

Timing is Everything: Labor Market Winners and Losers from Energy Booms and Busts

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Labor reallocation between booming and busting sectors is not frictionless

- ▶ Search and matching costs (Pissarides, 2014; Albrecht & Vroman, 2002)
- ▶ Skill loss during unemployment (Ortego-Martí, 2017)
- ▶ Skill mismatch between declining and expanding sectors (Şahin et al., 2014)
- ▶ Persistent penalties for bad entry timing (Davis & von Wachter, 2012)

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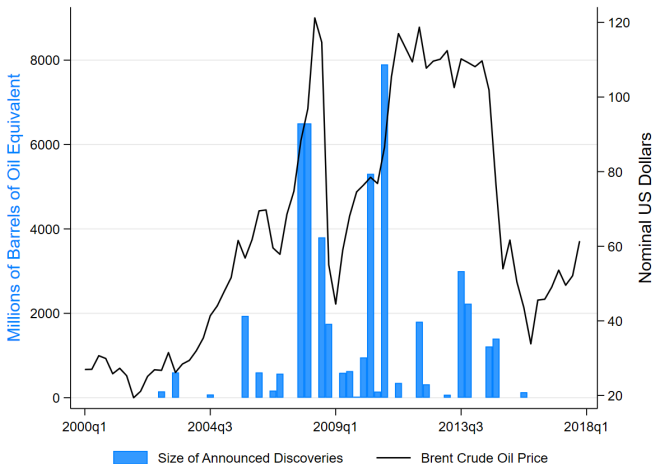
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Commodity-dependent countries face high sectoral volatility → more frictions



Countries in blue are export-dependent on extractive commodities (Roe and Dodd, 2016)

Global Oil Prices and Offshore Oil & Gas Discoveries in Brazil



► Petrobras Investment

Introduction
○

Context
●○○

Data
○○○

Empirical Strategy
○○○

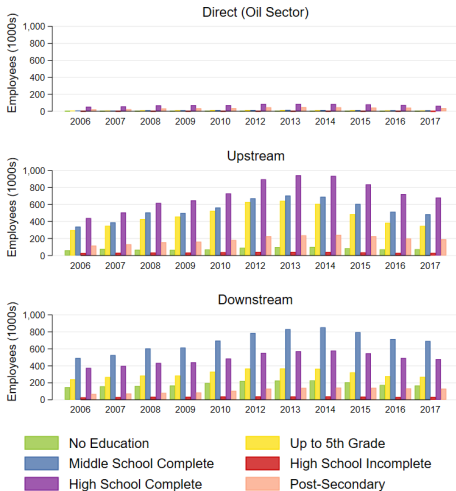
Results
○○○○○

Robustness
○

Mechanisms
○○○○○

Conclusion
○

► Identifying Upstream and Downstream Sectors Using Input-Output Table



► Oil-Linked Employment Growth Relative to Other Sectors

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 - > Accumulate knowledge in professional roles → job and occupation stability
 - > Later entrants compete with glut of new oil-specific graduates

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In the paper, we analyze **three types** of entrants into oil-linked sectors:

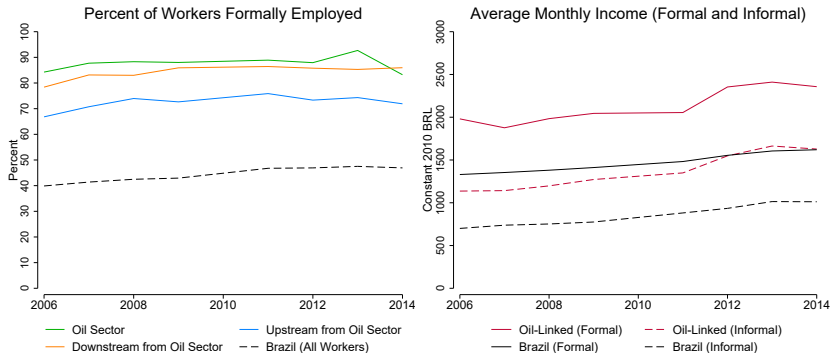
- ▶ **Poaches**: workers who voluntarily leave a job and are rehired by a new firm within 4 months
- ▶ **New Hires**: workers hired into their first formal job, who may make education choices based on anticipated sectoral dynamics
- ▶ **Unemployed/Informal Hires**: workers hired out of unemployment or the informal sector

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Note: Data are drawn from Brazil's Pesquisa Nacional por Amostra de Domicílios (PNAD), an annual nationally representative household survey.

