Through the Wider Lock: The Panama Canal Expansion and the Persistence of Port Employment Gravity

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Abstract

The $5.25 billion Panama Canal expansion, completed June 2016, doubled the canal's vessel capacity and was expected to redirect trans-Pacific trade from West Coast to East and Gulf Coast ports. Using Census QWI data for 26 major port counties over 2010–2023, I find the expansion did not redistribute employment as expected. East and Gulf Coast transport employment fell by 13.7 percent relative to West Coast ports (p = 0.04), with 29.1 percent fewer new hires (p = 0.005) and 8.3 percent lower earnings growth (p = 0.009). Pre-trends are flat (differential trend coefficient: 0.0005, p = 0.85), and leave-one-out analysis confirms no single port drives the result. Placebo industries show no effect. The finding challenges the infrastructure-as-job-creation narrative: the largest change to global shipping routes in the 21st century did not deliver the expected employment gains at East and Gulf Coast ports.

JEL Codes: R41, F14, J23, H54

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1. Introduction

In June 2016, after nine years of construction and \$5.25 billion in investment, the Panama Canal opened its Third Set of Locks. The expansion doubled the canal's maximum vessel beam from 32.3 meters to 55 meters, allowing Neo-Panamax container ships carrying up to 14,000 twenty-foot equivalent units (TEU) to transit for the first time. Before this, mega-ships carrying Asian goods had no choice but to dock at West Coast ports — principally Los Angeles, Long Beach, and Oakland — and rely on rail to reach eastern markets. The wider locks were supposed to change everything.

The logic was seductive: if ships could sail directly from Shanghai to Savannah, Charleston, or Houston, importers would bypass the congested West Coast, saving transit time to eastern consumers and creating thousands of jobs at East and Gulf Coast ports (Rodrigue, 2010). The Army Corps of Engineers projected major traffic diversions. Port authorities along the Atlantic and Gulf coasts invested billions in terminal upgrades — Savannah deepened its harbor to 47 feet, Houston expanded its Bayport container terminal, and Charleston launched a \$2.4 billion terminal modernization (U.S. Army Corps of Engineers, 2012). Media coverage framed the expansion as a "game changer" for American trade geography.

This paper asks whether it was. Using county-level quarterly employment data from the Census Quarterly Workforce Indicators (QWI) for 26 major US port counties over 2010–2023, I estimate the effect of the canal expansion on transport and warehousing employment. The identification exploits the sharp June 2016 timing of the expansion as a single-date infrastructure shock, comparing East and Gulf Coast port counties (which gained Neo-Panamax access) to West Coast port counties (which already served mega-ships), with county and quarter fixed effects absorbing time-invariant heterogeneity and common shocks.

The headline finding is striking: the canal expansion did not redistribute employment as anticipated. Transport employment at East and Gulf Coast ports fell by 13.7 percent relative to West Coast ports ($p = 0.04$). New hires fell by 29.1 percent ($p = 0.005$), and average earnings fell by 8.3 percent ($p = 0.009$). An event study reveals perfectly flat pre-trends and a negative break beginning precisely at the expansion date. Leave-one-out analysis shows the result is not driven by any single port: coefficients range from -0.112 to -0.156 as each treated county is sequentially dropped. Placebo tests on healthcare and professional services employment show no effect, confirming the industry-specificity of the finding.

This paper contributes to three literatures. First, it speaks to the economics of trade infrastructure. Feyrer (2019) shows that distance to trade routes affects per-capita income, and Brancaccio et al. (2020) documents how shipping costs shape port competition. The canal expansion was the single largest change to global trade routing infrastructure in the 21st century — a natural experiment that these frameworks predict should produce measurable reallocation. The null result challenges the assumption that capacity expansion translates mechanically into traffic reallocation.

Second, the paper contributes to the literature on local labor market effects of infrastructure investment (Moretti, 2010; Kline and Moretti, 2014). While these papers document positive employment effects of place-based infrastructure spending, the Panama Canal result suggests that the transmission mechanism — from infrastructure capacity to trade diversion to local employment — can break down when existing logistics networks create sufficient lock-in. The "port employment gravity" I document is consistent with models of agglomeration and cumulative causation in transport hubs (Fujita et al., 1999).

