The Quality of Jobs in Construction and Oil-and-Gas for High School Graduates

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Executive Summary

Those limited to a high school education often must start at the bottom of the labor market. But in some jobs the constraint of a high school education does not keep workers at the bottom. The accumulation of work experience, on-the-job training and work-related classroom and online study can lift workers beyond the constraints imposed by stopping formal education after high school graduation.

In some industries, the road to a productive and rewarding career need not go through college. Thirty percent of all employees and 25 percent of the workers 25 years and older in the US labor market are high school graduates with no college education. The construction and oil & natural gas industries rely heavily on high school graduates to staff about 45 percent of all the jobs in these two industries. Relative to many other high school graduates with no college education, high school graduates in construction, oil & natural gas are paid better while receiving more health insurance and pension coverage. This is both true for blue-collar and white-collar high school graduates in these two industries. It is especially true of union workers in construction and oil & natural gas.

Safety is a top priority for a quality job. Good wages mean little if workers cannot go home safe at the end of the workday. Both the construction and oil & natural gas industries seek to mitigate inherent safety risks through training and safety management.

The oil & natural gas industry through its various industry associations including the American Petroleum Institute partner with the Occupation Safety and Health Administration (OSHA) and the National Institute of Occupational Safety and Health (NIOSH) to develop safety standards and procedures to make workers safer in this industry. Injury rates are unusually low in oil & natural gas due in part to the online, face-to-face and on-the-job training that follows from the development of these standards and procedures. However, especially in upstream oil & natural gas support services, fatality rates are high reflecting both the inherent risks associated with work transportation activities and the need to continue developing and promulgating safety practices in this component of the industry.

Construction, also, faces serious safety risks. Injury and fatality rates in construction are above average, and due to its size, more workers die in construction than in any other major industry. Responding to these dangers, the industry cooperates with the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) while using apprenticeship training more than any other US industry to prepare new construction workers for the job and dangerws ahead.

Construction apprenticeship programs can last from two to five years and entail hundreds of hours of classroom instruction and thousands of hours of supervised and mentored on-the-job work. For instance, the joint union-management electrical apprenticeship program in Alameda County, California lasts five years, requires 900 hours of classroom training, 8000 hours of on-the-job training, $620 in books (the first year) and $500 in tools. Three out of every four apprentices in the US are in construction. In electrical and plumbing apprenticeship programs, half of the apprentices are in nonunion shops. In the rest of construction, 90 to 95 percent of the apprentices are in union-management programs.

Apprenticeships promote safety skills and culture through extensive classroom/workshop training and on-the-job mentoring. Young workers who commit from 2 to 5 years to apprenticeship training and then attach themselves to construction become experienced, well-paid, well trained and safer workers. In

construction—age, wage and unions matter in promoting jobsite safety. Nonetheless, the construction industry remains dangerous. While construction injury and fatality rates are falling, being safe at work is a challenge any worker entering this industry must face.

Having a good job presents the challenge of keeping it in seasonal and cyclical industries. Both the construction and oil & natural gas industries are turbulent with wide swings in employment. Construction is particularly sensitive to the overall economy's business cycle, while oil & natural gas extraction is sensitive to both domestic discoveries and international energy prices. In construction, workers who would make a career out of their craft must learn how to weather both seasonal and cyclical downturns. In oil & natural gas extraction, workers must go to the boom areas where new fields are opening up and older fields are expanding. There are ways to weather these booms and busts. In downstream oil refining, work is steadier, schools, shops and amenities typically close by, and the turbulence of construction and extraction absent.

In construction, while unemployment is typically higher than other industries, spells of unemployment are typically shorter. In unionized construction, health insurance and pension benefits that follow the worker from signatory contractor to signatory contractor helps soften the blow of leaving one union contractor after a project is completed to follow the work elsewhere. In oil & natural gas boomtowns, unemployment is low and overtime abundant.

This report examines the nature and quality of jobs in construction and oil & natural gas focusing on jobs held by workers with high school educations. The analysis looks at four dimensions of job quality: 1) remuneration, 2) safety, 3) job security and 4) career advancement—and benchmarks these characteristics in the construction and oil & natural gas against the overall economy.[1]

Employment, Wages and Benefits

- The construction, oil & natural gas industries remain enclaves of opportunity for high school graduates with no additional college education
    - 25 percent of all workers in the US hold high school degrees only
    - The construction (44 percent), oil & natural gas (45 percent) industries offer a higher percentage of their work to high school graduates than any of the other 11 major industries
- Whether union or nonunion workers, the construction, oil & natural gas industries pay prime-age (35 to 54) high school graduates better compared to the overall economy
    - Blue-collar
        - Nonunion
            - Overall economy: $16.58
            - Construction: $17.80
            - Oil & natural gas: $25.79
        - Union
            - Overall economy: $23.55
            - Construction: $29.04
            - Oil & natural gas: $33.43
    - White-collar
        - Nonunion
            - Overall economy: $18.73

            - Construction: $25.47
            - Oil & natural gas: $34.97
        - Union
            - Overall economy: $24.92
            - Construction: $32.72
            - Oil & natural gas: $33.03
- Inside and outside of the construction and oil & natural gas sectors, a substantial majority of union workers with high school degrees receive company sponsored health insurance and pension coverage. Nonunion workers with high school degrees receive less health and pension coverage, particularly nonunion blue-collar workers in construction.
    - Blue-collar
        - Nonunion
            - Overall economy: 68% health, 49% pension coverage
            - Construction: 53% health, 30% pension coverage
            - Oil & natural gas: 73% health, 60% pension coverage*
        - Union
            - Overall economy: 89% health, 77% pension coverage
            - Construction: 85% health, 71% pension coverage
            - Oil & natural gas: 100% health, 82% pension coverage*
    - White-collar
        - Nonunion
            - Overall economy: 64% health, 48% pension coverage
            - Construction: 77% health, 44% pension coverage
            - Oil & natural gas: 82% health, 64% pension coverage*
        - Union
            - Overall economy: 86% health, 74% pension coverage
            - Construction: 88% health, 67% pension coverage
            - Oil & natural gas excluding support services: 100% health, 100% pension coverage*

  *Because oil & natural gas support services (transporting materials and supporting well drilling and well operating activities) are combined in government benefits data with mining support services, these are excluded from data here. Oil and natural gas support services health and pension coverage may be less than the extraction and refining data reported here.

- Wages rise higher for union than for nonunion construction workers
    - Young nonunion construction workers' wages rise 13 percent in their 20s compared to 31 percent for young union construction workers
        - Young union workers' wages rise faster, and go farther than young nonunion construction workers because more young union workers go through apprenticeship programs
        - Apprenticeship programs act as a system of higher education building human capital and wages

- Industry sponsored training including apprenticeship programs contribute to the higher wages and better benefit coverage in oil & natural gas and particularly construction
    - In 2018, there were about 400,000 registered apprentices in the construction industry
        - 74% of all apprentices are in construction
            - However, half of the plumbing and electrical apprentices are in nonunion programs
            - Joint union/management programs account for 90 to 95 percent of all other apprentice graduates in construction (e.g. carpenters, painters, operating engineers, roofers, pipefitters etc.)
        - Construction apprenticeships typically require 2000 to 8000 hours of on-the-job, mentored work-experience along with 500 to 800 hours of classroom/workshop training
        - Construction apprentices earn while they learn and do not accumulate student loan debts
        - The size of the construction system of post-high school education compares with other systems of higher education in the US
            - University of North Carolina system had almost 250,000 enrolled students in 2019
            - University of California system had 280,000 enrolled students in 2019
            - The State University of New York system had 425,000 enrolled students in 2018

- The Department of Labor states of apprenticeship training, in general:
    - "Apprentices earn competitive wages, a paycheck from the first day of employment and incremental raises as skill levels increase. The average wage for a fully proficient worker who completes an apprenticeship is $50,000 annually. Apprentices who complete their program earn approximately $300,000 more during their career than non-apprenticeship workers."[2]
- Job and safety skills in the oil & natural gas industry are learned on-the-job and through short courses (face-to-face and online) developed by the industry
    - Industry organizations such as the National Fire Protection Association, the Steel Tank Institute and the American Petroleum Institute interact with OSHA in developing sound and safe workplace practices. The American Petroleum Institute (API) is an accredited Standards Developing Organization that meets the due process requirements of the American National Standards Institute (ANSI). API maintains more than 700 standards and recommended practices that form the basis for skills and safety curricula.

Safety

Oil & Natural Gas

- Compared to a serious injury rate of 90 per 10,000 fulltime workers for the overall economy, the upstream crude oil & natural gas extraction rate is 33; the midstream rate is 30; the downstream rate is 16
- In contrast, the fatality rate in 2017 for the extraction industry (which includes mining as well as oil & natural gas extraction) was a relatively high 13 deaths per 100,000 fulltime workers

- The four highest fatality rates in 2017 were agriculture, forestry, fishing and hunting (23) transportation (15), mining, quarrying, oil & natural gas extraction (13) and construction (9.5)
- Oil and natural gas extraction had a fatality rate of 7.9 in 2017 and 14.7 in 2018
- Support services for mining and oil and natural gas extraction has a fatality rate of 12,8 in 2017 and 13.7 in 2018
- While the BLS does not report a separate fatality rate for oil and natural gas support services, it does provide a separate count of deaths in this sector.
    - Of the 112 workers who died in 2017 in mining, quarrying, oil & natural gas extraction in 2017, 8 were in oil & natural gas extraction and the vast majority of deaths—73—were in oil and gas drilling and support activities
    - Of the 130 deaths in mining, quarrying, oil & natural gas extraction in 2018, 13 were in oil & natural gas extraction and the vast majority of deaths—81—were in oil and gas drilling and support activities

Construction

- While not the highest among all major industries, construction fatality rates are high (9.5 deaths per 100,000 fulltime workers) and much higher than the next most deadly industry—wholesale trade (5)
    - In 2017, 971 workers died at work in construction—due to construction's size and fatality rate, this is the most for any industry
- The construction serious injury and illness rate is 12 percent higher than the goods producing sector; 22 percent above manufacturing; 28 percent above the rate for the overall economy
- The construction industry has the highest workplace-injury hospitalization rate of any major industry
    - 10.5 hospitalized workers per 10,000 fulltime workers
    - Construction trades occupations which can be in the construction industry or outside construction in plant and facility maintenance has a slightly higher hospitalization rate of 11.1
- Injury rates vary widely and are based not just on inherent dangers, but also the training and protections provided
    - Unionized elevator constructors have a serious injury rate of 43 compared to an injury rate of 283 for nonunionized carpet layers
    - Unionized ironworkers have a serious injury rate of 45 compared to the framers' rate of 115
    - More generally, in construction, serious injury rates decline as unionization rates rise, the age and experience of workers rise and as wages rise
        - Because unionization, age and wage are correlated, it is difficult to disentangle these three factors

Employment Security

- From peak to valley at the outset of the Great Recession, construction employment fell from 7.7 million to 5.4 million—a loss of 30 percent of all construction jobs. The loss was 40 percent when the seasonal loss of jobs is added to the cyclical loss.
- While not as cyclically sensitive as construction, oil & natural gas gains and loses jobs responding to international energy prices and domestic discoveries. Between the early 1980s and the early 2000s, the BLS Current Employment Statistics show that oil & natural gas extraction employment fell from almost 270,000 to about 120,000. Then it rose to about 200,000 around 2015. Recently, oil & natural gas employment fell to around 140,000 only to begin rising again.
- Unemployment in construction runs higher than the overall economy
    - Between 2003 and 2018, the average unemployment rate for high school graduates in the overall economy was 7.6 percent.
    - In construction, it was 12.9 percent
        - But the median weeks of unemployment for construction workers tends to be relatively short
            - 45% of unemployed construction workers had been out for less than 5 weeks in November 2019 compared with 33% for the overall economy
            - Construction has high discharge rates but also high hire rates as workers hop from project to project
- Unemployment in oil & natural gas is lower than the overall economy
    - Between 2003 and 2018, in downstream refinery work, the average unemployment was 6.6 percent; in upstream oil & natural gas extraction, it was 2.3 percent
        - Most unemployment is short term in upstream oil & natural gas
        - In November 2019, 39% of unemployed mining, oil & natural gas workers had been out-of-work for less than 5 weeks
- Unlike construction, which is fairly evenly spread across the country, oil & natural gas extraction employment concentrates around new and expanding oil and gas fields
    - Where oil & natural gas extraction activity is most concentrated, average weekly wages are 3 times higher than in older, less active fields—partly due to abundant overtime

Opportunity

- Increase in wages from age 20 to age 40 for high school graduated, blue and white collar, union and nonunion workers averaged together
    - In the overall economy: $12 per hour to $20 between
    - Oil & natural gas industry: $15 to $30
    - Construction: $15 to $25
- Increase in wages from age 20 to age 40 for high school graduated, blue-collar construction workers rise faster and farther in the union sector
    - Nonunion: $15 to $21
        - Most nonunion construction workers do not go through apprenticeship training
            - In nonunion construction, apprenticeship training is most common for electricians
            - Nonunion high school educated electrician wages rise from $15 to $26 from age 20 to 40
    - Union: $21 to $31

        - Most union construction workers go through apprenticeship training
        - Blue-collar union construction workers' wages rise faster and farther because apprenticeship programs supercharge skill acquisition through a combination of classroom, workshop and on-the-job mentored training
            - Union high school educated electrician wages rise from $21 to $33 from age 20 to 40
- A high school-only education does not preclude one becoming a foreman/supervisor or manager in the oil & natural gas and construction industries
    - Compared to the overall economy where 45 percent of foremen/supervisors have a high school education
        - 50 percent of upstream oil & natural gas foremen/supervisors are high school graduates
        - 49 percent of construction foremen/supervisors are high school graduates
        - However, in downstream refineries, only 37 percent of foremen/supervisors are high school graduates
    - Compared to all other industries where 18 percent of managers are high school graduates
        - 26 percent of upstream oil & natural gas managers are high school graduates
        - 34 percent of construction managers are high school graduates
        - 16 percent of downstream refinery managers are high school graduates
- Compared to all other industries where 17 percent of the owners of businesses are high school graduates
    - 22 percent of the owners of businesses in mining, oil & natural gas are high school graduates
    - 32 percent of the owners of construction companies are high school graduates

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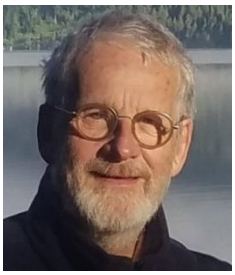

About the Author

Peter Philips (Ph.D. Stanford) is a professor of economics at the University of Utah. He has spent four decades studying the construction industry and the construction labor market. He has published in a range of academic journals on construction issues including construction safety, bidding on construction projects, construction labor market regulations, immigrants and minorities in construction, the building of renewable power generation facilities, absenteeism on construction projects and other similar issues. Philips has also written about construction for newspapers and industry publications including *Engineering News Record*. He is the co-author of several books on construction. Philips has testified on labor shortages in construction in the US Court of Federal Claims and testified before several legislative committees on regulations in the construction labor market. In the summertime, Philips is a back-country volunteer in the Grand Teton National Park.

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Institutional affiliation provided for identification purposes only. This report was funded by the Institute for Construction Economic Research (ICERES). The author retains complete editorial control over this report. The analysis and conclusions in this report belong solely to the author, and do not necessarily reflect the views of ICERES or the University of Utah.

