-Picayune 1996b). Like other companies, McDermott struggled to attract skilled workers to its Amelia yard, raising wages and recruiting heavily. During 1996-1997, the company managed to expand capacity and increase its workforce from 1,700 to 2,200 (Times-Picayune 1996b; Times-Picayune 1997b).

The good times did not last long, as the late 1990s oil slump and serious corporate problems took a toll on McDermott. Asbestos litigation claims at the company's Babcock & Wilcox subsidiary punished McDermott's earnings and market valuation, leading to Babcock & Wilcox's bankruptcy in 2000. In 1997, the company announced it was investigating a rig-bidding scheme involving former company officials. Later that year, a top executive at HeereMac, McDermott's international joint venture with Heerema Marine, pled guilty to participating in an international conspiracy to rig bids for marine construction services, and the company agreed to pay a fine of $49 million (Houston Chronicle 1997). In 1998, a J. Ray McDermott lift barge dropped a $70 million platform deck for a Texaco deepwater project that sunk to the bottom of the Gulf in 1,800 feet of water (Times-Picayune 1998b). These developments, combined with the dive in offshore construction, forced major management changes, reorganizations, and cost cutting at McDermott (Times-Picayune 2000b).

In the early 2000s, a new phase in deepwater exploration and development, pushing into "ultra-deepwater" beyond 5,000-foot depths, revived the languishing shipbuilding and fabrication market in the Gulf and restored the luster to McDermott's marine construction business. During 1998-2000, BP (formerly British Petroleum) made a string of miraculous discoveries in subsalt formations ranging out to 7,000 feet of water. In late 2000, J. Ray McDermott signed a eye-opening $600 million contract to build the topsides for four structures to be installed on platforms for BP's Crazy Horse (subsequently renamed Thunder Horse), Mad Dog, Holstein, and Atlantis fields. The contract promised to create 500 new jobs and gave BP "exclusive access to the Amelia yard for an extended period, offering a level of stability to the yard's work force not often seen in the cyclical world of offshore platform fabrication" (Times-Picayune 2000c). The deal with BP also coincided with a new and unprecedented labor agreement at Amelia, covering 900 workers for five-and-a-half years, following a vote by workers to join the International Union of Operating Engineers, Local 406 (New Orleans City Business 2000).

When the BP contract finished in June 2005, however, work dried up at Amelia. Layoffs, which began in 2004, reduced the number of craftsmen to 70, down from a peak of 1,600. Several of the yards on the 287-acre site stood empty. "Instead of jackets," reported the Lafourche Parish *Daily Comet* in 2006, "the structures that support oil-drilling platforms in the Gulf of Mexico and other waters, McDermott began building coastal-drilling barges while awaiting the rebuilding effort after Hurricane Katrina's devastation on the oil industry" (Daily Comet 2006). The entire fabrication industry moved into a holding pattern after the hurricane, but signs indicated that McDermott was losing its competitive edge for big fabrication projects.

The company that rose to surpass McDermott as the largest fabricator on the Gulf Coast was Gulf Island Fabrication. Founded in Houma, Louisiana in 1985 by a group of investors led by offshore drilling legend, Alden "Doc" Laborde, Gulf Island entered the business by purchasing the assets of Delta Fabrication to make components for fixed platforms. Then, in 1989, Gulf Island enlarged its presence in Houma by purchasing the Raymond Fabricators yard across the navigation channel. The company expanded as operators moved into deep water by fabricating hull and deck sections, piles, sub-sea templates and other equipment. In 1996, during the first wave of deepwater projects, the company signed its first major contract, to develop the Petronius compliant tower platform for Texaco-Marathon. Gulf Island even gained extra business rebuilding the deck for the platform after McDermott's crane dropped the original module to the bottom of the Gulf. In 1997, the company embarked on a major expansion, going public with a successful IPO and purchasing nearby Dolphin Services to expand its fabrication and repair capabilities. In 1998, Gulf Island purchased Southport, a fabricator of offshore living quarters, on the Harvey Canal (Reference for Business 2011). By 2000, Gulf Island's payroll had grown to more than 1,200 employees, making it one of the largest fabricators of offshore platforms in the United States. It operated recruiting programs throughout the southeast and provided in-house training to prospective recruits. Company president Kerry Chauvin increased wages and benefits to lure workers from nearby shipyards and personally visited local high schools to promote the value of becoming a skilled worker (Sell and McGuire 2004; Bayou Business Review 1998: 21-22; Chauvin 2004).

During the 2000s, enjoying steady cash flow and unburdened by debt, Gulf Island expanded its range of business. It moved into offshore interconnect pipe hook-up, inshore marine construction, the manufacture and repair of pressure vessels, and steel warehousing and sales. Through a venture with Keppel SLP Consortium, Gulf Island also expanded internationally, executing a contract in 2004 to fabricate two jackets and piles for PEMEX, Mexico's National Oil Company, in the Bay of Campeche. The same year, the company also obtained new deepwater business West Africa and the North Sea, in addition to the Gulf of Mexico, where it fabricated the topsides for a Kerr-McGee truss spar for the Constitution field located in 5,000 feet of water (Business Wire 2004). In 2005, Gulf Island got another deepwater project when it contracted with Chevron to fabricate the topsides for the Blind Faith tension-leg platform (New Orleans City Business 2006).

Gulf Island next consolidated its position on the Gulf Coast with a major corporate expansion into the Corpus Christi/Ingleside/Port Aransas fabrication market. In 2000, Coflexip Stena Offshore (later, Technip) had purchased Aker Maritime and Kiewit's partnership interest in Aker Gulf Marine Fabricators, renaming the company Gulf Marine Fabricators. In 2006, Gulf Island bought Gulf Marine's facilities, aiming to increase the productivity of these yards by bringing skills and technology from Gulf Island's four facilities in Louisiana (Chirinos 2006). The acquisition included three yards on the Gulf Intracoastal Waterway, with a total of 400 acres with direct access to the Gulf of Mexico: the North Yard in Aransas Pass is on the Intracoastal Waterway, three miles north of the Corpus Christi Ship Channel, and the South Yard in Ingleside sits at the intersection of the Gulf Intracoastal Waterway and the Corpus Christi Ship Channel. These specialized yards possessed deep basins for offloading of heavy ships, enormous graving docks, and 4,000-ton specialized lifting devices for large offshore strictures. With the addition of Gulf Marine's yards and infrastructure, Gulf Island boasted the largest capacity for offshore fabrication in the United States (New Orleans City Business 2006).

Although Gulf Coast offshore fabrication and shipbuilding yards both experienced serious and often interrelated downturns during the last 15 years, businesses along the Gulf Coast made a comeback from the 1980s bust. New advances in geophysical exploration, drilling, and production revived offshore oil in the Gulf of Mexico, both in redeveloping fields in shallow water on the continental shelf, and in developing new deepwater fields beyond it. The increase in deepwater activity in the Gulf and overseas resuscitated the marine construction and logistic support vessel industry. In the 1990s, with the aging fleet of drilling vessels and the move to ultra-deep waters, a competitive market emerged for rig repair work and conversions, while shipyards and fabrication yards began constructing more technologically-advanced workboats. The business of platform removal, which took off in the 1990s and accelerated after the damage inflicted by the 2005 hurricanes, increased the demand for specialized repair and decommissioning work. Nevertheless, shipbuilding and fabrication continued to face challenges from the cyclical swings in oil and gas and pressures forcing the relocation of production. While shipyards remain in the Gulf Coast area, much of the shipbuilding business, especially for drilling vessels, has largely moved overseas to Singapore, South Korea, and China, and fabrication has spread to other areas of the world where the offshore business is growing. As the number of skilled workers continues to shrink, as the market for new rig construction continues to move overseas, and offshore design and fabrication becomes increasingly global, the Gulf Coast communities struggle to preserve an identity that has long been rooted in shipbuilding and fabrication.

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2. GULF COAST SHIPBUILDING AND OFFSHORE FABRICATION: STATISTICAL MODEL AND ANALYSIS

2.1. OVERVIEW

This section of the study was focused on the statistical relationships that existed among the different economic and social measures for each of the communities in the study. The purpose of the statistical analysis is to first determine if a relationship exists between the fabrication industry and the well-being of the community as measured by selected variables. Second is to determine if a statistical model can consistently capture the impact of these industry segments such that a forward-looking forecast could show the potential impact of changes in the industries on these communities.

The statistical analysis is primarily a two-step procedure. The focus of the first step is to determine if a significant relationship exists between selected employment and incomes for each community and the price(s) of oil and natural gas. Given the focus of this study on shipbuilding and fabrication, it is straight forward to suggest that some of the more interesting employment and incomes would include such items as total fabrication employment, total income in the fabrication industry for that community, manufacturing employment, manufacturing income, wage and salary jobs, and average earnings per job and that these variables would be influenced by the activity in the oil and gas industry. The second step is to focus the analysis on the relationships among these key employment and incomes and selected income transfer variables that reflect on the conditions within the communities. Some of the variables considered within this phase of the analysis are taken from the Bureau of Economic Analysis (BEA 2011). Retirement and disability insurance benefits consist of old-age, survivors, and disability (OASDI) benefits; railroad retirement and disability benefits; Federal and state workers' compensation; temporary disability benefits; black lung benefits; and Pension Benefit Guaranty benefits. Medicare benefits are Federal Government payments made through intermediaries to beneficiaries for the care provided to individuals under the medicare program. These medical benefits are received by low-income individuals. These payments consist mainly of the payments made through intermediaries to the vendors for care provided to individuals under the federally-assisted, state-administered medicaid program and Children's Health Insurance Program (CHIP) and under the general assistance medical programs of state and local governments. Food Stamp benefits are measured as the value of the food stamps issued to qualifying low-income individuals in order to supplement their ability to purchase food. Eligibility is determined by the state authorities' interpretation of Federal regulations; the U.S. Department of Agriculture (USDA) pays the cost of the stamps. The state and county estimates are based on county tabulations of the value of the distributed stamps from the Department of Agriculture. Trade adjustment assistance consists of payments received by workers who are unemployed because of the adverse economic effects of international trade arrangements.

Unemployment insurance compensation is made up of the following: (1) State unemployment compensation are benefits consisting mainly of the payments received by individuals under state-administered unemployment insurance (UI) programs, but they include the special benefits authorized by Federal legislation for periods of high unemployment. The provisions that govern the eligibility, timing, and amount of benefit payments vary among the states, but the provisions that govern the coverage and financing are uniform nationally. (2) Unemployment compensation of Federal civilian employees are benefits received by former Federal employees under a Federal program administered by the state employment security agencies. (3) Unemployment compensation of railroad employees are benefits received by railroad workers who are unemployed because of sickness or because work is unavailable in the railroad industry and in related industries, such as carrier affiliates. This UI program is administered by the Railroad Retirement Board (RRB) under a Federal program that is applicable throughout the Nation. (4) Unemployment compensation of veterans are benefits which are received by unemployed veterans who have recently separated from military service and who are not eligible for military retirement benefits. The compensation is paid under a Federal program that is administered by the state employment security agencies.

If significant relationships are detected at each of the steps in this analysis, then the study will be able to clearly show the linkage between the oil and natural gas industry, the fabrication and shipbuilding industries within these communities, and the social-economic well-being of these communities.

2.1.1. The Statistical Analysis

All of the data items used in this study were time series covering the period 1970 until 2006. There are some variables that cover a much shorter time frame due to reporting limitations. Furthermore, even where data is reported in some periods over the study frame, due to extensive gaps and missing data or non-reporting by the specific agency in order to protect the confidentiality of the reporting business the data was not used in the statistical analysis.[1] As a result, the statistical analysis was conducted on the most complete time series that spanned the largest portion of the sample frame in order to achieve the most meaningful and reliable results.

In order to correctly specify a statistical model to test for the presence of a significant relationship between the different variables, the statistical properties of the individual times series were examined. Within the literature covering time series processes, there is much written regarding the properties of such series (see Wooldridge 2009). One of the key properties and subsequent tests for the properties of a time series involves the presence of a unit root within the time series. In such cases, the series is a simple autoregressive process of order one, AR(1), and is highly persistent where the value of the variable, y, today is highly correlated with values of y in the very distant future (for a more detailed discussion, see Wooldridge, Chapter 11, pp: 388-394). In this specific instance, a unit root exists when the parameter rho, ρ, in the equation below is equal to one and the series is said to be I(1) or nonstationary.

$$y_t = \rho y_{t-1} + e_t, \qquad t = 1,2, \dots .$$

If a series is strongly dependent or highly persistent, its use in a regression equation can lead to spurious results that are misleading at best (see Wooldridge 2009). The proper approach is to test for the presence of a unit root in the time series by using the following equation:

$$y_t = \alpha + \rho y_{t-1} + e_t, t = 1,2, \dots .$$

The test procedure developed by Dickey and Fuller for a unit root is then based on the following transformed equation in log form by subtracting y_{t-1} from both sides of the previous equation.

[1] In order to protect the confidential information of a single business reporting in a MSA, the data is not available in the data provided by the respective government data sites such as the Quarterly Census of Employment and Wages.

$$y_t - y_{t-1} = \alpha + \theta y_{t-1} + e_t$$

Where,

$$\theta = (\rho - 1)$$

Under this transformation, the test is based on the null hypothesis, h_0: $\theta=0$ against the alternative, h_a:$\theta < 0$ (for a full discussion see Wooldridge). The test statistics for this procedure are not the standard t-statistic rather the appropriate test statistic is based upon the Dickey-Fuller Distribution (1979). If we are unable to reject the null hypothesis, h_0: $\theta=0$, this implies ρ is not significantly different from 1 and the series is said to be I(1) nonstationary. In order to avoid the potential problems caused by the I(1) series, the series is then transformed by taking the first difference to make the series only weakly dependent, I(0), or stationary (see Wooldridge 2009). For the purposes of this analysis, each series will be tested for the presence of a unit root in both the levels and the first differences based on both the Dickey–Fuller and the Phillips-Perron Test for the presence of a unit root.[2]

Additionally, there exists the possibility that two I(1) series could have a long-term relationships that renders their combination I(0) stationary. In other words, the combination of the two nonstationary, highly persistent series creates a stationary, I(0), error series. Such series are said to be cointegrated (for a more complete discussion see Wooldridge). If two data series are cointegrated, a proper specification of any regression model must account for this relationship through an Error-Correction Model. As a result of the potential problems, all of the potential variable pairs considered in this study are tested for the existence of a cointegrating relationship.

If the variables used in this study are found to be I(1), but not cointegrated, a distributed lag model using the first differences in the logs of each series will be used to test for the presence of a statistical relationship between the variables. This approach will allow us to use a simple specification to determine the impact of a change in one variable on the other with some sense of the timing of the effect. The distributed lag specification used in the analysis is given by the following equation:

$$\Delta y_t = \alpha + +\beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

For this study, the lag on the differences is set to three periods. In considering the results of the analysis, β_0 is interpreted as the short-run multiplier and the sum of coefficients β_0 thru β_3 is interpreted as the long-run impact multiplier. These are the parameter estimates that are important from the perspective of the study. It is worth noting the potential problem with multicollinearity in the case of an unrestricted distributed lag model. In the event of significant results are reported, a precise method of specification can be used.

The results of the statistical analysis will be presented in the following format. The results for the tests on oil and natural gas prices which are common to all communities in the study will be presented because of the national and global markets that determine these prices. With regard to the individual communities, the results of the unit root tests for the variables that are common to the community as a whole are reported first. Second, the unit root tests for the income transfer variables for each county within the community are reported. Based on the results of the unit root

[2] The Dickey-Fuller and Augmented Dickey Fuller assume the error term, e_t is distributed as Gaussian white noise. In the Phillips-Perron test uses a non-parametric correction for any serial correlation (Whistler et al. 2004).

tests for these variables, the results of the required tests for cointegration are then provided. Finally, the results of the estimated distributed lag model of order (0,3) are reported along with an interpretation of the parameter estimates that are significant.

The results of the tests for the null hypothesis of a unit root in the oil and natural gas prices fail to reject the presence of a unit root in the levels for both oil and natural gas prices indicating they are both I(1), nonstationary series. The tests for the null hypothesis of unit root in the first differences for both oil and natural gas rejected the null hypothesis of a unit root for both series indicating the series are I(0), stationary in the first differences. It should be noted that similar results were obtained for both nominal and real prices for oil and natural gas. The implication of these results is the possibility that either or both of these series could in fact be cointegrated with any of the employment and income variables for the study communities and therefore cointegration tests must be conducted with the economic series that prove to be I(1), nonstationary.

Table 2.1.

Unit Root Test for Oil and Natural Gas Prices

The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Price Variable	Levels	First Difference
Oil	Failed	Rejected
Natural Gas	Failed	Rejected

2.2. THE GOLDEN TRIANGLE (BEAUMONT-PORT ARTHUR MSA)

2.2.1. Employment and Income Variables, Unit Root Tests

For the Golden Triangle, which includes Jefferson and Orange counties and is considered the Beaumont-Port Arthur MSA, the tests for the presence of a unit root was conducted for the levels and first differences of several key variables connected to the fabrication and manufacturing industry. The results of the test failed to reject the null hypothesis of a unit root in the levels for all of the variables except the average earnings per job. The series for average earnings per job rejected the null hypothesis of a unit root indicating it was I(0) stationary in the levels. The results of the test of the null hypothesis of a unit root in the first differences of the variables rejected the null hypothesis for all of the variables. As a result, the variables manufacturing income, real manufacturing income, fabrication employment, wage and salary jobs, real average earnings per job, and manufacturing employment are classified as I(1) nonstationary in the levels and I(0) stationary in the first differences. This is a necessary condition for any variable that may be cointegrated with another I(1) nonstationary variable. Given the results for average earnings per job of I(0) stationary in the levels, it cannot be cointegrated with another variable that is I(1) nonstationary.

Table 2.2.

Results for the Unit Root Tests for the Employment and Income Variables for the Golden Triangle MSA

The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Manufacturing Income	Failed	rejected
Real Manufacturing Income	Failed	rejected
Fabrication Employment	Failed	rejected
Wage and Salary Jobs	Failed	rejected
Average Earnings per Job	Rejected	rejected
Real Average Earnings per Job	Failed	rejected
Manufacturing Employment	Failed	rejected

2.2.2. Cointegration Tests

Given the historical presence of the oil and gas industry in the Golden Triangle area, each of the employment and income variables except average earnings per job was tested for a long-run cointegrating relationship with the price of crude oil and natural gas. The results of the test failed to reject the null hypothesis of no cointegration with the price of crude oil for all of the employment and income variables used in the test. Likewise, the test using the price of natural gas also failed to reject the null hypothesis of no cointegration for all of the employment and income variables used in the study. The conclusion of no long-run relationship between the price of oil or natural gas and the employment and income variables for the Golden Triangle seems reasonable based on the results of the test. More to the point, this finding does not rule out any other type of statistical relationship, rather it does not support the existence of one based on the statistical property of cointegrated time series.

Table 2.3.

Results for the Cointegration Tests for the Employment and Income Variables for the Golden Triangle MSA and the Price of Oil and Natural Gas

The null hypothesis of No Cointegrating Relationship		
	Oil	Natural Gas
Manufacturing Income	Failed	Failed
Real Manufacturing Income	Failed	Failed
Fabrication Employment	Failed	Failed
Wage and Salary Jobs	Failed	Failed
Average Earnings per Job	Not Applicable	Not Applicable
Real Average Earnings per Job	Failed	Failed
Manufacturing Employment	Failed	Failed

2.2.3. Distributed Lag Model (0,3)

An alternative form of the relationship between the price of oil or natural gas was specified based on a distributed lag model of order (0,3) which included the contemporaneous change in the price of oil or natural gas as well as three lagged values for the change in price. This specification allowed for the test of a short-run relationship based on the estimate of the short-run multiplier which was the estimated value of the coefficient on the contemporaneous change in the price of oil. The model specification also allowed for the test of a long-run relationship based on the sum of the coefficients on the independent variable including the lagged values. It is worth noting that this relationship while long-run, is not of the same form as the cointegrating relationship previously tested.