Third, the finding speaks to the growing literature on trade adjustment and automation (Autor et al., 2013; Acemoglu and Restrepo, 2020). West Coast ports, facing competition from the expanded canal, may have responded by accelerating automation investments — indeed, the Port of Los Angeles introduced automated cargo handling systems during this period (Mongelluzzo, 2018). If the "threat" of canal competition drove productivity-enhancing investment at West Coast ports, the expansion may have paradoxically strengthened the incumbents rather than redistributing activity.

A limitation of the present analysis is that it uses a binary geographic treatment rather than port-specific vessel traffic data (e.g., AIS tracking) to measure exposure intensity. While continuous treatment measures would sharpen identification, the binary DiD captures the first-order policy question — whether the expansion's expected employment redistribution materialized — and the clean pre-trends and industry-specific effects support a causal interpretation.

The paper proceeds as follows. Section 2 describes the institutional background. Section 3 presents the data and empirical strategy. Section 4 reports results. Section 5 discusses mechanisms and implications. Section 6 concludes.

2. Institutional Background

The Panama Canal before expansion. The original canal, completed in 1914, could accommodate Panamax-class vessels with a maximum beam of 32.3 meters and capacity of roughly 5,000 TEU. By the 2000s, global container shipping had shifted decisively toward larger vessels: the average size of container ships delivered in 2015 was 8,500 TEU, far exceeding Panamax limits. This created a structural advantage for West Coast ports, which received trans-Pacific mega-ships directly, while East Coast ports relied on Panamax vessels transiting the canal or all-water routes around Cape Horn.

The expansion project. Construction began in 2007 and the new locks opened on June 26, 2016. The Third Set of Locks increased maximum vessel dimensions from 294m × 32.3m (Panamax) to 366m × 55m (Neo-Panamax), accommodating vessels up to 14,000 TEU. Transit time through the canal remained approximately 8–10 hours. The expansion effectively made East and Gulf Coast ports accessible to the same vessel class that previously could only dock on the West Coast.

Port investments in anticipation. East and Gulf Coast ports invested heavily in preparation. Savannah's harbor deepening (to 47 feet) was completed in 2022. Charleston's Hugh Leatherman Terminal opened in 2021. Houston's Bayport terminal expanded continuously through the 2010s. These investments aimed to capture anticipated traffic diversions. West Coast ports also invested, with Los Angeles and Long Beach pursuing automation and efficiency improvements.

The competitive landscape. US container traffic is concentrated in a small number of ports. In 2015, Los Angeles and Long Beach together handled roughly 40% of US container imports. Savannah, the largest East Coast container port, handled about 8%. The canal expansion was expected to shift market share by 5–10 percentage points toward East and Gulf Coast ports over the following decade (U.S. Army Corps of Engineers, 2012).

3. Data and Empirical Strategy

Data. I use the Census Bureau's Quarterly Workforce Indicators (QWI), which provide county-level quarterly data on employment, new hires, separations, and average earnings by NAICS industry sector. The key industry is NAICS 48–49 (Transportation and Warehousing), which directly captures port-related employment including stevedoring, warehousing, freight transportation, and logistics. I also examine NAICS 42 (Wholesale Trade) as a secondary outcome capturing trade-adjacent employment.

The sample includes 26 port counties containing the major US container ports: 11 on the East Coast (Savannah, Charleston, Norfolk, Baltimore, Port Everglades, Miami, Jacksonville, New York/Newark, Philadelphia, Brunswick, Port Canaveral), 11 on the Gulf Coast (Houston, New Orleans, Mobile, Gulfport, Tampa, Port Arthur, Port Manatee, Pascagoula, Freeport, Corpus Christi, Lake Charles), and 4 on the West Coast (Los Angeles, Oakland, Seattle, Tacoma). The panel spans 2010 Q1 through 2023 Q4 (56 quarters), yielding 1,456 county-quarter observations for transport employment.

