Maritime Transportation in the Gulf of Mexico: Trends, Key Challenges, and Workforce Development Implications for Alabama, Mississippi & Louisiana

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Abstract: The maritime transportation sector in the Gulf of Mexico (GOM) is a major pillar of the U.S. regional and national economy, employing 127,132 workers and generating $12.08 billion in GDP as of 2021. Using the Economics: National Ocean Watch (ENOW) dataset for 2005–2021, this paper conducts a multi-method quantitative analysis to assess employment, wage, and productivity dynamics across the GOM and three principal contributing states: Louisiana, Alabama, and Mississippi.

Results show that aggregate employment in the maritime transportation sector in the GOM grew by 50.0% over the study period. Trend analysis confirms a statistically significant positive slope of 1,470 jobs per year for the Gulf ($R^2 = 0.390$, $p = 0.007$). While total wages expanded by 88.1% and GDP increased by 38.8%, wage-per-worker growth plateaued and productivity (GDP per worker) declined by 32.5% from its 2008 peak. State-level analysis shows major differences. Alabama achieved an extraordinary employment expansion of 345.8% in the maritime transportation sector, driven by port investment in Mobile, which grew from 2,959 workers in 2005 to 13,191 in 2021. Louisiana saw a contraction in employment by 24.7% from its 2014 peak as oil price shocks eroded its offshore service vessel base. Mississippi showed persistent stagnation, with a 6.3% employment decline and a deteriorating location quotient (0.41 to 0.25). Shift-share analysis reveals that Alabama generated 8,751 jobs above Gulf-wide trend predictions, while Louisiana underperformed by -10,193 jobs relative to its structural potential.

Keywords*:* Maritime transportation, Gulf of Mexico, workforce development, ocean economy

I. Introduction

The maritime industry, a cornerstone of global trade, transports over 80% of the world's goods (UNCTAD, 2022). In the United States, the maritime transportation system is critical to national and economic security, with the vast majority of the nation's overseas trade moving through its ports. In 2023, waterborne vessels were the leading mode for U.S. international trade in goods, carrying 41.5% of trade value ($2.1 trillion); by weight, waterborne vessels transported 78.6% of total trade volume (1.6 billion tons) in 2022 (Bureau of Transportation Statistics [BTS], 2025). However, maritime labor is challenged by persistent labor shortages, ongoing geopolitical tensions, and rapid technological advances, highlighting the fragility of the existing maritime ecosystem. Despite the sector's global nature, seafarers and port workers often face poor working conditions, job insecurity, and wage disparities. To address labor shortages and create improved pathways into maritime careers, workforce development must prioritize training, education, and accessibility. Investment in maritime workforce development is a crucial strategy for promoting economic mobility. High-quality jobs in the sector offer pathways to financial stability and generational wealth-building, but access remains uneven. This paper explores the dynamics of maritime labor, focusing on employment, wages,

and gross domestic product (GDP). The argument is that the current maritime industry requires systemic workforce reforms, proactive public-private collaboration, and sustained investment in human capital to become better positioned to navigate a course of innovation and sustained growth.

Within the United States, the Gulf of Mexico (GOM) is a premier maritime highway for the transportation of energy and goods. The region supports more than $34 billion in annual GDP through energy production and freight movement, anchors the offshore oil and gas supply chain, facilitates cross-border trade with Mexico, and provides resilient, lower-emission alternatives to land-based logistics. As of 2021, maritime transportation alone employed 127,132 workers and generated $12.08 billion in GDP across the Gulf, making it one of the most economically significant components of the U.S. ocean economy.

Sustained research on Gulf maritime transportation is essential because the sector sits at the intersection of several interconnected priorities including workforce development. Despite the sector's economic weight, the workforce that powers Gulf maritime transportation has received comparatively limited empirical attention. Systematic measurement of the ocean economy is a comparatively recent development. Kildow and McIlgorm (2010) argued that conventional national accounts obscure the oceans' contribution to output and employment, and subsequent work established standardized ocean-economy accounts culminating in NOAA's Economics: National Ocean Watch, which harmonizes employment, wage, and GDP data across ocean sectors and coastal geographies (Colgan, 2016). ENOW has enabled a growing body of research on the size and composition of the U.S. ocean economy, but applications at the state and sub-regional level remain comparatively rare. Within maritime economics, shipping labor markets are understood to be strongly cyclical and globally integrated, with demand tied to freight cycles and commodity markets (Stopford, 2009), while the port economics literature emphasizes ports as regional employment anchors whose performance depends on hinterland logistics, institutional capacity, and public investment (Notteboom, Pallis, & Rodrigue, 2022). At the global scale, workforce studies document a persistent and widening shortage of certified officers driven by retention failures rather than recruitment shortfalls (BIMCO & ICS, 2026), and U.S. policy analyses have identified maritime workforce development as a strategic vulnerability (MARAD, 2023). What this literature largely lacks is empirical analysis of how these global and national dynamics manifest in the workforce of a specific multi-state region. Despite hosting one of the largest concentrations of maritime transportation employment in the U.S. ocean economy, the Gulf of Mexico has received limited attention of this kind, a gap the present study addresses.