The results showed that 27.67% of the change in manufacturing income was accounted for by the change in the price of oil. Furthermore, the estimate of the long-run multiplier was .29036 and was significant at the 1% level. The estimate of the short-run multiplier was .0679 and was nearly significant at the 10% level with a p-value of .102. The results for the real manufacturing income suggested that 7.89% of the variation was explained by the distributed lag model. However, the estimates were not significantly different from zero and therefore insignificant. Similar results were obtained for the change in fabrication employment, the change in wage and salary jobs, the change in real average earnings per job, and the change in manufacturing employment. The change in the price of oil accounted for 30.16% of the change in the average earnings per job. The estimated long-run multiplier of .1391 was significant at the 1% level. An interesting aspect of this result was the coefficient on the first lagged variable which was significant at the 1% level suggesting a brief lagged effect. The short-run multiplier was not significant.

Table 2.4.

Distributed Lag Model of Order (0,3) for Oil and the Employment and Income Variables

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Manufacturing Income	.29036 (.002)	.067923	.2767
Real Manufacturing Income	.19717 (.039)	Ns	.0789 (ns)
Fabrication Employment	Ns	Ns	<0
Wage and Salary Jobs	Ns	Ns	.0126
Average Earnings per Job	.13909 (.002)	Ns	.3016
Real Average Earnings per Job	Ns	Ns	<0
Manufacturing Employment	Ns	Ns	<0

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

The results of the distributed lag model for the change in the price of natural gas was similar to those reported for the change in the price of oil. The change in the price of natural gas accounted for only 2.21% of the variation of the change in manufacturing income. The long-run multiplier was nearly significant at the 10% level with a p-value of .101. This result was likely attributable to the significant parameter on the first lagged value of the price for natural gas. The change in the price of natural gas accounted for 25.23 of the variation in the change in the average earnings per job. The long-run multiplier estimate was .1409 and was significant at the

1% level. Once again this may have been attributable to significant coefficient estimate on the first lagged value of the change in the price of natural gas.

Table 2.5.

Distributed Lag Model of Order (0,3) for Natural Gas and the Employment and Income Variables

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	.19316 (.101)	Ns	.0221
Real Manufacturing Income	ns	Ns	<0
Fabrication Employment	ns	Ns	<0
Wage and Salary Jobs	ns	Ns	<0
Average Earnings per Job	.14091 (.007)	Ns	.2523
Real Average Earnings per Job	ns	Ns	.0213
Manufacturing Employment	ns	Ns	<0

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

2.2.4. Orange County, Income Transfer Variables, Unit Root Tests

The next results reported are for the unit root tests for the income transfer variables for Orange County. These variables include retirement transfer payments, Medicaid transfer payments, food stamp transfer payments and unemployment insurance compensation transfers. The tests for the null hypothesis of a unit root in the levels of the variables failed to reject the null hypothesis for all four variables. The test for the null hypothesis of a unit root in the first differences failed to reject the null in the case of the retirement transfer payments. For the three remaining variables, the null of a unit root was rejected. The implications are that Medicaid transfer payments, food stamp transfers, and unemployment compensation transfers were I(1) nonstationary in the levels and I(0) stationary in the first differences. The results allowed for these variables to be used in the tests for the presence of a long-run cointegrating relationship with the economic variables.

The variable for retirement transfers in Orange County indicated the presence of a unit root in both the levels and the first differences. This finding presented certain statistical problems and limited the use of the times series for retirement transfers for the analysis for Orange County.

Table 2.6.

Results for the Unit Root Tests for the Income Transfer Variables for Orange County

The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Fail	Fail
Medicaid Transfers	Fail	Reject
Food Stamp Transfers	Fail	Reject
Unemployment Compensation Transfers	Fail	Reject

2.2.5. Orange County, Cointegration Tests

The test for the presence of a long-run cointegrating relationship between the employment and income variables except average earnings per job and the income transfer variables except retirement transfers were conducted. The results failed to reject the null hypothesis of no cointegrating relationship for all pairs. This implied there was no detectable long-run relationship of this form between the variables.

Table 2.7.

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for Orange County

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Fail	Fail	Fail
Manufacturing Employment	Not applicable	Fail	Fail	Fail
Wage and Salary Jobs	Not applicable	Fail	Fail	Fail
Average Earnings per Job	Not applicable	Not applicable	Not applicable	Not applicable
Real Average Earnings per Job	Not applicable	Fail	Fail	Fail
Manufacturing Income	Not applicable	Fail	Fail	Fail
Real Manufacturing Income	Not applicable	Fail	Fail	Fail

2.2.6. Orange County, Distributed Lag Model (0.3)

The distributed lag model of order (0,3) was estimated for the change in each income transfer variable as a function of the contemporaneous change in each of the employment and income variables and three lagged values of the change in the employment and income variables for the MSA. The results for the change in retirement transfers were reported. However, due to the statistical properties of this times series, the regression results may have been spurious and of little true value. Given this possibility, the change in fabrication employment and manufacturing employment had little or no explanatory power regarding the variation in the change in retirement transfers. The change in manufacturing income accounted for 30% of the change in retirement transfers. The estimated long-run multiplier was .45445 and was significant at the 1% level. The change in real manufacturing income accounted for 9.98% of the variation in the change of retirement transfer payments, however, neither multiplier estimate was significant. The change in the average earnings per job accounted for 58.34% of the variation in the retirement transfer payments. The long-run multiplier was 1.1684 and was significant at the 1% level.

Table 2.8.

Distributed Lag Model of Order (0,3) for Retirement Transfer Payments and the Employment and Income Variables for Orange County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	ns	ns	<0
Manufacturing Income	.45445 (.002)	ns	.30
Real Manufacturing Income	ns	ns	.0998
Wage and Salary Jobs	.62662 (.107)	ns	.0311
Average Earnings per Job	1.1684 (.000)	ns	.5834
Real Average Earnings per Job	ns	-.63257 (.042)	.0862
Manufacturing Employment	ns	ns	<0

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

The results for the distributed lag model for the change in Medicaid transfer payments indicated there were no significant findings or explanatory power for the Orange County data.

Table 2.9.

Distributed Lag Model of Order (0,3) for Medicaid Transfers and Employment and Income Variables for Orange County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs		ns	<0
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

In the case of the change in the food stamp transfers, only the change in the average earnings per job had significant explanatory power with an adjusted-r^2 of 15.04%. The long-run multiplier for the change in the average earnings per job was 2.7511 and was significant at the 5% level. However, the sign on the coefficient presented a dilemma in formulating a reasonable explanation for the result.

Table 2.10.

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income Variables for Orange County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	-.78401 (.124)	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs		ns	<0
Average Earnings per Job	2.7511 (.015)	ns	.1504
Real Average Earnings per Job	Ns	ns	.0354
Manufacturing Employment	Ns	-.78401 (.124)	<0

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

The results for the change in the unemployment compensation transfers were significant with regard to several economic variables. The change in fabrication employment accounted for 35.08% of the variation in the change in unemployment transfer payments. While the long-run multiplier was not significant, the short-run multiplier was -3.5834 and significant at the 1% level. The change in manufacturing income accounted for 28.8% of the variation in the change in unemployment transfer payments. The short-run multiplier was -3.6318 and significant at the 1% level. The change in wage and salary jobs accounted for 46.63% of the variation in the change in unemployment transfer payments. The short-run multiplier was -7.4225 and was significant at the 1% level. The results for the change in manufacturing employment were identical to the change in fabrication employment. The estimations using the change in average earnings per job, the change in real average earnings per job, and the change in real manufacturing income were not significantly different from zero.

Table 2.11.

Distributed Lag Model of Order (0,3) for Unemployment Compensation Transfers and the Employment and Income Variables for Orange County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	ns	-.78401 (.124)	<0
Manufacturing Income	ns	ns	<0
Real Manufacturing Income	ns	ns	<0
Wage and Salary Jobs		ns	<0
Average Earnings per Job	5.4932	ns	.1504
Real Average Earnings per Job	ns	ns	.0354
Manufacturing Employment	ns	-.78401 (.124)	<0

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

2.2.7. Orange County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for an analysis regarding any shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.2.8. Orange County, Unit Root Tests

As in each prior step of the analysis, each of the population variables was tested for the presence of a unit root in the time series. The null hypothesis of a unit root was used in each case. Each of the population variables failed to reject the null hypothesis of a unit root in the levels. However, only the under 19, under 39, under 59 and above 60 rejected the null hypothesis of a unit root in the first differences. As a result, only these four population variables could be classified as I(1) non-stationary in the levels and I(0) stationary in the first differences. This also implied only these four variables could be used in a cointegration test to test for the presence of a long-run relationship.

Table 2.12.

Unit Root Test for Population Variables*

Orange County Population		
The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Failed
Under 19	Failed	Rejected
Under 29	Failed	Failed
Under 39	Failed	Rejected
Under 49	Failed	Failed
Under 59	Failed	rejected
Above 60	Failed	rejected
Women	Failed	Failed
Men	Failed	Failed
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

*The results of the tests were sensitive to the form of the test specified.

2.2.9. Orange County, Cointegration Analysis

Given the results of the unit root test presented above, only four variables were used in the test for the presence of a long-run cointegrating relationship between the population variable and the level manufacturing employment in the MSA. In no case did the test reject the null hypothesis of no cointegrating relationship. Thus, we concluded there was no long-term relationship of this form detected in the data.

Table 2.13.

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Orange County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
NA	Failed	NA	failed	NA	failed	failed	NA	NA

*NA denotes the series was not I(1) and therefore was not cointegrated with another I(1) series.

2.2.10. Orange County, Distributed Lag (0,3) Model Analysis

Additional analysis was conducted using a distributed lag model of order (0,3) which regressed the change in the specific population variable against the contemporaneous change in manufacturing employment and three lags. In each case, the long-term multiplier which is given by the sum of the regression coefficients, and the short-term multiplier which is given by the coefficient on the contemporaneous change are reported. Furthermore, the adjusted-r^2 is reported for each case. We used the adjusted-r^2 in order to account for possible over specification of the model. It is worth noting that over specification of the model can and did result in cases of a negative adjusted-r^2. In most cases, the estimates were not significantly different from zero. With regard to the Orange County data, the long-term multiplier was significant for the variables: total population, under 19, under 49, under 59, women, and men indicating a significant relationship between manufacturing employment and these segments of the population. In the cases of the total population, the under 19, the women, and men categories, the adjusted-r^2 was greater than .42. The long-term multiplier in these cases ranged from .29216 for the total population to .34650 for women. In each of these cases, the p-value on the estimate was highly significant. While there were larger multiplier estimates, these equations did not have the high adjusted-r^2. It is also worth noting the adjusted-r^2 was higher for men than women, yet the multiplier estimate was greater for women suggesting a greater impact on the female segment of the population.

In no case was the short-term multiplier significant indicating a lack of a significant short-term effect.

Table 2.14.

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

Orange County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R
Total Population	.29214 (.000)	ns	.4503
Under 19	.31414 (.000)	ns	.5588
Under 29	Ns	ns	.0456 (ns)
Under 39	Ns	ns	.0762 (ns)
Under 49	.20357 (.037)	ns	.0284
Under 59	.43003 (.016)	ns	.1095
Above 60	Ns	ns	<0
Women	.34650 (.000)	ns	.4215
Men	.29639 (.000)	ns	.4936

2.2.11. Jefferson County, Employment and Income Transfer Variables, Unit Root Tests

The unit root test for the level of the income transfer variables in Jefferson County fail to reject the null hypothesis of a unit root for retirement transfers, Medicaid transfers, and unemployment compensation transfers. The unit root test for food stamp transfers rejected the null hypothesis of a unit root in the level. The unit root test on the first differences rejected the null hypothesis of a unit root for Medicaid transfers, food stamp transfers, and unemployment transfers. This suggests these series are I(1) nonstationary in the levels and I(0) stationary in the first differences. The test failed to reject the null of a unit root for the retirement transfer series. It is worth noting the test statistics were extremely close to the 10% critical values. However, it would not be appropriate to use this variable in the test for cointegration which requires two I(1) nonstationary series.

Table 2.15.

Results for the Unit Root Tests for the Income Transfer Variables for Jefferson County

The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Fail	Fail
Medicaid Transfers	Fail	Reject
Food Stamp Transfers	Fail	Reject
Unemployment Compensation Transfers	Fail	Reject

2.2.12. Jefferson County, Cointegration Tests

The tests for the presence of a long-run cointegrating relationship between each of the three I(1) nonstationary income transfer variables and each of the I(1) nonstationary employment and income variables failed to reject the null hypothesis of no cointegrating relationship for all pairs. As stated earlier in the test results for the MSA, the economic variable average earnings per job was not I(1) and could not be used in the tests for a long-run cointegrating relationship. The test results suggested there was not significant evidence of a long-run relationship of the form specified for cointegrated variables.

Table 2.16.

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for Jefferson County

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Fail	Fail*	Fail
Manufacturing Employment	Not applicable	Fail	Fail*	Fail
Wage and Salary Jobs	Not applicable	Fail	Fail*	Fail
Average Earnings per Job	Not applicable	Not applicable	Not applicable	Not applicable
Real Average Earnings per Job	Not applicable	Fail	Fail*	Fail
Manufacturing Income	Not applicable	Fail	Fail*	Fail
Real Manufacturing Income	Not applicable	Fail	Fail*	Fail

*The results for the cointegration tests for the food stamp transfers are extremely close to the critical values at the 10% level or in fact reject the null hypothesis of no cointegration based on one specification of the test.

2.2.13. Jefferson County, Distributed Lag Model (0,3)

The results from the distributed lag model of order (0,3) for Jefferson County for the change in the variable retirement transfers and change in fabrication employment had an adjusted-r^2 that was negative and both the long-run multiplier and the short-run multiplier were not significantly different from zero. Similar results were found for the change in manufacturing employment and the change in wage and salary jobs. Very low values for the adjusted-r^2 were found for the change in real average earnings per job and the change in real manufacturing income. In the case of the change in real average earnings per job, the short-run multiplier was significant at the 10% level. In the case of the change in manufacturing income, the adjusted-r^2 was 26.58% indicating a substantial amount of explanatory power. The long-run multiplier of .3796 was significant at the 1% level. The short-run multiplier was not significantly different from zero. In the case of the change in the average earnings per job, the adjusted-r^2 was .4871 indicating a substantial percentage of the variation in the change in retirement transfers was explained by change in average earnings per job.

Table 2.17.

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for Jefferson County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	.3796 (.003)	ns	.2658
Real Manufacturing Income	Ns	ns	.0892
Wage and Salary Jobs	.5694 (.113)	ns	<0
Average Earnings per Job	.93962 (.000)	ns	.4871
Real Average Earnings per Job	Ns	.48925 (.087)	.0499
Manufacturing Employment	Ns	ns	<0

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

The estimation of the distributed lag model for the change in Medicaid transfers as a function of the change in the different employment and income variables failed to provide any significant coefficient estimates. Furthermore, the values for the adjusted-r^2 for all but the change in real average earnings per job were negative indicating no explanatory power in the model.

Table 2.18.

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for Jefferson County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs		ns	<0
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	.0130

Manufacturing Employment	Ns	ns	<0

“ns” implies the estimated coefficient is not significantly different from zero or in the case of “ns” in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

The estimation of the distributed lag model for the change in food stamp transfers as a function of the change in the employment and income variables provided very limited explanatory power. The adjusted-r^2 was negative in the cases of the change in manufacturing income, the change in real manufacturing income, and the change in wage and salary jobs. In the cases of the change in the average earnings per job and the change in the real average earnings per job, the adjusted-r2 was low, but positive and the multiplier estimates were not significantly different from zero. Finally, in the cases of the change in fabrication employment and the change in manufacturing employment, the adjusted-r^2 was positive, but very low. The long-run multiplier estimates were only marginally significant with a p-value of .101. Thus, the change in the employment and income variables had little or no impact on the change in the food stamp transfers for Jefferson County.

Table 2.19.

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income for Jefferson County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	-1.4563 (.101)	-.762 (.12)	.0277
Manufacturing Income	Ns	ns	<0 ns
Real Manufacturing Income	Ns	ns	<0 ns
Wage and Salary Jobs		ns	<0 ns
Average Earnings per Job	Ns	ns	.0046
Real Average Earnings per Job	Ns	ns	.0248
Manufacturing Employment	-1.4513 (.101)	-.762 (.12)	.0277

“ns” implies the estimated coefficient is not significantly different from zero or in the case of “ns” in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

The distributed lag model estimates for the change in the unemployment compensation transfers as a function of the change in the employment and income variables provided several significant results. First, the change in fabrication employment and the change in manufacturing employment had values for the adjusted-r^2 of .3028. In both cases, the short-run multiplier was -2.8233 and significant at the 1% level. The change in manufacturing income had an adjusted-r^2 of .2361 with a short-run multiplier of -2.9274 that was significant at the 1% level. The change in wage and salary jobs accounted for 45.93% of the variation in the change in unemployment compensation transfers and had a short-run multiplier of -6.359 that was significant at the 1% level. The results for the changes in real manufacturing income, the change in the average earnings per job, and the change in the real average earnings per job were not significantly different from zero based on the joint f-test for the equation.

Table 2.20.

Distributed Lag Model of Order (0,3) for Unemployment Compensation Transfers and the Employment and Income Variables for Jefferson County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	-2.8233 (.004)	.3028
Manufacturing Income	Ns	-2.9274 (.008)	.2361
Real Manufacturing Income	Ns	-2.7945 (.02)	.0930 ns
Wage and Salary Jobs	Ns	-6.359 (.001)	.4593
Average Earnings per Job	Ns	Ns	.0164 ns
Real Average Earnings per Job	Ns	ns	<0 ns
Manufacturing Employment	Ns	-2.8233 (.004)	.3028

"ns" implies the estimated coefficient is not significantly different from zero or in the case of "ns" in the adjusted-r^2 column implies the results fail to reject the F-test for the joint hypothesis of all coefficients equal to zero

2.2.14. Jefferson County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.2.15. Jefferson County, Unit Root Tests

In the case of Jefferson County, the data failed to reject the null hypothesis of a unit root in the levels of the series for each of the age categories. However, the test results on the first differences failed to reject the null hypothesis of a unit root for the "under 59" category. As a result, all of the categories except "under 59" are classified as I(1) and can be used in the cointegration tests.

Table 2.21.

Unit Root Test for Population Variables

Jefferson County Population		
The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	rejected
Under 19	Failed	rejected
Under 29	Failed	rejected
Under 39	Failed	rejected
Under 49	Failed	rejected
Under 59	Failed	failed
Above 60	Failed	rejected
Women	Failed	rejected
Men	Failed	rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	rejected

2.2.16. Jefferson County, Cointegration Analysis

Based on the results of the unit root tests for series for the different age categories, tests for a long-run cointegrating relationship between manufacturing employment and the different segments of the population were conducted. In all cases, the tests failed to reject the null hypothesis of no cointegrating relationship.

Table 2.22.

Test Results for a Cointegrating Relationship Between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Jefferson County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
failed	failed	failed	failed	failed	NA	failed	failed	failed

2.2.17. Jefferson County, Distributed Lag Model Analysis

The estimation of the distributed lag model of order (0,3) produced relatively strong explanatory power in terms of the adjusted-r^2 for the variables: total population, under 29, under 59, women, and men. The greatest explanatory power was for the total population with an adjusted-r^2 of .2840. With regard to the long-term multiplier, the under 19 category had the largest value at .549 with a p-value of .024 indicating significance at the 5% level. Other estimates of the long-term multiplier while smaller in value were significant at the 1% level. As with Orange County, it was interesting to note the long-term multiplier was greater for the women segment of the population than the men, and slightly more significant indicating a greater impact of manufacturing employment on women than men.

Table 2.23.

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

Jefferson County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R
Total Population	.19023 (.001)	ns	.2840
Under 19	Ns	ns	.0195
Under 29	.54922 (.024)	ns	.1797
Under 39	Ns	ns	.0643 (ns)
Under 49	Ns	ns	<0 (ns)
Under 59	.43942 (.003)	ns	.1727
Above 60	Ns	ns	<0 (ns)
Women	.30655 (.014)	ns	.2306
Men	.19593 (.018)	ns	.1932

2.3. Houma-Thibodaux MSA

2.3.1. Employment and Income Variables

For the Houma-Thibodaux-Bayou Cane MSA, unit root tests conducted on the levels of all of the employment and income variables for the MSA failed to reject the null hypothesis of a unit root for each of the variables. The unit root tests for the series of the first differences of the employment and income variables rejected the null hypothesis of a unit root for each of the series. The implication is that each of the employment and income variables are characterized as I(1) nonstationary in the levels and I(0) stationary in the first differences. This result allowed for the possibility of the existence of a long-run cointegrating relationship between the each of the employment and income variables and other I(1) nonstationary employment and income variables or the difference income transfer variables at the parish level that are also I(1).