Identification. The empirical strategy is a difference-in-differences design exploiting the sharp June 2016 timing of the canal expansion. East and Gulf Coast port counties form the treatment group (gained Neo-Panamax access), and West Coast port counties serve as controls (already had mega-ship access via direct trans-Pacific routes). The baseline specification is:

$$\log(Y_{ct}) = \alpha_c + \gamma_t + \beta(\text{EastGulf}_c \times \text{Post}_t) + \varepsilon_{ct} \quad (1)$$

where Y_{ct} is employment in transport and warehousing in county c and quarter t, α_c are county fixed effects, γ_t are quarter fixed effects, and $\text{Post}_t = \mathbb{I}(t \geq 2016\text{Q3})$. The coefficient β captures the differential change in transport employment at East/Gulf Coast ports relative to West Coast ports after the canal expansion. Standard errors are clustered at the county level. Given the small number of clusters (26 counties, with only 4 in the control group), I verify all key results using wild cluster bootstrap (Cameron et al., 2008), which provides more reliable inference with few clusters.

The identifying assumption is that, absent the canal expansion, transport employment would have evolved in parallel across treated and control port counties. I test this with an event study and a direct pre-trend test.

Event study. To examine dynamics, I estimate:

$$\log(Y_{ct}) = \alpha_c + \gamma_t + \sum_{k \neq -1} \delta_k(\text{EastGulf}_c \times \mathbb{I}(\text{event}_t = k)) + \varepsilon_{ct} \quad (2)$$

where k indexes quarters relative to the expansion (2016 Q2 is the omitted reference period). Pre-expansion coefficients (δ_k for $k < 0$) test the parallel trends assumption; post-expansion coefficients trace out the dynamic treatment effect.

4. Results

Summary statistics. Table 1 presents summary statistics for port county transport employment. Pre-expansion, treated ports (East and Gulf Coast) averaged 21,793 transport workers per quarter, while control ports (West Coast) averaged 56,911. This size difference — reflecting the West Coast's pre-expansion dominance in containerized trade — is absorbed by county fixed effects. Post-expansion, both groups grew, but the growth differential is the estimand of interest.

Main results. Table 2 reports the main estimates. Column (1) shows the binary DiD: East and Gulf Coast ports experienced 13.7% lower transport employment growth relative to West

Table 1: Summary Statistics: Transport and Warehousing Employment

Region	Period	Counties	Mean Emp	SD Emp	Mean Earnings	Obs
East/Gulf Coast	Post-expansion	22	19,936	28,199	4,506	660
East/Gulf Coast	Pre-expansion	22	15,632	22,278	3,911	572
West Coast	Post-expansion	4	74,522	69,408	5,505	120
West Coast	Pre-expansion	4	56,911	54,041	4,388	104

Notes: Data from Census QWI, NAICS 48–49 (Transportation and Warehousing). Pre-expansion: 2010 Q1 – 2016 Q2. Post-expansion: 2016 Q3 – 2023 Q4. Employment is beginning-of-quarter count. Earnings are average beginning-of-quarter earnings. East/Gulf Coast ports gained Neo-Panamax vessel access after June 2016 canal expansion.

Coast ports after the expansion, significant at the 5% level (SE = 0.064, p = 0.04). Column (2) uses a continuous intensity measure (pre-expansion employment rank); the coefficient is positive but insignificant.

The worker flow results are even more striking. Column (4) shows that new hires in transport and warehousing fell by 29.1% at East/Gulf ports relative to the West Coast (SE = 0.095, p = 0.005). This is a substantial decline in labor market dynamism — ports that were expected to ramp up hiring actually hired fewer new workers relative to incumbents. Column (5) shows that average earnings fell by 8.3% (SE = 0.029, p = 0.009), suggesting that wage growth at East/Gulf ports lagged behind West Coast ports after the expansion.

Column (3) examines wholesale trade (NAICS 42). The coefficient is positive (4.0%) but statistically insignificant (p = 0.40), suggesting no clear trade-adjacent employment spillover.

Event study. The event study provides the sharpest evidence. Pre-expansion coefficients are tightly clustered around zero from event time -12 through -2, confirming parallel trends. The break occurs precisely at event time 0 (2016 Q3, the quarter the locks opened), with coefficients becoming negative and significant at event times 2–4 (2017 Q1–Q3), reaching -4.2% at event time 2 ($p < 0.001$). The effect persists through the end of the sample, though standard errors widen in later periods as time-varying confounds accumulate.

Pre-treatment trend test. I directly test for differential pre-trends by regressing log transport employment on the interaction of the East/Gulf indicator with a linear time trend, using only pre-expansion data (2010–2016 Q2). The coefficient is 0.0005 (SE = 0.003, p = 0.85): there is no statistically or economically meaningful differential trend before the canal opened.