The study's methods draw on established regional science traditions. Shift-share analysis, introduced by Dunn (1960), splits a region's job growth into three components showing how much regional employment change comes from overall national growth, specific industry trends and locally driven performance. Location quotients provide a complementary measure of regional industrial specialization and its change over time (Isserman, 1977) comparing local industry employment share to the national share. Both techniques show that regional prosperity rests on localized sources of competitive advantage rather than national trends alone (Porter, 1990). Finally, lead–lag testing in the Granger (1969) framework permits an assessment of whether business formation anticipates employment growth, giving the descriptive account a forward-looking, early-warning dimension. Used together, these methods triangulate the underlying question of whether a state's maritime transportation workforce is growing because of what the region is doing or merely with what the region is doing from complementary directions, confirming the true drivers of regional workforce growth.

For the theoretical framework, workforce dynamics in this paper is grounded in human capital theory, which contents that wages and productivity reflect that people's knowledge, skills and education are valuable assets that boost worker productivity and lead to higher lifetime earnings (Schultz, 1961; Becker, 1964; Mincer, 1974). Under this framework, wage per worker and output per worker serve as visible substitutions for the skill level of a

workforce, and the theory yields a testable distinction between two growth regimes. In quality-led (skill-deepening) growth, employment, average wages, and productivity rise together as investment in human capital raises the value of each worker's output. In quantity-led growth, employment expands while wage per worker and output per worker stagnate or decline, indicating that new hiring is concentrated in lower-skill roles without corresponding skill investment. This distinction structures the analysis that follows and provides the criterion by which workforce development changes in Alabama, Louisiana and Mississippi are evaluated, linking each state's empirical profile to a distinct workforce development prescription. The framework is complemented by a socio-technical systems perspective, which holds that productive performance does not emerge from technology alone but from the joint optimization of technical and social subsystems (Trist & Bamforth, 1951). Together, the two perspectives assign complementary roles. Human capital theory supplies the evaluative metric, that is the returns to skill investment while the socio-technical perspective frames the institutional adjustment problem that workforce policy must solve.

II. Materials and methods

This paper examines the maritime transportation sector in the Gulf of Mexico through a workforce development lens. Using the Economics: National Ocean Watch (ENOW) dataset for 2005–2021, the study conducts a multi-method quantitative analysis to assess employment, wages, and productivity dynamics across the Gulf and the three principal contributing states: Alabama, Louisiana, and Mississippi. The objective is to translate observed sectoral dynamics into actionable, state-specific workforce development strategies. Methods include descriptive trend analysis with ordinary least squares (OLS) regression, shift-share decomposition (Dunn, 1960), location quotient analysis (Isserman, 1977), one-way ANOVA with Tukey HSD post-hoc testing, and Granger causality testing (Granger, 1969). The geographic scope comprises the three central Gulf states of Alabama, Louisiana, and Mississippi whose coastal economies are most directly organized around the offshore energy supply chain and the inland waterway system and which operate at broadly comparable scale. Texas and Florida, whose far larger and more diversified coastal economies would dominate pooled comparisons, are reserved for future extensions of this framework.

III. Results

3.1 Employment Trends

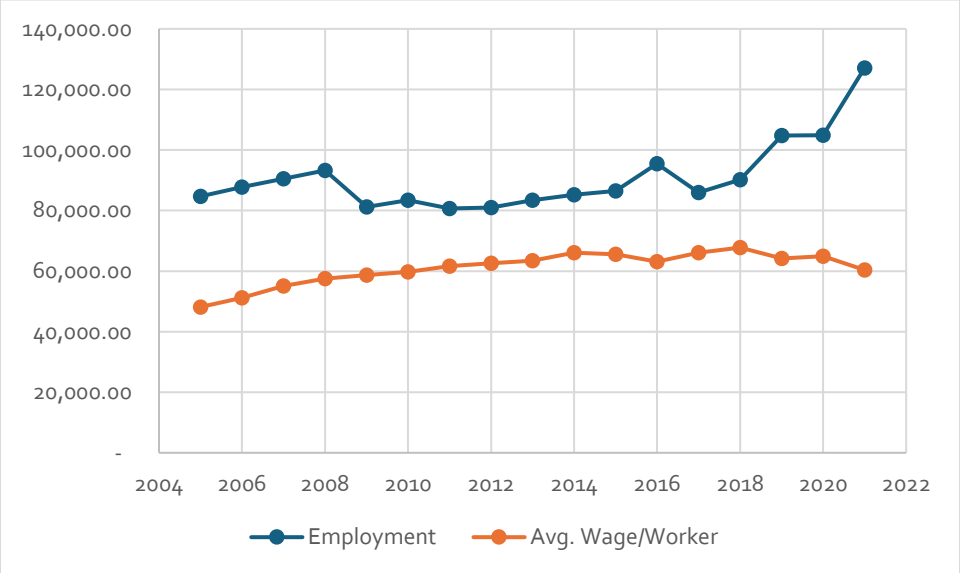
Maritime transportation employment in the Gulf of Mexico grew substantially over the 17-year study period, increasing from 84,728 workers in 2005 to 127,132 in 2021, representing a 50.0% increase and a compound annual growth rate (CAGR) of 2.6%. However, this overall growth rate conceals a cyclical pattern punctuated by three major disruptions which include the 2008–09 global financial crisis, the 2014–16 oil price collapse, and the 2020 COVID-19 pandemic. Each event produced measurable employment contractions. In addition, the trajectory of recovery differed markedly across states and sub-periods.