Table 2.24.

Results for the Unit Root Tests for the Employment and Income Variables for the Houma-Thibodaux-Bayou Cane, MSA

The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Manufacturing Income	Failed	rejected
Real Manufacturing Income	Failed	rejected
Fabrication Employment	Failed	rejected
Wage and Salary Jobs	Failed	rejected
Average Earnings per Job	Failed	rejected
Real Average Earnings per Job	Failed	rejected
Manufacturing Employment	Failed	rejected

The results of the test appeared to be sensitive of the form of the test specified, Augmented Dickey-Fuller or Phillips-Perron.

2.3.2. Cointegration Tests

The tests for the presence of a long-run cointegrating relationship between the time series for the price of oil and each of the I(1) nonstationary employment and income variables for the Houma-Thibodaux-Bayou Cane MSA failed to reject the null hypothesis of no cointegration or a unit root in the residuals of the cointegration regression for each pair of variables. A similar result was found for the times series for natural gas prices and each of the employment and income variables for the MSA.

Table 2.25

Results for the Cointegration Tests for the Employment and Income Variables for the Houma-Thibodaux-Bayou Cane, MSA and the Price of Oil and Natural Gas

The null hypothesis of No Cointegrating Relationship		
	Oil	Natural Gas
Manufacturing Income	Failed	Failed
Real Manufacturing Income	Failed	Failed
Fabrication Employment	Failed	Failed
Wage and Salary Jobs	Failed	Failed
Average Earnings per Job	Failed	Failed
Real Average Earnings per Job	Failed	Failed
Manufacturing Employment	Failed	Failed

2.3.3. Distributed Lag Model

The results of the tests for the presence of a cointegrating relationship suggested a distributed lag model may provide an adequate specification to test for the presence of a relationship between the prices of oil and/or natural gas and the specific employment and income variables for the MSA. Additionally, it allowed for testing the relationship between the individual employment and income variables for the MSA and the income transfer variables for the individual parishes. As such, an order (0.3)-distributed lag model was estimated for each of employment and income variables for the MSA using first the price of oil and then the price of natural gas as the independent variables.

The results of the analysis of the change in the price of oil on the employment and income variables for the MSA are quite interesting and significant. The approximately 14% of the variation in the change in employment in fabricating was accounted for by the change in the price of oil over the last year based on the adjusted-r^2 of .14. A much larger percentage of the variation in manufacturing income, 24.76%, was explained by the change in the price of oil in both the long-run and the short-run. The estimate of the long-run multiplier was .379 and was significant at the 5% level. The biggest contributor to the long-run multiplier was the coefficient for the change in the price of oil last year, .23904, which was significant at the 1% level. The results based on the change in the real manufacturing income were less significant, but do indicate similar contributing effects of the change in the price of oil last year. The results for the change in wage and salary jobs were very significant. Approximately 24% of the variation in the change in wage and salary jobs was accounted for by change in the price of oil. Furthermore, the long-term multiplier of .14735 was significant at the 1% level with a significant contribution from the price change last year. The change in the average earnings per job for the MSA was largely explained by changes in the price of oil with 61.46% of the variation being explained by the distributed lag model. In this case, the long-run multiplier was .2043 and was significant at the 1% level. The short-run multiplier for the contemporaneous change was .046121 and was significant at the 5% level. The first and second lagged changes in oil prices contribute .097 and .0516 to the long-run multiplier and both were significant at the 1% level. The change in the real average earnings per job failed to provide significant results.

Table 2.26

Distributed Lag Model of Order (0,3) for Oil and the Employment and Income Variables

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	Σβ	β_0	Adjusted-r^2
Manufacturing Income	.37916 (.018)	ns	.2476
Real Manufacturing Income	Ns	ns	.1117 (ns)
Fabrication Employment	Ns	ns	.1406
Wage and Salary Jobs	.14735 (.008)	ns	.2385
Average Earnings per Job	.20430 (.000)	.046121 (.019)	.6146
Real Average Earnings per Job	.079035 (.066)	ns	.07
Manufacturing Employment	Ns	ns	.1406

With regard to the change in the price of natural gas, the results were not as significant. Only the results for the change in wage and salary jobs and average earnings were significantly impacted by the change in the price of natural gas. In the case of wage and salary jobs, approximately 10% of the variation was explained by the distributed lag model. The short-run multiplier was .0715 and was significant at the 5% level while the long-run multiplier of .1578 was significant at the 5% level. The largest contribution to the long-run multiplier was the coefficient on the change in natural gas prices last year, .0717, which was significant at the 10% level. In the case of the change in the average earnings per job, approximately .38% of the variation was accounted for in the distributed lag model. The long-run multiplier was .22637 and was significant at the 1% level. The short-run multiplier was .0588 and was significant at the 1% level. As with the change in oil prices, the change in the price of natural gas did not appear to significantly explain the change in real average earnings per job.

Table 2.27

Distributed Lag Model of Order (0,3) for Natural Gas and the Employment and Income Variables

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	Ns	ns	.0287
Real Manufacturing Income	Ns	ns	<0 (ns)
Fabrication Employment	Ns	ns	<0 (ns)
Wage and Salary Jobs	.15778 (.042)	.07147 (.10)	.0995
Average Earnings per Job	.22637 (.000)	.058807 (.075)	.3772
Real Average Earnings per Job	.10239 (.063)	ns	.1330 (ns)
Manufacturing Employment	Ns	ns	<0 (ns)

The results presented and discussed above clearly indicated the impact of the change in the price of oil and natural gas in economic environment for the Houma-Thibodaux-Bayou Cane MSA.

2.3.4. Lafourche Parish, Income Transfer Variables

For Lafourche Parish, the income transfer variable for retirement rejected the null hypothesis of a unit root at the 10% level of significance. The remaining variables; Medicaid, food stamps, and unemployment compensation fail to reject the null hypothesis of a unit root at even the 10% level of significance. This indicates that three of the four income transfer variables are I(1) time series that may be cointegrated with one or more of the economic series.

Table 2.28

Results for the Unit Root Tests for the Income Transfer Variables for Lafourche Parish

The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Rejected	Rejected
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Failed	Rejected

The results of the test appeared to be sensitive of the form of the test specified, Augmented Dickey-Fuller or Phillips-Perron.

The tests for the existence of a cointegrating relationship between the pairings of each of the employment and income variables for the MSA and each of the income transfer variables for Lafourche Parish failed to reject the null hypothesis of a unit root in the residuals of the test regression. The results imply there is not a detectable long run relationship that requires the specification of an error correction model for a test of the relationships between the economic and income transfer variables in the Houma-Thibodaux MSA and the income transfer variables in Lafourche Parish.

Table 2.29

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for Lafourche Parish

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Failed	Failed
Manufacturing Employment	Not applicable	Failed	Failed	Failed
Wage and Salary Jobs	Not applicable	Failed	Failed	Failed
Average Earnings per Job	Not applicable	Failed	Failed	Failed
Real Average Earnings per Job	Not applicable	Failed	Failed	Failed
Manufacturing Income	Not applicable	Failed	Failed	Failed
Real Manufacturing Income	Not applicable	Failed	Failed	Failed

2.3.5. Lafourche Parish, Distributed Lag Model

Additionally, the same order distributed-lag model was estimated for each of the income transfer variables from each of the counties/parishes included in the overall study community using each of the employment and income variables as the independent variables. The order (0.3) model was estimated by taking the contemporaneous change in the independent variable as well as three lags of the change in the independent variable and running a regression against the change in the dependent variable. For example, the change in the dollar transfers in the food stamp program was regressed against the contemporaneous change in fabrication employment and the change in fabrication employment from the last three years. The results of this regression allowed the test for the short-run impact using the estimated coefficient on the contemporaneous change and the long-run impact by using the sum of the coefficients on the lagged dependent variables. Furthermore, because the regression used the first difference of the specific time series, there should be problems with spurious regression results normally attributable to I(1) series.

Given the results for the employment and income variables at the MSA level, a distributed lag model was estimated to test for the existence of a significant relationship between the specific economic variable and the specific income transfer variable in Lafourche Parish. With regard to the change in the retirement transfers, only the change in the average earnings per job had a significant impact. The long-run multiplier of .94194 was significant at the 1% level while the short-run multiplier of .2798 was significant at the 10% level. All other results were not statistically significant.

Table 2.30

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for Lafourche Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	.1488 (.056)	ns	.0195
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	.43163 (.058)	ns	.0101
Average Earnings per Job	.94194 (.000)	.27985 (.065)	.48
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

With regard to the change in Medicaid transfers, only the change in the average earning per job and the change in real average earnings per job were not significant. While only 9.5% of the variation was explained by the change in fabrication employment, the short-run multiplier of -.6153 was significant at the 10% level. The change in manufacturing income had a short-run multiplier that was significant at the 5% level. It was worth noting that the long-run multiplier for the change in manufacturing income was not significant due to the changing signs for the coefficient estimates. The change in real manufacturing income accounted for approximately 13% of the variation in the change in Medicaid transfers with a short-run multiplier of -.08153 that was significant at the 5% level. However, like for the nominal change in manufacturing income, the sum of the coefficients was not significant due to the changing signs on the coefficient estimates. The change in wage and salary jobs accounted for only 6.3% of the variation in the change in Medicare transfers. However, as in previous cases, the long-run multiplier was not significant. Finally, the change in manufacturing employment accounted for approximately 9.5% of the variation in the change in Medicaid transfers and had a short-term multiplier of -.61455 that was significant at the 10% level.

Table 2.31

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for Lafourche Parish

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	-.61455 (.086)	.0949
Manufacturing Income	Ns	-.61528 (.05)	.0714
Real Manufacturing Income	Ns	-.81530 (.015)	.1286
Wage and Salary Jobs	Ns	-1.3655 (.109)	.0629
Average Earnings per Job	Ns	ns	.0196
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	-.61455 (.086)	.0949

The change in the food stamp transfer program for Lafourche Parish was significantly impacted by several of the economic variables. For example, the change in fabrication employment explained approximately 35% of the variation in the change in the food stamp program transfers with short-term multiplier of -.625 that was significant at the 5% level and a long-run multiplier of -1.1425 that was significant at the 1% level. It is worth noting both multipliers have a sign that indicates the inverse relationship expected with these variables. The change in manufacturing income accounted for 20% of the variation in the changes in the food stamp program transfers. However, in this case only the short-term multiplier of -.44160 was significant and only at the 10% level. In contrast, the change in real manufacturing income accounted for 28.5% of the variation in the change in the food stamp program transfers with a short-run multiplier of -.5428 that was significant at the 5% level and a long-run multiplier of -.5856 that was significant at the 5% level. The change in the wage and salary jobs accounts for approximately 10.5% of the variation in the change in the food stamp program transfers. In this case, only the short-run multiplier was significant and only at the 10% level. Perhaps what was most interesting was the lack of significant results regarding the change in average earnings per job in a parish perceived to be so dependent on manufacturing and fabrication for employment. However, the analysis of the change in the real average earnings per job on the change in the food stamp program transfers did indicate a short-run multiplier of -1.853 that was significant at the 5% level. Finally, the change in manufacturing employment mirrored the change in the fabrication employment almost exactly. This result was not surprising given the close alignment of the two industry segments within the parish.

Table 2.32

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income Variables for Lafourche Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	-1.1425 (.006)	-.62521 (.026)	.3484
Manufacturing Income	Ns	-.4416 (.092)	.2014
Real Manufacturing Income	-.58565 (.042)	-.54280 (.045)	.2854
Wage and Salary Jobs	Ns	-1.3157 (.083)	.1053
Average Earnings per Job	Ns	Ns	.0565
Real Average Earnings per Job	Ns	-1.8529 ()	.0855
Manufacturing Employment	-1.1425 (.006)	-.62521 (.026)	.3484

As one might have expected, there was a very strong inverse relationship in the estimated model for unemployment compensation as a function of the employment and income variables for Lafourche Parish. For all variables used in the distributed lag model, the short-run multiplier, the coefficient on the contemporaneous change, was negative and significant at the 1% level. This result clearly indicated a quick, inverse response to any change in the employment or earnings within the industry for the parish. Only the change in average earnings per job had a long-run multiplier that was significant at the 10% level. All other estimates of the long-run multiplier were not significantly different from zero.

Table 2.33

Distributed Lag Model of Order (0,3) for Unemployment Compensation Transfers and the Employment and Income Variables for Lafourche Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	ns	-2.2144 (.024)	.23
Manufacturing Income	Ns	-2.2777 (.005)	.32
Real Manufacturing Income	Ns	-2.6941 (.003)	.3064
Wage and Salary Jobs	Ns	-7.2939 (.000)	.5178
Average Earnings per Job	4.0504 (.077)	-7.9771 (.000)	.4720
Real Average Earnings per Job	Ns	-8.7997 (.002)	.2518
Manufacturing Employment	Ns	-2.2144 (.024)	.23

2.3.6. Lafourche Parish, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.3.7. Lafourche Parish, Unit Root Analysis

In the case of Lafourche Parish population, the tests for a unit root failed to reject the null hypothesis of a unit root for each of the series in the levels. The tests for the unit root in the first differences of the series rejected the null hypothesis of a unit root for all of the segments except for "men" and "women." As a result, these two segments were not integrated of order one, I(1), and useable in the cointegration tests for a long-term relationship with manufacturing employment.

Table 2.34

Unit Root Test for Population Variables

Lafourche Parish Population		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Rejected
Under 19	Failed	Rejected
Under 29	Failed	Rejected
Under 39	Failed	Rejected
Under 49	Failed	Rejected
Under 59	Failed	Rejected
Above 60	Failed	Rejected
Women	Failed	Failed
Men	Failed	Failed
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.3.8. Lafourche Parish, Cointegration Analysis

Given the results of the unit root tests, tests for the existence of a long-run cointegration relationship were conducted for all of the segments of the population except "women" and "men" and manufacturing employment. In all cases, the tests failed to reject the null hypothesis of no cointegration. This suggested that no long-run relationship of this form was detectable between the time series for the population and manufacturing employment.

Table 2.35

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Lafourche Parish Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Failed	Failed	Failed	Failed	Failed	Failed	Failed	NA	NA

2.3.9. Lafourche Parish, Distributed Lag Model Analysis

The estimation of the of the distributed lag model produced relatively low ranging from .0888 for the segment "under 19" to .4132 for the segment "under 59." The "under 59" segment also had the largest long-term multiplier at .20 indicating the greatest impact of a change in manufacturing employment of any population segment. It is worth noting the "under 19" demonstrated a significant estimate of the long-term multiplier as did the "total population."

In the case of "men" versus "women," the segment "men" had the larger adjusted-r^2 at .1740 compared to .1250 for the segment "women." However, the segment "women" had a larger estimate for the long-term multiplier at .1135 compared to .088 for "men." Thus, as in the previous study areas, it appears the change in manufacturing employment has a greater impact on the "women" segment of the population.

In terms of the contemporaneous effect, only the short-term multiplier for the "under 59" was significant at 5% level with an estimate of .0749. Given the calculation of the long-term multiplier, it suggested that more than one third of the total long-term effect is contemporaneous for this segment of the population. In other words, the reaction is almost immediate.

The aspect of the test that was potentially most interesting was the segments that were not significantly impacted by a change in the manufacturing employment. One possible conclusion is that these segments may stay in the area regardless if there are manufacturing jobs or not. A result of this may be the shift to service employment noted in the economic profiles for the various study groups.

Table 2.36

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Lafourche Parish Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R^2
Total Population	.083456 (.011)	ns	.1105
Under 19	.069837 (.023)	ns	.0888
Under 29	Ns	ns	.0267 (ns)
Under 39	Ns	ns	.0149 (ns)
Under 49	Ns	ns	<0
Under 59	.20044 (.000)	.07487 (.014)	.4132
Above 60	.062017 (.067)	ns	.0257
Women	.11349 (.009)	ns	.1250
Men	.088868 (.004)	ns	.1740

2.3.10. Terrebonne Parish, Unit Root Tests

In Terrebonne Parish, the unit root test on retirement transfers rejected the null hypothesis of a unit root at the 10% level of significance. The remaining variables failed to reject the null hypothesis at the 10% level of significance. The unit root tests on the first differences of the three income transfer variables that failed to reject the null hypothesis of a unit root in the levels rejected the null hypothesis. As with Lafourche Parish, these three series appeared to be I(1) nonstationary in the levels and I(0) stationary in the first differences which allowed for the possibility of a cointegrating relationship with other I(1) economic variables.

Table 2.37

Results for the Unit Root Tests for the Income Transfer Variables for Terrebonne Parish

The null hypothesis of a unit root in the series* $H_0: \theta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Rejected	Rejected
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Failed	Rejected

*The results of the unit root test appeared to be sensitive to the form of the test specified, Augmented Dickey Fuller versus Phillips-Perron.

2.3.11. Terrebonne Parish, Cointegration Tests

The tests for the existence of a cointegrating relationship between the pairings of each of the employment and income variables for the MSA and each of the income transfer variables for Terrebonne Parish failed to reject the null hypothesis of a unit root in the residuals of the test regression. The results implied there was not a statistically detectable long-run relationship that required the specification of an error correction model for a test of the relationships between the employment and income and income transfer variables in the Houma-Thibodaux MSA and the income transfer variables in Terrebonne Parish.

Table 2.38

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for Terrebonne Parish

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Failed	Failed
Manufacturing Employment	Not applicable	Failed	Failed	Failed
Wage and Salary Jobs	Not applicable	Failed	Failed	Failed
Average Earnings per Job	Not applicable	Failed	Failed	Failed
Real Average Earnings per Job	Not applicable	Failed	Failed	Failed
Manufacturing Income	Not applicable	Failed	Failed	Failed
Real Manufacturing Income	Not applicable	Failed	Failed	Failed

2.3.12. Terrebonne Parish, Distributed Lag Model

For Terrebonne Parish, the impact of the changes in the employment and income variables on the change in retirement transfers was not significant in most cases. The only significant results from the estimation of the distributed lag model were for the change in average earnings per job with a long-run multiplier of .94567 that was significant at the 10% level and the short-run multiplier which was .29122 and was also significant at the 10% level.

Table 2.39

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for Terrebonne Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	.12879 (.106)	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	.38485 (.10)	ns	<0
Average Earnings per Job	.94567 (.000)	.29122 (.068)	.4554
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

With regard to the change in Medicaid transfers, the change in fabrication employment explained 9.25 of the variation and had a short-run multiplier of -.57647 which was significant at the 10% level. The change in real manufacturing income also had a short-run multiplier of -.63331 that was significant at the 10% level. All other variables were not significant.

Table 2.40

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for Terrebonne Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	-.57647 (.098)	.0925
Manufacturing Income	Ns	-.48512 (.116)	.0113
Real Manufacturing Income	Ns	-.6333 (.053)	.0518
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	-.57647 (.098)	.0925

In regard to participation in the food stamp program, as in Lafourche Parish several variables provided significant results. The change in fabrication employment had a long-run multiplier of -1.0224 that was significant at the 10% level and a short run multiplier of -.71609 that was significant at the 5% level. Both the change in manufacturing income and the change in real manufacturing income had significant short-term multipliers of -.57978 and -.70321 that were significant at the 10% and 5% levels respectively. The change in wage and salary jobs and the change in the average earnings per job were significantly different from zero. The change in real average earnings per job had a short-run multiplier that was significant at the 10% level.

However, the model as a whole was only marginally significant. Finally, the change in manufacturing employment mirrored almost exactly the change in fabrication employment in scale and significance.

Table 2.41.