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Strategy: Match workers **poached into an oil-linked establishment in year t** with counterfactual workers **poached into other sectors in t**

Exact match on:

- ▶ **Demographics:** schooling, sex, race, age bin
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Use analogous strategy for **newly hired workers** and **workers hired from unemployment/informality**, omitting previous labor market experience

- ▶ Let E_{ic} be period when worker i in cohort c is hired into oil. Let $K_{ict} = t - E_{ic}$ be number of years before or after this event
- ▶ Let Y_{ict} be outcome (e.g., wages) for i in cohort c in year t
- ▶ Include worker and year fixed effects; cluster standard errors at worker level

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Standard event study approach: center staggered events using relative time indicators to estimate average $\hat{\beta}_k$'s

We're interested in **cohort-specific** $\hat{\beta}_{ck}$'s \Rightarrow estimate event studies separately for each cohort c relative to **matched controls**

► **Minimize bias from selection into treatment**

- 1 **Exact matching on labor market characteristics** over t , $t - 1$ and $t - 2$ captures nearly all information employers have access to when hiring
- 2 Match on **destination municipality** accounts for location-specific shocks
- 3 **Worker-level fixed effects** absorb time-invariant characteristics, including unobservables (e.g, ability, risk preferences)
- 4 **Comparing poaches to poaches** avoids selection on willingness to leave job

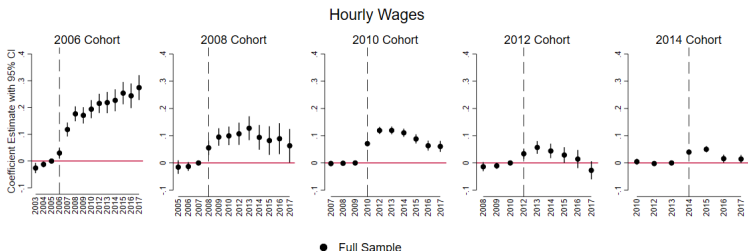
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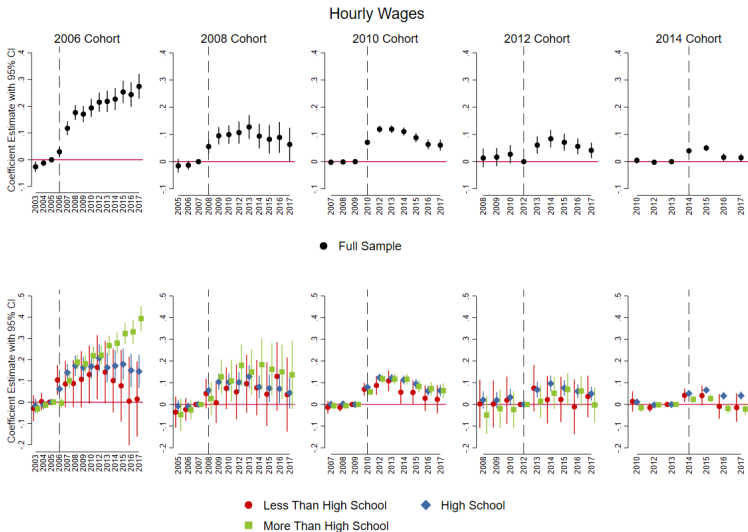
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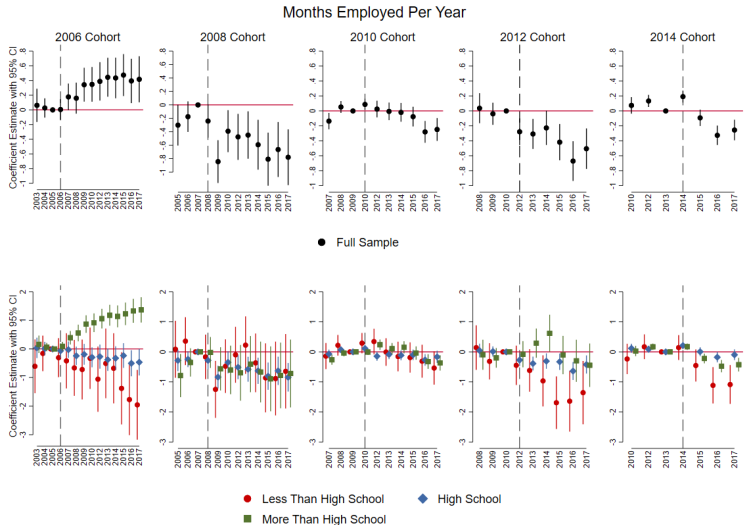
- ▶ Strategy identifies **“Average Treatment Effect in Matched Sample” (ATM)**