An overall view of employment trends shows a mean employment level of 90,951 during the study period demonstrating a moderate overall growth, but with noticeable fluctuations. Employment figures showed declines from a pre-crisis peak of 93,282 in 2008 to 80,692 by 2011, a 13.5% contraction consistent with reduced freight volumes and port throughput. Recovery was gradual with a 2016 peak of 95,499, followed by another decrease to 85,952 in 2017, corresponding to restructuring in offshore oil and gas services after the commodity price crash. The most dramatic growth phase occurred between 2017 and 2021, with employment climbing 47.9% in four years, driven largely by Alabama's port expansion and increased GOM freight volumes. Alabama Port Authority's 2021 Economic Impact Study showed that harbor-wide, the Port of Mobile delivered $85 billion in value to the state of Alabama over the calendar year 2021. The result speaks to three distinct shock cycles. The Great Recession (2008–2011) cut employment 13.5%, the oil price crash (2014–2017) drove another pullback, and COVID-19 (2020–2021) is the outlier as employment remained flat while GDP fell 7%, then both surged sharply in 2021.

Analysis shows that wages expanded more than twice as fast as economic output with wages growing by 88.1% and GDP by 38.8%. Widening since 2010, this gap is an important structural signal that labor costs are rising faster than the value being produced. GDP per worker peaked at approximately $140,800 in 2008 and fell to $95,043 by 2021, a 32.5% drop. This pattern is an urgent workforce indication that as the sector employs more people, it is generating less output per person suggesting a productivity collapse. The average wage per worker grew steadily between 2005 and 2018 by 25.3% but experienced a decline of 11% through 2021. Average pay peaked at $67,766 in 2018, then dropped to $60,355 in 2021 despite record total wages. Alabama's employment surge onboarded thousands of entry-level workers, pulling the Gulf-wide average down. The result is headcount growth without skill growth.

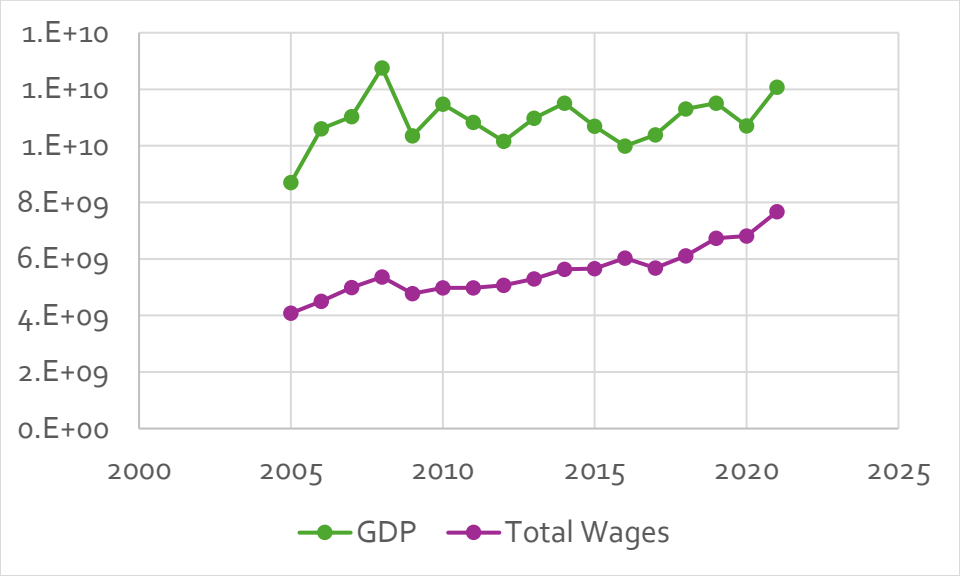
Analysis shows a very weak relationship (0.097) between employment and average wage (Figure 1). Increasing employment does not meaningfully raise wages per worker. This suggests possibly low-wage job growth or labor market saturation effects. However, there is a very strong relationship (0.853) between employment and total wages, as would be expected since more workers result in significantly higher total wages. Figure 2 shows a moderate relationship (0.480) between GDP and total wages.