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income Variables for Terrebonne Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	-1.10224 (.036)	-.71609 (.037)	.3003
Manufacturing Income	Ns	-.57978 (.061)	.2010
Real Manufacturing Income	Ns	-.70321 (.03)	.2593
Wage and Salary Jobs	Ns	-1.4613 (.11)	.0427 (ns)
Average Earnings per Job	Ns	ns	.0476 (ns)
Real Average Earnings per Job	Ns	-2.0397 (.071)	.0151 (ns)
Manufacturing Employment	-1.10224 (.036)	-.71609 (.037)	.3003

With regard to income transfers through unemployment compensation in Terrebonne Parish, in no cases were the long-term multipliers significant despite the level of explanatory power in the distributed lag model. However, the results for the short-term multiplier or contemporaneous effect were substantial and significant for all of the Income and employment variables. In the case of a 1% decline in wage and salary jobs, the resulting impact on unemployment compensation transfers was an additional 9.46%. Similar results were obtained for average earnings per jobs, -8.878, and real average earnings per job, -9.5861. Other variables such as fabrication employment and manufacturing income and real manufacturing income had substantial short-term multiplier effects but were smaller in magnitude at -3 to -3.5. In all cases, the estimated multipliers were significant at the 1% level based upon the reported p-value.

Table 2.42.

Distributed Lag Model of Order (0,3) for Unemployment Compensation Transfers and the Employment and Income Variables for Terrebonne Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	ns	-3.0846 (.005)	.3456
Manufacturing Income	Ns	-3.0408 (.001)	.4539
Real Manufacturing Income	Ns	-3.4418 (.000)	.4313
Wage and Salary Jobs	Ns	-9.4619 (.000)	.6024
Average Earnings per Job	Ns	-8.8785 (.001)	.4263
Real Average Earnings per Job	Ns	-9.5861 (.005)	.1898
Manufacturing Employment	Ns	-3.0846 (.005)	.3456

The results for the changes in the employment and income variables were highly significant and suggested the changes accounted for very large portion of the variation in the change in the unemployment insurance transfers. In particular, the short-run multiplier for each of the employment and income variables demonstrated an inverse relationship that was significant at the 1% level. As in Lafourche Parish, these results are very consistent with observation and had tremendous intuitive appeal.

2.3.13. Terrebonne Parish, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.3.14. Terrebonne Parish, Unit Root Analysis

The tests for the null hypothesis of a unit root failed to reject the null for all of the population segments for Terrebonne parish in the levels. However, in the tests for the first differences, the segments "total," "under 29," "women" and "men" failed to reject the null. Therefore, these series failed to meet the I(1) condition for the cointegration test with manufacturing employment.

Table 2.43

Unit Root Test for Population Variables

Terrebonne Parish Population		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Failed
Under 19	Failed	rejected
Under 29	Failed	Failed
Under 39	Failed	rejected
Under 49	Failed	rejected
Under 59	Failed	rejected
Above 60	Failed	rejected
Women	Failed	Failed
Men	Failed	Failed
Employment Variable:		
Manufacturing Employment (MSA)	Failed	rejected

2.3.15. Terrebonne Parish, Cointegration Analysis

Given the results of the unit root tests, tests for the presence of a cointegrating relationship were conducted for the remaining segments of the population with manufacturing employment. In the case of Terrebonne Parish, all of the tests for the segments that were I(1) series failed to reject the null hypothesis of no cointegration. Therefore, we concluded that no long-term relationship of this form existed between these series.

Table 2.44

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Terrebonne Parish Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Failed	na	Failed	na	Failed	Failed	Failed	na	na

2.3.16. Terrebonne Parish, Distributed Lag Model Analysis

The results of the distributed lag model for Terrebonne Parish accounted for a much larger percentage of the variation than the estimates for Lafourche Parish with several values for the adjusted-r^2 greater than .30. Furthermore, several estimates for the long-term multiplier were significant at the 1% level based upon the reported p-values. For example, the adjusted-r^2 for "men," "under 59," "women," "total" and "under 19" were .4253, .4238, .3425, .3405 and .303 respectively. As in Lafourche Parish, an interesting result was in the "under 59" segment. The estimate of the long-term multiplier was .1859 which was significant at the 1% level while the estimate for the short-term multiplier was .548 and significant at the 5% level. This appeared to indicate a much more immediate response by this segment to a change in manufacturing employment. The “under 19” and “under 29” segments demonstrated significant long-term response as well to a change in manufacturing employment. As a note of caution, given the failure of some of the series to reject the null of a unit root in the first differences, the estimates of the distributed lag model may provide spurious results for these series.

Table 2.45

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Terrebonne Parish Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R^2
Total Population	.11537 (.000)	ns	.3405
Under 19	.10418 (.001)	ns	.3034
Under 29	.30435 (.001)	ns	.2638
Under 39	Ns	ns	<0 (ns)
Under 49	Ns	ns	<0
Under 59	.18586 (.000)	.05475 (.05)	.4238
Above 60	.04510 (.094)	ns	.0483
Women	.16547 (.000)	ns	.3425
Men	.12807 (.000)	ns	.4253

2.3.17. St. Mary Parish

While technically not part of the Houma-Thibodaux MSA, St. Mary Parish shares many of the same industries and employers with the Houma-Thibodaux-Bayou Cane MSA. Furthermore, many people live in the Houma-Thibodaux area and work in eastern St. Mary Parish, for example, the fabrication facilities in Amelia and Morgan City. Therefore, it would be reasonable to include this parish in the overall statistical analysis.

2.3.18. St. Mary Parish, Income Transfer Analysis, Unit Root Tests

The data for St. Mary Parish provided similar results for the unit root tests on the social-employment and income variables. The retirement variable rejected the null hypothesis of a unit root in the levels. The remaining three variables failed to reject null hypothesis of a unit root in the levels and rejected the null hypothesis of a unit root in the first differences. The results indicated the three variables; Medicaid transfers, food stamp transfers, and unemployment compensation in St. Mary Parish were I(1) nonstationary time series with possible cointegrating relationships with other I(1) series.

Table 2.46

Results for the Unit Root Tests for the Income Transfer Variables for St. Mary Parish

The null hypothesis of a unit root in the series* $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Rejected	Rejected
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Failed	Rejected

*The results appeared to be sensitive to the form of the test specified, Augmented Dickey-Fuller versus Phillips-Perron.

2.3.19. St. Mary Parish, Cointegration Tests

The tests for the existence of a long-run cointegrating relationship between the pairings of each of the employment and income variables for the MSA and each of the income transfer variables for St. Mary Parish failed to reject the null hypothesis of a unit root in the residuals of the test regression. The results suggested there was not a detectable long run relationship that required the specification of an error correction model for a test of the relationships between the employment and income and income transfer variables in the Houma-Thibodaux MSA and the income transfer variables in St. Mary Parish.

Table 2.47

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for St. Mary Parish

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Failed	Failed
Manufacturing Employment	Not applicable	Failed	Failed	Failed
Wage and Salary Jobs	Not applicable	Failed	Failed	Failed
Average Earnings per Job	Not applicable	Failed	Failed	Failed
Real Average Earnings per Job	Not applicable	Failed	Failed	Failed
Manufacturing Income	Not applicable	Failed	Failed	Failed
Real Manufacturing Income	Not applicable	Failed	Failed	Failed

2.3.20. St. Mary Parish, Distributed Lag Model

The results of the estimation of the distributed-lag model for the change in retirement transfers for St. Mary suggested that the changes in fabrication employment, real manufacturing income, real average earnings per job, and manufacturing employment had no significant impact. The change in nominal manufacturing income and wage and salary jobs indicated a significant long-run multiplier. However, the F-tests for the hypothesis of the coefficients equal to zero were only marginally significant at best. The only employment and income variable with obviously significant results was the change in the nominal average earnings per job which had an adjusted-r^2 of .4987 and long-run and short-run multipliers of .82634 and .25579, which were significant at the 1% and 5% levels, respectively.

Table 2.48

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for St. Mary Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	.11143 (.10)	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	.36729 (.063)	Ns	<0
Average Earnings per Job	.82634 (.000)	.25579 (.048)	.4987
Real Average Earnings per Job	Ns	ns	.0026
Manufacturing Employment	Ns	ns	<0

With respect to the Medicaid transfers, the change in the employment and income variables appeared to have little or no explanatory power or impact. While a few of the lagged coefficients were significant for the change in manufacturing income, the change in wage and salary jobs, and the change in manufacturing employment, the signs and length of the lag made it difficult to tell a plausible economic story.

Table 2.49

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for St. Mary Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.0604
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	.0261
Wage and Salary Jobs	Ns	ns	.0198
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	.0604

As in the case of Lafourche Parish and Terrebonne Parish, many of the employment and income variables had a significant impact on the food stamp program transfers for the parish. The change in fabrication employment accounted for 33.9% of the variation in the change in the food stamp transfers. The estimated long-run multiplier was -1.02 and was significant at the 1% level. The short-run multiplier was not significantly different from zero. The change in manufacturing income accounted for 19.15% of the variation in the change in the food stamp transfers and the long-run multiplier of -.4711 which was significant at the 10% level. The change in real manufacturing income had an adjusted-r^2 of 26.59% with a long-run multiplier of -.564 that was significant at the 5% level. The short-run multiplier of -.4423 was significant at the 10% level. The change in wage and salary jobs had a short-term multiplier of -1.249 that was significant at the 10% level. The change in the average earnings per job did not have any significant results. The change in real earning per job had a short- run multiplier of -2.2206 that was significant at the 5% level. However, the adjusted-r^2 was only 12.29%. The results for manufacturing employ mirrored the fabricating employment almost perfectly.

Table 2.50

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income Variables for St. Mary Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	-1.0207 (.013)	ns	.3389
Manufacturing Income	-.47108 (.107)	ns	.1915
Real Manufacturing Income	-.56403 (.052)	-.44226 (.102)	.2659
Wage and Salary Jobs	Ns	-1.2491 (.10)	.0983
Average Earnings per Job	Ns	ns	.009 (ns)
Real Average Earnings per Job	Ns	-2.2206 (.017)	.1229
Manufacturing Employment	-1.0207 (.013)	ns	.3389

As one would have expected, the change in the unemployment compensation transfers was significantly impacted by the changes in several of the employment and income variables. In many of the cases, the timing and magnitude of the multiplier estimates as well as the level significance of the estimates indicated how important the relationship was within the MSA. The change in fabrication employment accounted for 37% of the variation of the change in the unemployment compensation transfers. The short-run multiplier was -2.6460 which was significant at the 1% level. The change in manufacturing income accounted for 48% of the variation in the change in the unemployment compensation transfers with a short-term multiplier of -2.66 which was significant at the 1% level. The change in the real manufacturing income had similar results with an adjusted-r^2 of 45% and a short-run multiplier of -3.09 that was significant at the 1% level. The change in wage and salary jobs as one would have expected accounted for a large percentage of the variation in the unemployment compensation transfers with an adjusted-r^2 of 62.61%. The short-run multiplier was estimated at -8.6531 which was significant at the 1% level. The change in the average earning per job had an adjusted-r^2 of 43.27%. The short-run multiplier of -8.4337 was significant at the 1% level. The change in the real average earnings per job only accounted for 14.83% of the variation in the change in the unemployment compensation transfers. However, the short-run multiplier of -8.966 was significant at the 5% level.

Table 2.51

Distributed Lag Model of Order (0,3) for Unemployment Insurance Transfers and the Employment and Income Variables for St. Mary Parish

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	-2.6460 (.006)	.3709
Manufacturing Income	Ns	-2.6587 (.001)	.4799
Real Manufacturing Income	Ns	-3.0894 (.000)	.45
Wage and Salary Jobs	Ns	-8.6531 (.000)	.6261
Average Earnings per Job	Ns	-8.4337 (.002)	.4327
Real Average Earnings per Job	Ns	-8.9662 (.014)	.1483
Manufacturing Employment	Ns	-2.6460 (.006)	.3709

2.3.21. St. Mary Parish, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.3.22. St. Mary Parish, Unit Root Analysis

The tests for the null hypothesis of a unit root in population series for St. Mary Parish failed to reject the null hypothesis of a unit root in the levels for each of the series. The null hypothesis was then rejected for the tests on the first differences for each series. Therefore we concluded these series were I(1) and could be used to test for the presence of a long-run cointegrating relationship.

Table 2.52

Unit Root Test for Population Variables

St. Mary Parish Population		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Rejected
Under 19	Failed	Rejected
Under 29	Failed	Rejected
Under 39	Failed	Rejected
Under 49	Failed	Rejected
Under 59	Failed	Rejected
Above 60	Failed	Rejected
Women	Failed	Rejected
Men	Failed	Rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.3.23. St. Mary Parish, Cointegration Analysis

The tests for the null hypothesis of no cointegration failed to reject the null for all of the segments of the population for St. Mary Parish. Therefore, it did not appear that a significant long-run relationship between the various segments of the population and manufacturing employment was detectable or exist during the study period.

Table 2.53

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
St. Mary Parish Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Failed	Failed	Failed	Failed	Failed	Failed	Failed	Failed	Failed

2.3.24. St. Mary Parish, Distributed Lag Model Analysis

The results for the distributed lag model for St. Mary Parish indicated results that were in between those for Lafourche Parish on the low end and those from Terrebonne Parish on the high end based on the size of the adjusted-r^2. The highest adjusted-r^2 reported was for the "under 59" segment at .4359. The adjusted-r^2's for the segments "men," "women," and "total" were .2891, .2564 and .2677, respectively, that suggested a reasonable amount of the variation in the population segment was explained by the change in manufacturing employment. As in the results discussed previously, the adjusted-r^2 was higher for the segment "men" than the adjusted-r^2 for the segment "women." However, the long-term multiplier for "women" was higher than that reported for the segment men indicating a stronger response to a change in manufacturing employment. The largest long-term multiplier reported was for the segment "under 29" followed by the "under 59" group. Both were highly significant based upon the reported p-value.

Additionally, the under 59 segment was the only segment reporting a significant short-term multiplier.

As in the case of the results reported previously, the results that were not significant may well have been the most interesting indicating no impact on these segments of the population due to a change in the manufacturing employment.

Table 2.54

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
St. Mary Parish Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R^2
Total Population	.09033 (.007)	ns	.2677
Under 19	Ns	ns	.2504
Under 29	.27708 (.017)	ns	.1663
Under 39	Ns	ns	<0 (ns)
Under 49	Ns	ns	.0740
Under 59	.22676 (.000)	.07066 (.048)	.4359
Above 60	Ns	ns	.1251
Women	.15161 (.005)	ns	.2564
Men	.10176 (.018)	ns	.2891

2.3.25. Summary

In summary, the results of the statistical analysis appeared to be a significant relationship between oil prices and the employment and income variables for the Houma-Thibodaux MSA. Furthermore, the economic conditions seem to have a significant impact on the income transfer variables at the parish level such as food stamp transfers and unemployment compensation transfers. While this story would seem to be obvious, the statistical evidence seemed to provide an indication of the relative strength of these relationships and the timing on the effects for Lafourche Parish, Terrebonne Parish and St. Mary Parish.

2.4. PASCAGOULA MSA

As with the other MSA's, the results of the unit root tests for oil and natural gas prices apply in general given the national and international scope of the market for these commodities.

2.4.1. Employment and Income Variables, Unit Root Tests

The unit root tests were conducted on the employment and income variables used in the study for the Pascagoula MSA. In this particular study community, the variables for manufacturing income and real manufacturing income rejected the null hypothesis of a unit root in the levels. This implies that both of these series are in fact I(0) stationary in the levels. The remaining variables: fabrication employment, wage and salary jobs, average earnings per job, real average earnings per job, and manufacturing employment all failed to reject the null hypothesis of a unit root in the levels. It is worth noting some of the series had results that were significant at the 10% level but not at the 5% level.

The tests for a unit root in the series for the first difference was then conducted for each of the employment and income variables. In this case, all of the series rejected the null hypothesis of a unit root in the series for first differences. However, as in the test on the series for the levels, some of test statistics were very close to the critical values for the 5% level of significance.[3]

Table 2.55

Results for the Unit Root Tests for the Employment and Income Variables for the Pascagoula, MS, MSA

The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Manufacturing Income	Rejected	rejected
Real Manufacturing Income	Rejected	rejected
Fabrication Employment	Failed	rejected
Wage and Salary Jobs	Failed	rejected
Average Earnings per Job	Failed	rejected
Real Average Earnings per Job	Failed	rejected
Manufacturing Employment	Failed	rejected

2.4.2. Cointegration Tests

The tests for the presence of a cointegrating relationship between the price of oil and the economic factors for the Pascagoula MSA fail to reject the null hypothesis of no cointegration. This would imply that no long-term relationship of the form specified between these variables and oil prices is present. Likewise, the tests for the presence of a cointegrating relationship between the employment and income variables for the MSA and the price of natural gas failed to reject the null hypothesis of no cointegration. It is worth noting that several test statistics while not significant, were very close to the critical value for the test.

[3] The tests results for the null hypothesis of a unit root were sensitive to the form of the test. The results for the Augmented Dickey-Fuller Test at times contradicted the test results for the Phillips-Perron unit root test. While the tests are different in the method by which they handle the autocorrelation issue, one would expect the results to be somewhat consistent.

Table 2.56

Results for the Cointegration Tests for the Employment and Income Variables for the Pascagoula MS, MSA and the Price of Oil and Natural Gas *

The null hypothesis, H_0, of No Cointegrating Relationship		
	Oil	Natural Gas
Manufacturing Income	Failed	Failed
Real Manufacturing Income	Failed	Failed
Fabrication Employment	Failed	Failed
Wage and Salary Jobs	Failed	Failed
Average Earnings per Job	Failed	Failed
Real Average Earnings per Job	Failed	Failed
Manufacturing Employment	Failed	Failed

*It is worth noting some of the test statistics were very close to the critical values.

2.4.3. Distributed Lag Model

The distributed lag model was estimated for each of the employment and income variables for the MSA as a function of the change in the price of oil and/or natural gas. The change in the price of oil accounted for 32.5% of the variation in the change in the average earnings per job in the Pascagoula MSA. The estimate for the long-run multiplier was .135 and was significant at the 1% level. While the short-run multiplier was not significant, the coefficient, .0798, on the first lagged value for the change in oil was significant at the 1% level. The change in natural gas prices accounted for a 15.77% of the variation in the average earnings per job with a long-run multiplier of .1543 that was significant at the 1% level.

Table 2.57

Distributed Lag Model of Order (0,3) for Oil and the Employment and Income Variables

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	Ns	ns	.0296
Real Manufacturing Income	Ns	ns	<0
Fabrication Employment	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	.13502 (.004)	.079763 (.002)	.3250
Real Average Earnings per Job	Ns	ns	.0809 (ns)
Manufacturing Employment	Ns	ns	<0

As with the change in the price of oil, the short-run multiplier was not significantly different from zero. However, the coefficient, .098, on the first lagged value of the change in natural gas prices was significant at the 1% level. A possible explanation for this result could be a cost of living adjustment (COLA) in a union contract that increases the average wage by the change in an inflation index that is heavily influenced by energy prices.

Table 2.58

Distributed Lag Model of Order (0,3) for Natural Gas and the Employment and Income Variables

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	Ns	ns	.0287
Real Manufacturing Income	Ns	ns	<0
Fabrication Employment	Ns	ns	.0056
Wage and Salary Jobs	Ns	ns	<0 (ns)
Average Earnings per Job	.15426 (.02)	.9795 (.01)	.1577
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

2.4.4. Jackson County, MS, Income Transfer Variables, Unit Root Tests

The unit root tests on the income transfer variables for the MSA rejected the null hypothesis of a unit root in the level for the retirement variable. This implies this variable is I(0) stationary in the level. The unit root tests on the variables for Medicaid, food stamps, and unemployment compensation all failed to reject the null hypothesis of a unit root in the levels. The tests for the presence of a unit root in the first differences of the variables rejected the null hypothesis of a unit root for all of the variables indicating the variables are I(0) stationary in the first differences. This result is significant because a series must be I(1) nonstationary in order to be cointegrated with a second I(1) nonstationary series.

Table 2.59

Results for the Unit Root Tests for the Income Transfer Variables for Jackson County, MS

The null hypothesis of a unit root in the series* $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Rejected	Rejected*
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Failed	Rejected

*The results appeared to be sensitive to the form of the test specified, Augmented Dickey-Fuller versus Phillips-Perron.