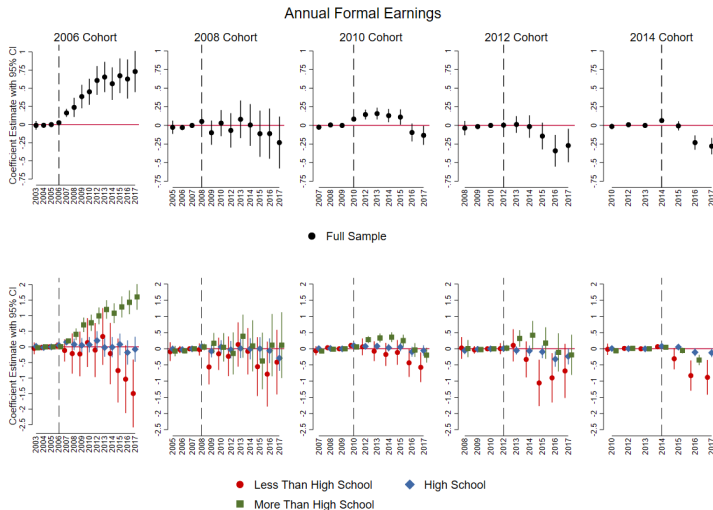
Note: Wages deflated to 2018 BRL and transformed using IHS. Standard errors clustered at individual level. This specification keeps only employed individuals to focus on intensive margin.



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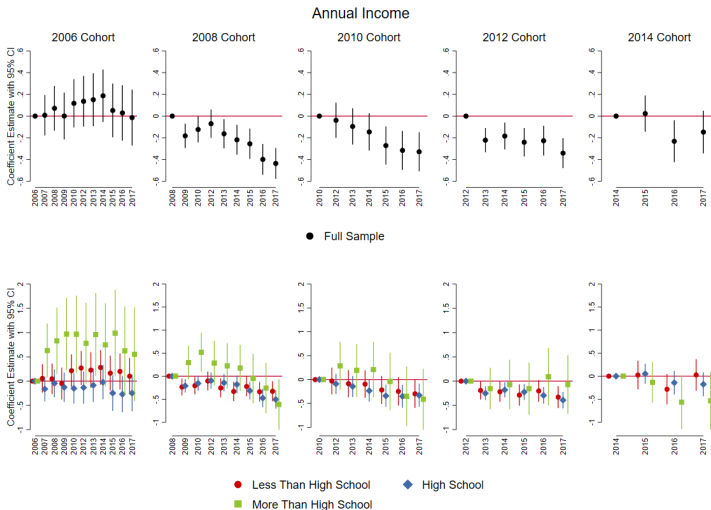


Note: Months employed ranges from zero if worker never appeared in RAIS registry during a year, to 12 if individual was employed each month. This specification keeps all treated individuals and matched controls (whether formally employed or not).