Figure 1: Employment & Average Wage, Gulf of Mexico, 2005–2021



Source: Economics: National Ocean Watch (ENOW), NOAA Office for Coastal Management.

Figure 2: GDP & Total Wages, Gulf of Mexico, 2005–2021



Source: Economics: National Ocean Watch (ENOW), NOAA Office for Coastal Management.

3.2 State-Level Analysis

At the state level, the GOM maritime transportation sector is dominated in absolute terms by Louisiana, which accounted for 14.2% of GOM maritime transportation employment in 2021. However, Louisiana's trajectory reveals that employment peaked at 24,030 in 2014 and contracted to 18,083 by 2021, a 24.7% decline over seven years. This contraction seems to be associated with the 2014–16 oil price collapse which devastated offshore service vessel operations and resulted in mass layoffs and company insolvencies that eroded institutional knowledge built over decades. OLS trend analysis shows an insignificant slope of -68.6 jobs per year (R^2 = 0.041, p = 0.433), confirming that no consistent directional trend is detectable across the full period.

Alabama presents the contrasting story of the study period. Maritime transportation employment grew from 2,959 in 2005 to 13,191 in 2021, a major 345.8% expansion with a CAGR of 9.8%, driven by sustained investment in the Port of Mobile's container and bulk cargo facilities and expanded logistics operations. This surge, heavily concentrated in the 2020–2021 window, likely reflects diversion of cargo from congested West Coast ports during the pandemic, new liner service launches, and potential reclassification of logistics workers. Notably, GDP per employee fell sharply from $88,100 in 2019 to $52,300 in 2021, suggesting the rapid onboarding of large numbers of lower-wage workers rather than high-skill workforce growth.

The scale and timing of this surge justify scrutiny before it is read as an organic maritime boom. Nearly all of the increase occurred in a single year from 4,603 workers in 2020 to 13,191 in 2021, an implausible pace for vessel-operations hiring alone. Two internal signals help identify the composition of the new employment. First, the implied output of the marginal workforce is low: applying the reported GDP-per-employee figures, the roughly 8,800 workers added between 2019 and 2021 generated approximately $34,700 in GDP per additional worker, a level characteristic of warehousing and distribution roles rather than vessel operations or licensed maritime occupations.

Second, ENOW's maritime transportation sector definition includes warehousing alongside deep-sea freight, maritime passenger transportation, and maritime transportation services (NOAA Office for Coastal Management, 2024), so rapid growth in port-adjacent distribution facilities is recorded as maritime transportation employment. A reasonable reading is that Alabama's surge reflects a genuine

logistics expansion anchored by the Port of Mobile which is consistent with pandemic-era cargo diversion and new liner services but concentrated in lower-wage, land-side logistics occupations rather than maritime crafts.

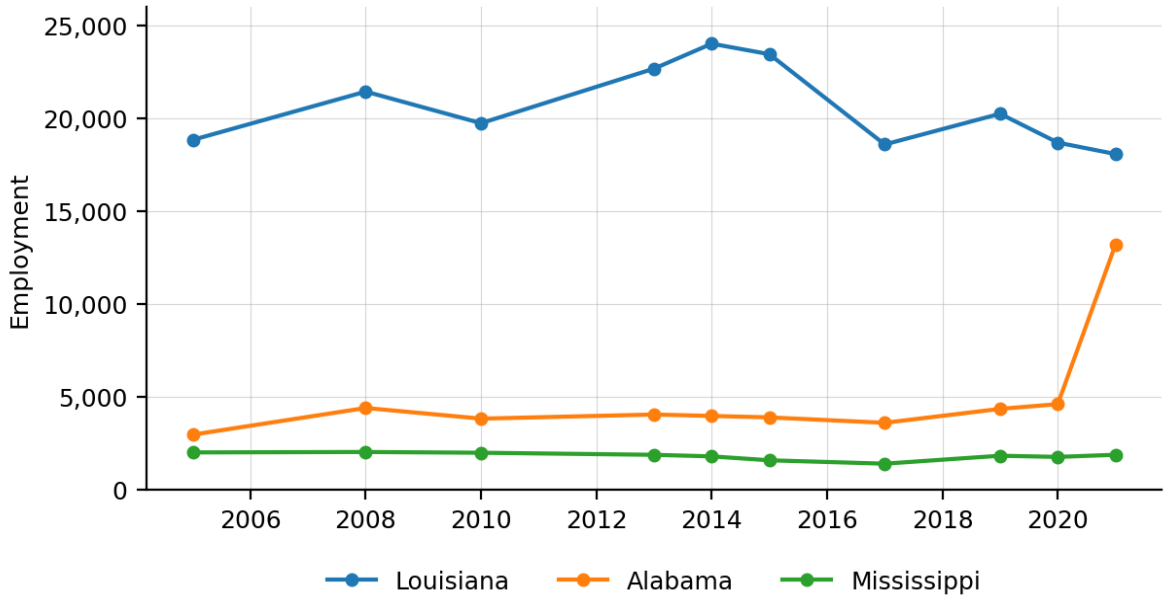
Mississippi's maritime transportation sector has been characterized by persistent stagnation. Employment declined from 2,001 in 2005 to 1,875 in 2021 (-6.3%), with an all-time low of 1,395 in 2017 during post-oil-crash restructuring. Despite stagnant employment, wages grew from $72.1 million to $131.2 million (+81.9%), suggesting that compensation growth is occurring within an essentially flat headcount structure.