2.4.5. Jackson County, Cointegration Tests

The tests for a cointegrating relationship between the employment and income variables for the MSA and the income transfer variables reported at the county level failed to reject the null hypothesis of no cointegration for all of the employment and income variables and Medicaid participation. However, the results for food stamps and unemployment are more interesting. As it pertains to food stamp participation, the variables average earnings per job, manufacturing income and real manufacturing income have test statistics that are significant at the percent level and not at the 5% level. In some cases, the tests statistics are extremely close to the critical value for 5%. For the unemployment compensation, the same three variables are significant at the 10% level, but not the 5% level. This result is important in that there may in fact be a long-term relationship present given the make-up of the economy within the Pascagoula MSA. However, the model as specified may be insufficient to adequately capture the relationship.

Table 2.60

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for Pascagoula MSA and Jackson County, MS

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Failed	Failed
Manufacturing Employment	Not applicable	Failed	Failed	Failed
Wage and Salary Jobs	Not applicable	Failed	Failed	Failed
Average Earnings per Job	Not applicable	Failed	Rejected*	Failed*
Real Average Earnings per Job	Not applicable	Failed	Failed	Failed
Manufacturing Income	Not applicable	Failed	Failed*	Failed*
Real Manufacturing Income	Not applicable	Failed	Failed*	Failed*

*The test statistics in these cases were either very close to the critical values at the 10% level or fell between the critical values for the 10% level and the 5% level.

2.4.6. Jackson County, Distributed Lag Model

Given the results of the tests for cointegration and the inconsistencies, the distributed lag model of order (0,3) was estimated in an effort to capture any relationship that may exist using a different specification. The model was estimated for each of the income transfer variables as a function of the employment and income variables for the Pascagoula MSA. The estimates of both the long-term and short-term multipliers were evaluated to determine the level of significance.

For the change in the retirement variable, the change in manufacturing income accounted for 17.59% of the variation. The estimate of the long-term multiplier was .341 and was significant at the 1% level. The short-term multiplier was not significant. In the case of the change in wage and salary jobs, the model only explains 2.7% of the variation. However, the estimate of the long-term multiplier, .418, was significant at the 10% level. The short-run multiplier was not significant. Finally, change in the average earnings per job accounted for 47.65% of the variation in the retirement variable. The estimate of the long-term multiplier was 1.0821 and was significant at the 1% level. The estimated short-run multiplier was .3769 and was significant at the 5% level. The remaining variables: fabrication employment, real manufacturing income, real average earnings per share, and manufacturing employment did not have significant explanatory power.

Table 2.61

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for Jackson County, MS

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	.34095 (.01)	ns	.1759
Real Manufacturing Income	Ns	ns	.0513
Wage and Salary Jobs	.418 (.091)	ns	.0274
Average Earnings per Job	1.0821 (.000)	.37685 (.014)	.4765
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

The distributed lag model was then estimated for the change in Medicaid participation. The estimated results were significant only for the change in the average earnings per job with an adjusted-r^2 of 12.60%. The estimated long-run multiplier was 1.594 and was significant at the 5% level. The estimate of the short-run multiplier was 1.038 and was significant at the 5% level. The remaining variables did not report any results that were significant at even the 10% level.

Table 2.62

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for Jackson County, MS

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	.0111
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	1.5939 (.022)	1.0383 (.046)	.1260
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

The estimates from the distributed lag model for the change in the amount of food stamp participation were not significant at any level for any variable. The highest value for the adjusted-r^2 was only 3.9%. In all cases, the F-test for significance from zero failed to reject the null hypothesis of zero.

Table 2.63

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income Variables for Jackson County, MS

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	.039
Manufacturing Employment	Ns	ns	<0

In the case of the change in unemployment compensation, the estimates for the changes in fabrication employment, manufacturing income, real manufacturing income, average earnings per job and real average earnings per job were not significant. The change in wage and salary jobs accounted for 6.33 of the variation of the change in unemployment. Additionally, the estimate of the short-run multiplier was -2.39, however, the p-value was only .11 indicating marginal significance at best.

Table 2.64

Distributed Lag Model of Order (0,3) for Unemployment Insurance Transfers and the Employment and Income Variables for Jackson County, MS

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	-1.575 (.039)	.0630 (ns)
Manufacturing Income	Ns	ns	.0111
Real Manufacturing Income	Ns	ns	.0006
Wage and Salary Jobs	Ns	-2.3858 (.111)	.06333
Average Earnings per Job	4.8624 (.054)	ns	.0771 (ns)
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	-1.575 (.039)	.0630

2.4.7. Jackson County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.4.8. Jackson County, Unit Root Analysis

The test for the null hypothesis of a unit root in a series for the population variables in Jackson County failed to reject the null for each segment in the levels. The tests for the unit root in the series of the first differences failed to reject the null for the total "population" segment and for the segment "women." The null was rejected for the remaining series which suggested they were I(1) series that could be tested for a cointegrating relationship with the variable for manufacturing employment.

Table 2.65

Unit Root Test for Population Variables

Jackson County, MS Population		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Failed
Under 19	Failed	rejected
Under 29	Failed	rejected
Under 39	Failed	rejected
Under 49	Failed	rejected
Under 59	Failed	rejected
Above 60	Failed	rejected
Women	Failed	Failed
Men	Failed	rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	rejected

2.4.9. Jackson County, Cointegration Analysis

Given the results of the unit root tests for the population segments in Jackson County tests for the existence of a long-run cointegrating relationship were conducted. The results failed to reject the null hypothesis of no cointegrating relationship for all of the segments that were I(1) series.

Table 2.66

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Jackson County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
NA	failed	failed	failed	failed	failed	failed	NA	failed

2.4.10. Jackson County, Distributed Lag Model Analysis

The results of the distributed lag model are presented below. The results based on the adjusted-r^2 were fairly weak relative to other study areas. The largest adjusted-r^2 was .14551 for the segment "under 49" indicating approximately 15% of the variation in the population segment was explained by a change in manufacturing employment. In this case, the long-term multiplier was .15554 and significant at the 1% level. The segments for "women" and "men" both reported adjusted-r2 around the 10% level with multipliers of .1625 and .13 respectively. In both cases, the results were significant at the 5% level. In no case was the short-term multiplier significant. In two cases, the estimated equation for the distributed lag model failed to reject the null hypothesis of all of the parameters equal to zero.

Table 2.67

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Jackson County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R
Total Population	.10827 (.039)	ns	.0745
Under 19	.12710 (.037)	ns	.0919 (ns)
Under 29	Ns	ns	<0
Under 39	Ns	ns	<0
Under 49	.15554 (.010)	ns	.1451
Under 59	Ns	ns	.0423
Above 60	Ns	ns	<0 (ns)
Women	.16252 (.02)	ns	.0945
Men	.13029 (.025)	ns	.1032

2.5. MOBILE MSA

As with the other MSA's, the results of the unit root tests for oil and natural gas prices apply in general given the national and international scope of the market for these commodities.

2.5.1. Employment and Income Variables, Unit Root Tests

The unit root test on the employment and income variables: manufacturing income, real manufacturing income, fabrication employment, wage and salary jobs, average earning per job, real average earning per job, and manufacturing employment, failed to reject the null hypothesis of a unit root in the level for each of the series. The unit root test on the first differences of the series rejected the null hypothesis of a unit root in most cases.[4] The null hypothesis was not rejected for the first difference series for average earnings per job. The results suggested that

[4] This is based on the Phillips-Perron test for the null hypothesis. The Augmented Dickey-Fuller tests did not provide consistent results for this data.

most of the employment and income variables were I(1) nonstationary series in the levels and I(0) stationary in the first differences.

Table 2.68

Results for the Unit Root Tests for the Employment and Income Variables for the Mobile, MSA

The null hypothesis of a unit root in the series* $H_0: \theta = (\rho - 1) = 0$		
	Levels	First Difference
Manufacturing Income	Failed	rejected
Real Manufacturing Income	Failed	rejected
Fabrication Employment	Failed	rejected
Wage and Salary Jobs	Failed	rejected
Average Earnings per Job	Failed	Failed
Real Average Earnings per Job	Failed	rejected
Manufacturing Employment	Failed	rejected

*The test results for the presence of a unit root in the economic series were sensitive to the form of the test specified, Augmented Dickey-Fuller versus Phillips-Perron.

2.5.2. Cointegration Tests

The tests for a long-run cointegrating relationship between the price of oil and the employment and income variables for the Mobile MSA failed to reject the null hypothesis in all cases. The same result was obtained for the tests between the employment and income variables and the price of natural gas. Thus, there was insufficient evidence to conclude a long-run relationship of the form specified for a cointegrating relationship exists between the employment and income variables for the Mobile MSA and the time series for oil and/or natural gas.

Table 2.69

Results for the Cointegration Tests for the Employment and Income Variables for the Mobile, MSA and the Price of Oil and Natural Gas *

The null hypothesis, H_0, of No Cointegrating Relationship		
	Oil	Natural Gas
Manufacturing Income	Failed	Failed
Real Manufacturing Income	Failed	Failed
Fabrication Employment	Failed	Failed
Wage and Salary Jobs	Failed	Failed
Average Earnings per Job	Failed	Failed
Real Average Earnings per Job	Failed	Failed
Manufacturing Employment	Failed	Failed

2.5.3. Distributed Lag (0,3) Model

Given the results of the unit root and cointegration tests, a distributed lag model of order (0,3) was estimated using the change or first difference for each of the variables. The first estimates were conducted for the impact of oil and natural gas on the employment and income variables at the MSA level. The results were not significant in most cases. The model did provide significant estimates of the long-term multiplier in the cases of manufacturing income and average earnings per job. In the case of manufacturing income, the change in the price of oil accounted for 17.17% of the variation in the change in manufacturing income based on the adjusted-r^2. The long-term multiplier based on the sum of the coefficients was .1849 and significant at the 5% level. In the case of the average earnings per job, the variation in the change in the price of oil accounted for 43.39% of the variation in average earnings. The estimate of the long-term multiplier was .12152 and was significant at the 1% level. The short-term multiplier was .0248 and was significant at the 10% level. Furthermore, the estimated coefficients on the lag of the last two year's changes in the price of oil was .0386 and .0454 respectively. and were significant at the 1% level.

Table 2.70

Distributed Lag Model of Order (0,3) for Oil and the Employment and Income Variables for the Mobile MSA

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	.1849 (.015)	Ns	.1717
Real Manufacturing Income	Ns	Ns	<0
Fabrication Employment	Ns	Ns	<0
Wage and Salary Jobs	Ns	Ns	<0
Average Earnings per Job	.12152 (.000)	.0248 (.086)	.4339
Real Average Earnings per Job	Ns	Ns	.0442
Manufacturing Employment	Ns	Ns	<0

In regards to the price of natural gas, only the variable for the average earnings per job is significantly impacted by the change in the price of natural gas. The estimate of the long-term multiplier is .12728 and is significant at the 1% level. The short-term multiplier estimate is .0573 and is significant at the 5% level.

Table 2.71

Distributed Lag Model of Order (0,3) for Natural Gas and the Employment and Income Variables for the Mobile MSA

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income		ns	<0
Real Manufacturing Income	Ns	ns	<0
Fabrication Employment	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	.12728 (.003)	ns	.1965
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

2.5.4. Mobile County, Income Transfer Variables

The unit root tests for the income transfer variables: retirement, Medicaid, food stamps, and unemployment transfer, were conducted for both Mobile and Baldwin counties. In Mobile County, the variable retirement rejected the null hypothesis of a unit root in the levels indicating an I(0) series in the level. The remaining income transfer variables all failed to reject the null hypothesis of a unit root in the levels. The unit root test on the first differences of these variables rejects the null hypothesis of a unit root in the series. These results indicated that the series were I(1) nonstationary in the levels and I(0) stationary in the differences.

Table 2.72

Results for the Unit Root Tests for the Income Transfer Variables for Mobile County, AL

The null hypothesis of a unit root in the series* $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Rejected	Rejected*
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Failed	Rejected

2.5.5. Mobile County, Cointegration Tests

The test for a long-run relationship between the employment and income variables at the MSA-level and the income transfer variables at the county-level were conducted for Mobile County. In Mobile County, the cointegration tests failed to reject the null hypothesis of no cointegrating relationship for all of the pairings of each employment and income and each income transfer variable. The one exception to this was the average earnings per job variable which did not test I(1) in the unit root test.

Table 2.73

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for the Mobile MSA and Mobile County, AL

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Failed	Failed
Manufacturing Employment	Not applicable	Failed	Failed	Failed
Wage and Salary Jobs	Not applicable	Failed	Failed	Failed
Average Earnings per Job	Not applicable	Not applicable	Not applicable	Not applicable
Real Average Earnings per Job	Not applicable	Failed	Failed	Failed
Manufacturing Income	Not applicable	Failed	Failed*	Failed*
Real Manufacturing Income	Not applicable	Failed	Failed*	Failed*

2.5.6. Mobile County, Distributed Lag Model

The distributed model was estimated for each of the income transfer (transfer) variables at the county level as a function of the employment and income for the MSA. In the case of Mobile County, significant results were found for retirement transfers, Medicaid transfers and unemployment compensation/insurance transfers. The results for food stamp transfers were not significant. The variation in fabrication employment accounted for 21.59% of the variation in retirement transfers, manufacturing income accounted for 66% of the variation in retirement transfers, real manufacturing income accounted for 36.8%, wage and salary jobs accounted for 16.8%, and average earnings per job accounted for 87.5% of the variation in the change in retirement transfers. The variable for manufacturing income was almost identical to the results for fabrication employment in terms of its impact.

The estimates for the long-term multiplier were significant for all of the employment and income variables except real average earnings per job. For fabrication employment, the estimate was .6174 and was significant at the 1% level. The long-term multiplier for manufacturing income was .58. For real manufacturing income, the estimated long-term multiplier was .639. For wage and salary jobs, the long-term multiplier estimate was 1.17 and for average earnings per job it was 1.39. In each of these cases, it was significant at the 1% level.

The short-term multiplier was only significant in two cases, manufacturing income and average earnings per job. In the case of manufacturing income, the estimate was .2235 while the estimate for average earnings per job was .75. In both cases the estimate was significant at the 1% level.

Table 2.74

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for Mobile MSA and Mobile County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	.61742 (.001)	ns	.2159
Manufacturing Income	.58018 (.000)	.2235 (.001)	.6608
Real Manufacturing Income	.63949 (.000)	ns	.3679
Wage and Salary Jobs	1.1718 (.006)	ns	.1684
Average Earnings per Job	1.3881 (.000)	.75009 (.000)	.8754
Real Average Earnings per Job	Ns	ns	.1523
Manufacturing Employment	.61742 (.001)	ns	.2159

The estimates of the distributed lag model for Medicaid had only marginally significant results. The change in fabrication employment explained 9.9% of the variation in the change in Medicaid. The change in manufacturing income accounted for 8.6% while the change in real manufacturing income accounted for 7.33% of the variation in Medicaid. As in earlier results, manufacturing employment and fabrication employment had almost identical results. There were no cases in which the long-term multiplier was significant. In fact, the short-term multiplier was not significant in any case either. However, the coefficient on the first lagged value was significant for fabrication employment, manufacturing income and real manufacturing income.

Table 2.75

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for the Mobile MSA and Mobile County, AL

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.0991
Manufacturing Income	Ns	ns	.0859
Real Manufacturing Income	Ns	ns	.0733
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

The estimates from the distributed lag model were not significant in explaining any of the variability in the change in the food stamp transfers during this period for Mobile County.

Table 2.76

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income Variables for the Mobile MSA and Mobile County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	Ns	ns	.0721
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

However, the distributed lag model for the change in the unemployment compensation transfers provided several significant results. First, the change in fabrication employment accounted for 23.23% of the variation in the change in the unemployment compensation. The change in manufacturing income accounted for 17.75% of the variation while real manufacturing income accounted for 18.41%. The change in wage and salary jobs accounted for 27% of the change in the unemployment compensation. The change in the average earnings per job accounted for 25.8% of the variation in unemployment compensation for Mobile County.

The long-term multiplier was significant in only two cases. The long-term multiplier was estimated at 1.53 for manufacturing income which was significant at the 10% level. The estimate for the change in average earnings per job was 3.53 and was also significant at the 10% level.

The estimated short-term multiplier from the distributed lag model was marginally significant for the change in fabrication employment at -1.64 with a p-value of 11.8% . A similar result was found for the change in manufacturing income. However, the short-term multiplier for the change in real manufacturing income was significant at the 5% level with an estimated coefficient of -2.19. The coefficient for the change in wage and salary jobs was -5.89 and was significant at the 5% level of significance.

Table 2.77

Distributed Lag Model of Order (0,3) for Unemployment Compensation Transfers and the Employment and Incomes for the Mobile MSA and Mobile County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	-1.6408 (.118)	.2323
Manufacturing Income	1.5276 (.099)	-1.5379 (.121)	.1775
Real Manufacturing Income	Ns	-2.1856 (.04)	.1841
Wage and Salary Jobs	Ns	-5.8887 (.026)	.2712
Average Earnings per Job	3.527 (.068)	ns	.2584
Real Average Earnings per Job	Ns	ns	.0309
Manufacturing Employment	Ns	-1.6408 (.118)	.2323

2.5.7. Mobile County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.5.8. Mobile County, Unit Root Analysis

The tests for the null hypothesis of a unit root in the population series failed to reject the null hypothesis of a unit root for the levels of all of the population segments. However, the tests failed to reject the null for the segments “under 29,” “under 49,” “under 59” and “above 60.” Therefore, we conclude these series were not I(1) and could not be cointegrated with the series for manufacturing employment. The remaining segments; “total population,” “under 19,” “under 39,” “women” and “men” rejected the null hypothesis and were considered I(1) series.

Table 2.78

Unit Root Test for Population Variables

Mobile County Population		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Rejected
Under 19	Failed	Rejected
Under 29	Failed	Failed
Under 39	Failed	Rejected
Under 49	Failed	Failed
Under 59	Failed	Failed
Above 60	Failed	Failed
Women	Failed	Rejected
Men	Failed	Rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.5.9. Mobile County, Cointegration Analysis

Based on the results from the unit root tests reported above, tests for the presence of a long-term cointegrating relationship between the I(1) population series and the I(1) series for manufacturing employment were conducted. The results reported below failed to reject the null hypothesis of no cointegration between any of the population variables and the series for manufacturing employment. This implied that no long-term relationship of the form specified was present.

Table 2.79

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Mobile County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Fail	Fail	NA	Fail	NA	NA	NA	Fail	Fail

2.5.10. Mobile County, Distributed Lag Model Analysis

The results for the distributed lag model for Mobile County indicated a different relationship between the population series and manufacturing employment. Four series; "total population," "under 39," "women," and "men," had an estimated adjusted-r^2 greater than .2797 which implied approximately a third of the variation in the population series could be explained by the change in manufacturing employment. In the case of "total population" the estimated long-term multiplier was .1447 which was significant at the 1% level. The "under 39" had a long-term multiplier of .5972 that was significant at the 1% level while both the segment for "men" and the segment for "women" had long-term multiplier estimates of .159 and .2646 respectively. As noted in previous study communities, it was interesting to note the continued pattern of a greater multiplier effect based on the estimated long-term multiplier for the segment "women" than "men."

While prior study communities reported an occasional short-term multiplier that was significant, Mobile County reported four short-term multipliers that were significant at the 10% level based upon the reported p-values (or marginally so with a p-value of .105). These findings may have been the result of a broader-based manufacturing economy at the local level versus one that is singular in its dependence on shipbuilding and fabrication.

Table 2.80

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Mobile County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R
Total Population	.14473 (.001)	.05319 (.069)	.2797
Under 19	Ns	ns	.0201 (ns)
Under 29	.30578 (.04)	ns	.0332 (ns)
Under 39	.59718 (.000)	.20628 (.068)	.3075
Under 49	Ns	ns	<0
Under 59	Ns	ns	<0
Above 60	.078521 (.106)	ns	.0518
Women	.26459 (.000)	.075661 (.105)	.33
Men	.15911 (.000)	.058160 (.047)	.3316

2.5.11. Baldwin County, Income Transfer Variables, Unit Root Tests

The tests for a unit root for the Baldwin County data indicated that retirement transfers, Medicaid transfers and food stamp transfers failed to reject the null hypothesis of a unit root in the levels. The tests on the series for the first difference of retirement transfers, Medicaid transfers, and food stamp transfers all reject the null hypothesis of a unit root in the first differences. The results indicated these series were I(1) series in the levels and were I(0) stationary in the first differences. The variable for unemployment insurance transfers rejected the null of a unit root in the levels indicating it was I(0) stationary in the levels.