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- ▶ Early entrants (2006) earn 31.6% higher wages and cumulative earnings premiums of $\approx 763\%$ baseline annual earnings by 2017
- ▶ 2008 cohort hit by brief 2008 bust and never recovers: earn 41.5% baseline average annual earnings *less* by 2017
- ▶ 2012 and 2014 cohorts hurt by 2014 bust: employed 39.7% fewer months by 2017
- ▶ All positive effects are among high-education workers; negative effects on low-education workers driven by extensive (employment) margin



Note: Annual earnings refers to total earnings across all formal jobs. Earnings are transformed using IHS and deflated to 2018 BRL. To analyse effects at extensive margin, specification keeps all treated individuals and matched controls, whether formally employed or not, in strongly balanced panel. In periods where individuals do not appear in panel, they are ascribed a value of zero formal earnings.

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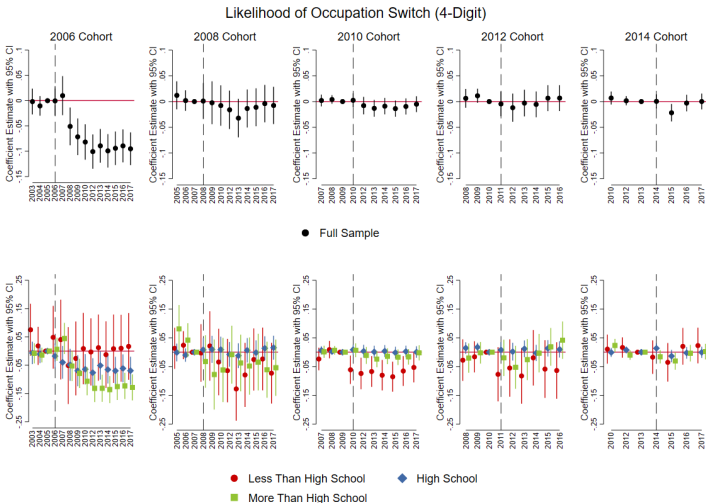
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- 4 Re-estimate preferred specification using **Callaway and Sant’Anna (2021)** estimator to account for heterogeneous treatment effects ▶ csdid
→ Effects are unchanged

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→ **Occupation and Job Stability**



Note: Outcome is a 0/1 indicator of whether the worker holds a different 4-digit CBO 2.0 Occupation Code from the one they were originally poached into. [▶ Establishment Switching](#)

- 2 **Seniority-Bias or Knowledge-Accumulation and Replacement Costs?** Do firms retain high-education early entrants during busts due to (i) seniority-biased labor regulations, or (ii) because these workers have firm-specific knowledge and are costly to replace?

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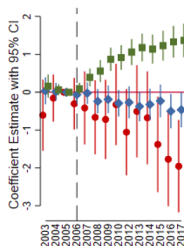
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→ **Knowledge-Accumulation and Asymmetric Replacement Costs**

- ▶ All workers in 2006 cohort have same seniority within firm, but only high-education workers are retained through bust

Poached Workers (2006 Cohort): Employment

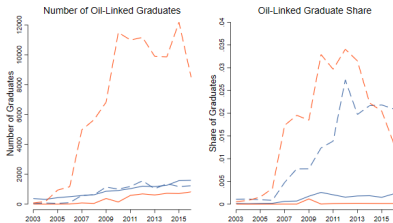




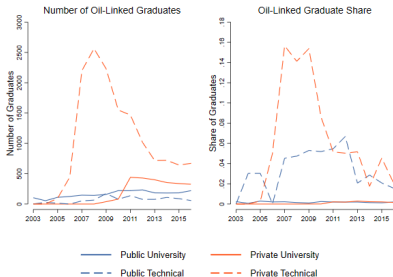
Note: Professional roles are defined as CBO occupations with codes beginning with 2. These roles are primarily described as “researcher,” “scientist,” “engineer,” “pilot,” “doctor,” “nurse,” “professor,” “lawyer,” and “analyst.” [▶ Managerial Roles](#)

▶ Oil-Linked Degree Programs

Brazil



Rio de Janeiro



— Public University — Private University
- - - Public Technical - - - Private Technical

Note: Data are drawn from Brazil's annual Census of Higher Education.