Introduction

- Thirty percent of the workers in the US labor market have high school degrees and no additional formal education. The construction and mining, oil and natural gas extraction industries have substantially higher percentages of high school graduates with no additional college education compared to the overall US economy and compared to all other major segments of the economy. Figure 1 shows that these two major industries—construction and mining/oil & natural gas—rely more upon high school graduates—45 percent—for their workforce compared to manufacturing, the armed forces, wholesale and retail trade and all the other 11 major industrial segments.[3]

This report examines the nature and quality of jobs in construction and oil & natural gas focusing on jobs held by workers with high school educations. The analysis looks at four dimensions of job quality: 1) remuneration, 2) safety, 3) job security and 4) career advancement—and benchmarks these characteristics in the construction and oil & natural gas against the overall economy.[4]

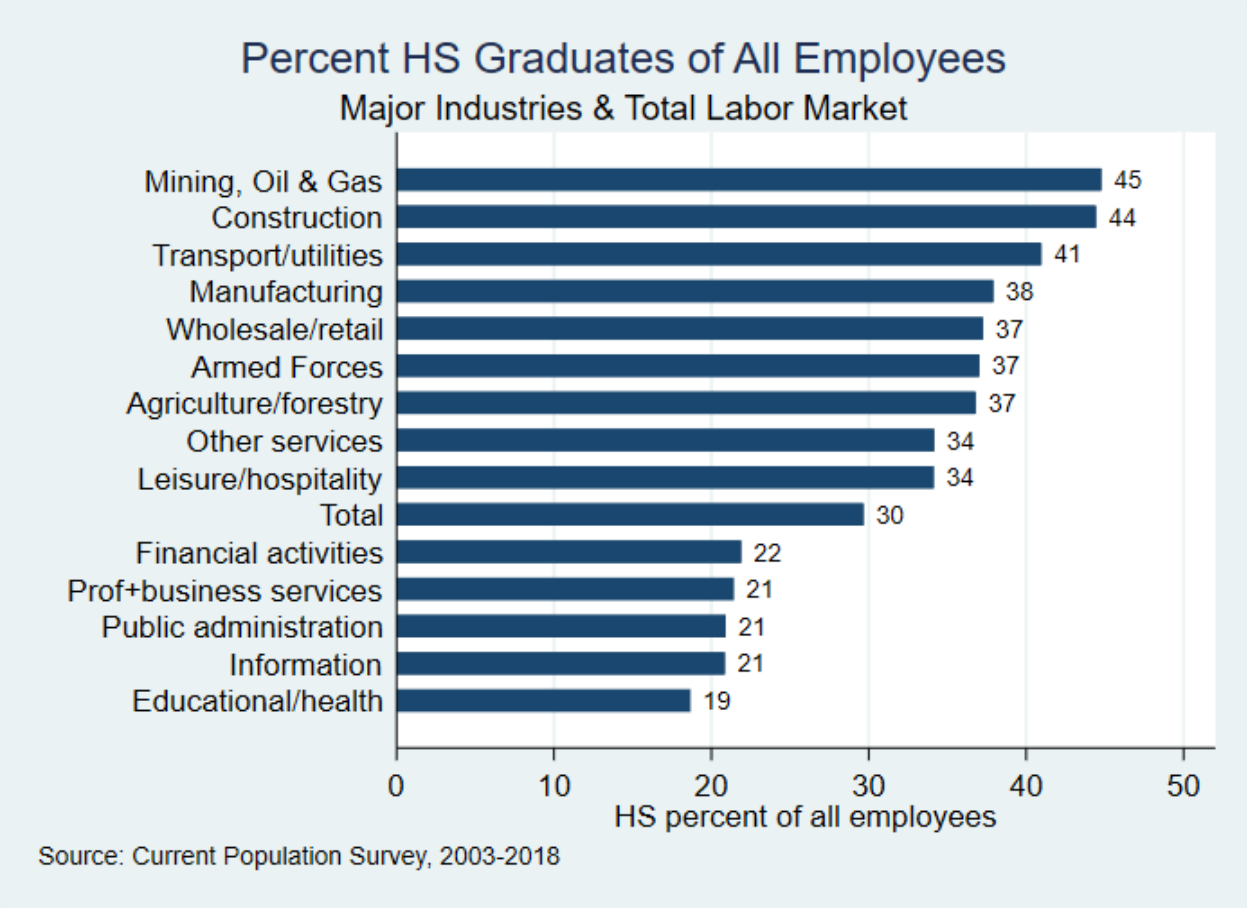


Figure 1: High school graduates with no additional college education as a percent of all employees for 14 major industries and the total economy, average for 2003 to 2018

The oil & natural gas industry consists of three sectors—upstream exploration, drilling and well operations, midstream oil & natural gas pipeline construction and operation, and downstream refining. The construction industry is also divided into three sectors—residential, commercial and industrial construction. Construction employment accounts for about 5 percent of the overall US labor market and is about 10 times greater than oil & natural gas employment.[5]

Both oil & natural gas and construction are parts of the goods producing sector of the economy. Besides construction and oil & natural gas, goods production involves manufacturing, mining, material handling and transportation, agriculture, forestry and fishing. Service sector work includes all work outside the goods producing sector or the military. Government employment, excluding the military, is considered part of the service sector. While goods production and blue-collar work were once central to the US labor market, today, goods production accounts for just 17 percent of total employment. Service work now accounts for about 83 percent of all jobs.

Blue-collar work involves hands-on work sometimes referred to as manual labor. This can be skilled or unskilled work. Most blue-collar workers are found in goods production, although grounds keeping, waste disposal, custodial, maintenance, repair and other blue-collar work is also found in the service sector.

White-collar workers perform managerial, administrative, professional, office and clerical, marketing, sales and similar activities. For the purpose of this report, white-collar work also includes care-oriented work in nursing, social work, teaching, secretarial and childcare occupations. While white-collar workers are found in the goods producing sector of the economy, most white-collar workers are in the service sector.

Skilled workers may be found in both blue-collar and white-collar jobs, but the source of skill acquisition in white-collar jobs centers on formal education, particularly college education, while skill acquisition in blue-collar jobs centers on on-the-job work experience and in some cases includes apprenticeship training. Formal education and work experience are important in both blue-collar and white-collar jobs, but the balance between on-the-job learning and classroom learning differs between the two types of work.

Four Dimensions of Job Quality

High school educated workers in the construction and oil and natural gas industries typically have relatively high-paying jobs often with good health insurance and pension coverage. In these jobs, workers must navigate the challenges of shifting job locations and turbulent demand for their services. Once on the job, to be safe, these workers must be well trained in their work and in jobsite safety.

For those high school educated workers who commit to these two industries, opportunities to advance are not stunted by formal education that did not include college. Because these industries rely upon on-the-job training, industry specific short courses and apprenticeship training, effectively high school workers in these two industries go on to higher education through their work, earning while they learn. There is no student debt, and no one is too poor to go on with their schooling even if that schooling is not college, takes place at a workshop, or at a job site, or at an apprenticeship facility.

Because of this industry located higher education, wages for high school graduates in construction, oil and natural gas rise more quickly and farther than compared to high school graduates in the overall

economy. Also, due to the relevance of industry specific training and experience, the path for a high school graduate to become a foreman, supervisor or manager in these two industries is relatively more open than in the overall economy.

Also, in construction, due to the relatively low initial capital investment required, a high school graduate who has learned the trade is well positioned to move on from management to ownership by becoming a construction contractor.

As the overall economy shifts from goods production to a service economy, and as work shifts from blue collar production work to white collar service work, most young people are urged to go to college. Those who stopped at high school are seen as trapped in low paying jobs. But those who go into construction and the oil and natural gas industries can, in fact, reach the middle class. It helps to join a union in these two industries, particularly in construction where unions and union contractors finance extensive apprenticeship training systems. But even nonunion workers in these two industries have better pay and superior advancement opportunities compared to high school graduates in the rest of the economy.

To explore the quality of jobs in these two industries compared to the rest of the economy, jobs are analyzed along four dimensions—remuneration (including both wages and benefits), workplace safety (including the risks of injuries and fatalities), security (focusing on the risks of unemployment and having to move to find a job) and opportunities (including wages rising with experience and the potential for advancement into supervision, management and ownership).

Remuneration

This report finds that the oil & natural gas and construction industries are well paying with good benefits for workers with a high school education compared to high school educated workers in other sectors of the economy. However, in construction, it matters whether you are a union or nonunion worker. Many nonunion construction jobs, particularly in residential construction, are poorly paid with fewer benefits.

Safety

Oil & natural gas is a relatively safe industry compared to other sectors of the economy, though the potential exists for catastrophic events and in some years, fatality rates can be high. Thus, workplace safety is a continuing priority for this industry. Construction faces more inherent workplace dangers compared to the overall economy; both injury and fatality rates are higher in construction than in the overall economy. However, injury rates are lower where workers are well trained both in their craft and in safety awareness. The cooperation facilitated by collective bargaining in particular enhances the safety of union workers in construction.

Security

Both oil & natural gas and construction can be cyclical industries. Upstream and midstream oil & natural gas workers follow jobs to where work is concentrated, which may necessitate moving. Construction workers must learn how to survive the recessions that construction is prone to. This entails working and saving in the boom and finding side activities in the bust. Collective bargaining assists in saving behavior by contractually obliging construction workers to contribute regularly to pension savings and in many cases health-insurance banks that bridge family health coverage during spells of unemployment.

Advancement

Career advancement in both industries proceeds from inexperienced worker to experienced worker to foreman, supervisor and manager. Those who stopped formal education at high school are not precluded from rising through the ranks in both industries as they may be in other industries. Apprenticeship training in construction serves as a system of post-high school education that prepares workers not only to move up the ladder, but also to become owners of construction companies. The barriers to becoming a construction contractor are low and having only a high school diploma does not preclude a construction worker from becoming a contractor.

This report describes the data that fleshes out these patterns of remuneration, safety, security and advancement. We begin with an overview that tells the story of workers in these two industries. We itemize the key facts that characterize jobs in these two industries. Then, section by section, we describe the wages and benefits, safety risks, employment risks and job opportunities of these workers relative to their counterparts in other areas of the economy.

Overview

Good jobs have always been decently paying jobs that are safe, secure and open to advancement. But where good jobs are to be found and how one goes about getting those jobs has altered over the last two generations.

The US labor market has radically changed over the last 80 years. Where once goods production and blue-collar workers were the mainstays of American work, now white-collar workers in the service sector form the center of the labor force. This transformation has changed the way Americans prepare themselves for their work lives. In the past, some schooling or a high school education followed by on-the-job training and apprenticeships carved out a career in blue-collar jobs. Indeed, in 1940, only 30 percent of all workers had a high school diploma or better. What they needed to know on the job, they learned on the job.

Today, 67 percent of adult workers have at least some college or a college degree. This rise in post-high school education has been driven by the demands of the many white-collar jobs primarily in the service sector.[6] Most well-paying service sector jobs require or strongly recommend formal schooling past high school. Wages reflect this demand for training outside of and typically prior to work.

In the service sector, the average wage for a high school graduate is more than 40 percent higher than for a worker with less than a high school degree. A worker with a college degree, on average, earns 72 percent more per hour than a worker with a high school degree. These incentives tell the story—to get ahead in white-collar work, stopping at high school is not enough; one typically needs to attend college.

However, a four-year bachelor's degree is not the path everyone chooses. Some people learn better with their hands and see the purpose of learning when they can see its practical applications. Today, 25 percent of adult workers hold only a high school diploma. In contrast, in construction and oil & natural gas, 45 percent of all employees hold only a high school diploma. Nonetheless, this report shows that the high school graduates in these two industries still have quality jobs with advancement opportunities. Construction emphasizes post-high school, industry-sponsored, apprenticeship training. In the oil & natural gas industry, success comes with a willingness to follow the work, work hard, and take the short classroom or online courses which teach safe and efficient workplace practices.

Remuneration

The construction and oil & natural gas industries both employ a large number of workers with a high school diploma, and they pay these workers well relative to similarly educated individuals in other sectors of the economy.

The average wage for high school graduates with no additional college education in construction and mining/oil & natural gas are higher than those for any of the other major industries.[1] Figure *2* shows that among the industries with high percentages of high school graduates, construction, mining/oil & natural gas pay substantially better, with transportation coming closest to construction wages. Among industries with low percentages of high school graduates, construction, mining/oil & natural gas also pay substantially better, with information and public administration coming closest to construction. None come close to the average wage in mining/oil & natural gas.[7]

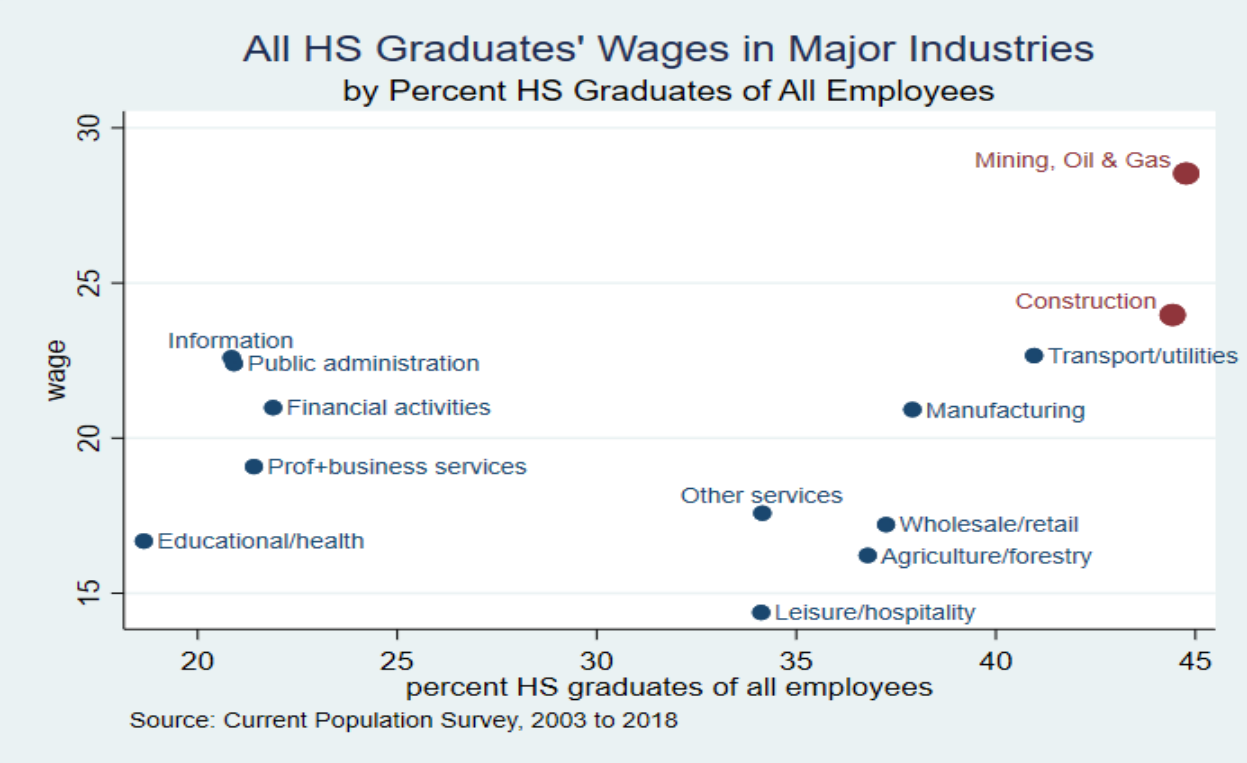


Figure 2: Average, inflation adjusted wages for workers in the 13 major industrial segments of the US labor market, 2003 to 2018

[1] In government data, when reporting "major" industries, the oil and natural gas extraction industry is combined with mining. When not comparing major industries, this report excludes mining to focus on oil and natural gas. However, here we follow government categories to preserve the major industry comparison. Government data allows construction to be subdivided into building, civil and specialty contractors. But overall construction is not easily broken down into specific project types such as renewable energy generation, sports stadiums or luxury housing. It is even more difficult to assign specific construction workers to specific construction project types. For instance, an electrician may work on utility scale solar farms for the first third of the year, new home construction for the next third and a sports stadium for the last third of the year. Thus, the quality of jobs within construction can be disaggregated by contractor type, union-nonunion, location and craft but not by project type (wind farms, grocery stores, churches). This is because individual construction workers move across project types as they move from project to project and contractor to contractor.

In construction/oil & natural gas, post-high school formal education matters less than post-high school apprenticeship training and work experience. In construction, in today's dollars, a beginning young nonunion worker has starting wages of about $15/hour. The beginning young union worker has starting wages of about $21/hour. By the time these young workers are around 40, this $6 union premium has grown to a $10 premium—the nonunion worker's wages have risen (in inflation adjusted dollars) to about $21/hour, while the union worker's wages have risen to around $31 per hour. The nonunion worker's wage rises by about 40 percent in real terms over the first 20 to 25 years of work; the average union worker's wage has risen by almost 50 percent over those 20 years.

The union worker's wage rises faster and farther than the typical nonunion worker's wage because apprenticeship training is more common in the union sector. In nonunion construction, most apprenticeship training focuses on electricians and plumbers. In the union sector, all construction crafts provide apprenticeship training, and through collective bargaining experienced journeymen and their contractors agree to make investment in the next generation of young apprentices the joint responsibility of labor and management. Part of every journeyworker's total pay package is contributed to the apprenticeship program. This means that new construction apprentices not only earn while they learn in their two to five-year apprenticeship programs, but also that all the apprentices are on full scholarships. Every generation has their training paid for, and every generation pays for the next generation's training. There is no student debt crisis, and one cannot be "too poor" to go to school.

Through apprenticeship programs, the construction industry ensures that their skill base does not erode even in the face of severe labor market turbulence such as the Great Recession. Apprentices, journeyworkers, contractors and owners all benefit from this system. Apprentices earn while they learn. Journeyworkers surround themselves with both trained peers and rookies, which makes the job of each construction worker safer. Contractors get the skilled labor force they need to accurately estimate a job and then complete that job to specifications on time. Owners—the consumers of construction services—can come into the construction market at any time confident that the industry will provide them with the building or infrastructure skill they need.

Once workers are trained, it is important that workers remain in the industry so that training can pay off for these workers, their contractors and the owners who purchase their services. Wage premiums paid to prime-age construction workers (ages 35 to 54) help preserve the human capital investments made in these workers. While both prime-age nonunion-and-union blue-collar workers in construction who have a high school education only receive a wage premium over blue-collar high school educated workers in the rest of the economy, the union wage premium is substantially higher. The nonunion blue-collar prime-age construction worker earns about $1 per hour more than nonunion prime-age workers in the rest of the economy, the union blue-collar prime-age construction worker earns $5/hour wage more than prime-age union workers in the rest of the economy and $12/hour more than the prime-age nonunion blue-collar workers in the rest of the economy. These nonunion and particularly union wage advantages help keep trained workers in construction and preserve the investments in their skills made by contractors.

High wages are also the key to skill development for high school graduates in oil & natural gas. The oil & natural gas industry pays, on average, $26/hour to *nonunion* blue-collar employees with high school degrees. Oil & natural gas pays $29/hour for *union* blue-collar workers with high school degrees. In the rest of the economy, high school/blue-collar workers earn, on average, $16.50 for nonunion workers

and $23.50 for union workers. These union and nonunion oil & natural gas wage premiums relative to the rest of the labor market serve two purposes. First, they encourage workers to follow the work (work in the upstream oil & natural gas sector is generally concentrated where the resource base is; work in midstream oil & natural gas pipeline construction can be both remote and constantly moving). Second, the oil & natural gas wage premiums encourage workers to stay in the industry and build careers. This allows for a buildup of industry specific skills learned on-the-job or in short courses online or in classrooms.

Construction and oil & natural gas pay premium wages to high school graduates for a reason. These industries need workers with industry specific skills and experience that formal education cannot provide. As the world turns to white-collar, service sector work, a sizable core of blue-collar, hands-on work nonetheless remains. While formal education develops many valuable pathways, the hands-on education of work and apprenticeship allows for these different but equally important pathways.