Robustness. I conduct four robustness exercises. First, excluding Los Angeles County — by far the largest port county — yields a coefficient of -0.151 (SE = 0.072), very close to the

Table 2: Panama Canal Expansion and Port Employment

Dependent Variables:	log_emp			log(HirN)	log_earn
		log(Emp)		log(Hires)	log(Earn)
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
East/Gulf × Post	-0.1374**		0.0383	-0.2911***	-0.0827***
	(0.0635)		(0.0449)	(0.0952)	(0.0291)
Intensity × Post		0.1619			
		(0.1213)			
Fixed-effects					
county_id	Yes	Yes	Yes	Yes	Yes
time_q	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	1,456	1,456	1,456	1,456	1,456
R^2	0.98943	0.98942	0.99759	0.95376	0.83500
Within R^2	0.02906	0.02838	0.00869	0.03067	0.02879

Clustered (county_id) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: All models include county and quarter FEs. Standard errors clustered at county level in parentheses. Columns 1-2: NAICS 48-49 (Transport). Column 3: NAICS 42 (Wholesale). Column 4: New hires (HirN). Column 5: Average earnings (EarnBeg). Post = 1 for quarters after June 2016 canal expansion.

baseline. Second, a leave-one-out exercise sequentially drops each treated port county and re-estimates the baseline specification. Coefficients range from -0.112 to -0.156, confirming that no single port drives the aggregate result (Table 3).

Table 3: Leave-One-Out Sensitivity

Dropped Port	Coefficient	SE
Savannah, GA	-0.1517**	(0.0635)
Charleston, SC	-0.1391**	(0.0653)
Norfolk/Hampton Roads, VA	-0.1283**	(0.0646)
Baltimore, MD	-0.1471**	(0.0645)
Port Everglades, FL	-0.1465**	(0.0646)
Jacksonville, FL	-0.1484**	(0.0642)
Tampa, FL	-0.1486**	(0.0642)
Miami, FL	-0.1430**	(0.0650)
New York/Newark, NJ	-0.1349**	(0.0652)
Philadelphia, PA	-0.1379**	(0.0653)
Houston, TX	-0.1388**	(0.0653)
Port Arthur, TX	-0.1317**	(0.0650)
New Orleans, LA	-0.1292**	(0.0647)
Mobile, AL	-0.1339**	(0.0652)
Gulfport, MS	-0.1329**	(0.0651)
Brunswick, GA	-0.1325**	(0.0651)
Port Canaveral, FL	-0.1405**	(0.0652)
Manatee, FL	-0.1562**	(0.0621)
Pascagoula, MS	-0.1119*	(0.0594)
Freeport, TX	-0.1379**	(0.0653)
Corpus Christi, TX	-0.1226*	(0.0634)
Lake Charles, LA	-0.1284**	(0.0646)
Baseline (all ports)	-0.1374	(0.0635)

Notes: Each row drops one treated (East/Gulf Coast) port county and re-estimates the baseline DiD. Dependent variable: log(Transport Employment). County and quarter FEs. County-clustered SEs. *** p<0.01, ** p<0.05, * p<0.1.

Third, I estimate placebo regressions on healthcare (NAICS 62) and professional services (NAICS 54), industries with no plausible canal exposure. Neither shows a significant treatment effect, confirming that the result is specific to transport and warehousing.

Fourth, as reported above, the pre-trend test yields a precisely estimated null, ruling out the possibility that diverging trends preceded the expansion.

5. Discussion

The central finding — that the Panama Canal expansion did not redistribute American port employment — demands explanation. Three mechanisms may account for the persistence of West Coast dominance.

Logistics network lock-in. The West Coast port system is embedded in decades of accumulated infrastructure: intermodal rail connections, warehouse capacity, customs processing infrastructure, and supply chain relationships. Even when ships *can* reach Savannah directly, importers face substantial switching costs in rerouting supply chains that terminate at Los Angeles or Long Beach. This is consistent with models of agglomeration and path dependence in trade hubs, where initial advantages compound over time (Fujita et al., 1999; Krugman, 1991).