Variables	Number of Graduates from Oil-Linked Majors				
	Total	Public 4-Year	Private 4-Year	Public Tech.	Private Tech.
<i><50km from Shipyard</i>	0.382*** (0.099)	0.257*** (0.063)	0.095* (0.052)	0.073 (0.048)	0.278*** (0.081)
<i>Boom Year (2006-2013)</i>	0.197*** (0.018)	-0.001 (0.008)	0.001 (0.004)	0.032*** (0.009)	0.184*** (0.016)
<i>Near × Boom</i>	0.415*** (0.158)	0.032 (0.095)	0.019 (0.075)	0.048 (0.072)	0.522*** (0.144)
State FEs	YES	YES	YES	YES	YES
Observations	16,600	16,600	16,600	16,600	16,600
DV Mean (IHS) (Pre-Boom)	0.073	0.045	0.001	0.007	0.029
R-squared	0.074	0.076	0.037	0.014	0.067

Note: Table reports results for the following specification:

$y_{mt} = \beta Close_m + \gamma Boom_t + \delta(Close_m \times Boom_t) + \mu_s + \epsilon_{mt}$, where y_{mt} is the number of oil-linked graduates or oil-linked share of total graduates in municipality m in year t , $Close_m$ indicates proximity to a shipyard (oil-industry hub), $Boom_t$ indicates boom years, and $Close_m \times Boom_t$ is a diff-in-diff interaction term. Number of graduates uses inverse hyperbolic sine transformation. Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

- ▶ **Timing of entry into oil & gas sector has lasting impacts:** Early entrants earn more than matched controls; workers who enter prior to or during busts suffer persistent penalties
- ▶ **Inequality:** Highly educated workers earn more during booms and keep jobs during busts; low-education workers never enjoy premiums during booms and lose their jobs during busts
- ▶ **Highly educated early entrants accumulate firm-specific knowledge,** making them costly to replace; **low-education workers are firms' margin of adjustment to busts**
- ▶ **Oil boom provoked growth in sector-specific higher education** (driven by technical training programs), bidding down premiums for later entrants

Oil and Gas Sector	Leontief Coefficient
Oil and Gas Extraction and Support Activities	1.068
Top Upstream Sectors	
Legal, Accounting, and Consulting Services	0.055
Land Transportation of Cargo	0.039
Petroleum Refining and Coke Plants	0.032
Fabrication of Machines and Mechanical Equipment	0.027
Production of Pig Iron, Alloys, Steel, and Steel Pipes	0.023
Storage and Logistics	0.021
Construction	0.021
Maintenance, Repair, and Installation of Machines and Equipment	0.020
Architecture, Engineering, and R&D	0.018
Aquatic Transportation	0.017
Top Downstream Sectors	
Petroleum Refining and Coke Plants	0.411
Land Transportation of Cargo	0.088
Production of Organic and Inorganic Polymers and Resins	0.053
Electrical Energy and Utilities	0.047
Extraction of Non-Ferruginous Metals	0.045
Fabrication of Non-Metallic Mineral Products	0.029
Production and Refining of Sugar	0.029
Air Transportation	0.028
Production of Biofuels	0.027
Fabrication of Cellulose and Paper Products	0.026

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⇓ (SCN/CNAE 2.0 Conversion Table)