Safety

Construction is a dangerous industry. Figure 3 shows that in 2018, construction had a serious injury rate that was one-third higher than the serious injury rate for overall private industry. (Serious injuries are ones that result in lost days from work.) The construction fatality rate in 2018 was more than 2.5 times

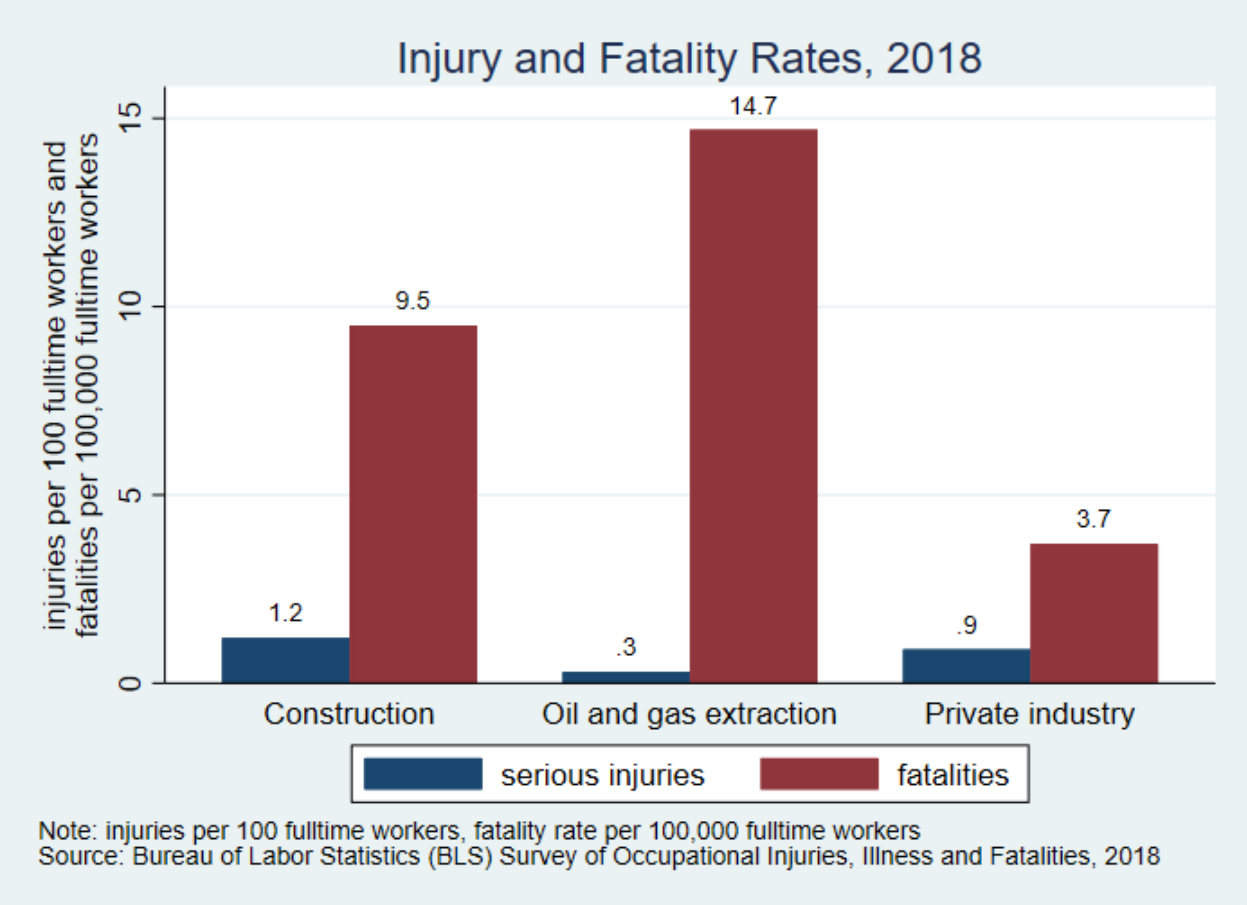


Figure 3: Comparison of injury and fatality rates for construction, oil & gas extraction and the overall private sector, 2018

higher than the fatality rate for overall private industry. (The fatality rate is per 100,000 fulltime workers while the injury rate is per 100 fulltime workers.) These injury and fatality rates partly reflect inherent dangers from working at height, outdoors, among a shifting set of contractors and co-workers in facilities that are always works-in-progress. But these high injury and fatality rates are also the product of work safety cultures, safety management and worker training. Safety management is a continuing concern in construction.

The oil and natural gas extraction industry is a study in contrasts. The serious injury rate in 2018 was one-third the serious injury rate for overall private industry while the fatality rate was almost 4 times higher than overall private industry.[8] Low serious injury rates in oil and natural gas extraction reflects industry efforts to mitigate the inherent risks in oil well operations, but the high fatality rate reflects the ever-present risks of catastrophic accidents. Despite low injury rates, safety management is also a continuing concern in the oil and natural gas industry.

A case study of the wood framing of buildings and the steel framing of office towers provide an instructive comparison for construction workers. Both framers and ironworkers construct the skeletons of buildings. Framers work with wood; ironworkers work with structural steel. Framers typically work at heights of up to four stories; ironworkers typically work at higher than four stories. Framers work with lighter materials; ironworkers move heavy beams and work with large cranes. There is no reason to believe that ironworkers have inherently safer jobs than framers. If anything, working at heights with heavy materials around big cranes (while welding and riveting instead of hammering) would create *more* inherent dangers. Yet, ironworkers have half the injury rate of framers.

The same can be said for carpet layers and elevator constructors. Carpet layers lay and stretch carpets using knee kickers; elevator constructors raise and rig elevator shafts, and they install elevators while working around energized systems at heights. There is no reason to believe that elevator construction is inherently safer than carpet laying. Yet the rate of serious injuries is five times higher for carpet layers than it is for elevator constructors.

What accounts for these differences? Training, awareness, and a culture of safety, all of which are standardized and enhanced with unions. Ironworkers and elevator constructors are among the most unionized crafts in construction, while framers and carpet layers are among the least unionized. Unions promote safety in several ways:

- Apprenticeship training is designed to instill both skill competency and safety awareness;
- Unions work with their signatory contractors to develop extensive safety protocols, and provide protections for workers who see dangers on the job and want to do something about them;
- Unions promote higher wages and better benefits, which retain workers in the industry and deepen the pool of experienced workers.

Individual and group experience is foundational to group safety awareness and safety culture. While construction is indeed more dangerous than any other major industry based on the fatality rate, the danger is greatly alleviated when workers know what they are doing and the workers around them know what they are doing. Unions and signatory contractors in construction, through collective action, build, promote and protect the safety knowledge and culture that mitigates the inherent dangers of construction work. To the extent that nonunion workers and their companies also prioritize safety through standardized processes and culture, these workers would experience similar benefits.

Safety in oil & natural gas differs by segment. In downstream refineries, permanent employees work in a familiar environment employed steadily by the same employer. Here, company safety training addresses relatively known workplace hazards. Maintenance workers, however, employed by outside contractors, face workplace safety challenges characteristic of construction—changing workplace environments, worker movement between contractors and coordination with other maintenance contractors as well as the refinery facility itself. Apprenticeship training for pipefitters, boilermakers, electricians and other construction maintenance workers facilitates refinery safety.

In upstream oil & natural gas extraction and support services, workplace hazards are primarily addressed through short-course and on-site training on well drilling and operation safety practices. The primary area of concern for both injuries and especially fatalities in upstream oil & natural gas is well-support services. Here, the main source of injuries and fatalities is transportation of supplies to the well head. Like transportation in the overall economy, upstream transportation safety remains an ongoing challenge.

Industry associations such as the National Fire Protection Association, Steel Tank Institute, American Chemistry Council, American Fuel & Petrochemical Manufacturers and American Petroleum Institute interact with OSHA, NIOSH[9] and state regulatory agencies to develop safe workplace practices on upstream, midstream, and downstream oil and natural gas jobsites. These approaches are disseminated through online study, short classroom courses and workplace safety meetings often organized by a plant or well-rig safety officer.

Security

Both construction and oil & natural gas can be turbulent industries. Figure 4 shows that since 1972, production worker annual employment in oil & natural gas has risen about 20 percent and construction production worker annual employment has risen about 60 percent. But these long-term trends have been punctuated by large swings up and down. Around 1980, blue collar oil & natural gas employment was almost 80 percent above 1972 but in 2003, oil & natural gas employment was a mere 4 percent above employment in 1972. Construction's upward trend in blue collar employment has been interrupted dramatically during every business cycle downturn in the overall economy. In the Great Recession, construction production worker employment fell from about 70 percent above 1972 levels to about 20 percent above 1972 blue collar construction employment.

In construction, turbulence expresses itself in severe booms and busts. Because construction builds the most durable of all major goods produced within the economy, spending on construction is often delayed when economic prospects darken. During the Great Recession, the overall economy lost 6 percent of all jobs while construction lost 30 percent of all its jobs.[10] Seasonal downturns also occur. How do workers carve out fulfilling, successful careers in a labor market that holds the potential of shrinking with the season and disappearing with every economic crisis?

The answer is well-known in construction: "You make hay while the sun shines." In the upturn, at some point, skill shortages in construction drive up wages while work becomes abundant. Construction workers who wish to make a career out of their craft seize these times of rising wages, and construction families learn rainy-day saving behavior. For union workers, collective bargaining helps by contractually obligating the worker to contribute to their retirement each paycheck. That same contract requires workers to pay into health insurance, which often includes a health savings account. That collectively

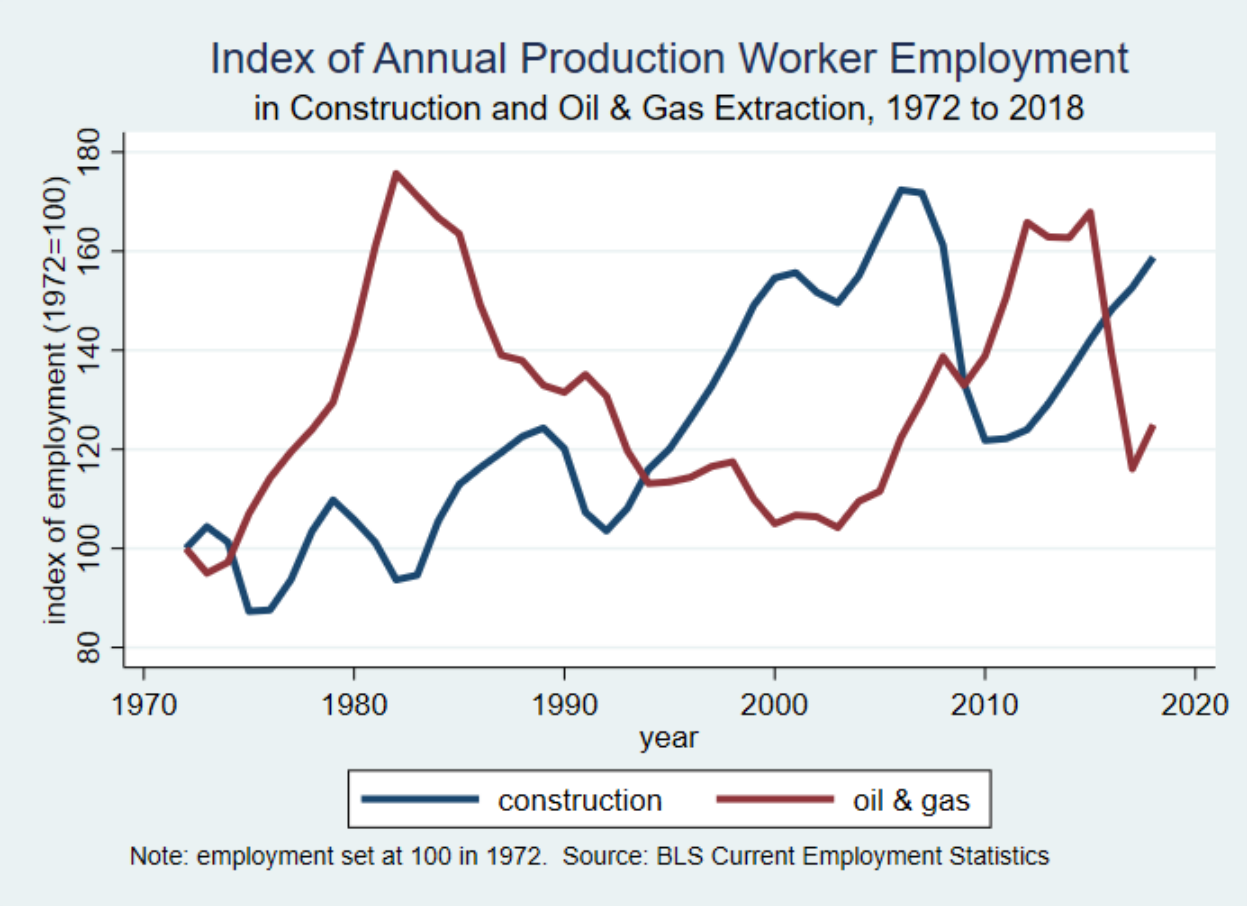


Figure 4: Index of annual production and nonsupervisory worker employment in construction, oil & natural gas, 1972 to 2018 (index set at 100 in 1972)

agreed upon provision provides the discipline needed for the construction worker's family to have health coverage when spells of unemployment arrive.

The turbulence of oil & natural gas work is different. Upstream oil & natural gas extraction responds to international energy prices and domestic oil & natural gas discoveries. The upcycle for blue-collar work in oil & natural gas extraction is often centered around discoveries or expansions of oil & natural gas fields. To harvest good wages in oil & natural gas, upstream workers must work where there are upstream operations. In the midstream sector, pipelayers must follow the work. If construction workers must "make hay while the sun shines," oil & natural gas workers must "go where the action is."

Advancement

Having only a high school diploma does not preclude the oil & natural gas or construction worker from becoming a foreman, supervisor or manager. In fact, in construction many blue-collar, high school educated, apprenticeship graduates eventually become contractors. The rungs of the ladder in construction go from helper and pre-apprentice through apprenticeship training, journeyworker, foreman, manager, and all the way up to ownership.

One-third of all construction managers have only a high school degree; one-quarter of all upstream oil & natural gas managers have but a high school degree. This compares with the overall economy where

only 18 percent of managers are high school educated. One third of all construction contractors have a high school degree, while only 17 percent of business owners elsewhere have only a high school degree.

This report lays out the data that highlight the quality of construction and oil & natural gas jobs for those with a high school education relative to the rest of the economy. These are critical segments of the US labor market that construct, heat, and power the buildings we live and work in, fuel the cars we drive, and build the roads we drive on. Inherent in this report is a story of talented high school graduates who have been given the opportunity to use those talents to grow in skill, in economic security and in their contributions to society, despite sometimes turbulent labor markets and potentially dangerous work. How they manage their jobs and their risks matters to them and to all of us who enjoy the fruits of their labor.

Section 1: Remuneration

The Wages of High School Graduates

The average wage for high school graduates with no additional college education in construction and mining/oil & natural gas are higher than those for any of the other major industries.[2] Figure *2* above showed that among the industries with high percentages of high school graduates, construction, mining/oil & natural gas pay substantially better, with transportation coming closest to construction wages. Among industries with low percentages of high school graduates, construction, mining/oil & natural gas also pay substantially better, with information and public administration coming closest to construction. None come close to the average wage in mining/oil & natural gas.[11]

We will see below that the premium pay for high school graduates in construction, oil and natural gas comes, in part, from the way these industries rely upon industry training to enhance the skills of these workers with less reliance upon formal schooling for many good jobs in these two industries.

Formal Schooling

The structure of the US labor market has changed dramatically in the last 80 years. Known collectively as goods production—manufacturing, construction, mining and oil & natural gas extraction were once a mainstay of employment in the US labor market. In 1940, goods production accounted for 40 percent of total US non-farm employment with services accounting for the remaining 60 percent. Today, goods production accounts for 17 percent of total employment, while service work now accounts for 83 percent of all jobs. (Figure *5*) The relative decline in goods production employment has been due to both automation of production processes and the global outsourcing of manufacturing jobs.

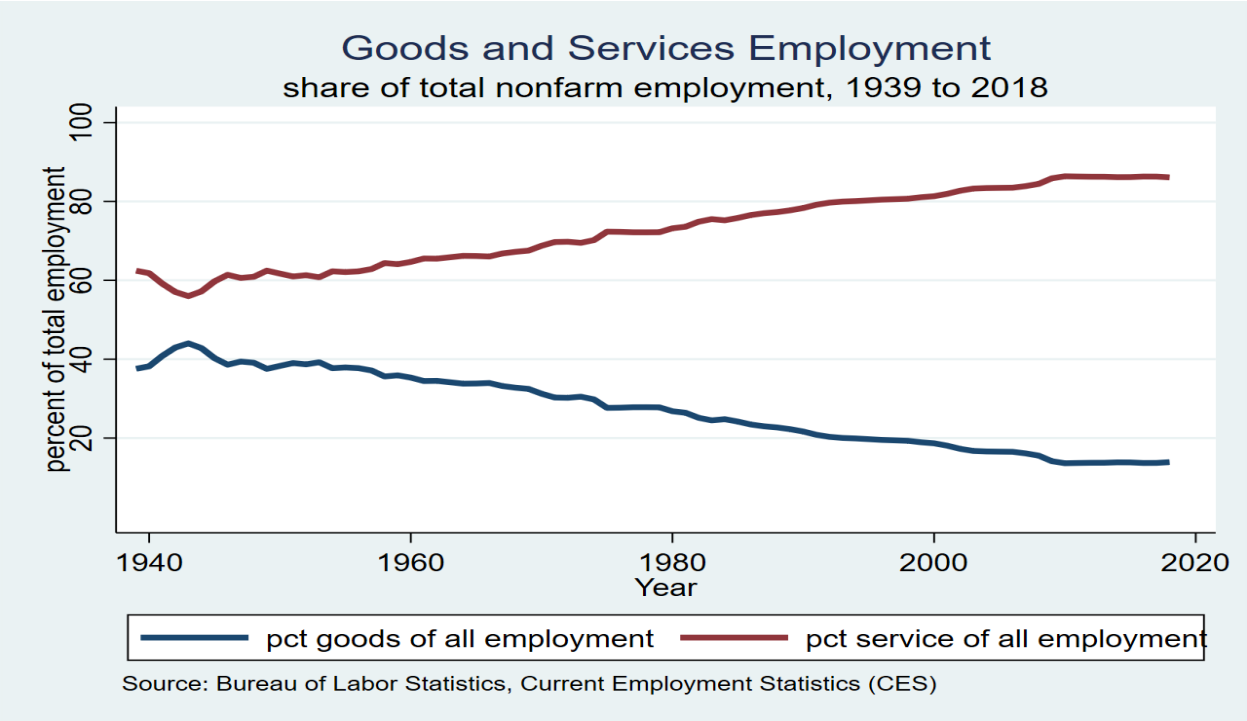


Figure 5: Changing share of total employment between goods producing industries and service industries, 1939 to 2018[12]

[2] Government data do not break out education levels for oil & natural gas extraction separate from mining.