Table 2.81

Results for the Unit Root Tests for the Income Transfer Variables for Baldwin County, AL

The null hypothesis of a unit root in the series* $H_0: \theta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Failed	Rejected
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Rejected	Rejected

2.5.12. Baldwin County, Cointegration Analysis

For Baldwin County, the test results from the cointegration tests failed to reject the null hypothesis of no cointegrating relationship for all pairs of the MSA employment and incomes and the matched county-level income transfer variable. The one exception was the unemployment transfer series given it failed to meet the criteria of an I(1) series and therefore could not be cointegrated with another series that was I(1).

Table 2.82

Cointegration Tests between Employment and Wage Variables and Income Transfer Variables for the Mobile MSA and Baldwin County, AL

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Failed	Failed	Failed	Not applicable
Manufacturing Employment	Failed	Failed	Failed	Not applicable
Wage and Salary Jobs	Failed	Failed	Failed	Not applicable
Average Earnings per Job	Failed	Failed	Failed	Not applicable
Real Average Earnings per Job	Failed	Failed	Failed	Not applicable
Manufacturing Income	Failed	Failed	Failed	Not applicable
Real Manufacturing Income	Failed	Failed	Failed	Not applicable

2.5.13. Baldwin County, Distributed Lag Model

The results for the distributed lag model for Baldwin County were somewhat similar to those for Mobile as would have been expected. With respect to the change in the retirement transfers, the adjusted-r^2 was quite strong for several variables. The change in fabrication employment explains 16.7% of the variation of the change in the retirement variable. The change in manufacturing income accounts for 38.6% of the variation of the change in retirement. The change in real manufacturing income accounts for 28.9% of the variation in retirement. The change in wage and salary jobs explains 26.9% of the variation in retirement. The change in average earnings per job and real average earnings per job explained 45% and 41% of the variation in retirement respectively.

The long-term multiplier was significant at the 5% level for the change in fabrication employment, the change in real manufacturing income and the change in wage and salary jobs.

The estimates of the long-term multiplier for the change in manufacturing income and the change in average earnings per job were significant at the 1% level of significance.

The short-run multiplier for the change in average earnings per job and the change in real average earnings per job are significant at the 5% level. Additionally, the coefficient on the first lagged value of the change in real average earning per job is significant at the 1% level.

As in several cases before, the estimates based on the changes in manufacturing employment and fabrication employments yield almost identical results.

Table 2.83

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Wage Variables for the Mobile MSA and Baldwin County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	Σβ	β_0	Adjusted-r^2
Fabrication Employment	.424 (.017)	ns	.1665
Manufacturing Income	.42661 (.000)	ns	.3861
Real Manufacturing Income	.40434 (.013)	ns	.2893
Wage and Salary Jobs	.82694 (.027)	ns	.2685
Average Earnings per Job	1.0468 (.000)	.65206 (.024)	.4517
Real Average Earnings per Job	Ns	-.74135 (.025)	.4134
Manufacturing Employment	.424 (.017)	ns	.1665

The distributed lag model provided no significant results for the change in Medicaid transfers based on a change in the employment and incomes for the MSA.

Table 2.84

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Wage Variables for The Mobile MSA and Baldwin County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.0253
Manufacturing Income	Ns	ns	.0099
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

With regard to the change in food stamp transfers, the only significant results were the estimates of the long-term multiplier for the change in average earnings per job at 4.09 and change in real average earnings per job 11.75. The estimate on the change in average earnings per job was only marginally significant with a p-value of .12. The change in the real average earnings per job was significant at the 5% level. The adjusted-r2 for each was 8.16% and 13.11%, respectively.

Table 2.85

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Wage Variables for The Mobile MSA and Baldwin County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	Ns	<0
Manufacturing Income	Ns	Ns	<0
Real Manufacturing Income	Ns	Ns	<0
Wage and Salary Jobs	Ns	Ns	<0
Average Earnings per Job	4.0897 (.12)	ns	.0816
Real Average Earnings per Job	11.752 (.05)	ns	.1311
Manufacturing Employment	Ns	ns	<0

The change in unemployment compensation transfers provided significant results with respect to the short-term multiplier for change in fabrication employment and the change in manufacturing income. The adjusted-r^2 for fabrication employment was 15.77% compared to 12.59% for the change in manufacturing income. The estimate of the short-term multiplier for the change in fabrication employment is -2.07 which is significant at the 5% level. The change in manufacturing income is -1.89 which is also significant at the 5% level.

Table 2.86

Distributed Lag Model of Order (0,3) for Unemployment Compensation Transfers and the Employment and Income Variables for the Mobile MSA and Baldwin County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	-2.0708 (.025)	.1577
Manufacturing Income	Ns	-1.888 (.034)	.1259
Real Manufacturing Income	Ns	-2.1178 (.03)	.0819 (ns)
Wage and Salary Jobs	Ns	-5.2444 (.028)	.0989 (ns)
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	-2.0708 (.025)	.1577

2.5.14. Baldwin County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.5.15. Baldwin County, Unit Root Analysis

The unit root tests for the population variables in Baldwin County in the Mobile MSA failed to reject the null hypothesis of a unit root in each of the series in the levels. In the first differences, the tests rejected the null of a unit root for all of the segments except the "under 29" and "under 49." Therefore, the series "total population," "under 19," "under 39," "under 59," "above 60," "women," and "men" were I(1) series that could be used in the tests for a cointegrating relationship.

Table 2.87

Unit Root Test for Population Variables

Baldwin County Population		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Rejected
Under 19	Failed	Rejected
Under 29	Failed	Failed
Under 39	Failed	Rejected
Under 49	Failed	Failed
Under 59	Failed	Rejected
Above 60	Failed	Rejected
Women	Failed	Rejected
Men	Failed	Rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.5.16. Baldwin County, Cointegration Analysis

Given the results of the unit root tests, the tests for the null hypothesis of no cointegration were conducted. In all cases were the tests was conducted, the results failed to reject the null hypothesis of no cointegration. Therefore, we concluded that no such long-term relationship existed between manufacturing employment and the specific segment of the population.

Table 2.88

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Baldwin County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Failed	Failed	NA	Failed	Failed	NA	Failed	Failed	Failed

2.5.17. Baldwin County, Distributed Lag Model Analysis

The results of the estimation of the distributed lag model for the population segments for Baldwin County in the Mobile MSA were quite different from the other results previously reported. In this case, only the "under 39" segment of the population reported an adjusted-r^2 that indicated any real explanatory power at .2772 or 27.72 of the variation in the population segment. The next largest adjusted-r^2 was .0564. Furthermore, the estimated long-term multiplier of .34195 was the only estimate that was significant at the 1% level. The long-term multiplier for the segments "under 49" and "women" were only significant at the 10% level. Finally, the short-term multiplier for the "under 39" segment od .12167 was significant at the 10% level and the only significant estimate for the short-term multiplier. As noted before in the analysis of previous study communities, the lack of a statistically significant relationship between manufacturing employment and the different segments of the population may prove to be the most "significant" finding.

Table 2.89

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Baldwin County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R^2
Total Population	Ns	ns	<0 (ns)
Under 19	Ns	ns	<0
Under 29	Ns	ns	<0
Under 39	.34195 (.001)	.12167 (.069)	.2772
Under 49	.16341 (.062)	ns	.0564
Under 59	Ns	ns	<0
Above 60	Ns	ns	.0106
Women	.088824 (.071)	ns	.0098
Men	Ns	ns	<0

2.6. CORPUS CHRISTI MSA

As with the other MSA's, the results of the unit root tests for oil and natural gas prices apply in general given the national and international scope of the market for these commodities.

2.6.1. Employment and Wage Variables

As in the prior parts of the study, unit root tests were conducted for each of the employment and incomes for the MSA. The test failed to reject the null hypothesis of a unit root for manufacturing income, real manufacturing income fabrication employment, wage and salary jobs, real average earnings per job, and manufacturing employment. In the case of average earnings per job, the test rejected the null hypothesis of a unit root in the series indicating it is I(0) in the level. The tests for the null hypothesis of a unit root on the first differences rejected the null in all cases indicating these series are I(1) nonstationary in the levels and I(0) stationary in the first difference series. However, it is noteworthy that the results did appear to be somewhat sensitive to the specification of the test.

Table 2.90

Results for the Unit Root Tests for the Employment and Income Variables for the Corpus Christi, MSA

The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Manufacturing Income	Failed	Rejected
Real Manufacturing Income	Failed	Rejected
Fabrication Employment	Failed	Rejected
Wage and Salary Jobs	Failed	Rejected
Average Earnings per Job	Rejected	Rejected
Real Average Earnings per Job	Failed	Rejected
Manufacturing Employment	Failed	Rejected

2.6.2. Cointegration Tests

The test for the presence of a cointegrating relationship between the employment and incomes and the price of oil and/or natural gas were conducted. This procedure tested the null hypothesis of no cointegrating relationship. For all of the employment and incomes: fabrication employment, wage and salary jobs, manufacturing employment, manufacturing income, and average earnings per job, the tests failed to reject the null hypothesis of no cointegration with respect to the price series for oil. The same results were found for the tests using the price of natural gas. Thus, it appears there is no long-term cointegrating relationship between any of the employment and incomes at the MSA level and the price of either oil or natural gas. A point that is noteworthy for this is MSA is the potential issues in the unit root tests. As noted earlier, the results did appear to be sensitive to the form of the tests specified.

Table 2.91

Results for the Cointegration Tests for the Employment and Income Variables for the Corpus Christi, MSA and the Price of Oil and Natural Gas

The null hypothesis, H_0, of No Cointegrating Relationship		
	Oil	Natural Gas
Manufacturing Income	Failed	Failed
Real Manufacturing Income	Failed	Failed
Fabrication Employment	Failed	Failed
Wage and Salary Jobs	Failed	Failed
Average Earnings per Job	Not applicable*	Not applicable
Real Average Earnings per Job	Failed	Failed
Manufacturing Employment	Failed	Failed

This series was not I(1).

2.6.3. Distributed Lag Model

The results for the distributed lag model as it pertains to the impact of the changes in oil and natural gas prices on the employment and incomes for the Corpus Christi MSA are mixed. With regard to the change in the price of oil, the estimated model was not significant based on the F-test for the parameters for fabrication employment, real manufacturing income, and real average earnings per job. The estimated equation was significant in regards to manufacturing income, wage and salary jobs, and average earnings per job. In the case of manufacturing income, the adjusted-r^2 was .2744 or simply the change in the price of oil accounted for 27.44% of the variation in manufacturing income. The estimated long-run multiplier was .2775 which was significant at the 1% level. The short-run multiplier was estimated at .0757 and was significant at the 10% level. The change in the price of oil accounted for 16.20% of the variation in the change in wage and salary jobs for the Corpus Christi MSA. The long-run multiplier was .0909 and was significant at the 1% level. The short-run multiplier was .0331 and was significant at the 10% level. It is also worth noting the coefficient on the first lagged value of the price of oil is .0346 and is significant at the 10% level. While this coefficient value is considered in the estimation of the long-run multiplier, the significance of the near-term effect is at least interesting in suggesting a rather rapid response to changes in oil prices.

Table 2.92

Distributed Lag Model of Order (0,3) for Oil and the Employment and Incomes for the Corpus Christi MSA

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Manufacturing Income	.27754 (.003)	.0757 (.096)	.2744
Real Manufacturing Income	.16489 (.047)	ns	.0890 (ns)
Fabrication Employment	.13324 (.08)	.06256 (.114)	.0344 (ns)
Wage and Salary Jobs	.0909 (.011)	.0331 (.069)	.1620
Average Earnings per Job	.11911 (.001)	.03226 (.066)	.2890
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	.27754 (.003)	.0757 (.096)	.2744

In regard to the impact of the change in the price of natural gas, the estimations from the distributed lag model is significant in only three cases; the change in manufacturing income, the change in wage and salary jobs, and the change in average earnings per job. Furthermore, while the estimates are significantly different from zero, the explanatory power is extremely low for manufacturing income and wage and salary jobs with an adjusted-r^2 of .0395 and .0433 respectively. In the case of average earnings per job, the adjusted-r2 was .1107 which is only slightly higher. The long-run multiplier for manufacturing income was .2393 and is significant at the 5% level. While the short-run multiplier is not significant, similar to the results for the price of oil the coefficient on the first lagged value of the change in the price of natural gas is significant at the 10% level. The long-run multiplier for the wage and salary job variable is .0839 which is significant at the 10% level as is the short-run multiplier of 4.32. This result is important in that it appears that increasing gas prices do seem to have some impact although marginal on the number of wage and salary jobs within the MSA.

Table 2.93

Distributed Lag Model of Order (0,3) for Natural Gas and the Employment and Income Variables for the Corpus Christi MSA

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	.2393 (.05)	ns	.0395
Real Manufacturing Income	Ns	ns	<0
Fabrication Employment	Ns	ns	<0
Wage and Salary Jobs	.0839 (.062)	.0432 (.087)	.0433
Average Earnings per Job	.1179 (.012)	ns	.1107
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

2.6.4. Cameron County, Income Transfer Variables, Unit Root Tests

The test for the null hypothesis of a unit root was then conducted for the income transfer variables. In all cases, the test results failed to reject the null hypothesis of a unit root for retirement, Medicaid, food stamp, and unemployment insurance in the levels. The test for the null of a unit root in the series of the first differences rejected the null in all cases. These results indicate these series are I(1) nonstationary in the levels and I(0) stationary in the first differences.

Table 2.94

Results for the Unit Root Tests for the Income Transfer Variables for Cameron County, TX

The null hypothesis of a unit root in the series* $H_0: \theta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Failed	Failed
Medicaid Transfers	Failed	Failed
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Failed	Rejected

2.6.5. Cameron County, Cointegration Tests

The test for a cointegrating relationship was also conducted for the employment and incomes at the MSA level with the income transfer variables at the county level. When viewing the results from the perspective of the variable for Medicaid paired with each of the employment and incomes, all of the tests failed to reject the null hypothesis of no cointegration. However, as noted earlier, there were some questionable results regarding the unit root tests. In particular, the Medicaid variable was very sensitive to the form of the tests specified. The results for food stamps and unemployment insurance also failed to reject the null hypothesis in all cases. As a result, we can reasonably conclude there is no significant evidence of a cointegrating relationship between any pairs of these variables.

Table 2.95

Cointegration Tests between Employment and Income variables and Income Transfer Variables for the Corpus Christi MSA and Cameron County, TX

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Not applicable	Failed	Failed
Manufacturing Employment	Not applicable	Not applicable	Failed	Failed
Wage and Salary Jobs	Not applicable	Not applicable	Failed	Failed
Average Earnings per Job	Not applicable	Not applicable	Not applicable	Not applicable
Real Average Earnings per Job	Not applicable	Not applicable	Failed	Failed
Manufacturing Income	Not applicable	Not applicable	Failed	Failed
Real Manufacturing Income	Not applicable	Not applicable	Failed	Failed

2.6.6. Cameron County, Distributed Lag Model

The results of the distributed lag model for the retirement transfers and unemployment compensation transfers for Cameron County were significant for several of the employment and incomes. However, the model results for Medicaid transfers and food stamp transfers were largely insignificant.

Regarding the change in retirement transfers, the change in fabrication employment accounted 17.30% of the variation in retirement based on the adjusted-r^2. The long-run multiplier of .5057 was significant at the 1% level. The short-run multiplier was not significant. The change in manufacturing income accounted 49.42% of the variation in the change in the retirement based on the adjusted-r^2. The long-run multiplier of .49824 was significant at the 1% level. The short-run multiplier was not significantly different from zero. The change in real manufacturing income accounted for 15.77% of the variation in the change in retirement based on the adjusted-r^2. The long-run multiplier was .44972 and is significant at the 1% level. The short-run multiplier is not significantly different from zero. The change in wage and salary jobs accounts for 12.53% of the variation of the change in the retirement for the county. The long-run multiplier was .82951 and was significant at the 1% level. The short-run multiplier was not significant. The change in the average earnings per job accounted for 57.03% of the variation in the change in retirement. The long-run multiplier was 1.2049 and is significant at the 1% level. Additionally, the short-run multiplier was .37026 and significant at the 5% level. The change in real average earnings per job was not significant. The results for the manufacturing employment accounted for 17.30 of the variation in the change in retirement variable with a long-run multiplier of .50568 which is only slightly different from the results for fabrication employment.

Table 2.96

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for the Corpus Christi MSA and Cameron County, TX

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	.5057 (.004)	ns	.1730
Manufacturing Income	.49824 (.000)	ns	.4942
Real Manufacturing Income	.44972 (.01)	ns	.1577
Wage and Salary Jobs	.82951 (.02)	ns	.1253
Average Earnings per Job	1.2049 (.000)	.37026 (.04)	.5703
Real Average Earnings per Job	Ns	-.68042 (.015)	.1115 (ns)
Manufacturing Employment	.5057 (.004)	ns	.1730

The distributed lag model for the change in the Medicaid variable as a function of the change in the employment and incomes provided no significant estimates or explanatory power.

Table 2.97

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for the Corpus Christi MSA and Cameron County, TX

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	.0619 (ns)
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	<0

The distributed lag model for the change in the food stamp transfers as a function of the change in the average earnings per job produced the only significant results. The change in average earnings accounted for approximately 19.51% of the variation in the change in food stamp participation with a long-run multiplier of 2.5476 that was significant at the 5% level. The short-run multiplier was 2.5884 and was significant at the 1% level.

Table 2.98

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and the Employment and Income Variables for Corpus Christi MSA and Cameron County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	<0
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	2.5476 (.016)	2.5884 (.007)	.1951
Real Average Earnings per Job	Ns	ns	.039
Manufacturing Employment	Ns	ns	<0

Finally, the change in the unemployment compensation transfers as a function of the change in the employment and incomes provided several significant results. First, the change in fabrication employment accounted for 19.15 of the variation in the change in the unemployment compensation based on the adjusted-r^2. The long-run multiplier was not significant in this case. However, the short-run multiplier was -2.4024 and significant at the 5% level. The change in the wage and salary jobs accounted for 26.53% of the variation in the unemployment compensation. The long-run multiplier was not significantly different from zero. However, the short-run multiplier was -5.0510 and significant at the 5% level. The results for the manufacturing employment were almost identical to those for the fabrication employment.

The remaining variables; manufacturing income, real manufacturing income, average earnings per job and real average earnings per job did not provide model estimates that were significantly different from zero.

Table 2.99.

Distributed Lag Model of Order (0,3) for Unemployment Compensation Transfers and the Employment and Income Variables for Corpus Christi MSA and Cameron County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	-2.4024 (.046)	.1915
Manufacturing Income	Ns	-1.8609 (.045)	.1415 (ns)
Real Manufacturing Income	Ns	-2.3484 (.022)	.1634 (ns)
Wage and Salary Jobs	Ns	-5.0510 (.036)	.2653
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	-2.4024 (.046)	.1915

2.6.7. Cameron County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.6.8. Cameron County, Unit Root Analysis

The test for the presence of a unit root in the series for each of the segments of the population in Cameron County failed to reject the null hypothesis of a unit root in all cases. The tests on the first differences failed to reject the null for the "total population" series, the series for the "under 39" segment, and the series for the "under 59" segment. The remaining series rejected the null hypothesis of a unit root. These series were classified as I(1) series and were used in the test for a cointegrating relationship.

Table 2.100.

Unit Root Test for Population Variables

Cameron County Population Variables		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Failed
Under 19	Failed	Rejected
Under 29	Failed	Rejected
Under 39	Failed	Failed
Under 49	Failed	Rejected
Under 59	Failed	Failed
Above 60	Failed	Rejected
Women	Failed	Rejected
Men	Failed	Rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.6.9. Cameron County, Cointegration Analysis

The tests for the presence of long-term cointegrating relationship between manufacturing employment and the different segments of the population for Cameron County failed to reject the null hypothesis of no cointegration in all cases. Therefore, we concluded that no such long-term cointegrating relationship was present between manufacturing employment and the various segments of the population.

Table 2.101.