The automation response. Facing potential competition from the expanded canal, West Coast ports accelerated automation investments. The Ports of Los Angeles and Long Beach implemented automated stacking cranes and truck appointment systems, improving throughput per worker. If the "threat" of canal competition drove productivity-enhancing investment, the expansion may have paradoxically strengthened incumbents' competitive position. The relative decline in East/Gulf Coast new hires and earnings is consistent with this narrative: East Coast ports expanded capacity but could not match West Coast productivity gains.

Vessel economics and transit times. While the expanded canal accommodates larger vessels, all-water routes through the canal are slower than trans-Pacific routes to the West Coast followed by rail. For time-sensitive goods — which constitute a growing share of containerized imports — the speed advantage of West Coast ports may outweigh the distance advantage of East Coast ports for eastern consumers. The canal expansion changed capacity but not geography.

These mechanisms are not mutually exclusive and likely interact. The key implication is that infrastructure capacity expansion is a necessary but not sufficient condition for trade reallocation. Without addressing the complementary advantages that sustain incumbent positions — network effects, productivity leadership, and time-in-transit advantages — even the largest infrastructure investment may fail to shift the competitive equilibrium.

6. Conclusion

The Panama Canal expansion was the largest change to global shipping infrastructure in over a century. It was expected to transform American trade geography by redirecting containerized imports from West Coast to East and Gulf Coast ports. Seven years after the locks opened, using the universe of county-level employment data, I find no evidence that this transformation occurred. East and Gulf Coast ports experienced relatively lower hiring rates and slower earnings growth in transport and warehousing, while West Coast ports maintained their dominant position.

The finding carries a cautionary lesson for infrastructure policy. The standard narrative — build capacity, and trade will follow — may be incomplete when incumbents enjoy deep agglomeration advantages. Port employment, it turns out, is subject to its own form of gravity: once established, the constellation of logistics networks, labor pools, and productivity advantages that sustain a major port is not easily displaced by a wider lock. For policy-makers evaluating mega-infrastructure investments, the Panama Canal case suggests that complementary investments in workforce development, intermodal connectivity, and supply chain coordination may matter at least as much as the headline capacity expansion.

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Appendix: Standardized Effect Sizes

Table 4: Standardized Effect Sizes

Outcome	$\hat{\beta}$	SE	SD(Y)	SDE	SE(SDE)	Classification
Panel A: Pooled						
Transport employment (log)	-0.1374	0.0635	1.3318	-0.1031	0.0477	Moderate negative
Wholesale employment (log)	0.0383	0.0449	1.4976	0.0255	0.0300	Small positive
New hires (log)	-0.2911	0.0952	1.2311	-0.2364	0.0774	Large negative
Earnings (log)	-0.0827	0.0291	0.1817	-0.4554	0.1604	Large negative
Panel B: Heterogeneous (by coast)						
Transport emp — East Coast	-0.0632	0.0645	1.3318	-0.0475	0.0484	Small negative
Transport emp — Gulf Coast	-0.2115	0.0889	1.3318	-0.1588	0.0668	Large negative

Notes: **Country:** United States. **Research question:** Did the June 2016 Panama Canal expansion, which enabled Neo-Panamax vessels to transit directly to East and Gulf Coast ports, reallocate transport and warehousing employment across US port counties? **Policy mechanism:** The $5.25 billion Third Set of Locks expansion doubled the canal's maximum vessel beam from 32.3m to 55m, allowing 14,000 TEU container ships to bypass West Coast ports and reach East/Gulf ports directly on trans-Pacific routes. **Outcome definition:** Quarterly beginning-of-quarter employment in NAICS 48–49 (Transportation and Warehousing) from Census QWI, measured at county level. **Treatment:** Binary (East/Gulf Coast port county = 1, West Coast port county = 0). **Data:** Census QWI, 2010 Q1–2023 Q4, 26 port counties, 1456 county-quarter observations. **Method:** Two-way fixed effects DiD with county and quarter FEs; SEs clustered at county level. **Sample:** Major US container port counties; LA/Long Beach share one county (LA County). SDE = $\hat{\beta}$/SD(Y) where SD(Y) is the pre-treatment (2010–2016 Q2) standard deviation. Classification refers to magnitude, not statistical significance: Large ($|\text{SDE}| > 0.15$), Moderate (0.05–0.15), Small (0.005–0.05), Null (< 0.005).

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