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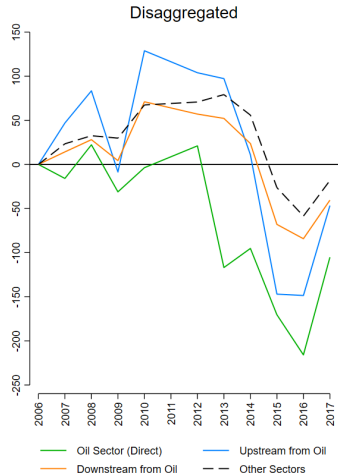
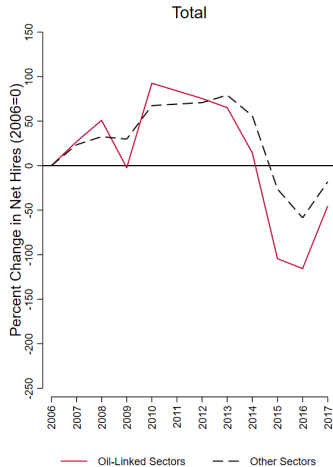
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⇓

14 Directly-Linked, 109 Upstream, 31 Downstream Subclasses

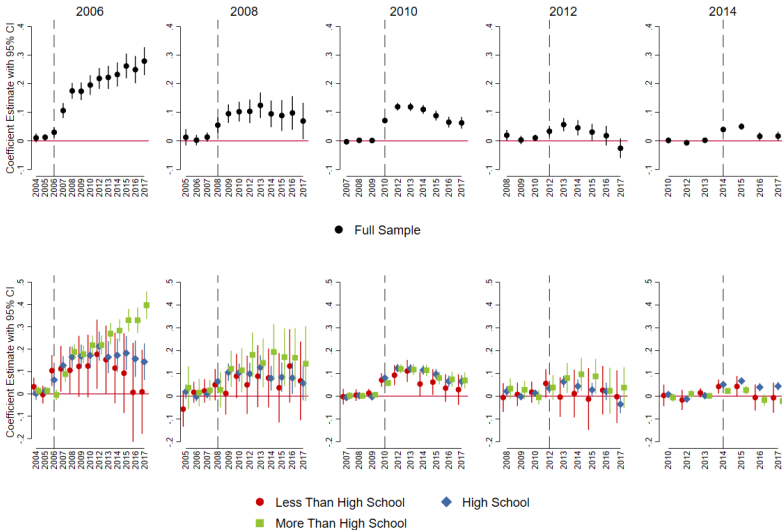
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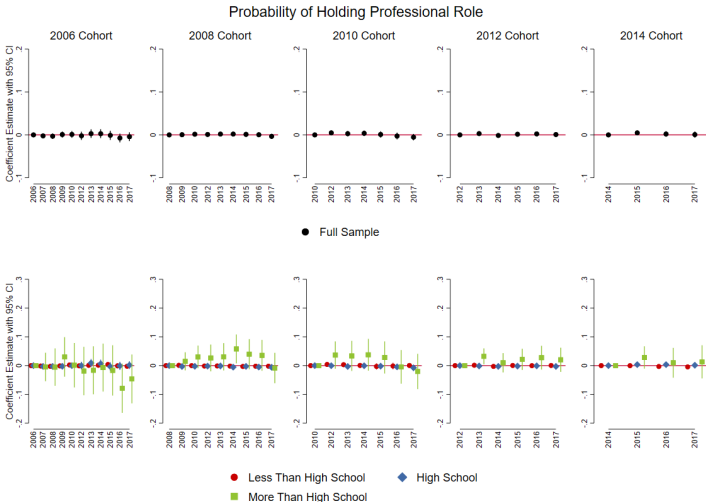


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Hourly Wages





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Oil-Linked Majors (Narrow Definition)	
Petroleum Engineering	Environmental Management
Geological Engineering	Naval maintenance
Naval Engineering	Petrochemical Maintenance
Shipbuilding	Mining & Extraction
Shipbuilding (non-motorized)	Marine Navigation
Naval Construction	Operation of Ships
Environmental Control	Paleontology
Water Pollution Control	Petrology
Extraction of Petroleum & Gas	Processing of Petroleum & Petrochemicals
Geoscience	Petroleum Refining
Geophysics	Environmental Cleanup
Geology	Environmental Protection Technology

Disaggregate degree programs into:

- ▶ 4-Year and Technical
- ▶ Public and Private
- ▶ STEM and Other

▶ [Return](#)