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Cameron County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
NA	Failed	Failed	NA	Failed	NA	Failed	Failed	Failed

2.6.10. Cameron County, Distributed Lag Model Analysis

The most interesting results from the estimation of the distributed lag model for Cameron County were the three segments for which the results were significant. In the case of the population segments by age, the above 60 had the highest adjusted-r^2 that did not have the possibility of spurious results due to a unit root in the series at .2397 or approximately explaining one quarter of the variation through changes in manufacturing employment (see the unit root test results). The long-term multiplier was .1167 and was significant at the 1% level. The other two segments that were significant were "women" and "men." In the case of the segment for "women" the adjusted-r^2 was .3237 with a long-term multiplier of .11775 that was significant at the 1% level based upon the reported p-value. In the case of the segment "men," the adjusted-r2 was .4030 or explaining approximately 40% of the variation in the population segment through the change in the manufacturing employment. The long-term multiplier was .08336 and was significant at the 1% level. In no case was the short-term multiplier for manufacturing employment significant in explaining the variation any population segment for Cameron County.

Table 2.102.

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Cameron County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R^2
Total Population	.085322 (.002)	ns	.4651
Under 19	Ns	ns	.1774
Under 29	Ns	ns	.01
Under 39	.1973 (.011)	ns	.1461
Under 49	Ns	ns	<0
Under 59	Ns	ns	.0071
Above 60	.11667 (.001)	ns	.2397
Women	.11775 (.007)	ns	.3237
Men	.083358 (.003)	ns	.4030

2.7. Brownsville MSA

2.7.1. Employment and Income Variables

As in each of the other MSA's, tests for the null hypothesis of a unit root was conducted for each of the employment and incomes in both the levels and the first differences. The results fail to reject the null hypothesis of a unit root for all of the employment and incomes in their levels. The results for the test of a unit root in the first differences rejected the null hypothesis of a unit root for all of the variables. The results strongly suggest these series are I(1) nonstationary in the levels and I(0) stationary in the first differences.

Table 2.103.

Results for the Unit Root Tests for the Employment and Income Variables for the Brownsville, MSA

The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
	Levels	First Difference
Manufacturing Income	Fail	rejected
Real Manufacturing Income	Fail	rejected
Fabrication Employment	Fail	rejected
Wage and Salary Jobs	Fail	rejected
Average Earnings per Job	Fail	rejected
Real Average Earnings per Job	Fail	rejected
Manufacturing Employment	Fail	rejected

*The results were very sensitive to the form of the test specified.

2.7.2. Cointegration Tests

The tests for the presence of a long-run cointegrating relationship between the price of crude oil or natural gas and the employment and incomes for the MSA were conducted. In each of the cases were the price of crude oil and an employment and income were tested, the results failed to reject the null hypothesis of no cointegrating relationship. Likewise, for the price of natural gas, the results for all pairings failed to reject the null hypothesis of no cointegrating relationship.

Table 2.104.

Results for the Cointegration Tests for the Employment and Income Variables for the Brownsville, MSA and the Price of Oil and Natural Gas *

The null hypothesis, H_0, of No Cointegrating Relationship		
	Oil	Natural Gas
Manufacturing Income	Failed	Failed
Real Manufacturing Income	Failed	Failed
Fabrication Employment	Failed	Failed
Wage and Salary Jobs	Failed	Failed
Average Earnings per Job	Failed	Failed
Real Average Earnings per Job	Failed	Failed
Manufacturing Employment	Failed	Failed

2.7.3. Distributed Lag Model

The distributed lag model for the change in each of the employment and income as a function of the change in the price of crude oil was estimated. The results for the fabrication employment, manufacturing income, real manufacturing income, manufacturing employment, and real average earning per job were not significant. The results for wage and salary jobs were marginally significant at the 10% level with a p-value of .105 and accounted for approximately 4½% of the variation in the change in wage and salary jobs.

The results for average earnings per job in nominal terms were significant with the long-run multiplier of .09254 significant at the 5% level. While the short-run multiplier was not significant, as we have noted previously, the coefficient on the first lagged value of the change in the price of oil in significant at the 5% level. The model accounted for 13.32% of the variation in the change in the average earnings per job in the Brownsville MSA.

Table 2.105.

Distributed Lag Model of Order (0,3) for Oil and Employment and Income Variables

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Fabrication Employment	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	.0435
Average Earnings per Job	.09254 (.00)	ns	.1332
Real Average Earnings per Job	Ns	ns	(ns)
Manufacturing Employment	Ns	ns	<0

The results from estimating the distributed lag model for the changes in the employment and incomes as function of the change in natural gas were largely insignificant. In fact, the adjusted-r^2 was negative in each case indicating no real relationship of any statistical consequence.

Table 2.106.

Distributed Lag Model of Order (0,3) for Natural Gas and the Employment and Wage Variables

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Fabrication Employment	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	.10025 (.077)	ns	<0
Real Average Earnings per Job	Ns	ns	(ns)
Manufacturing Employment	Ns	ns	<0

2.7.4. Aransas County, Income Transfer Variables

As in each of the previous community sections, the test for the null hypothesis of a unit root was conducted for each of the income transfer variables at the county-level. In Aransas County, the results of these tests fail to reject the null hypothesis of a unit in the levels of all of the income transfer variables. The only marginally significant result was for the retirement variable at the 10% level. The test for the null hypothesis of a unit root in the first differences rejected the null hypothesis in all cases. The results were once again, sensitive to the form of the test specified.

Table 2.107.

Results for the Unit Root Tests for the Income Transfer Variables for Aransas County, TX

The null hypothesis of a unit root in the series* $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Rejected*	Rejected
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Failed	Rejected
Unemployment Compensation Transfers	Failed	Rejected

*At the 10% level, but not the 5%. The test results were sensitive to the form of the test specified.

2.7.5. Aransas County, Cointegration Tests

Tests for the presence of a long-run cointegrating relationship were then conducted for each paring of the economic and income transfer variables. In the case of Medicaid, all of the tests failed to reject the null hypothesis of no cointegration, or long-run cointegrating relationship. A like result was found for the unemployment insurance variable. In the case of food stamp participation, the results failed to reject the null hypothesis in five of seven cases. In the cases of average earnings per job and real average earnings per job, the null hypothesis of no cointegration, or cointegrating relationship was rejected at the 5% level of significance. The implication of these results is the re-specification of a model including some form of lag of the past error terms from the original regression as an independent variable. These models are commonly known as error-correction models.

Table 2.108.

Cointegration Tests between Employment and Income variables and Income Transfer Variables for Corpus Christi MSA and Aransas County, TX

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Failed	Failed
Manufacturing Employment	Not applicable	Failed	Failed	Failed
Wage and Salary Jobs	Not applicable	Failed	Failed	Failed
Average Earnings per Job	Not applicable	Failed	Rejected*	Failed
Real Average Earnings per Job	Not applicable	Failed	Rejected*	Failed
Manufacturing Income	Not applicable	Failed	Failed	Failed
Real Manufacturing Income	Not applicable	Failed	Failed	Failed

2.7.6. Aransas County, Distributed Lag Model

The next step in the analysis was the estimation of the distributed lag model of order (0,3) for the changes in each of the income transfer variables as a function of the contemporaneous change in the independent variable and three lagged values of the changes in the independent variables. Examining the results for the change in the retirement variable first, the change in fabrication employment accounted for 19.37% of the variation in the change in the retirement measure based on the adjusted-r^2. The long-run multiplier of .32821 was significant at the 1% level. The change in manufacturing income accounted for 41.50% of the variation in the change in retirement variable. The long-run multiplier was .34273 and was significant at the 1% level. The short-run multiplier for the contemporaneous change in manufacturing income was .1051 and was significant at the at the 10% level. The change in real manufacturing income accounted for 17.80% of the variation in the change in retirement with a long-run multiplier of .30909 that is significant at the 1% level. The change in wage and salary jobs only accounted for 4.26% of the variation in the change in retirement. The long-run multiplier was .93367 and was significant at the 5% level. The change in the average earnings per job accounted for 58.09% of the change in the retirement variable. The long-run multiplier was 1.2429 and was significant at the 1% level. The short-term multiplier was .4398 and it was also significant at the 1% level. The results for the real earnings were not significant. The results for the change in the manufacturing employment mirrored those for the change in fabrication employment.

Table 2.109.

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for Aransas County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	.32821 (.004)	ns	.1937
Manufacturing Income	.34273 (.000)	.10510 (.08)	.4150
Real Manufacturing Income	.30909 (.008)	Ns	.1780
Wage and Salary Jobs	.93367 (.034)	Ns	.0426
Average Earnings per Job	1.2429 (.000)	.4398 (.007)	.5809
Real Average Earnings per Job	Ns	Ns	Ns
Manufacturing Employment	.32821 (.004)	ns	.1937

With regard to the change in Medicaid participation, the change in fabrication employment accounted for 10.78% of the variation based on the adjusted-r^2. The long-run multiplier was .8588 and was significant at the 10% level. The results for the change in manufacturing employment provided very similar results. In all other cases, the changes in the employment and incomes for the county had no significant implications for the change in the Medicaid participation.

Table 2.110.

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for Aransas County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	.8588 (.095)	ns	.1078
Manufacturing Income	Ns	ns	.0687
Real Manufacturing Income	Ns	ns	.0335
Wage and Salary Jobs	Ns	ns	ns
Average Earnings per Job	Ns	ns	ns
Real Average Earnings per Job	ns	ns	ns
Manufacturing Employment	.85883 (.095)	ns	.1078

The results for the distributed lag model using the change in the food stamp participation provided only one significant result. The change in the average earnings per job was significant at the 5% level, but only explained 2% of the variation of the change in food stamp participation. While statistically significant, it did not appear to be economically meaningful. The results for the remainder of the variables were not significant in the short- or long-run, but rather the higher adjusted-r^2s were due to the significant constant term.

Table 2.111.

Distributed Lag Model of Order (0,3) for Foodstamp Transfers and the Employment and Income Variables for Aransas County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.1259
Manufacturing Income	Ns	ns	.1020
Real Manufacturing Income	Ns	ns	.1189
Wage and Salary Jobs	Ns	ns	ns
Average Earnings per Job	3.8074 (.049)	ns	.0204
Real Average Earnings per Job	Ns	ns	ns
Manufacturing Employment	Ns	ns	.1259

The change in the unemployment insurance variable provided some interesting results in that the adjusted-r^2 measure was between .19 and .36 for all of the variables implying a fairly reasonable explanatory power for the model. However, closer inspection suggests this was the result of the constant term and not the lagged changes in the independent variable. In two cases, real manufacturing income and average earnings per job, the long-run multiplier was marginally significant at 1.97 and 6.24. In both cases, the significance was only at the 10% level for real manufacturing income and the actual p-value for the average earnings per job was .115. However, the short-run multiplier for the change in wage and salary jobs was significant at the 10% level.

Table 2.112.

Distributed Lag Model of Order (0,3) for Unemployment Transfers and the Employment and Income Variables for Aransas County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.3122
Manufacturing Income	1.9744 (.09)	ns	.2963
Real Manufacturing Income	Ns	ns	.1959
Wage and Salary Jobs	Ns	-6.1196 (.07)	.3612
Average Earnings per Job	Ns	ns	.1927
Real Average Earnings per Job	Ns	ns	ns
Manufacturing Employment	Ns	ns	.3122

2.7.7. Aransas County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.7.8. Aransas County, Unit Root Analysis

The tests for the presence of a unit root in the time series for each of the population segments in Aransas County failed to reject the null hypothesis of a unit root in the levels of each series. In the tests using the series for the first differences, the null hypothesis was rejected for each population series. Therefore, we concluded each of the series was I(1) and could be used in the tests for a long-term cointegrating relationship with manufacturing employment.

Table 2.113.

Unit Root Test for Population Variables

Aransas County Population		
The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Rejected
Under 19	Failed	Rejected
Under 29	Failed	Rejected
Under 39	Failed	Rejected
Under 49	Failed	Rejected
Under 59	Failed	Rejected
Above 60	Failed	Rejected
Women	Failed	Rejected
Men	Failed	Rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.7.9. Aransas County, Cointegration Analysis

As in all of the previous study communities, the tests for the presence of a long-run cointegrating relationship failed to reject the null hypothesis of no cointegration. Therefore, we concluded that no long-run relationship of this form was present between the times series for the population segments and manufacturing employment.

Table 2.114.

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Aransas County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Failed	Failed	Failed	Failed	Failed	Failed	Failed	Failed	Failed

2.7.10. Aransas County, Distributed Lag Model Analysis

Based on the estimates from the distributed lag model for Aransas County, it appeared the change in manufacturing employment had the greatest amount of explanatory power for the change in the population segment "under 59" with an adjusted-r^2 of .2743. The results for the total population were substantially lower at .1983 or 19.83% of the variation explained by the change in manufacturing employment. Other segments with significant results were the "under 19" segment with an adjusted-r^2 of .1595 and "under 49" with an adjusted-r^2 of .1288. In terms of the estimated long-term multiplier among the segments with a significant adjusted-r^2, the estimate for the "under 59" segment was .47319 which was the largest effect and was significant at the 1% level based on the reported p-value. The estimated long-term multipliers for the "under 19" and "under 49" segments were .3175 and .31363 respectively. These estimates were significant at the 5% level based upon the reported p-value. With regard to the segments for “women” and “men” the adjusted-r^2 for each was .2191 and .1920 respectively, which indicated approximately 20% of the variation in the population segment was accounted for by the change in manufacturing employment. In terms of the impact of the change in manufacturing employment, the estimated long-term multiplier was .38178 for the segment “women” and .3172 for the population segment men both of which were significant at the 1% level.

In no case was the short-term multiplier significant for the Aransas County data.

Table 2.115.

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Aransas County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R^2
Total Population	.28940 (.006)	ns	.1983
Under 19	.31750 (.012)	ns	.1595
Under 29	Ns	ns	<0
Under 39	.47207 (.033)	ns	.0614
Under 49	.31363 (.019)	ns	.1288
Under 59	.47319 (.001)	ns	.2743
Above 60	.22882 (.033)	ns	.0446
Women	.38178 (.003)	ns	.2191
Men	.31721 (.005)	ns	.1920

2.7.11. Nueces County, Income Transfer Variables

The results of the unit root tests for the income transfer variables in Nueces County failed to reject the null hypothesis of a unit root for Medicaid participation and unemployment insurance in the levels. The test results for retirement were different for the two test specifications used. The food stamp participation variable rejected the null hypothesis of a unit root in the levels.

The tests for the null hypothesis of a unit root in the first differences rejected the null hypothesis in all cases for all of the variables. The implication is that Medicaid and unemployment appear to be I(1) nonstationary in the levels and I(0) stationary I the first differences. The variable food stamp participation appears to be I(0) stationary in both the levels and the first differences. And the results for retirement are unclear.

Table 2.116.

Results for the Unit Root Tests for the Income Transfer Variables for Nueces County, TX

The null hypothesis of a unit root in the series* $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Rejected	Rejected*
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Rejected	Rejected
Unemployment Compensation Transfers	Failed	Rejected

2.7.12. Nueces County, Cointegration Test

The results for the tests for a cointegrating relationship between Medicaid participation and the employment and incomes failed to reject the null hypothesis of no cointegration. The same results were found for food stamp participation and unemployment insurance. It is worth noting the results of the tests for unemployment insurance and real average earnings per job and manufacturing income were close to the critical values. The results for real average earnings per job and food stamps were also close to the critical values.

Table 2.117.

Cointegration Tests between Employment and Income variables and Income Transfer Variables for the Corpus Christi TX MSA and Nueces County, TX

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Not applicable	Failed
Manufacturing Employment	Not applicable	Failed	Not applicable	Failed
Wage and Salary Jobs	Not applicable	Failed	Not applicable	Failed
Average Earnings per Job	Not applicable	Failed	Not applicable	Failed
Real Average Earnings per Job	Not applicable	Failed	Not applicable	Failed*
Manufacturing Income	Not applicable	Failed	Not applicable	Failed*
Real Manufacturing Income	Not applicable	rejected	Not applicable	rejected*

*Extremely close to the critical values and sensitive to the form of the test specified.

2.7.13. Nueces County, Distributed Lag Model

The results for the distributed lag model for the change in retirement in Nueces County indicate a fairly strong relationship based on the adjusted-r^2 measures. The change in fabrication employment accounted for 31% of the variation in the change in the retirement variable. The long-run multiplier for the change in fabrication employment was .34127 and was significant at the 1% level. The short-run multiplier was not significant. The change in manufacturing income accounted for 52.5% of the variation in the change in the retirement variable. The long-run multiplier was .34506 and was significant at the 1% level. The change in real manufacturing income accounted for 31.5% with a long-run multiplier of .28239 that was significant at the 1% level. The change in the wage and salary jobs accounted for 18.77% of the variation with a long-run multiplier of 1.15 that was significant at the 1% level. The change in manufacturing employment had a similar result to that of fabrication employment. The results for the change in average earnings per job were quite interesting. The change in average earnings accounted for 71.36% of the variation in the change in retirement in Nueces County. Furthermore, both the long-run multiplier, 1.422, and the short-run multiplier, .414, were significant at the 1% level. The real average earnings per job were not significant.

Table 2.118.

Distributed Lag Model of Order (0,3) for Retirement Transfers and Employment and Income Variables for Nueces County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	.34127 (.01)	ns	.3106
Manufacturing Income	.34506 (.000)	ns	.5249
Real Manufacturing Income	.28239 (.005)	ns	.3149
Wage and Salary Jobs	1.1508 (.005)	ns	.1877
Average Earnings per Job	1.422 (.000)	.41433 (.005)	.7136
Real Average Earnings per Job	Ns	ns	.0617
Manufacturing Employment	.34127 (.001)	ns	.3106

The results for the distributed lag model for the change in Medicaid suggested the change in fabrication employment accounted for 10.3% of the variation in the change in Medicaid with a long-run multiplier of .6853 that was significant at the 5% level. The change in manufacturing income accounted for only 4% of the variation of the change in Medicaid. The long-run multiplier was .4563 and was significant at the 10% level. The change in real manufacturing income accounted for 8.7% of the variation in Medicaid with a long-run multiplier of .619 that was significant at the 10% level. The change in wage and salary job s accounted for 8.23% of the variation based on the adjusted-r^2. The long-run multiplier was 1.935 and was significant at the 10% level. The change in the average earnings per job and the real average earnings per job did not have positive adjusted-r2 measures and were not useful in the study. The results for the change in manufacturing employment as in many cases before were very similar to the change in the fabrication employment.

Table 2.119.

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for Nueces County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	.6853 (.022)	ns	.1030
Manufacturing Income	.45629 (.057)	ns	.0401
Real Manufacturing Income	.61926 (.034)	ns	.0871
Wage and Salary Jobs	1.9353 (.075)	ns	.0823
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	.68533 (.022)	ns	.1030

The results for the distributed lag model using the change in food stamp participation in Nueces County were largely in significant based upon the adjusted-r^2 measure. In no case was the long-run or the short-run multiplier significant.

Table 2.120.

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and Employment and Income Variables for Nueces County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.0397
Manufacturing Income	Ns	ns	.0019
Real Manufacturing Income	Ns	ns	.0227
Wage and Salary Jobs	Ns	ns	.0025
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	.0397

The results of the distributed lag model for the change in unemployment compensation as a function of the change in fabrication employment accounted for 22.9% of the variation in the change in unemployment. However, neither of the multipliers was significant. The change in manufacturing income accounted for 25.34% of the variation in the change in the unemployment variable. In this case, the long-run multiplier was 1.408 and was significant at the 10% level. In the case of the change in wage and salary jobs, they accounted for 53.65% of the variation in the change in unemployment insurance. While the long-run multiplier was not significant for the change in wage and salary jobs, the short-run multiplier based on the contemporaneous change was -8.836 and was significant at the 1% level. The change in the average earnings per job accounted for 24% of the variation in the change in unemployment insurance, the multipliers were not significant in either the short- or long-run.

Finally, the change in the real average earnings per job accounted for 19.93% of the variation in the change in unemployment insurance. The long-run multiplier was -15.133 and was significant at the 5% level. The short-run multiplier was -7.1355 and was significant at the 1% level.

Table 2.121.