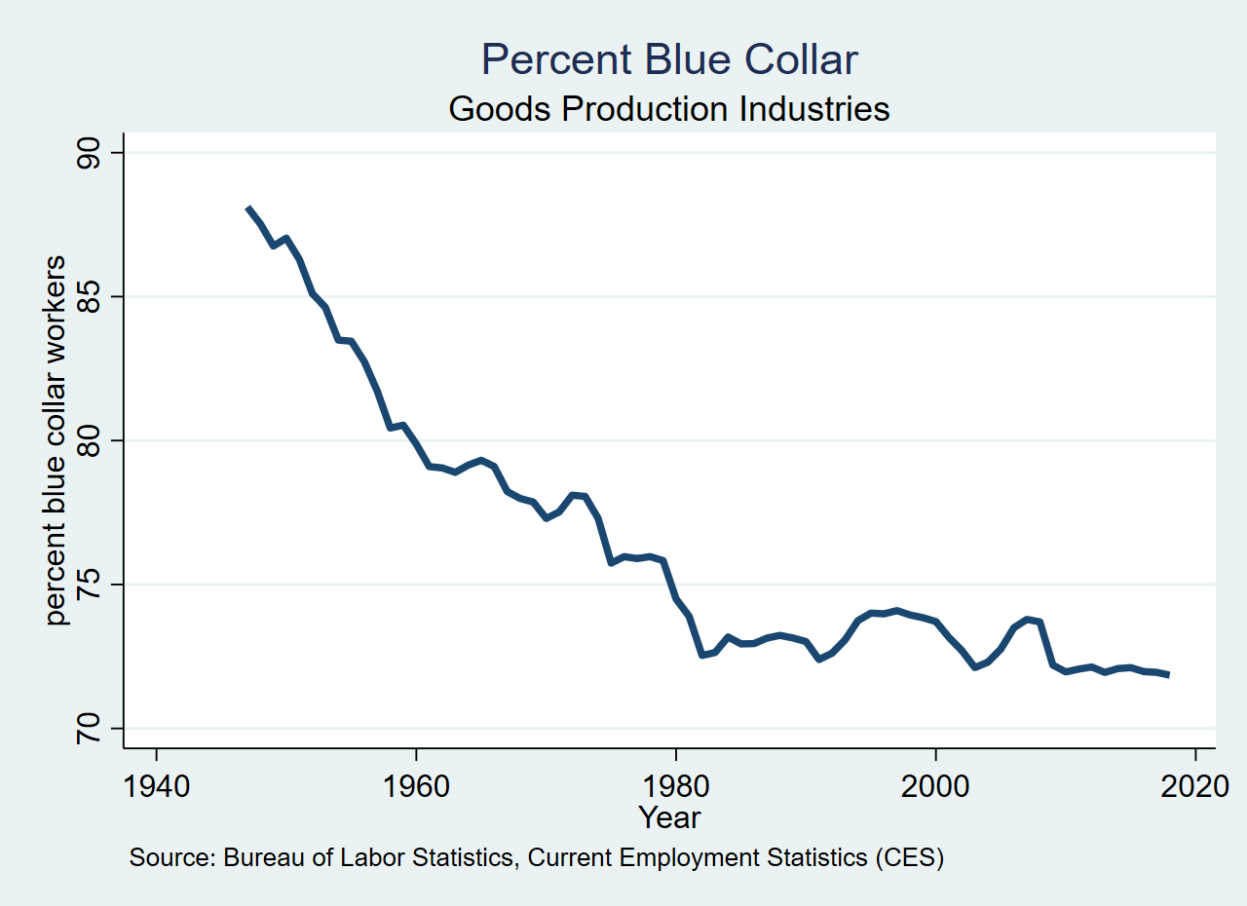


Figure 6: The decline of blue-collar jobs within goods producing industries, 1947 to 2018

Known collectively as blue-collar work, production, construction, extraction, transportation and material handling occupations have always been a mainstay of goods production. However, blue-collar work within goods production has fallen from 88 percent in 1940 to 72 percent today. (Figure *6*) White-collar work has expanded both by an expansion of the service sector and by an expansion of white-collar work in goods production. [13]

The decline of the goods producing sector and the decline of blue-collar jobs within goods production has meant that white-collar work has come to dominate jobs in the US labor market. The rise of white-collar jobs has transformed the way Americans prepare themselves for the labor force. Foremost in this transformation has been the rise of formal schooling. While many of the skills needed for blue-collar jobs are learned on the job, skills needed for white-collar jobs are primarily learned in school.

The 80 years since 1940 has seen a steady rise in educational attainment for those who enter the labor force. In 1940, most workers in the US labor market did not have a high school degree much less any college education. In 1940, 71 percent of American workers did not have a high school diploma. By 2017, only 8 percent of those in the workforce did not have a high school diploma. In contrast, only 11 percent of those in the labor force had some college or a college degree in 1940. Today, 67 percent of American adult workers have at least some college or a college degree. This rise in educational attainment parallels the rise in white-collar work.

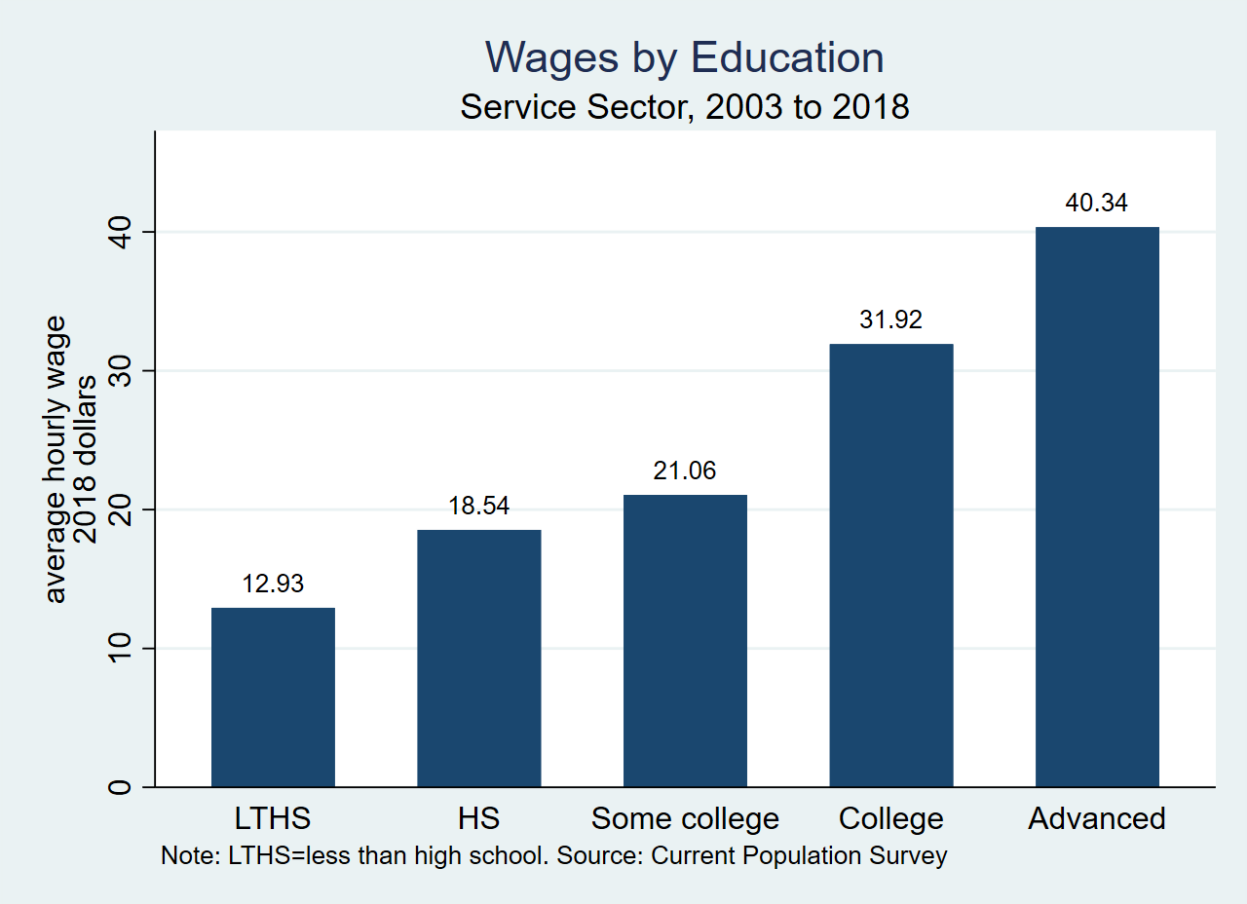


Figure 7: Average wage rate by educational attainment for service sector jobs, 2003 to 2018 (2018 dollars)

Workers with only a high school degree rose from 18 percent in 1940 to a peak of 38 percent in 1980. But, currently just 25 percent of the adult labor force stopped their formal education after graduating from high school.[14] While the GI Bill after World War Two stimulated an unprecedented rise in US higher education,[15] the expansion of formal educational attainment over the long run has been primarily driven by the rise in the service sector and white-collar work in goods production. The service segment of the labor market strongly rewards higher levels of formal educational attainment.

Figure *7* shows that in the service sector, the average hourly wage rate is 3 times higher for a worker with an advanced degree (masters, PhD, law, medical, etc.) compared to a worker with less than a high school education. A worker with a college degree, on average, earns 72 percent more per hour than a worker with a high school degree. The average wage for a high school graduate is more than 40 percent higher than for a worker with less than a high school degree. With these kinds of incentives in the growing service sector, the rush to obtain more formal education has lasted for 80 years.

While most white-collar workers are in the service sector, for white-collar workers in the goods producing sector, the rewards for more formal education are similarly strong (Figure *8*—right panel). A high school graduate in white-collar work in goods production earns, on average, 38 percent more than someone with less than a high school degree. A college graduate earns 46 percent more than a high school graduate. Those with a master's degree or more earn 23 percent more than those with a BA.

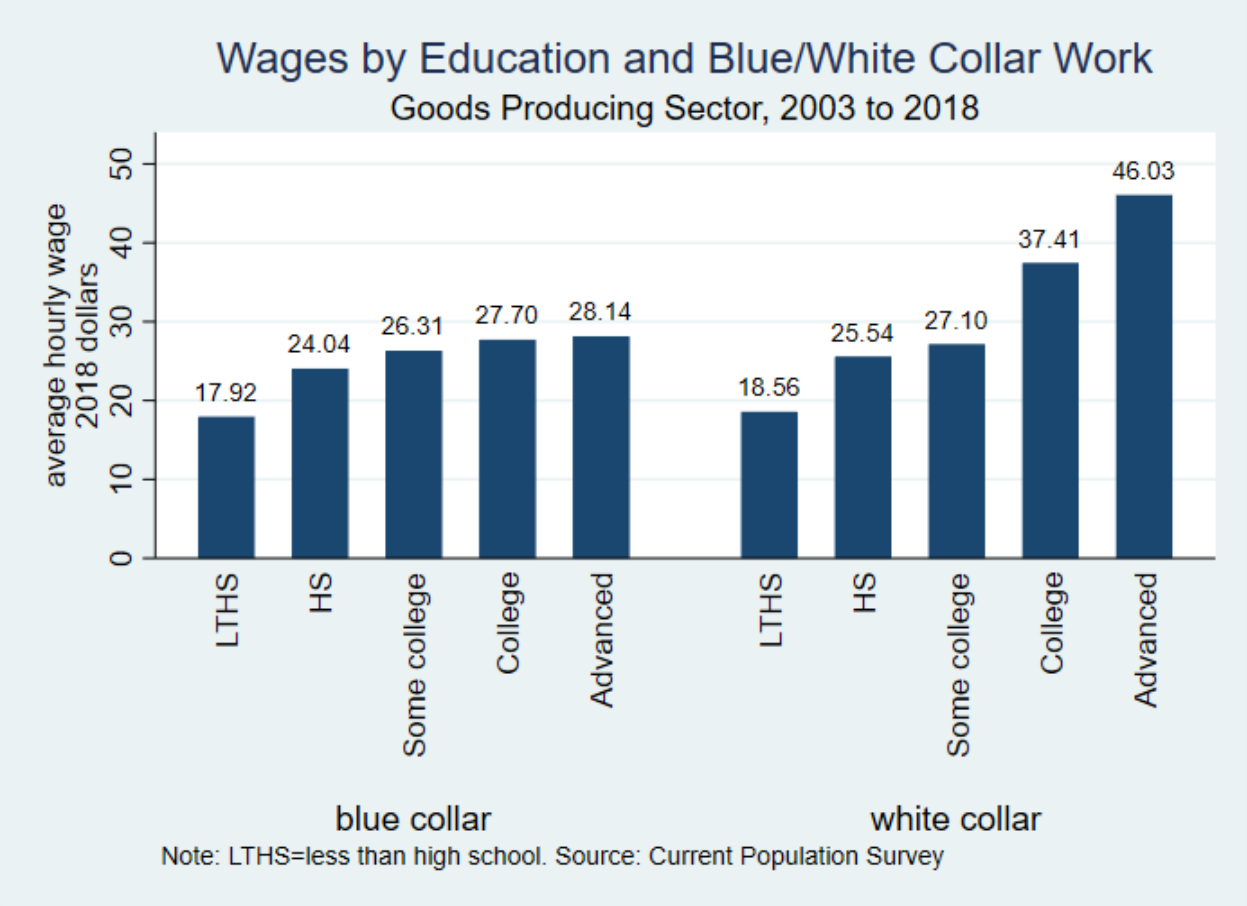


Figure 8: Average wage rate (including overtime) by educational attainment, for service sector jobs, 2003 to 2018

These wage differentials based on education strongly incentivize the acquisition of more formal educational credentials.

But for blue-collar work in the goods producing sector, the world of wages and formal education look sharply different. The left panel in Figure *8* shows a more muted effect of formal education on hourly wages. The jump from "no high school degree" to "high school degree" is similar to white collar work (34 percent vs. 37 percent). But after that, the bump-up in wages associated with more formal education is much weaker. The average high school-to-college degree wage jump for blue-collar workers in goods production is 15 percent compared to 47 percent among white-collar workers. The reward for going on to a master's degree for blue-collar workers is a mere 2 percent over a bachelor's degree in goods production. The market does not dangle the same educational premiums to blue-collar workers that the market uses to incentivize white-collar workers to stay in school.

With less incentive to obtain formal educational credentials, blue-collar workers in both the goods and service sectors seek less schooling outside the work context. Figure *9* shows that high school graduates dominate the blue-collar labor force while those with college educations dominate the white-collar labor force. Blue-collar work in oil & natural gas and construction attach less importance to a college education. Because returns to formal education are less for blue-collar workers, not surprisingly, we find fewer college degrees among these workers.