Table 1. Maritime Transportation Employment by State, Select Years (2005–2021)

Year	GOM Total	LA	AL	MS	
2005	84,728	18,845	2,959	2,001	
2008	93,282	21,448	4,397	2,025	
2010	83,409	19,744	3,822	1,984	
2013	83,421	22,685	4,044	1,872	
2014	85,204	24,030	3,968	1,788	
2015	86,436	23,462	3,889	1,577	
2017	85,952	18,599	3,598	1,395	
2019	104,781	20,252	4,349	1,823	
2020	104,862	18,699	4,603	1,759	▼
2021	127,132	18,083	13,191	1,875	▲

Source: ENOW, NOAA Office for Coastal Management. (▲) = year of post-pandemic recovery peak; (▼) = COVID-19 impact year. Alabama's 2021 figure reflects port expansion-driven surge. Mississippi 2016 data suppressed (SUP).

Figure 3: Maritime Transportation Employment by State, 2005–2021 (select years)



Source: Economics: National Ocean Watch (ENOW), NOAA Office for Coastal Management.

3.3 Shift-Share Decomposition

Shift-share analysis decomposes employment change between 2005 and 2021 into three main components: a Gulf-wide growth effect, the industry mix effect, and the competitive effect. The most noticeable finding is Alabama's competitive effect of 8,751 jobs added, indicating that Alabama generated almost nine thousand jobs above what

Gulf-wide employment trends would have predicted. This outcome is a result of local competitive strength, whether through port infrastructure investment, favorable logistics costs,

or the geographic diversion of pandemic-era cargo flows.

Louisiana's competitive effect represents a glaring underperformance in the region with a loss of 10,193 jobs during the study period. Despite Gulf-wide growth of 50.0%, Louisiana's actual employment growth was essentially flat (-762 jobs), implying that without Gulf-wide tailwinds, Louisiana would have experienced significant decline. This structural underperformance was concentrated in the post-2014 period following the oil price crash, which possibly reflects the erosion of Louisiana's offshore service vessel specialization and the failure to replace those losses with new maritime transportation activity.

Mississippi's competitive effect confirms a modest but persistent structural disadvantage with a loss of 1,127 jobs. Mississippi's maritime transportation sector is not keeping pace with regional trends and is losing relative economic importance within the state's broader ocean economy portfolio.

Table 2. Shift-Share Analysis: Maritime Transportation Employment Decomposition (2005–2021)

State	Emp. 2005	Emp. 2021	Net Change	Competitive Effect
AL	2,959	13,191	+10,232	+8,751
LA	18,845	18,083	-762	-10,193
MS	2,001	1,875	-126	-1,127
GOM	84,728	127,132	+42,404	0

3.4 Location Quotient Analysis

Location quotients (LQs) measure the degree to which a state's ocean economy workforce is concentrated in maritime transportation relative to the Gulf of Mexico benchmark. An LQ greater than 1.25 indicates meaningful specialization; below 0.75 indicates under-representation. Louisiana exhibited consistent specialization in maritime transportation throughout the study period, with LQs ranging from 1.17 in 2005 to a peak of 1.48 in 2014 before declining to 0.968 in 2021. LQs fell below 1.0 for the first time in the dataset, signaling that Louisiana's historic dominance in maritime transportation has been structurally eroded, a watershed finding for workforce planning. Alabama's LQ trajectory is the most dramatic in the dataset: declining from 0.969 in 2005 to 0.797 in 2017, then surging to 1.589 in 2021. This reflects both the dramatic absolute employment increase and the compression of other ocean economy sectors in Alabama. It also confirms that maritime transportation has become the dominant component of Alabama's ocean economy workforce. Mississippi's LQ has declined from 0.41 in 2005 to 0.25 in 2021, remaining well below the Gulf benchmark. Maritime transportation accounts for only 2.7% of Mississippi's total ocean economy employment in 2021, compared to 10.7% for the Gulf of Mexico overall. This reflects a persistent and deepening under-representation in maritime transportation.