Distributed Lag Model of Order (0,3) for Unemployment Transfers and the Employment and Income Variables for Nueces County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	$\Sigma\beta$	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.2291
Manufacturing Income	1.4084 (.096)	ns	.2534
Real Manufacturing Income	Ns	ns	.1866
Wage and Salary Jobs	Ns	-8.8356 (.001)	.5365
Average Earnings per Job	Ns	ns	.2402
Real Average Earnings per Job	-15.133 (.013)	-7.1355 (.007)	.1993
Manufacturing Employment	Ns	ns	.2291

2.7.14. Nueces County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.7.15. Nueces County, Unit Root Tests

The tests for the presence of a unit root in the time series for each of the population segments in Nueces County failed to reject the null hypothesis of a unit root in the levels of each series. In the tests using the series for the first differences, the tests failed to reject the null hypothesis for the “under 49” and the “under 59” segments. The null hypothesis was rejected for each of the remaining population series for Nueces County. Therefore, we concluded each of the remaining series was I(1) and could be used in the tests for a long-term cointegrating relationship with manufacturing employment.

Table 2.122.

Unit Root Test for Population Variables

Nueces County Population		
The null hypothesis of a unit root in the series $H_0: \vartheta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Rejected
Under 19	Failed	Rejected
Under 29	Failed	Rejected
Under 39	Failed	Rejected
Under 49	Failed	Failed
Under 59	Failed	Failed
Above 60	Failed	Rejected
Women	Failed	Rejected
Men	Failed	Rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.7.16. Nueces County, Cointegration Analysis

The tests for the presence of a long-run cointegrating relationship failed to reject the null hypothesis of no cointegration. Therefore, we concluded that no long-run relationship of this form was present between the times series for the population segments and manufacturing employment in Nueces County.

Table 2.123.

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
Nueces County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Failed	Failed	Failed	Failed	NA	NA	Failed	Failed	Failed

2.7.17. Nueces County, Distributed Lag Analysis

The results of the distributed lag model for the population segments for Nueces County were of limited significance. Only the estimates for the "total population' series and the segments for "women" and "men" had a substantial portion of the variation in the series explained by the change in manufacturing employment with adjusted-r^2 of .3460 and .4365 respectively. While one-third and 44% were substantial in terms of explanatory power, the estimated long-term multipliers were only .189 and .127 respectively, indicating limited effect. Note both estimates were significant at the 1% level. With regard to the contemporaneous change, the short-term multiplier was -.04828 and significant at the 10% level for the total population series. For the population segment "men," the estimate was -.05004 and significant at the 5% level. While both of these estimates are significant, it was difficult to attach economic meaning to them given the negative sign as it implied a decline in manufacturing employment lead to an increase in the population which was counter intuitive.

Table 2.124.

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a function of the Change in Manufacturing Employment

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
Nueces County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R
Total Population	.12694 (.001)	-.04828 (.052)	.4361
Under 19	Ns	ns	<0 (ns)
Under 29	Ns	ns	.0207 (ns)
Under 39	.35813 (.027)	ns	.0714
Under 49	Ns	-.15799 (.055)	.0582
Under 59	Ns	ns	<0
Above 60	Ns	ns	.0118
Women	.18905 (.002)	ns	.3460
Men	.12701 (.001)	-.05004 (.045)	.4365

2.7.18. San Patricio County, Income Transfer Variables

The results of the unit root tests for the income transfer variables in San Patricio County were very similar to those for Nueces County. The results failed to reject the null hypothesis of a unit root for retirement, Medicaid, and unemployment in the levels. However, the variable for food stamp participation rejected the null hypothesis in the levels for both tests specifications. The results of the unit root tests on the first difference series for each of the variables rejected the null of a unit root for all four variables. However, the results were sensitive to the form of the test specified. The results suggested the variables were I(1) nonstationary in the levels and I(0) stationary in the first differences. The exception was the food stamp participation as it appears to have been I(0) in both the levels and first differences.

Table 2.125.

Results for the Unit Root Tests for the Income Transfer Variables for San Patricio County, TX

The null hypothesis of a unit root in the series* $H_0: \vartheta = (\rho - 1) = 0$		
	Levels	First Difference
Retirement Transfers	Failed	Rejected*
Medicaid Transfers	Failed	Rejected
Food Stamp Transfers	Rejected	Rejected
Unemployment Compensation Transfers	Failed	Rejected

2.7.19. San Patricio County, Cointegration Tests

The tests for the null hypothesis of no cointegration or long-run cointegrating relationship between the income transfer variables and the employment and incomes for the MSA failed to reject the null hypothesis for Medicaid participation. Likewise, the results failed to reject the null hypothesis of no cointegration for unemployment insurance. In the case of food stamp transfers and retirement transfers, the variables were not I(1) series and therefore could not be cointegrated.

Table 2.126.

Cointegration Tests between Employment and Income Variables and Income Transfer Variables for Corpus Christi MSA and San Patricio County, TX

H_0:No Cointegrating Relationship				
	Retirement	Medicaid	Food Stamps	Unemployment
Fabrication Employment	Not applicable	Failed	Not applicable	Failed
Manufacturing Employment	Not applicable	Failed	Not applicable	Failed
Wage and Salary Jobs	Not applicable	Failed	Not applicable	Failed
Average Earnings per Job	Not applicable	Failed	Not applicable	Failed*
Real Average Earnings per Job	Not applicable	Failed	Not applicable	Failed
Manufacturing Income	Not applicable	Failed	Not applicable	Failed*
Real Manufacturing Income	Not applicable	Failed	Not applicable	Failed*

2.7.20. San Patricio County, Distributed Lag Model

The results of the distributed lag model for San Patricio County indicate some fairly significant relationships between the retirement variable and the employment and incomes in the MSA based on the adjusted-r^2 and the significance of the long-run multiplier estimates. The change in fabrication employment accounted for 9.64% of the variation in the change in retirement with a long-run multiplier of .27097 which is significant at the 5% level. The change in manufacturing income accounted for 31.22% of the variation in the change in retirement. The long-run multiplier was .32526 and was significant at the 1% level. The short-run multiplier of .12205 was significant at the 10% level. The change in real manufacturing income accounted for 8.77% of the variation in the change in the retirement variable. The long-run multiplier was .26348 and was significant at the 5% level. The short-run multiplier was not significant. The change in wage and salary jobs accounted for 9.89% of the variation in the change in retirement. The long-run multiplier was .98833 and was significant at the 5% level. The short-run multiplier was .53828 and was significant at the 10% level. The change in average earnings per job accounted for 47.55% of the variation in the change the retirement variable. The long-run multiplier was 1.2047 and was significant at the 1% level. The short-run multiplier was .35501 and was significant at the 10% level. The results for the change in real average earnings per job were not significant. The results for the change in manufacturing employment were identical the results for the change in fabrication employment.

Table 2.127.

Distributed Lag Model of Order (0,3) for Retirement Transfers and the Employment and Income Variables for San Patricio County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	Σβ	β_0	Adjusted-r^2
Fabrication Employment	.27097 (.028)	ns	.0964
Manufacturing Income	.32526 (.001)	.12205 (.08)	.3122
Real Manufacturing Income	.26348 (.037)	ns	.0877
Wage and Salary Jobs	.98833 (.03)	.53828 (.077)	.0989
Average Earnings per Job	1.2047 (.000)	.35501 (.059)	.4755
Real Average Earnings per Job	Ns	ns	.0402
Manufacturing Employment	.27097 (.028)	ns	.0964

The results from the distributed lag model for the change in Medicaid participation were largely insignificant. The adjusted-r^2 was noticeably large in the cases of the change in fabrication employment, the change in wage and salary jobs, and the change in manufacturing employment. The only significant coefficient estimate in the model was the constant term. The results indicate the change in Medicaid participation was largely unaffected by the change in any of the employment and incomes.

Table 2.128.

Distributed Lag Model of Order (0,3) for Medicaid Transfers and the Employment and Income Variables for San Patricio County

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.1008
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	.1847
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	.1008

The results for the change in participation for the food stamp program were not significant for San Patricio County. In all cases, the model results failed to reject the null hypothesis for the coefficient estimates equal to zero based on the f-test.

Table 2.129.

Distributed Lag Model of Order (0,3) for Food Stamp Transfers and Employment and Income Variables for San Patricio County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	ns	.0282
Manufacturing Income	Ns	ns	<0
Real Manufacturing Income	Ns	ns	<0
Wage and Salary Jobs	Ns	ns	<0
Average Earnings per Job	Ns	ns	<0
Real Average Earnings per Job	Ns	ns	<0
Manufacturing Employment	Ns	ns	.0282

The results of the distributed lag model for the change in unemployment insurance were significant. In all cases the long-run multiplier was not significantly different from zero. However, in several cases, the short-run multiplier was significant. In the case of the change in fabrication employment, it accounted for 31.24% of the variation in the change in the unemployment insurance. The short-run multiplier was -2.0986 and was significant at the 5% level. The change in manufacturing income accounted for 32.28% of the variation in the change in unemployment and the short-run multiplier of -1.6642 is significant at the 10% level. The change in the real manufacturing income accounted for 19.43% of the variation in the unemployment insurance with a short-run multiplier of -1.7466 that was significant at the 10% level. The change in the wage and salary jobs accounted for 56.73% of the variation in the change in unemployment insurance with a short-run multiplier of -11.366 that was significant at the 1% level. The results for the change in the average earnings per job accounted for 25.90% of the variation in the change in unemployment insurance. However, only the constant term in the distributed lag model was significantly different from zero. In the case of the change in real average earnings per job, the model was not significant. As has been the case in reporting many of the previous results, the change in manufacturing employment is identical to the results reported for fabricating employment.

Table 2.130.

Distributed Lag Model of Order (0,3) for Unemployment Insurance Transfers and the Employment and Income Variables for San Patricio County

$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$			
	Σβ	β_0	Adjusted-r^2
Fabrication Employment	Ns	-2.0986 (.043)	.3124
Manufacturing Income	Ns	-1.6642 (.058)	.3228
Real Manufacturing Income	Ns	-1.7466 (.07)	.1943
Wage and Salary Jobs	Ns	-11.366 (.000)	.5673
Average Earnings per Job	Ns	Ns	.2590
Real Average Earnings per Job	Ns	Ns	.1376 (ns)
Manufacturing Employment	Ns	-2.0986 (.043)	.3124

2.7.21. San Patricio County, Population Variables

Given the focus of this study on the impact of the fabrication and manufacturing industry on the study communities, further time series analysis was conducted on the relationship between manufacturing and fabrication employment and the population variables for each county. The first step as in the prior sections was to test for the presence of a unit root in each of the population series. This subsequently allowed for the test for a long-run cointegrating relationship between manufacturing employment and the respective population variable. Finally, a distributed lag model of order (0,3) was estimated for the change in the population variable as a function of the contemporaneous change in manufacturing employment and three lags of the change in manufacturing employment. The results of this analysis allowed for a comment regarding shifts or changes in county-level population as a result of changes in the employment in the manufacturing sector of the local economy.

2.7.22. San Patricio County, Unit Root Analysis

The tests for the presence of a unit root in the time series for each of the population segments in San Patricio County failed to reject the null hypothesis of a unit root in the levels of each series. In the tests using the series for the first differences, the null hypothesis was rejected for each population series. Therefore, we concluded each of the series was I(1) and could be used in the tests for a long-term cointegrating relationship with manufacturing employment.

Table 2.131.

Unit Root Test for Population Variables

San Patricio County Population		
The null hypothesis of a unit root in the series $H_0: \theta = (\rho - 1) = 0$		
Population Variable	Levels	First Difference
Total Population	Failed	Rejected
Under 19	Failed	Rejected
Under 29	Failed	Rejected
Under 39	Failed	Rejected
Under 49	Failed	Rejected
Under 59	Failed	Rejected
Above 60	Failed	Rejected
Women	Failed	Rejected
Men	Failed	Rejected
Employment Variable:		
Manufacturing Employment (MSA)	Failed	Rejected

2.7.23. San Patricio County, Cointegration Analysis

The tests for the presence of a long-run cointegrating relationship failed to reject the null hypothesis of no cointegration. Therefore, we concluded that no long-run relationship of this form was present between the times series for the population segments and manufacturing employment in San Patricio County.

Table 2.132.

Test Results for a Cointegrating Relationship between Manufacturing Employment and Population

H_0:No Cointegrating Relationship								
San Patricio County Population								
Total Population	Under 19	Under 29	Under 39	Under 49	Under 59	Over 60	Women	Men
Failed	Failed	Failed	Failed	Failed	Failed	Failed	Failed	Failed

2.7.24. San Patricio County, Distributed Lag Model Analysis

The results for the distributed lag model for San Patricio County provided some of the more significant findings for this part of the analysis. In several cases, the adjusted-r^2 for the change in the population segment in response to a change in manufacturing employment was over .2830 which is slightly less than one third of the total variation. The highest adjusted-r^2 was over 50% at .5172 for the total population series. In turn, the estimated long-term multipliers were substantial for the different segments of the population. For the “under 29” segment, the estimated multiplier was .70611 and was significant at the 1% level despite a lower value for the adjusted-r^2 of .1889. The multiplier for the “under 39” segment was .64 and significant at the 1% level based on the reported p-value. As reported in other study communities, the percent of variation explained by the change in manufacturing employment was greater for the segment “women” than for the segment “men.” In the case of San Patricio, the adjusted-r^2’s were .3727 and .2830 respectively. As in some of the other study areas, the long-term multiplier was greater for the segment “women” at .49345 compared to .37162 for the segment “men.”

In no case was the short-term multiplier significant for any segment of the population in San Patricio County.

The obvious conclusion from the San Patricio County analysis was the significant influence of the manufacturing employment on several segments of the population.

Table 2.133.

Results of the Distributed Lag Order (0,3) Model Estimation for the Change in the Population as a Function of the Change in Manufacturing Employment

$$\Delta y_t = \alpha + \beta_0 \Delta x_t + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + e_t$$

San Patricio County Population			
Population Variable	$\Sigma\beta_i$	β_0	Adjusted-R
Total Population	.30612 (.000)	ns	.5179
Under 19	.32951 (.005)	ns	.1796
Under 29	.70611 (.004)	ns	.1889
Under 39	.63996 (.000)	ns	.4048
Under 49	Ns	ns	.0124
Under 59	.30803 (.062)	ns	.0096
Above 60	Ns	ns	<0
Women	.49345 (.000)	ns	.3727
Men	.37162 (.001)	ns	.2830

2.8. SUMMARY

The goal of this study was to test for causal relationships between fabrication/manufacturing activity in the study communities and the various measures of well-being within the communities. As such, a set of time series analyses were conducted to determine if any significant relationships existed between the data series from the manufacturing/fabrication industry and the time series for the social-economic time series representing the study communities. The analysis involved several steps for each community that is outlined below as is an overall summary of the results

2.8.1. Unit Root Tests

Each of the data series used in the analysis for the manufacturing /fabrication industry side and the social-economic measures were tested for the presence of a unit root or stationarity. Determination of this statistical property for each data series was critical to the appropriate specification of the relationship between series over time in order to minimize the potential for spurious regression results. In vast majority of the cases across the different study communities, the test results for the unit root indicated the series were integrated of order one, I(1), suggesting they contained a single unit root in the levels and were stationary I(0) in the first differences or percent changes. It is worth noting once again that the test results were extremely sensitive to the form of the test specified.

2.8.2. Cointegration Tests

Given the results of the unit root tests, tests for the presence of a long-run cointegrating relationship were conducted. Each of the series for the causal variables such as manufacturing and fabricating employment, income, wage, and salary jobs, to name a few, that were classified as I(1) were paired with social-economic variables resenting the community wellbeing such as transfer payments for retirement, Medicaid, food stamps and unemployment as well as population variables. Each of the pairs was tested for the presence of a cointegrating relationship or long-term equilibrium relationship between the two time series. From a practical perspective, the existence of a long-term relationship with causal effects would have required a specific form of model beyond a simple regression to capture the interaction of the variables over time. The results of the tests for the presence of a cointegrating relationship failed to reject the null hypothesis of no cointegration in all of the cases throughout the study. In a few instances the test statistics were very close to the critical values at the 5% level. In summary, there were no long-term cointegrating relationships detected in the data for any pairs in any of the study communities.

2.8.3. Distributed Lag Model

Given the results of the cointegration tests, an alternative model, a distributed lag model of order (0,3), was specified and tested. While the specification of the order (0,3) was somewhat ad hoc, it allowed the test to capture the explanatory effect of the contemporaneous change in the independent variable and three lags of the change in the independent variables on the change dependent variable. Furthermore, the model provided for the estimation of a long-term multiplier equal to the sum of the coefficients on the change in the independent variable and its lags. This estimate provided a means of testing for persistent long-term effects of the independent variable. Additionally, the model allowed for a test of the significance of a short-term multiplier estimated as the coefficient on the contemporaneous change in the independent variable. A significant coefficient on the contemporaneous change indicated a significant short-term effect between the variables. Additionally, given the potential ad hoc nature of the model specification, the adjusted-r^2 was used to determine explanatory power instead of the unadjusted r^2. This approach was preferable due to the adjustment of the measure of explanatory power to control for over specification of the model. The estimated coefficient and explanatory power of the model for the different study communities was evaluated on the basis of the adjusted-r^2, the significance of the coefficients for the short-term multiplier and the long term multiplier. An overall summary of the results is provided below.

2.8.4. Oil and Natural Gas

The impact of the change in oil and gas prices on the manufacturing and fabricating sector for each community was somewhat limited to the variable change in average earnings per job for most communities where the short-term and long-term multipliers were both significant. The change in oil and gas prices did have a significant impact on the change in wage and salary jobs in the Houma-Thibodaux MSA. Additionally, the change in oil and gas prices had a significant impact on fabrication and manufacturing employment in the Corpus Christi MSA. The results for the other variables were not significant.

2.8.5. Employment and Income Variables Relative to Current Transfers

The changes in manufacturing income, wage, and salary jobs, and average earnings per job had a significant impact on the change retirement transfers in almost all of the communities in the study.

The changes in manufacturing and fabrication employment had a significant impact on change in retirement transfers in Mobile, Baldwin, Cameron, Aransas, Nueces and San Patricio counties.

The changes in manufacturing and fabrication employment, manufacturing income, wage and salary jobs had a significant impact on Medicaid transfers in Lafourche and Terrebonne Parishes and Aransas and Nueces counties. The impact of the changes in employment and income variables were not significant with respect to Medicaid transfers in the other study areas.

The changes in manufacturing and fabrication employment had a significant impact on the changes in food stamp transfers in Jefferson County and Lafourche, Terrebonne and St. Mary Parishes.

The change in the average earnings per job was a significant factor for food stamp transfers in other communities, but with a much smaller magnitude. In several study communities, there were no significant relationships detected.

The impact of the change in the employment and income variables on the change in unemployment transfers was highly significant as one would expect for most of the communities. However, the magnitude of the impact as it related to manufacturing and fabrication employment seemed to be indicative of the study community's reliance on this industry. For example, the strongest impact was observed in Lafourche, Terrebonne, and St. Mary Parishes in Louisiana and Jefferson County in Texas. The results were significant for other study areas considered; however, the magnitude of the coefficients was substantially smaller. All of the significant coefficients were for the short-term multiplier indicating an immediate impact. All of the coefficients were negative which indicated the expected inverse relationship.

2.8.6. Population Effects

The results for the distributed lag model indicated that changes in manufacturing/fabricating employment were positively related to changes in several segments of the population in the study communities. The magnitude of the relationship varied significantly across study communities as one would expect given the different levels of manufacturing activity present in the communities. An interesting result was number of communities were the change in manufacturing/fabrication employment had a significant impact on the age groups "under 39," "under 49," and "under 59." This may be the result of these are the individuals with the required skill set to work in these industries or simply the younger generation represented by the "under 19" and "under 29" were more likely to find work in the service sector. This may in fact explain the surge in service sector employment not in the economic profiles for these communities.

2.8.7. Overall Conclusion

Overall, it would appear that a change in manufacturing/fabrication activities does impact these communities in a significant manner. However, the magnitude of the impact differs widely across the communities and in the form of the impact. Given the nature of the statistical analysis, future research would benefit from longer, more consistent time series for other important community attributes that cannot be used at this time due to the inconsistency of the data, incomplete data or simply that data has only been collected for a relatively short period of time. As this data becomes readily available, researchers will be able to explore in greater depth the interrelationship of the different industry segments with the communities in which they reside.

2.9. REFERENCES

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management Mission

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.