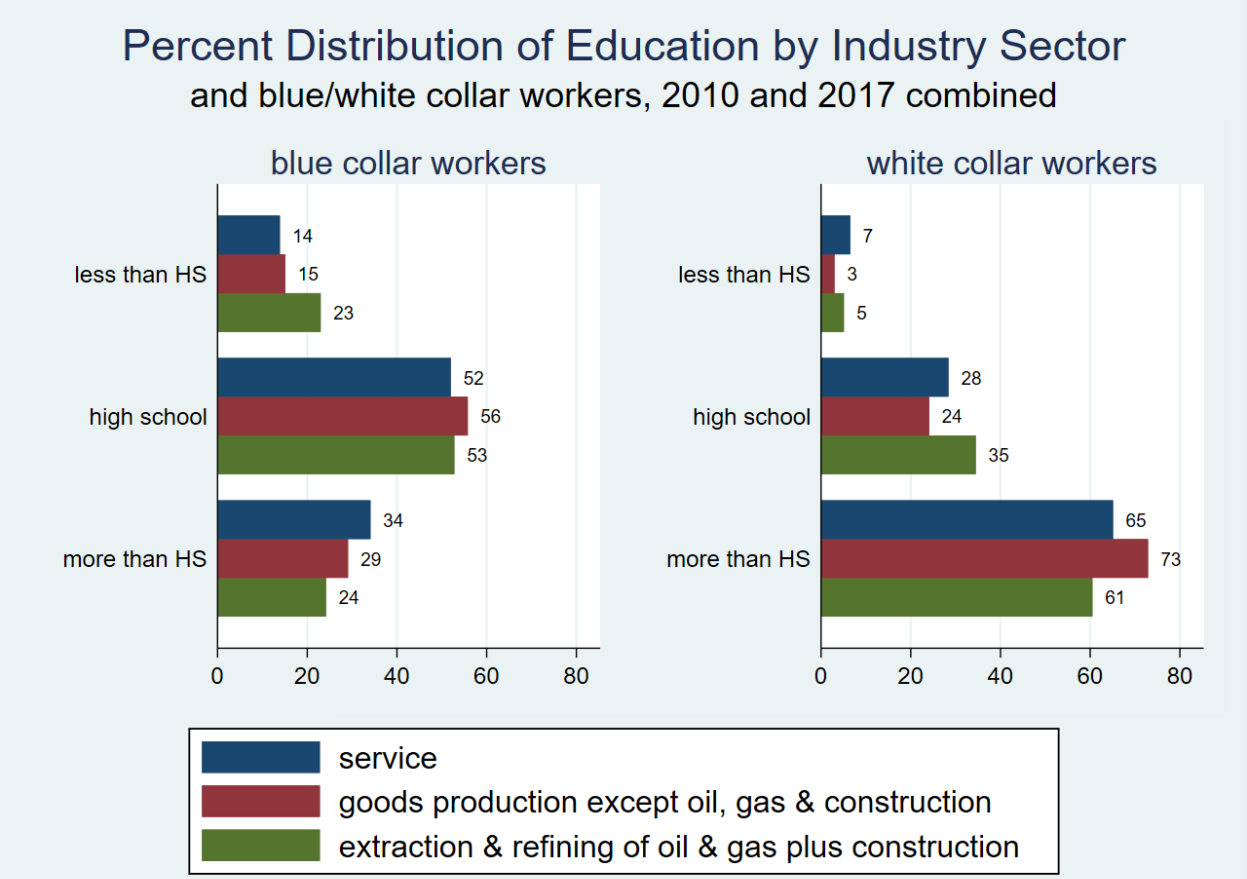


Figure 9: The distribution of educational attainment within in the goods and service sectors

Industry Training and Experience

The Advantages of Apprenticeships

On-the-job and apprenticeship training in goods-production, blue-collar work is substantial. This is especially true for apprenticeship training in construction. The construction industry is the primary user of apprenticeship training in the US. In 2018, 74 percent of all active private-sector apprentices tracked by the US Department of Labor were construction apprentices. There were almost 400,000 active construction apprentices registered either by the US Department of Labor or by state apprenticeship committees.[16] This compares to 280,000 enrolled in the Fall of 2019 at the University of California system, almost 250,000 enrolled at the 17 campuses of the University of North Carolina system and 425,000 enrolled at the State University of New York system in the Fall of 2018.[17] Thus, the industry-based, primarily industry-financed system of post-high school education in construction matches, in size, two of the largest publicly-financed systems of higher education in the US. About 70 percent of these construction apprentices were registered into jointly managed, union/contractor-association apprenticeship programs. The remaining 30 percent were enrolled into individual, nonunion-contractor programs.[18]

Construction apprenticeship programs typically combine competency and time-based criteria, often requiring from 2000 to 8000 hours of on-the-job, mentored work-experience along with 500 to 800

hours of classroom/workshop training. Aspiring apprentices typically must be 18+ years old with a high school or equivalent degree.[19] This helps explain the dominance of high school education in construction shown in Figure 9. Access to apprenticeship programs are an important incentive for workers who want to rise in construction to complete high school.

In jointly managed union-contractor programs, an apprentice coordinator oversees the rotation of apprentices across signatory contractors to expose apprentices to a range of work assignments and management styles. In the single-contractor, nonunion programs, an apprentice will typically stay with that contractor but rotate across the range of tasks available from that contractor in the apprentice's craft.

White-collar work incentivizes formal education through the prospect of higher wages after the person is done with school and has gone to work. In blue-collar work, through apprenticeships, industry directly finances formal training. This means that the student debt crisis that has emerged in the white-collar world has been largely avoided in blue-collar work. Contractors invest in their apprentices and have an incentive to recoup that investment by making the education of construction apprentices relevant and efficient. Contractors also have an incentive to hold onto increasingly trained and experienced workers.

Figure 10 shows that for both nonunion and union blue-collar workers with a high school education, inflation-adjusted wages rise as these construction workers get older. This is because they are accumulating training and work experiences that enhance their productivity and workplace safety. But real increases in wages peak around age 40 and then level off for the next 20 years. This is because most

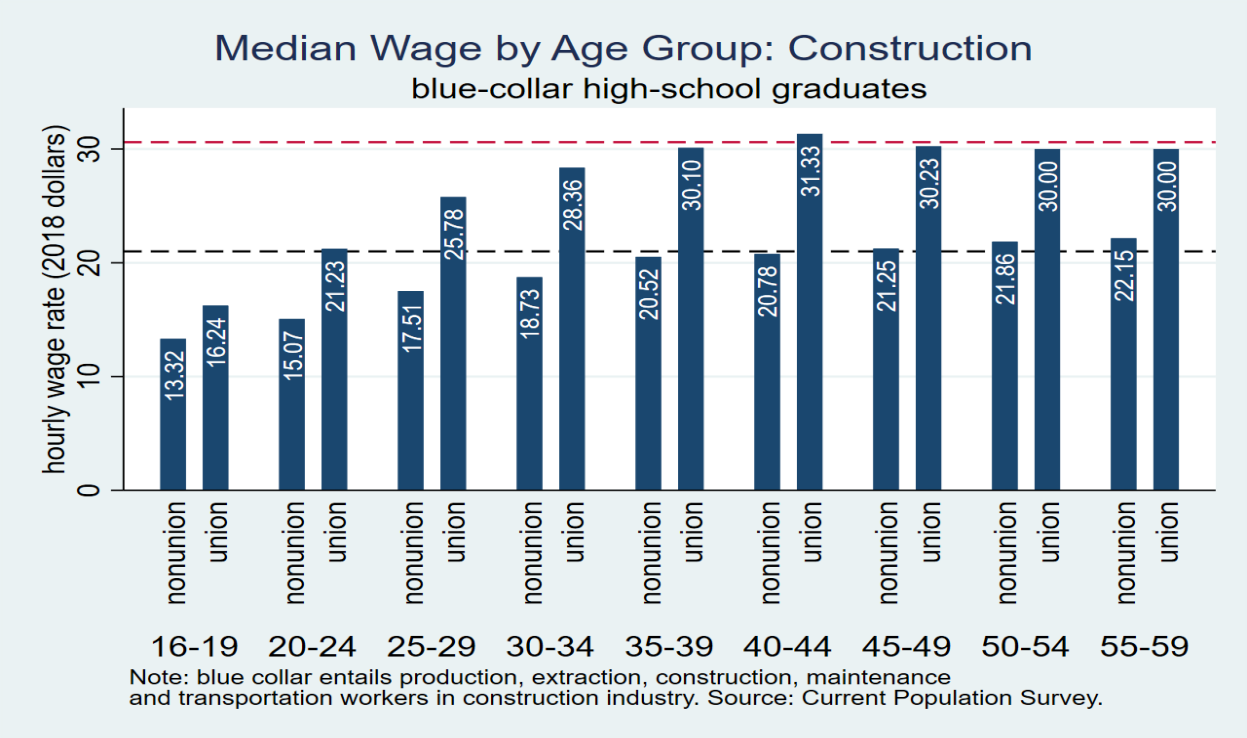


Figure 10: Average hourly wage rates (including overtime) for union and nonunion blue-collar workers in construction, 2003 to 2018 data in 2018 dollars (Dashed lines compare stabilized prime age earnings of blue-collar, union and nonunion construction high school graduates)

relevant training and work experiences that enhance a worker's productivity and safety come in the first couple of decades of their construction careers.

In the nonunion sector, the average blue-collar, high school graduate's wages rise by 13 percent between their teen years and their early 20s. Average wages rise again by 16 percent as these workers get into their late 20s. In the next decade, nonunion construction workers' wages rise 7 percent in their early 30s and 10 percent in their later 30s. After about age 40, in inflation-adjusted terms, these prime-age workers in nonunion construction hang onto their increased real wages, but on average, they will not see any additional increments in real earnings. For most, their construction productivity and safety skills are in place by around age 40. These skills hold steady for the next 20 years and their inflation-adjusted wages hold steady too.

The pattern is similar for blue-collar, high school educated union construction workers. Gains in real wages are concentrated in their first 25 years of construction work. But union construction wages rise sooner and higher than nonunion wages. The jump from teen years to the early 20s is 31 percent compared to 13 percent for young nonunion workers. From the early to the late 20s, the jump is 21 percent compared to 16 percent. The bump-ups in the 30s for union and nonunion construction workers are similar (10 percent and 6 percent compared to 7 percent and 10 percent). But the faster run-up in their 20s means that by the time union workers' wages level off after age 40, union workers are earning about 50 percent more than nonunion workers in construction.[20]

A major reason union construction workers wages rise faster and farther than nonunion workers is the predominance of apprenticeship training in the union sector. While a small minority of nonunion construction workers, primarily electricians and plumbers, go through apprenticeship programs, a substantial majority of union workers receive apprenticeship training.[21] For most, this training comes towards the front-end of their construction careers in the teens or twenties. This is when union wages diverge quickly, substantially, and permanently from nonunion wages.

Apprenticeship training is a form of education that is closely linked to industry and occupation skill requirements through a combination of classroom training, workshop practice, and on-the-job supervised experience. Apprenticeship training supercharges the mastery of skills by linking abstract and on-the-job learning through a formal and coordinated process. By coming early and supercharging learning, the apprentice harvests the benefits of accumulating skills quickly and for a longer time. The Department of Labor states of apprenticeship training, in general:

> *Apprentices earn competitive wages, a paycheck from the first day of employment and incremental raises as skill levels increase. The average wage for a fully proficient worker who completes an apprenticeship is $50,000 annually. Apprentices who complete their program earn approximately $300,000 more during their career than non-apprenticeship workers.*[22]

The effect of apprenticeship training on construction average wages is clearly seen in the union sector in Figure 10 . The big and early jump in average wages in union construction compared to nonunion construction reflects the broader early skill enhancements among young union workers through apprenticeship training compared to nonunion workers, the majority of whom do not go through apprenticeship training.

The same apprenticeship-based wage acceleration takes place on the nonunion side of construction. However, this supercharging of skills (and wages) is less visible in the nonunion wage data. The nonunion apprenticeship-wage effect gets hidden in average wage data behind the wages of nonunion workers who do not go through an apprenticeship program. Over the long haul, going through a construction apprenticeship pays off for blue-collar workers because 1) they earn while you learn, 2) they get a higher education without debt, 3) they get paid better sooner, 4) they get paid better longer.

Unions and Wages

Figure *11* refers to median wages for high school graduates only (including GEDs) in their prime working years (35 to 54 years old). Thus, the wages shown in Figure *11* reflect the results of 20 to 25 years of accumulated work experience and whatever front-end formal education or training workers received in those years. Figure *11* shows that if you stopped formal education at high school, it helps to be in construction or oil & natural gas compared to the typical worker in all other industries. Wherever you are, if you are a high school graduate, it helps to be a union worker.

The left panel in Figure *11* refers to nonunion workers. It groups wages by construction, oil & natural gas and all other industries. Within each industry, Figure *11* separates out blue-collar from white-collar wages.

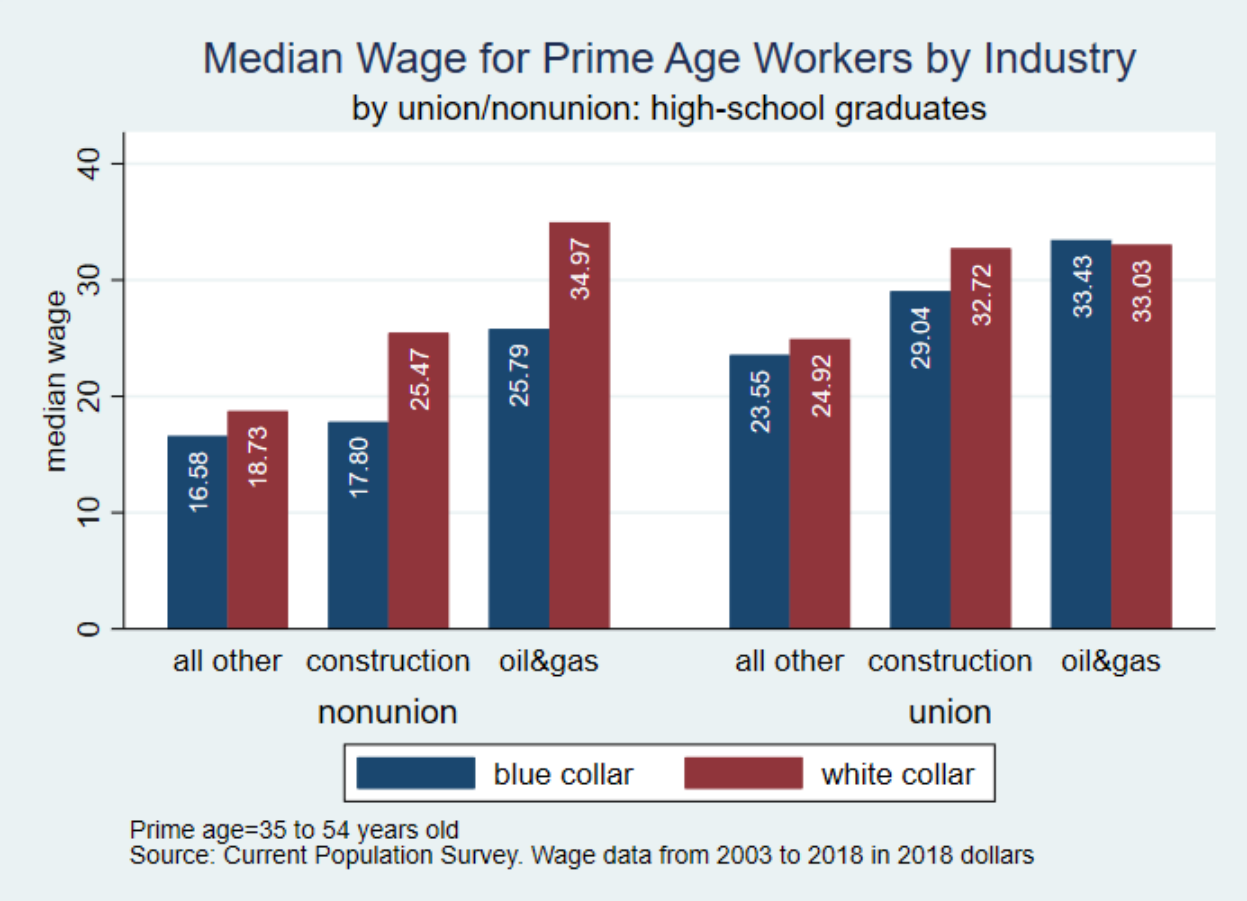


Figure 11: Median wage for prime age workers (ages 35 to 54) by union/nonunion and blue/white collar for construction, oil&gas and all other industries

Figure 11 shows that both blue-collar and white-collar nonunionized construction workers are paid better than their corresponding blue-collar and white-collar workers in all other industries taken as a group. Both blue-collar and white-collar nonunionized oil & natural gas workers are better paid than their nonunion counterparts in all other industries. They are also better paid than nonunionized construction workers. Unionized construction workers along with oil & natural gas workers are paid best among all prime-age high school educated workers. Compared to nonunionized blue-collar workers in all other industries, unionized construction workers earn 64 percent more. Unionized blue-collar workers in oil & natural gas take home 80 percent more per hour compared to their blue-collar, prime-age, nonunion counterparts in all other industries.

In short, the construction and oil & natural gas industries provide relatively well-paying jobs for high school graduates. Unionization provides further advantages. In an economy that is shifting away from goods production and away from blue-collar work, formal education has become the primary ticket to well-paying jobs. However, in construction and oil & natural gas, apprenticeship training and industry experience provide an alternative to formal education as a path towards better earnings.

Unions and Benefits

The foregoing examined take-home pay. But in addition to wages in your pocket, benefits account for a substantial part of remuneration. For instance, in construction in 2017, legally required benefits (social security, worker compensation insurance for injuries and unemployment insurance) added an additional 14 percent to payroll. Voluntary benefits (primarily employer financed health insurance and pensions) also added an additional 16 percent to payroll.[23] Thus legally required and voluntary benefits added an average of 30 percent to wages in construction. The data shows that the incidence of voluntary benefits is more related to union versus nonunion workers rather than blue- versus white-collar workers.

Most government data on voluntary benefits do not tell how much benefits costs, but only whether a person receives a pension or health insurance. Figure 12—left-panel shows that for high school graduates across construction, oil & natural gas and all other industries taken as a group, union workers receive more employer sponsored health insurance and pensions compared to the nonunion workers. Oil & natural gas tops the list on the union side relative to other union workers. Oil & natural gas also tops the list on the nonunion side relative to other nonunion workers. Systematically, it is better to be a union worker in any sector compared to any nonunion worker, and it is better to be in the oil & natural gas industry compared to all other industries.

Health insurance is more common than employer financed pensions. But the step down in pension coverage is not sharp on the union side. Figure 12—right-panel shows that on the nonunion side, only white-collar nonunion workers in oil & natural gas have better than a 50 percent chance of receiving a pension from their employer. The workers with the least health coverage and the least chance of receiving a pension are nonunion blue-collar construction workers. Just about half have employer-provided health insurance and one-third have an employer-financed pension.