Table 3. Location Quotients: Maritime Transportation Workforce Specialization, Select Years

Year	Alabama LQ	Louisiana LQ	Mississippi LQ
2005	0.969	1.172	0.412
2007	1.191	1.356	0.409
2010	1.065	1.221	0.389
2013	1.042	1.437	0.430
2014	0.983	1.480	0.390
2017	0.797	1.241	0.285
2019	0.827	1.118	0.322
2020	0.848	1.134	0.284
2021	1.589	0.968	0.253

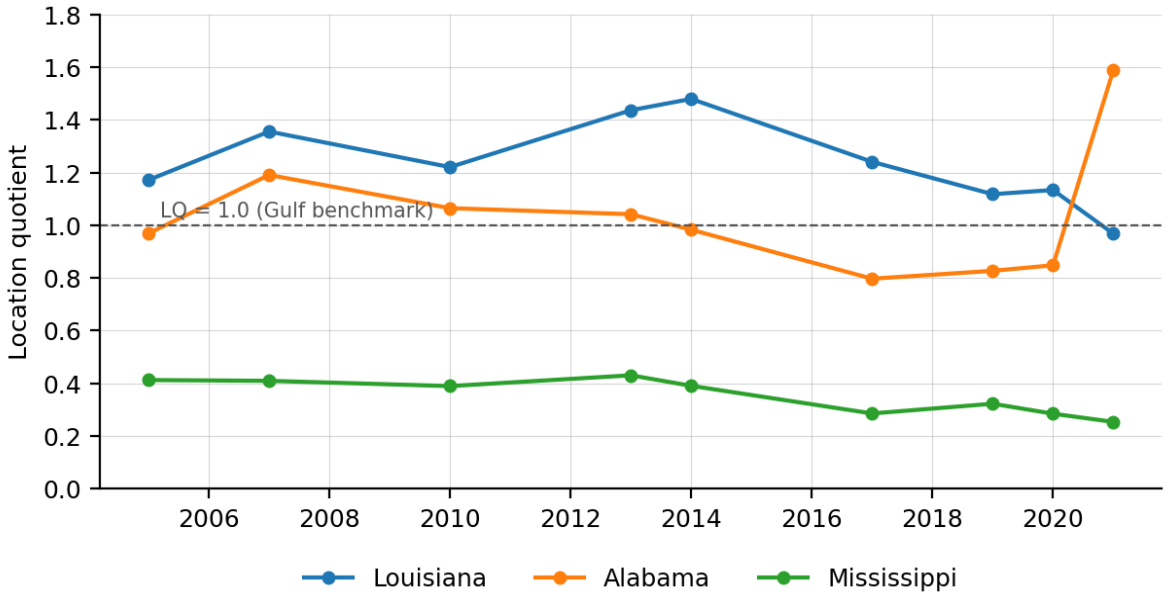
Source: Calculated from ENOW data

3.5 Statistical Significance and Causal Analysis

To assess whether observed workforce differences are statistically robust, this analysis employs one-way ANOVA for cross-geographic comparisons, Tukey HSD post-hoc testing for pairwise contrasts, and Granger causality testing for business formation as a leading employment indicator. The ANOVA confirms highly significant differences across all three workforce dimensions. The high F-statistic for employment levels ($F = 777.24$) reflects the enormous scale gap between the Gulf of Mexico (mean 90,950 workers) and the three states. For wage per employee, the significant F-statistic ($F = 21.58$, $p < 0.001$) indicates that compensation structures differ meaningfully by geography, with Tukey HSD confirming that Louisiana's wages are

significantly higher than both Alabama (mean difference: $19,251; $p < 0.001$) and Mississippi (mean difference: $16,278; $p < 0.001$). Alabama and Mississippi do not differ significantly from each other ($p = 0.683$).

Figure 4: Maritime Transportation Location Quotients by State, 2005–2021 (select years)



Source: Calculated from ENOW data, NOAA Office for Coastal Management.

Table 4. Statistical Test Results: Maritime Transportation Workforce Analysis

Test	F-Statistic	P-Value	Result	Interpretation
Employment Levels	777.24	< 0.001	Significant	Gulf of Mexico significantly larger; all states differ from Gulf
GDP per Employee	20.85	< 0.001	Significant	Productivity varies significantly; Louisiana & Gulf lead
Wage per Employee	21.58	< 0.001	Significant	Louisiana highest; Alabama and Mississippi trail significantly
Estab. → Employment (Granger, Lag 1)	4.29	0.059	Marginal	Establishments marginally predict employment 1 year ahead

Note: ANOVA tests conducted across four geographies (Gulf of Mexico, Alabama, Louisiana, Mississippi). Granger causality test conducted on Gulf of Mexico time series only (n=17). All tests use $\alpha = 0.05$.