Typically, union benefits are more generous than nonunion benefits. This is partly due to collective bargaining emphasizing benefits, but also because multiemployer benefit programs provided through collective bargaining enjoy economies of scale both in buying medical care and in delivering medical benefits. Also, on the union side, benefits are portable across signatory contractors. This is important in

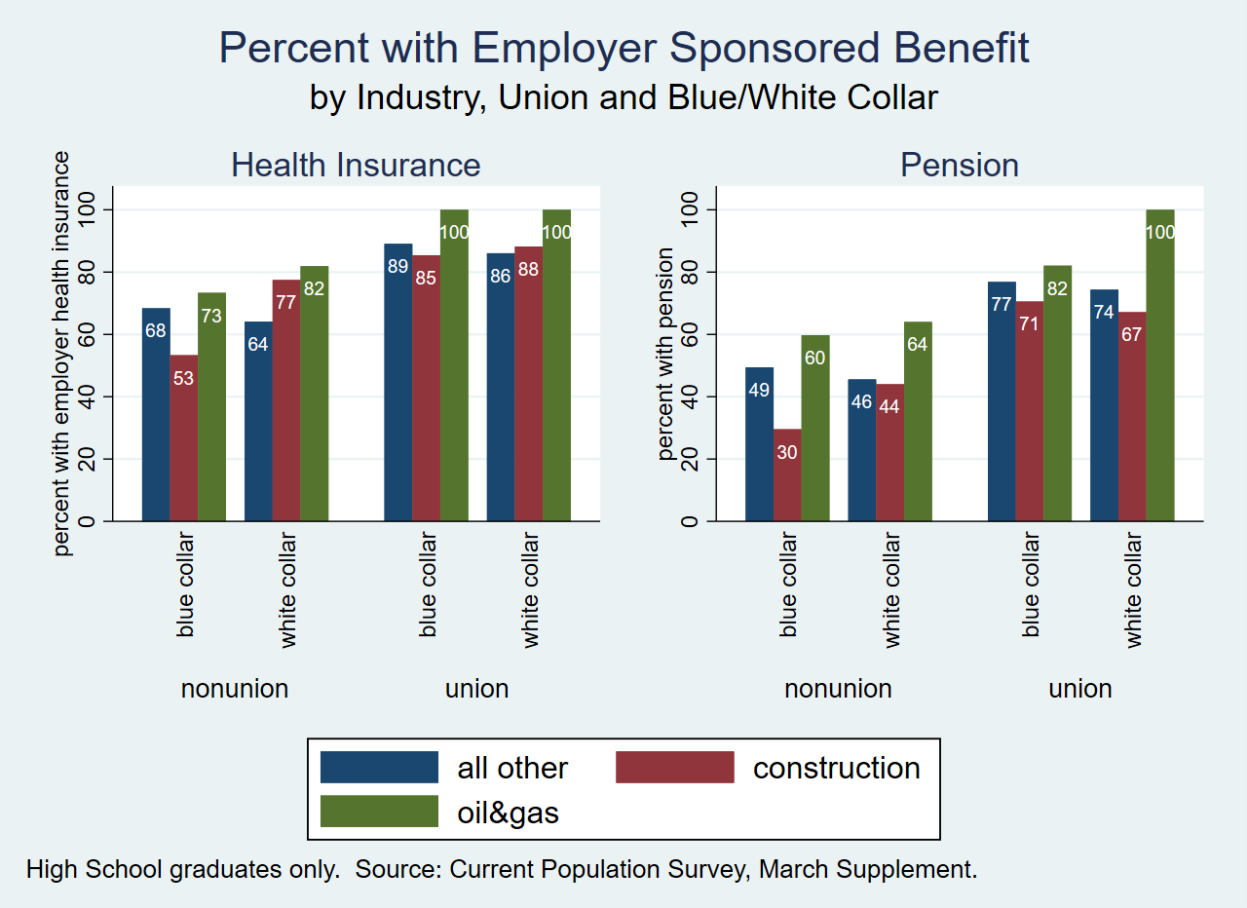


Figure 12: Percent receiving employer-sponsored health and pension benefits by industry, blue/white-collar and union/nonunion, 2003 to 2018

construction because it cuts down on the problem of waiting periods for health insurance when workers move between contractors.

Conclusions About Remuneration

In sum, both the oil & natural gas and construction sectors of the economy provide well-paying blue and white-collar jobs for high school educated workers compared to high school graduates in all other industries taken together. The advantage in these two industries is most pronounced for union workers, and the union advantage is strongest in construction. When it comes to benefits, union membership is key. The prevalence of benefits is less a matter of which industry sector the high school graduate is in and more a matter of whether that worker is a member of a union. Collective bargaining both incentivizes the payment of benefits relative to wages and bumps benefits up in the case of multiemployer benefit programs that exploit economies of scale.

Section 2: Safety

Safety is another important aspect of job quality. Most workplace accidents can be foreseen, and many are preventable. Trench fatalities exemplify this. When the Occupational Safety and Health Administration (OSHA) strengthened the excavation and trenching safety standard to require that all trenches be sloped or shored to prevent cave-ins, there was a twofold decline in trenching fatalities.[24] Yet workers continue to die in trenches when those standards are not adhered to. Standards, worker training, and solid safety management save many from injury and death. This section examines how safe the construction and the oil & natural gas industries are compared to other industries, and for the injuries that do occur, to what extent they are the result of inherent dangers versus the result of the arrangements of work.

The risks in construction vary by sector, by activity, by training, by experience and by workplace organization and management. This section first assesses the risk of being injured or killed on the job in construction and oil & natural gas. It then examines who gets hurt in construction.[25]

How Safe is Oil & Natural Gas and Construction Work?

Lost Workday Injuries and Illnesses.

Figure *13* shows that over the entire economy, the annual serious workplace injuries and illnesses rate is 90 incidences per 10,000 fulltime workers employed. Serious injuries are defined by the Bureau of Labor Statistics (BLS) as workplace injuries or illnesses that result in one or more lost workdays.[26]

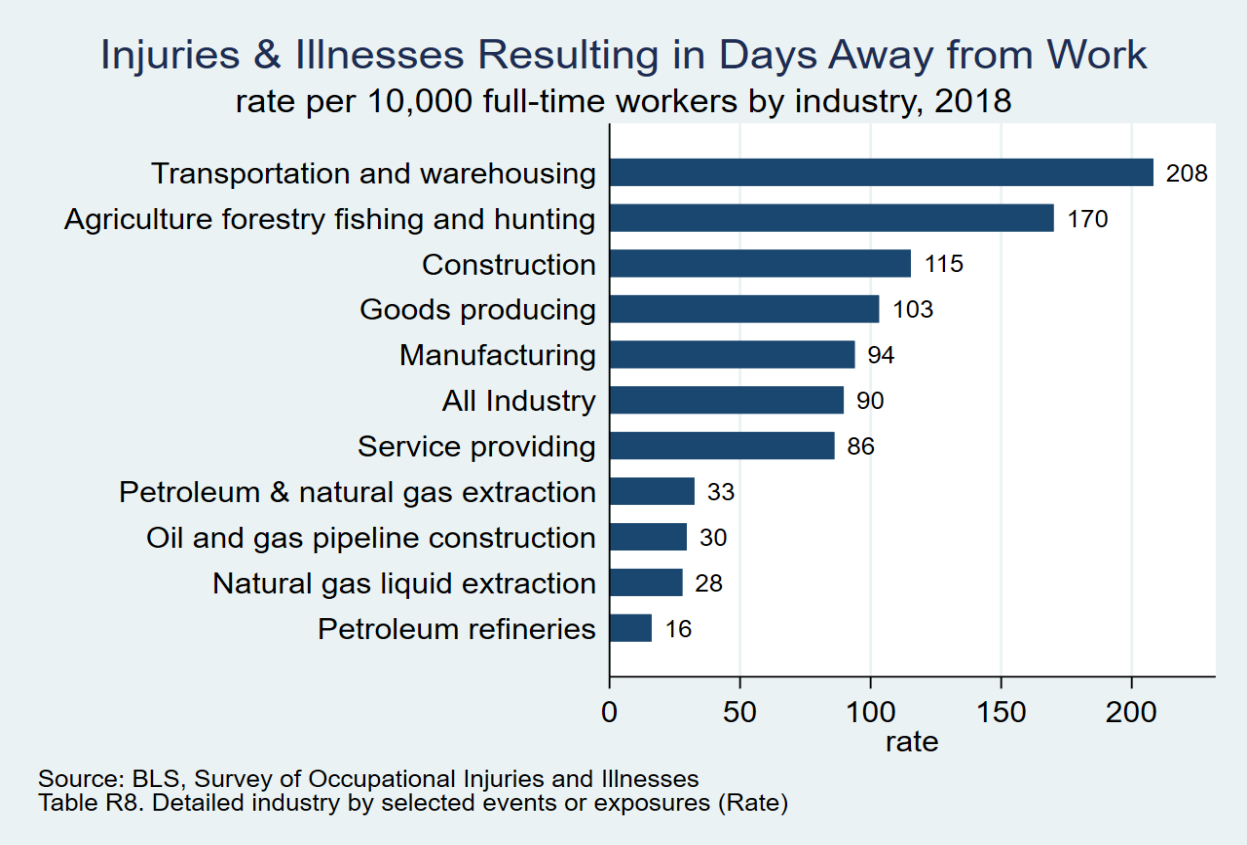


Figure 13: Serious injury and illness rates per 10,000 fulltime workers in selected industries, 2018

Compared to the cross-industries rate of 90, upstream crude petroleum and natural gas extraction rate is 33. This segment of the oil & natural gas industry entails the exploration, drilling and extraction of crude oil and natural gas. The midstream segment of oil & natural gas transports extracted oil and gas by pipelines. Workers constructing oil & natural gas pipelines have a serious injury rate of 30. The downstream serious injury-and-illness rate for petroleum refining is 16. Based on this comparison, the oil & natural gas industry performs quite well.[27]

Much of the work in refineries is done by outside contractors engaged in the periodic maintenance of refineries and other contracted services.[28] Boilermakers are a common occupation coming onto refineries to perform maintenance work during shutdowns. These boilermakers are employed by outside contractors. When they get hurt, their injury is assigned to the industry of the outside contractor—typically construction. The Bureau of Labor Statistics (BLS) reports both industrial and occupational serious injury rates. The boilermaker occupational serious injury rate in 2018 was 82. This boilermaker rate of 82 suggests that the work of outside contractors employing boilermakers, pipefitters, electricians, welders and others on refinery turnarounds are more at risk of injuries compared to direct employees engaged in refinery operations.[29] This is not surprising. Tearing down and rebuilding industrial structures is typically more dangerous than operating those facilities.

Figure *13* shows that construction has the third highest serious injury and illness rate of all major US industries (115 incidents per 10,000 fulltime workers)—behind only transportation/warehousing and agriculture/forestry/fishing/hunting.

The construction serious injury and illness rate is 12 percent higher than the goods producing sector, 22 percent above manufacturing, and 28 percent above the average serious injury rate for all industries. In contrast, in the oil & natural gas sector, the extraction serious injury rate is 63 percent below the all-industry average. The oil and gas pipeline construction rate is 67 percent below the all-industries rate. The natural gas liquid extraction subsector rate is 72 percent below the all-industries average, and petroleum refining's rate is 82 percent below the overall average. Notwithstanding the rare possibility of a catastrophic event, on average, the oil & natural gas industry is considerably safer than construction and most major industries.

Hospitalization Rates.

The BLS serious injury and illness rate makes no distinction between losing one workday or losing 100, which means that "serious injuries" can vary in their severity. In order to address this measurement issue, the BLS now gathers additional data on workplace injuries and illnesses by counting the events that result in overnight (or longer) hospitalization.

Figure *14* shows the rate of overnight hospitalization stays for selected major industries. Among these, construction has the highest rate of 10.5 hospitalized workers per 10,000 fulltime workers employed in a year. The construction hospitalization rate is double that of manufacturing and five times higher than the hospitalization rate in health care and social assistance jobs.

Figure *15* shows that the rate of hospitalization by occupation ranges more widely compared to major industry averages. The average hospitalization rate for all construction trade workers in construction and maintenance jobs is 11.1. This is slightly higher than the construction industry average of 10.5 because construction trades workers do not include white collar occupations in construction which have less risky jobs.

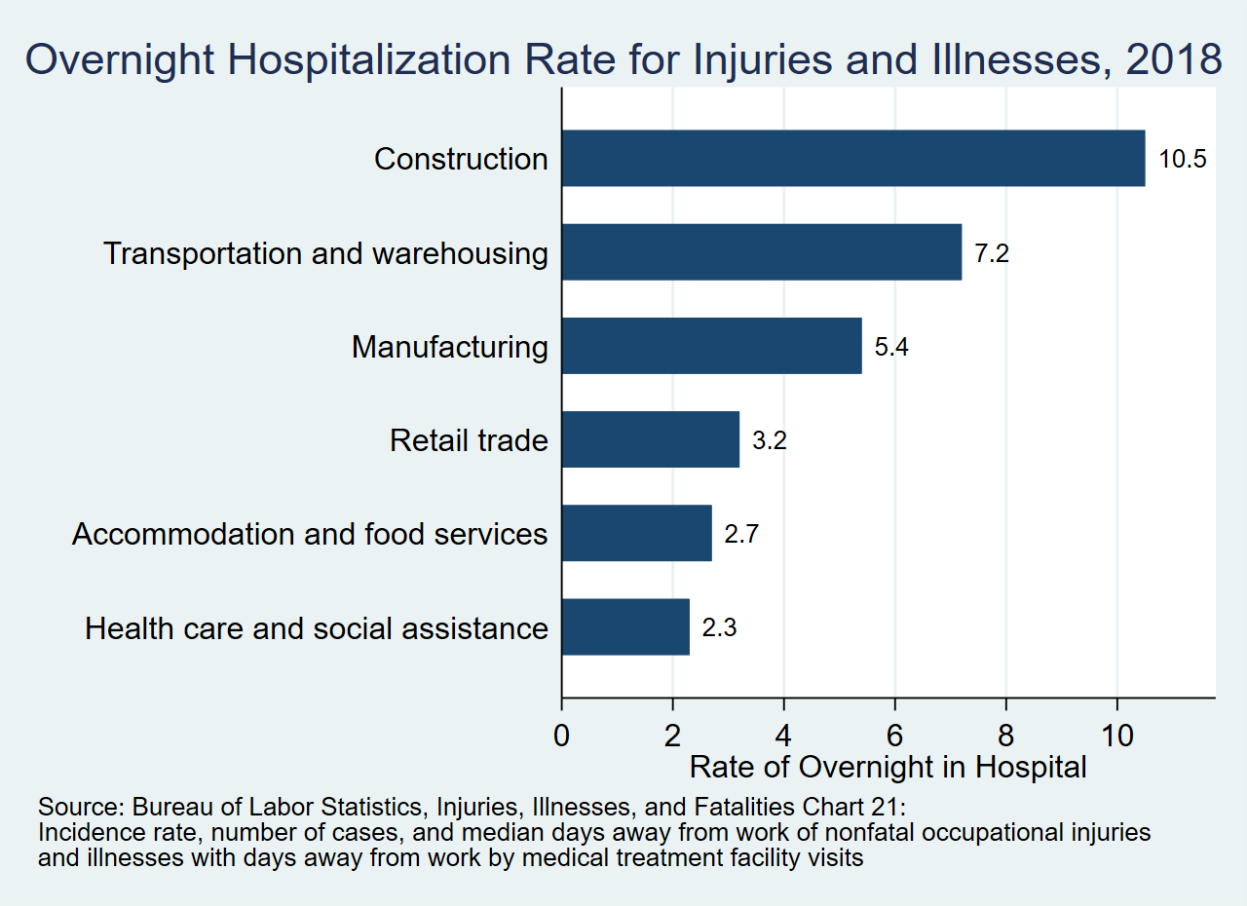


Figure 14: Overnight hospitalization, including emergency room by major industries, 2018[30]

But painters and paperhangers have a hospitalization rate of 1.4 (left panel). Tile and marble setters have a hospitalization rate of 78.4 (right panel). This reflects, in part, the inherent danger of saws used by tile setters compared to brushes used by painters. However, training and experience also play an important role.

Oil & natural gas roustabout work is more like construction work than plant operations at a refinery. In oil & natural gas extraction, roustabouts assemble or repair oil field equipment using hand and power tools. They also perform other tasks as needed.[31] The left panel in Figure *15* shows a roustabout hospitalization rate of 6.9. Compared with an overall construction hospitalization rate of 11.1, this lower roustabout rate is consistent with the conclusion above that on average, the oil & natural gas sector is safer than overall construction. Some segments of construction, including operating engineers, electricians, plumbers, pipefitters and steam fitters, have hospitalization rates that are similar to oil & natural gas roustabouts, demonstrating that safety within an industry can vary widely by occupation.

The right panel in Figure *15* shows the more dangerous construction occupations including helpers (14.3), iron workers (17.4), laborers (18.9), roofers (43.4) and tile setters (78.4). Helpers and laborers may be less experienced and less well-trained; ironworkers and roofers work at heights; tile setters work with saws. These data suggest that an interaction between the inherent dangers of a job and the

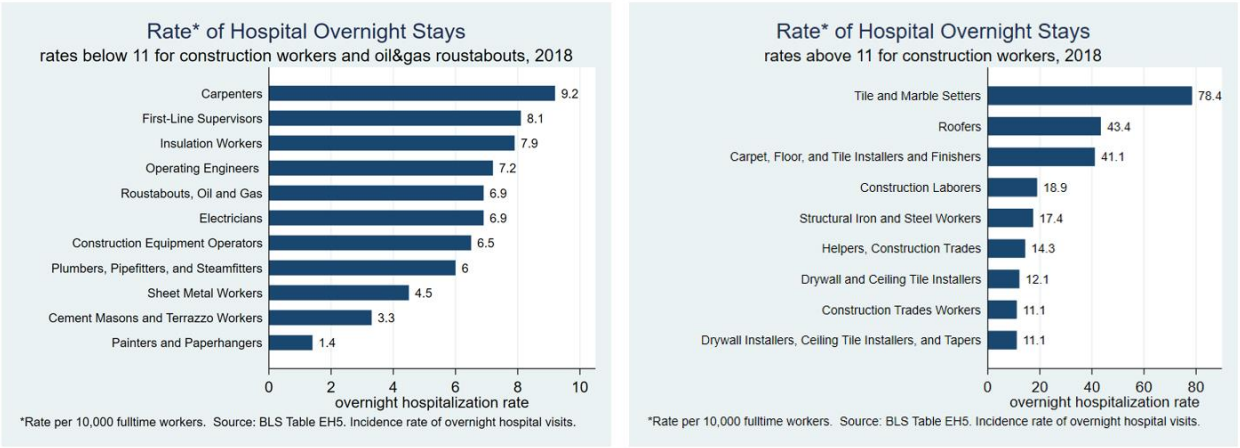


Figure 15: Rate of hospital overnight stays from workplace nonfatal accidents for construction workers and oil&gas roustabouts by overnight rate below 11 (left panel) and above 11 (right panel)

training and experience of workers combine to determine the ultimate safety of the work. Training and experience are important not only to reduce serious injuries, but also to fend off workplace fatalities.

Fatality Rates

The risk of dying while at work is much higher in construction and in mining/oil & natural gas compared to the overall US labor market.[32] The left panel in Figure *16* compares the fatality rate per 100,000 fulltime workers for the major segments of the US economy in 2017. By far, the most dangerous is agriculture, forestry, fishing and hunting (23 deaths per 100,000). Transportation (15.1) is second. Mining, quarrying, oil & natural gas extraction together have the third highest fatality rate in the US (12.9 annual workplace deaths per 100,000 fulltime workers). Construction has the fourth highest (9.5 deaths per 100,000 fulltime workers). The rest of the labor market is substantially less deadly with the next closest—wholesale trade—having a fatality rate of 4.8.

Because construction is the biggest of the top four, the right panel in Figure *16* shows that construction accounts for the most deaths per year (971) while the much smaller mining and extraction industry accounted for 112 deaths in 2017. Of those 112 deaths in extraction, 8 were in oil & natural gas extraction and 73 were in oil and gas drilling and support activities.

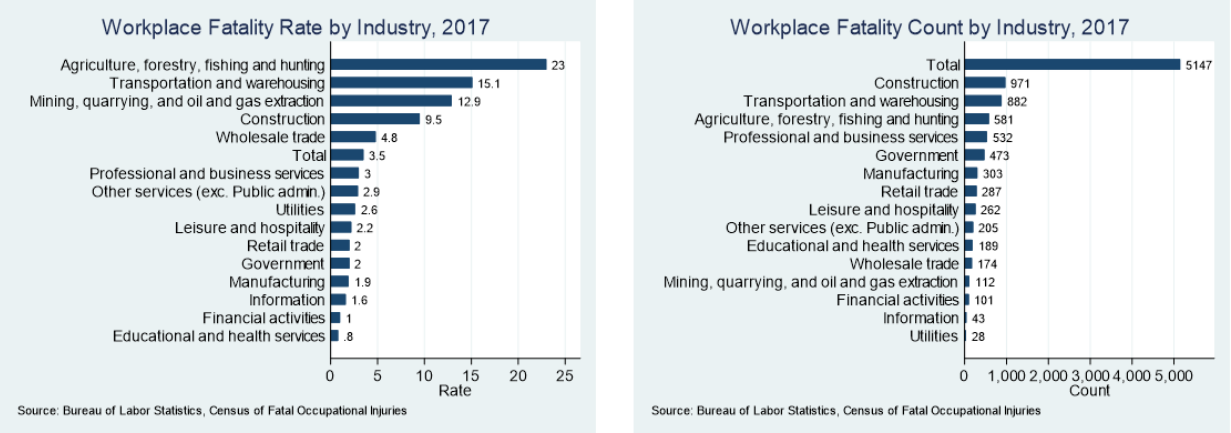


Figure 16: Workplace fatality rates per 100,000 fulltime workers (left panel) and fatality counts (right panel) by major industries, 2017

Similarly, of the 130 deaths in mining, quarrying, oil & natural gas extraction in 2018, 13 were in oil & natural gas extraction and the vast majority of deaths—81—were in oil and gas drilling and support activities [33]

Fatality rates fluctuate. In 2017, the fatality rate in oil and natural gas extraction was 7.9 while for support activities which includes both mining and oil and natural gas, the fatality rate was 12.8. In 2018, the oil and natural gas fatality rate rose to 14.7 per 100,000 fulltime workers while the joint mining and oil and natural gas support services fatality [34]rate rose to 13.7.

These figures demonstrate that while the oil & natural gas industry is comparably a safe industry to work in based on risk of injury and illness, there can be rare but catastrophic events, making safety training and awareness of primary importance to the industry and its workers.[35]

Those going into these industries need to know the risks they are exposed to and how to mitigate them. Injury and fatality risks are not the sole product of inherent physical risks; they are, in a real and significant way, the product of awareness, training, and risk management. This raises two questions: how do workers get hurt in these industries, and who gets hurt?

Causes of Injuries

How Do Workers Get Hurt?

The BLS reports three main causes of workplace injuries. "Struck by" refers to workers who were either struck by an object or caught in or compressed by an object. "Falls" refer to slips and falls that can be subsequently broken down into falls to a lower level, falls at the same level, and slips that do not include a fall. "Transportation" includes accidents that occur on the road or at a worksite.

Getting hit (by something other than a vehicle) and falling are the major causes of workplace injuries. Figure *17* compares the rates of injuries by cause for selected industries and an all-industry average.[36]

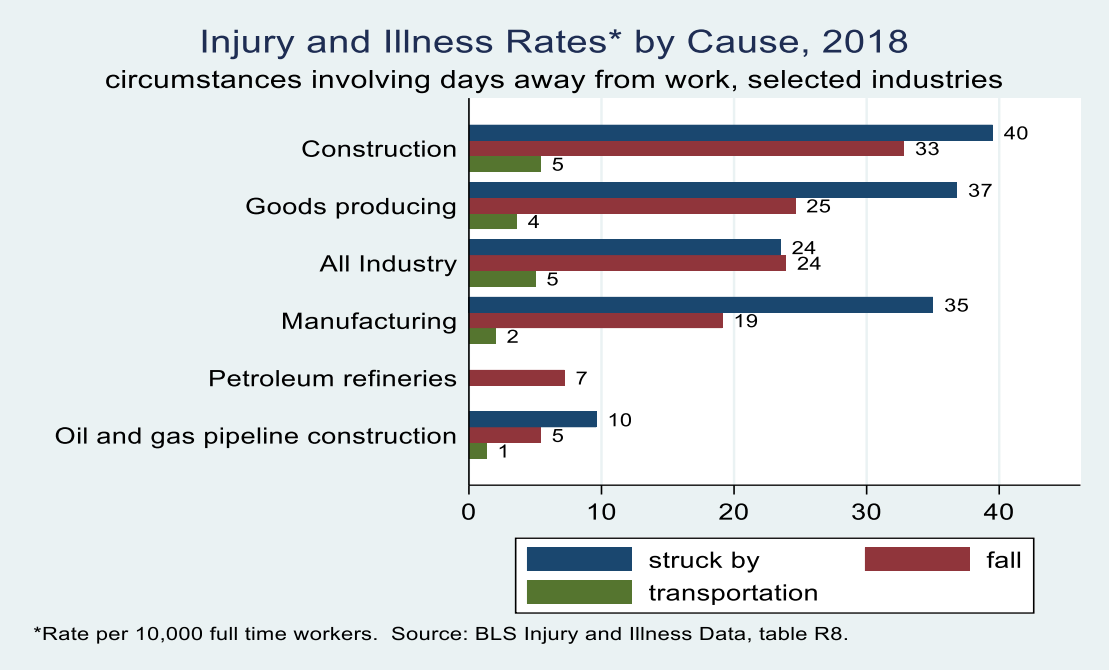


Figure 17: Serious illness and injury rates per 10,000 fulltime workers by major cause for selected industries, 2018

For all industries, the rate of injuries from falls and from being struck by an object are basically the same (24 per 10,000 fulltime workers). The rate of injuries from workplace-related transportation such as the travel or arrival of a cement truck is substantially lower (5 per 10,000).

While construction's transportation injury rate (5) is the same as the all-industry average, construction workers get struck by objects and fall more often than other workers. The construction fall rate (33) and struck by rate (40) rates are one-third and two-thirds higher than the overall economy.

The construction fall rate (33) is the highest of any in Figure *17*, and half-again higher than manufacturing (19). This reflects two factors. First, many construction workers work at heights while many manufacturing workers do not. Second, manufacturing facilities are finished structures set in place. Construction sites are works-in-progress. This means manufacturing has the advantage of perfecting the walkways, scaffolding and safety rails within its facilities. Construction is continually tearing down old scaffolding and building new ones and does not have the luxury of fixing and perfecting protections against falls that manufacturing may enjoy. Furthermore, because construction is done through constantly re-forming sets of subcontractors as each project begins, construction faces coordination problems among subcontractors that more permanent management systems do not face. In sum, the fact that construction is constantly taking on new projects, in new places, with new sets of contractors, where the infrastructure of the workplace has to be built and rebuilt, and workers must work at heights, creates higher risks of falling from heights at work. The turbulent physical and managerial setting of construction work must be offset by diligent safety training and management to mitigate the inherent risks of falling on construction sites.

Oil & natural gas pipeline construction has much lower rates of injuries and a notably lower risk of falls (5) compared to the overall economy (24) and construction (33). This reflects the fact that horizonal pipeline construction is not building structures but rather, laying pipe. There is much less working at heights in laying pipes, and there are fewer subcontractors on a pipelaying project compared to many commercial and industrial building projects. Thus, pipelaying has less physical and organizational risks related to falling.

Refinery work also has a low risk of falling (7) associated with direct employees engaged in normal refinery operations. Many injuries and fatalities that occur in refineries are recorded not as refinery work falls but as construction falls because the injured worker is working for a construction maintenance contractor during a refinery shutdown and not a direct employee of the refinery working under normal operations.[37] Shutdown work is more dangerous because more workers are working at height, the maintenance workers and their contractors are less familiar with the plant, and older equipment is being swapped out for newer machinery and parts.

The physical characteristics of work in construction and oil & natural gas play into the incidence of being struck by an object or slipping and falling, but the physical characteristics of work are only one contributing factor to the risks of injuries and fatalities. The second key factor is the social characteristics of work—safety culture, workplace management, the age, training and experience of workers, and the presence of unions—all of which contribute to how humans respond to the physical dangers of work. Those responses can raise or lower the rate of injuries and fatalities.

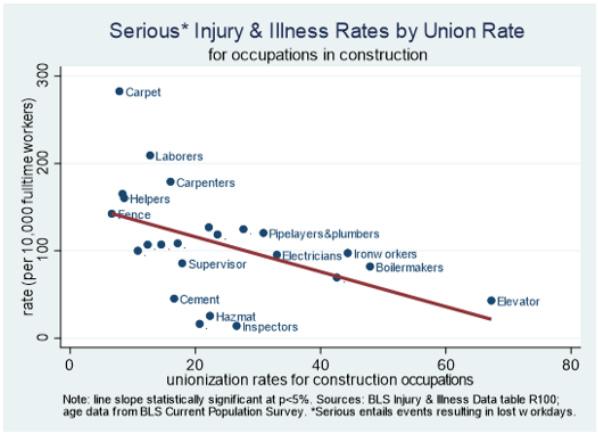
Who Gets Hurt?

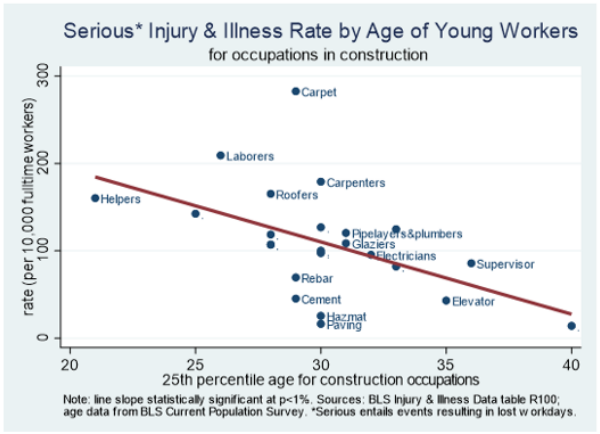
Construction accounts for roughly 5 percent of all jobs in the US economy. Consequently, in construction, we have the data to answer the question who gets hurt?[38] Those who get hurt in construction are disproportionately the young, the poorly paid, and those who do not have the protections and training that collective bargaining provides. There are three panels in Figure *18* that show this.[39]

Unions and Safety[40]

The upper left panel shows that as unionization rates rise across construction occupations, serious injury rates fall. Carpet layers, for instance, have the highest serious injury rates. There are few union workers among carpet layers. Elevator constructors, in contrast, are highly unionized, and their serious injury rate is low.

Both carpet laying and elevator construction have inherent injury risks associated with the physical characteristics of their work. Carpet layers install carpets working on floors, using knee kickers that stretch the carpets before tacking them into place. The Center for Disease Control warns that "serious knee injuries frequently result when carpet layers kneel on hard surfaces and use a knee kicker to install carpet." Carpet layers often report knee bursitis (fluid buildup that requires knee taps), skin infections





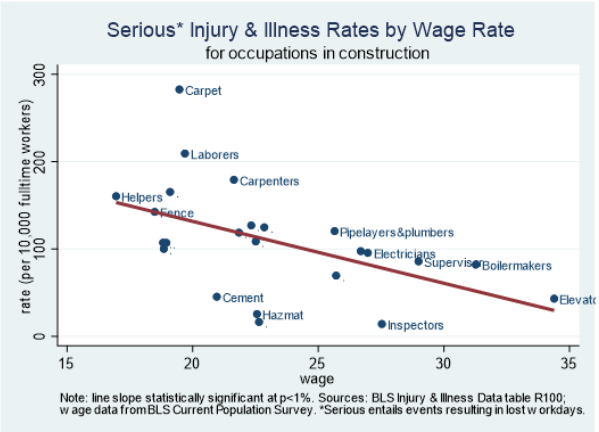


*Figure 18: Serious injury and illness rates by unionization, the age of the youngest 25 percent of workers and wage by occupation in construction, 2018 *"serious" entails events resulting in lost workdays (Solid lines are regression lines relating each horizontal axis variable (union, age, wage) to injury rates on the vertical axes)*

and a variety of infirmities resulting from frequent kneeling on hard surfaces. Carpet layers account for less than 0.06 percent of the US workforce but 6.2 percent of worker compensation claims.[41]

Elevator constructors work at heights, with moving elevator cars and equipment, hoisting and rigging elevators and their shafts. They use temporary electrical circuits and work in and around energized systems. This highly unionized workforce goes through a four-year apprenticeship that emphasizes safety. The major elevator manufacturers partner with the elevator constructors' union to continually improve workplace safety and safety training.[42] All elevator constructors are taught to adhere rigorously to a set of safety absolutes designed to reign in workplace hazards. In rigging, alone, safety protocols are developed to address load share, control and leveling, safely using hoists, inverting loads with cranes, two-crane lifts and all the calculations for determining the center of gravity.[43] Obviously, elevator construction is not inherently physically safer than carpet laying. If anything, it may be more dangerous. Yet, there is a substantially lower rate of serious injuries among elevator constructors compared to carpet layers (43 vs. 283).

Two reasons for this relative safety are 1) the training that comes from apprenticeship programs, and 2) the cooperation around safety management that comes from a labor-management safety partnership. Collective bargaining fosters both. Lacking collective bargaining and often employed by small contractors, carpet layers are deprived of union protections, economies of scale in designing safe workplace practices, and the buildup of work-safety cultures as a product of long-term bargaining between labor and management.

What is true in comparing carpet layers to elevator construction is more generally true across industry segments in construction. The regression line in the upper-left panel of Figure *18* statistically summarizes the observed relation between the rate of serious injuries and the prevalence of collective bargaining. The slope of this line is statistically significant indicating that as unionization rates rise across construction segments, injury rates fall. That fall is due to the benefits that worker protections, concerted safety planning and workplace safety cultures bring to construction projects.

Experience and Safety

In addition to workplace organization, age and experience also matter. There are more young carpet layers compared to elevator constructors. This is measured by calculating the age of the 25th percentile in each construction craft. The 25th percentile age is the age where 25 percent of workers in the construction craft are younger than this age. This measures the prevalence of a pool of workers who are potentially more vulnerable, less experienced and possibly more reckless than more mature workers. [44]

The upper right panel in Figure *18* shows the age of the 25th percentile of workers by construction occupation on the horizontal axis. For carpet layers, this is 29 years. This means that 25 percent of all carpet layers are younger than 29 years old. For elevator constructors, the 25th percentile is 35 years. More generally, the line in the upper-right panel shows that as the age of the 25th percentile rises from construction helpers in their early 20s to elevator constructors in their mid-30s, injury rates fall. With fewer younger, inexperienced workers, more mature workforces experience lower injury rates.

Wages and Safety

The lower-left panel in Figure *18* shows that lower-paid workers in construction get hurt more compared to higher-paid workers. Carpet layers along with laborers, fence erectors, helpers, and roofers all earn less than $20 per hour and all have serious injury rates above 140. Drywall installers, painters

and plasters have wages less than $20 and serious injury rates between 100 and 110. In contrast, boilermakers, inspectors, electricians, elevator erectors, supervisors, and ironworkers all are paid above $26 per hour and all have injury rates below 98.

The line in this lower-left panel of Figure *18* summarizes. As wages rise, injuries fall. Workers with higher wages have higher bargaining power and better labor market options. Lower-wage workers with fewer labor market opportunities may be willing to take on higher injury risks to get and hang onto jobs. The correlation between low wages and higher injuries across occupations is statistically significant in construction.

These factors of age, wage and union status go together and are not easily disentangled. Union workers tend to be older workers partly because unions foster craft pride and career attachment. This pride in one's craft helps workers stick to their occupation and build experience despite the ups and downs of the construction business cycle. Higher wages, whether in the union or nonunion sector of construction, also tend to attach workers leading to an older and more experienced workforce. Collective bargaining in construction promotes higher wages along with more training which, in itself, leads to a more attached, better paid and more safely trained labor force. Thus age, wage and unions join hands to make construction work safer.[45]

Comparable Occupations—Different Results

What is true of occupations in construction is also true of industry segments in construction. Age, wage and unions matter. Here we compare framing contractors to structural steel contractors. Both contractors build the skeletons of buildings—one with wood and the other with steel. Both work at heights. But framers are found in residential and light commercial work, while ironworkers are found in heavy commercial and industrial work. Residential work is less well-paid and less unionized. High iron work is better paid and more unionized.