The Granger causality test which examines whether establishment counts predict future employment levels yields a marginally significant result at lag 1 ($F = 4.285$, $p = 0.059$). This finding suggests that business formation is a leading indicator of employment growth with approximately a one-year lag, which has important implications for workforce planning. Analysts and policymakers monitoring establishment growth in maritime transportation can use it as an early warning system for anticipated hiring demand. The pattern shows that the relationship weakens at lag 2 ($F = 2.317$, $p = 0.149$), consistent with short-run labor market adjustment dynamics.

IV. Discussion

4.1 National Transportation Workforce Pressures

The Gulf-level dynamics documented above unfold within a national transportation workforce under severe structural stress. The sector has one of the oldest workforces in the U.S. economy which is approximately 43% of transit workers are over the age of 55, nearly double the share in other sectors and highly skilled maintenance technicians and veteran operators are retiring faster than they can be replaced, eroding institutional knowledge. Simultaneously, the deployment of autonomous vehicles, electric fleets, and AI-driven route optimization is shifting labor demand from routine operational roles toward advanced technical proficiencies faster than vocational programs and community colleges can update curricula in areas such as automated maintenance, cybersecurity, and predictive analytics. Quality-of-life factors compound both problems: long and unpredictable hours, forced overtime, and elevated early-career injury rates drive high turnover and deter younger entrants, while recent signing bonuses and accelerated pay scales have slowed vacancies without creating a sustainable pipeline.

4.2 The Global Officer Shortage

Maritime transportation faces these pressures in acute form because of the isolated, strictly regulated, and specialized nature of ocean-going commerce. While the industry maintains an adequate pool of entry-level ratings, it confronts a severe bottleneck in certified leadership. The BIMCO and International Chamber of Shipping Seafarer Workforce Report 2026 estimates a current global supply of approximately 2,565,580 STCW-certified seafarers (1,048,980 officers and 1,516,600 ratings) against a demand of 2,547,790, producing an immediate shortage of 39,100 certified officers alongside a surplus of roughly 56,890 ratings (BIMCO & ICS, 2026). Meeting projected demand would require an additional 113,735 officers by 2030, approximately 22,747 new officers per year, a 2% annual increase. The binding constraint is retention rather than recruitment: contracts of six to nine months away from family, workplace isolation, and the ready availability of shore-side logistics and port management careers draw officers ashore before they advance into senior certified roles.

4.3 Technological and Regulatory Transition

Two transition dynamics intensify the shortage. First, the International Maritime Organization's decarbonization trajectory requires officers to manage alternative propulsion systems, including liquefied natural gas, methanol, ammonia, and hydrogen, for which existing training systems are not yet adequately equipped; maritime academy curricula and federal training infrastructure are being upgraded but continue to lag the pace of fleet technology adoption (IMO, 2023; MARAD, 2023). Second, the sector maintains some of the highest regulatory barriers to entry in transportation: obtaining and maintaining STCW certification requires extensive classroom hours and costly sea time, and backlogged security clearances, background checks, and physical requirements lengthen entry timelines, pushing younger workers toward less credential-intensive construction and manufacturing employment.

4.4 Gulf Coast Industrial Base Constraints

These global and national pressures converge on the Gulf Coast, the central industrial engine of American maritime operations, which supports deepwater energy ports, inland barge corridors, major defense yards, and more than 120 small and

medium fabrication and repair facilities. Shipyards across the region report persistent vacancies in specialized, safety-sensitive trades, including maritime electricians, pipefitters, riggers, and certified structural welders, within a national maritime manufacturing workforce gap projected to exceed 75,000 jobs through 2028 (SME, 2025). The region's labor force is also deeply exposed to volatile energy markets: project-based hiring cycles at LNG and petrochemical hubs generate recurrent layoffs that push certified maritimers permanently into land-based industrial roles, and new large-scale port developments intensify wage competition that smaller barge operators and repair yards cannot match. Emerging responses include employer-led training, such as Bollinger Shipyards' 14-week shipfitter and pipe-welder programs in Gulfport, Mississippi; the Society of Manufacturing Engineers' Maritime Manufacturing Workforce Pipeline – Gulf Coast, which links six community colleges across Louisiana, Mississippi, and Alabama including Nunez Community College and Bishop State Community College to standardize maritime career pathways and dual-enrollment credit (SME, 2025); and the U.S. Maritime Administration's Centers of Excellence designation program for domestic maritime workforce training (MARAD, 2026).

4.5 Policy Recommendations

Overall, workforce development has received renewed attention at the state level as policymakers work to develop and execute strategies to expand the labor force, increase access to good jobs and provide high quality training and educational opportunities amidst changing labor markets and demand particularly in certain critical sectors. States have also been turning their attention to improved data collection and reporting. Better data provides better information with which better decisions can be made on how to target workforce development. A strong call for investment in robust data collection and reporting systems will enable better measurement of program quality and performance in order to help craft policy and better target interventions. In addition, there is a critical need to build strong partnerships among labor representatives, employers, educational institutions, workforce boards and other important voices to create sectoral approaches and interventions to workforce development challenges. Up front is the need to engage employers in all steps of the policy process and provide information on how to promote inclusivity in hiring. U.S. DOT Volpe Center (2024) in its report on opportunities for maritime highway transportation, discusses several opportunities for the Gulf of Mexico. The report indicates that the Gulf region, serving as a key gateway to inland waterways, has the potential to develop hub-and-spoke systems centered on ports like New Orleans and Houston. Important policy considerations are differentiated state workforce strategies. Appropriate for a region with the divergent trajectories documented in this analysis, these workforce development program strategies would be tailored and customized.

Alabama's maritime transportation sector is in a period of transformative expansion that creates both opportunity and risk. The 345.8% employment growth documented in this analysis has rapidly made maritime transportation the dominant component of Alabama's ocean economy workforce. However, the sharp decline in GDP per employee and wage per employee signals that the current growth is quantity-led rather than quality-led. For sustainable workforce development, Alabama should invest in upskilling the large cohort of entry-level workers onboarded during the pandemic surge into certified, higher-wage maritime professionals. Alabama's focus should be on quality-upgrades.

Louisiana's maritime transportation sector faces the most complex workforce development challenge in the region. The state's competitive effect of -10,193 jobs and the crossing of its location quotient below 1.0 for the first time in 2021 represent a structural inflection point. Louisiana can no longer assume its historical dominance in GOM maritime transportation will self-perpetuate. The state's relative wage strength, $76.9K per employee in 2021, the highest in the region, provides a foundation for a quality-focused recovery strategy that leverages Louisiana's existing high-skill maritime workforce. A recommendation is for Louisiana to double down on specialization

including offshore vessel operations, port logistics management, maritime law and insurance, and the emerging LNG bunkering infrastructure along the Lower Mississippi River corridor. Workforce development investments should be targeted toward accredited maritime training programs; retention incentives for experienced maritime professionals who represent institutional knowledge at risk of permanent loss through retirement or out-of-state migration; and partnerships with the Port of New Orleans, Port of South Louisiana, and the Lake Charles deep-water port to develop employer-led apprenticeship frameworks that align training investments with employer demand.

Mississippi's maritime transportation sector, characterized by persistent employment decline, a low and falling location quotient and a limited base of only 1,875 workers, requires a different strategic approach than its larger neighbors. The challenge is to expand the pipeline without diluting that quality. Mississippi's coastal geography, concentrated along the Gulf Coast and the Tombigbee-Tennessee waterway system, offers underutilized infrastructure assets including the Port of Gulfport and the Pascagoula Ship Channel. Developing these assets as workforce development anchors, through port authority-community college partnerships, pre-apprenticeship programs targeting coastal communities, and targeted marketing of maritime careers to the state's fishing and coastal tourism workforce, could organically grow the sector from its current narrow base.

Finally, across all three states, maritime education, training, and careers at sea should be actively promoted including clear information on pathways into shore-based roles and maritime administrations should regularly monitor seafarer recruitment and retention to keep industry and policymakers informed of the supply and demand outlook for the maritime workforce.

V. Contributions & Limitations

This paper used the ENOW dataset for 2005–2021 and a multi-method quantitative design to document sharply divergent maritime transportation workforce trajectories across the Gulf of Mexico and its three central states. Gulf-wide employment grew 50.0%, with a statistically significant trend of roughly 1,470 jobs per year, yet wage per worker plateaued and output per worker declined substantially from its 2008 peak — the signature, under the human capital framework developed in Section 2, of quantity-led rather than quality-led growth. The analysis makes three contributions. It demonstrates that regional ocean-economy accounts can support state-level workforce diagnosis, not merely national measurement. It shows that the quality-led versus quantity-led distinction converts descriptive indicators of wages, productivity, location quotients, and shift-share components into differentiated policy prescriptions: skill upgrading for Alabama's newly expanded workforce, retention and specialization for Louisiana's eroding high-wage base, and pipeline construction for Mississippi's narrow one. And the marginally significant lead of establishment formation over employment offers workforce boards a practical early-warning indicator for anticipating hiring demand roughly one year ahead.

Several limitations qualify these findings. ENOW is constructed from Quarterly Census of Employment and Wages records, which exclude self-employed workers and proprietorsseg, ments that are non-trivial in small-operator maritime activity and suppressed cells (such as Mississippi in 2016) interrupt some series. Monetary values are analyzed as reported; to the extent they are nominal, long-run wage and GDP growth rates overstate real changes, and re-estimation in constant dollars would sharpen the productivity conclusions. The sector definition includes warehousing, which complicates the interpretation of rapid employment surges, as examined for Alabama in Section 3.2. The Granger analysis rests on seventeen annual observations and should be read as suggestive rather than definitive. Finally, the three-state scope excludes Texas and Florida, whose inclusion would test whether the patterns documented here generalize across the full Gulf.

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