The left panel in Figure 19 shows the total serious injury rate and rates by cause for framing and structural steel contractors. Framing contractors do structural framing and sheathing using materials other than steel or concrete—primarily wood. Framing contractors employ a subset of carpenters known as framers. Structural steel and precast concrete contractors frame buildings using steel beams and reinforce poured-in-place concrete using steel rods, bars, rebar, mesh and cages.[46] Structural steel contractors employ primarily ironworkers. Employees of both these types of contractors work at heights, but ironworkers work at greater heights than do framers. There is no reason to conclude that wood framing is inherently more dangerous than steel framing. Yet wood framers are hurt at a much higher rate than ironworkers.

The total injury rate for framing contractor employees is 302 while for the employees of structural steel contractors, the total injury rate is less than half that at 137. Framers fall at a rate three times higher than ironworkers (149 vs. 49.8) despite working closer to the ground. Framers are more than twice as likely to get struck by an object compared to ironworkers (115 vs. 45.4) despite ironworkers handling steel beams hoisted by heavy cranes at substantial heights. What accounts for this reversal where the seemingly safer activity—wood framing of typically one-and two-story buildings—is substantially more dangerous than the seemingly more perilous activity of steel framing at heights?

The right-hand panel in Figure 19 gives us the basic answer. Framers are a subset of carpenters. Because the Current Population Survey does not specifically identify framers, we use carpenters as a proxy. The

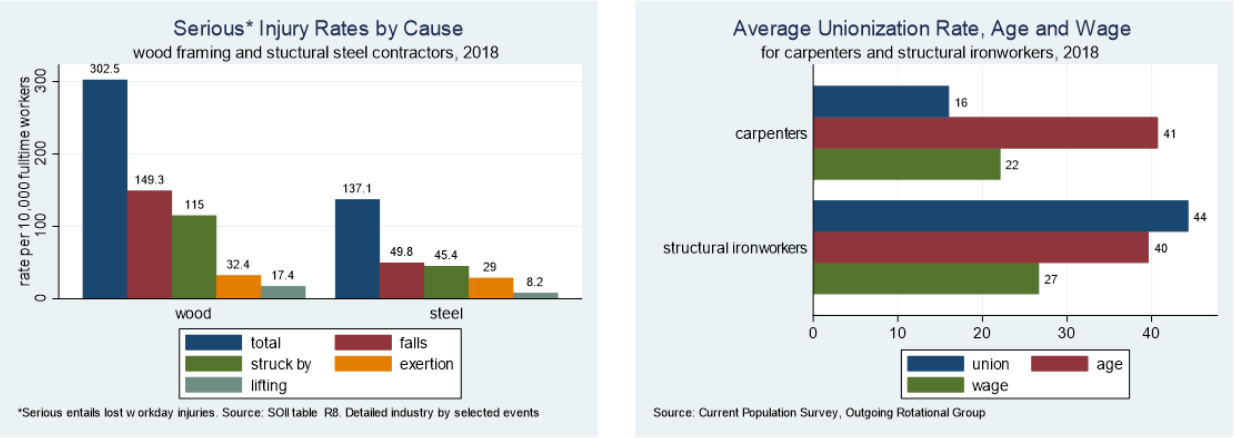


Figure 19: Serious injury rates by cause for wood and steel framing contractors (left panel) and unionization, age and wage for carpenters and ironworkers (right panel), 2018[47]

average ages of carpenters and ironworkers are almost the same (41 for carpenters vs. 40 for ironworkers) so we cannot attribute the greater accidents among framing contractor employees to youth.[48] The difference between carpenters and ironworkers lies in unionization and wages. While just 16 percent of carpenters are unionized, 44 percent of ironworkers are unionized. This means that compared to carpenters, more ironworkers have gone through apprenticeship programs, received extensive safety training and are protected from dangerous activities by union-management agreements and arrangements.

Because few framing contractors are signatory to collectively bargained agreements, in general, they do not benefit from the safety regimes that emerge from collective bargaining. Safety is often a tradeoff against speed or cost.

Figure 19 also shows that ironworkers are paid better than carpenters ($27 vs. $22 per hour). Lower-wage workers are under greater economic pressures to do what the supervisor says without question. They also may be willing to take greater risks in order to bring home a paycheck. The lower wages associated with higher injuries for carpenters in Figure 19 is consistent with the pattern of lower wages tied to higher injury rates in construction shown in the lower-left panel of Figure *18* above. Framers are not doing inherently more dangerous work than ironworkers, and framers are not significantly younger than ironworkers, but the arrangements and remuneration of their work have made their jobs more dangerous.

Size Matters[49]

The left panel in Figure *20* shows by establishment size, the total injury rates for four broad sectors of the economy—all-private-production, goods production, manufacturing and construction. In all four cases, injury rates rise with the employment size of establishments up to a point. Subsequent to that point, injury rates fall as establishment sizes get even larger.

The switching relationship between employment-size and injury-risk reflects both the inherent dangers of work and economies of scale in managing those risks. For small firms taking on projects limited by their size, injury rates are low because often the physical risks of these smaller projects are low. As firms get larger, they take on bigger projects. Injury rates rise with the challenges and complexities of those

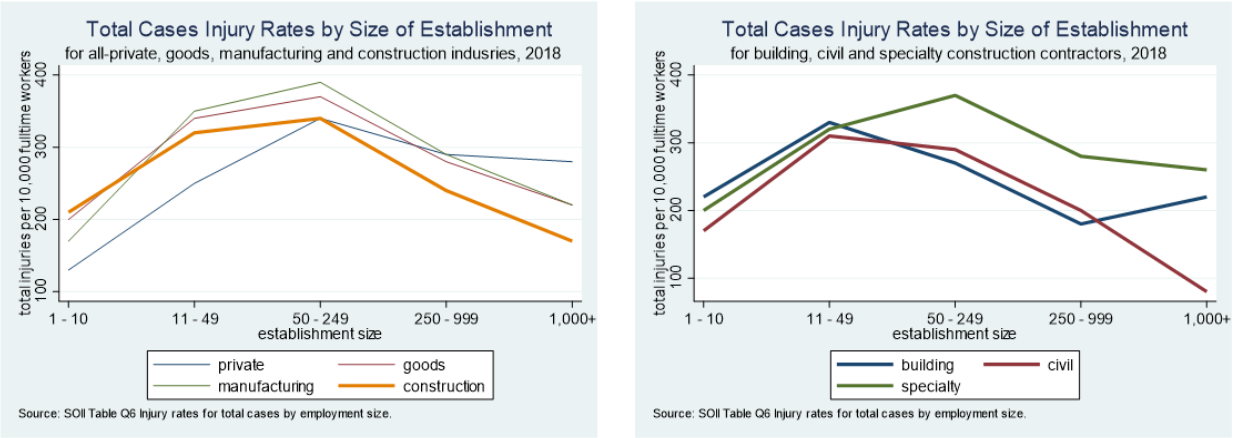


Figure 20: Total injury rates for major industrial sectors (left panel) and major construction sectors (right panel) by establishment employment size, 2018

larger projects. But as establishment employment size rises further, injury rates peak. This peak is in the 50-to-249-employees range. After 250 employees, injury rates fall. Why?

Injuries are a function of inherent dangers and the ability to manage those dangers. Larger establishments can afford to have a dedicated safety manager. Larger establishments may be more stable allowing for the development of a company safety culture. Larger establishments may be able to afford rigorous safety training. Larger establishments may be more unionized. There are a host of potential explanations, but they all entail social factors—safety management, training, unions, culture—that offset the inherent physical dimensions of injury risks.

The right panel in Figure *20* shows that the pattern for overall construction is replicated for the major segments of construction—building, civil and specialty construction. However, for civil and building contractors, injury risks peak at a lower establishment size of from 11 to 49 employees. Not only do building and civil contractor injury risks peak sooner, but they also fall off faster compared to specialty contractors. This reflects the distinctive role of subcontracting in construction.

Specialty contractors typically receive their work as subcontractors to general contractors. Building and civil contractors typically receive their work from the owners of projects. On projects where there is a prime general contractor, that general contractor determines what its scope of work will be. The general then determines how much of the project will be offloaded to others through subcontracting. In subcontracting out to specialty contractors, generals may choose to offload more risky aspects of the project. When that happens, specialty contractors have inherently more dangerous work to handle. Also, when generals decide not to self-perform work, the web of subcontracting they devise can create coordination problems between subs in managing the overall safety of the project. Whether subs get more dangerous work or whether subcontracting makes work more dangerous, in either case, Figure *20* shows that only the very largest subcontractors are able to lower risks as they get larger.[50]

Conclusions About Safety

Injury risks are not evenly distributed: Falls are the biggest risk in construction relative to other parts of the economy. Younger, less-well-paid, less unionized workers, especially in the residential sector of construction, are at greater risk of getting hurt.

This exposure to injury risks is not just a result of differences in the physical aspects of work. Indeed, in some cases, injury rates are higher in inherently safer work such as wood framing in residential housing compared to steel framing of commercial and industrial buildings. Construction injury risks are the joint product of physical and social factors. Working in the oil & natural gas industry is quite safe, though, like construction, it can be punctuated by catastrophic events that cause fatalities. Good jobs in these industries are safer jobs because the joint factors of lower inherent risk and better management of those risks.

Section 1 showed that jobs in construction and oil & natural gas are well-paid work for high school graduates. This section shows that measures of serious injuries in oil & natural gas are low, while workplace dangers plague construction. This plague of injury risks concentrates in the less-well paid segments of construction—residential and nonunionized construction. Construction need not be exceedingly dangerous. Unionized ironworkers are safer than nonunionized framers. Construction workers laying oil & natural gas pipelines share the relatively safe profile of the oil & natural gas industry. In short, well-paying construction jobs can also be relatively safe work—in fact, they are. A unionized elevator constructor or pipeline worker can expect to be well-paid, have family friendly benefits and safely go home at night to their family.

The concerning finding about construction work is that injuries devolve onto the less well paid, the younger, the less organized and the less protected workers in the industry. A job cannot be “good work” if it puts workers heedlessly in harm’s way.[51]

Section 3: Employment Security[52]

Upstream oil & natural gas extraction and construction are both among the most turbulent industries in the economy.[53] Figure *21* shows that employment in both industries varies considerably over time. This turbulence differs between construction and oil & natural gas.[54] In oil & natural gas, domestic employment responds to international energy prices as well as domestic discoveries.[55] In construction, employment volatility is tied to the business cycle with both jobs and wages booming and busting as the economy expands or goes into recession. This employment and wage pattern require construction workers to follow the old adage—make hay while the sun shines.

Turbulent Employment

Over the long-run, construction employment grows with the economy. In the short-run construction booms and busts with the business cycle. Because buildings are the most durable of consumer and investment goods, when the economy begins to tank, would-be owners of new buildings put off their purchases until the economic future improves. Thus, when the economy slumps, construction employment falls off dramatically. When the economy begins to recover, construction often still lags simply because buildings are expensive, and owners tend to hold off until it is clear the economy is on the mend. At some point in the recovery, confidence returns, and companies and families make up for lost time by hurriedly jumping into the next building boom. Thus, the amplitude of the construction business cycle is an exaggerated version of the overall business cycle.

Figure *21* shows that with each recession, construction turns down. Sometimes the downturn can be precipitous such as during the 1973 oil crisis. Sometimes the downturn can be relatively mild such as

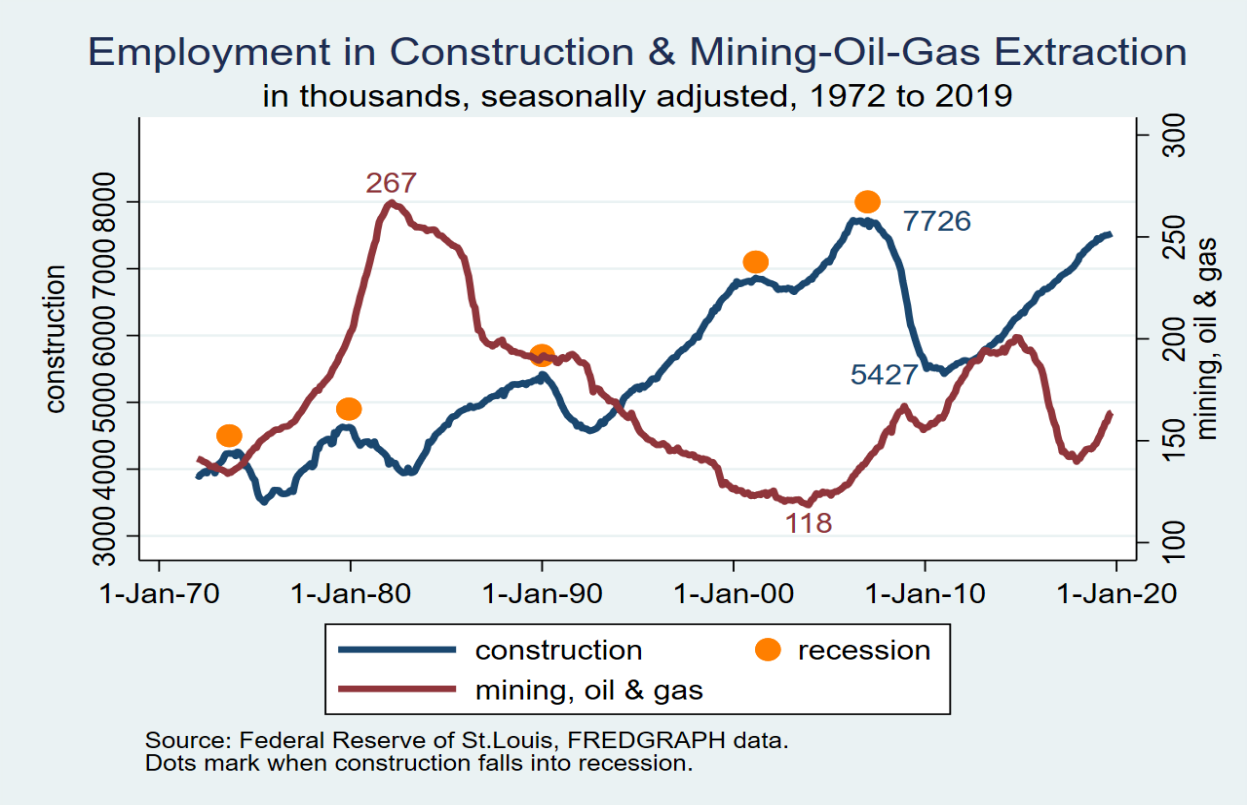


Figure 21: Employment in mining/upstream oil&gas extraction and construction, 1972 to 2019 (in thousands). Economy-wide beginning of recessions indicated by dots

after the dot-com crisis of 2000 when the Federal Reserve eased interest rates stimulating the residential construction market and dampening the construction downturn. In recent history, no construction downturn was worse than during the Great Recession of 2008. Construction led the way into the Great Recession with the subprime mortgage crisis. From peak to valley, construction employment fell from 7.7 million to 5.4 million—a loss of 30 percent of all construction jobs. In some parts of the country such as Las Vegas, more than two-thirds of all construction jobs were lost between June 2006 and February 2012.[56] Even by 2019, construction employment had not recovered to the 2006 level. It can be a daunting challenge to carve out a career in an industry that holds out the potential of losing one-fourth to one-third of all its jobs when the economy goes into a deep recession. As Figure *21* shows, this has happened more than once over the lifetime of a construction worker who began as a 20-year-old in 1970 and retired at 65 in 2015.

Turbulence in the mining/oil & natural gas industry is similar in magnitude but much different in pattern. First, the mining/oil & natural gas industry is not nearly as sensitive to the overall US business cycle as is construction. For instance, during the oil crisis of 1973 when OPEC countries raised crude oil prices dramatically, employment in domestic oil & natural gas extraction boomed. That boom rammed its way not only through the downturn of 1973, but also through the double-dip recession of 1979 to 1982. But in the early 1980s, employment in the mining/oil & natural gas industry began a long-term decline independent of the recessions of 1990 and 2000. Over a 20-year period employment in mining/oil & natural gas fell by over half.

While the amplitude of the employment cycle in oil & natural gas is as wide as in construction, the oil & natural gas cycle is not tied as directly to the overall business cycle. Nonetheless, like construction, it can also be challenging to carve out a lifelong career in blue-collar mining/oil & natural gas. Like the construction industry, those who do make careers out of oil & natural gas work find ways to persevere through long stretches of limited employment.

To drive this point home, let us look at overall employment in the US economy compared to construction and oil & natural gas. Figure *22* benchmarks employment against peak employment at the outset of the Great Recession. We compare the total nonfarm labor market to total construction and total mining/oil and natural gas. Employment data for mining/oil & natural gas, construction and overall nonfarm employment are expressed as percentages of the peak employment for each sector. Construction peaks in 2006. Total nonfarm employment peaks in late 2007. Mining/oil & natural gas peaks in 2009. The dashed line in Figure *22* marks the peak level of employment and is set at 100 percent.

As the recession kicks in, employment in each sector falls below its previous peak employment. At bottom, both the overall nonfarm labor market and mining/oil & natural gas lost a bit less than 10 percent of all jobs in those sectors.[57] In contrast, construction lost 40 percent of all its jobs at the bottom of its downturn. Of this 40 percent loss, 30 points of the loss are due to the recession and another 10 points are due to the normal seasonal downturn. Construction workers not only have to contend with the booms and busts of the economy, they also must weather the peaks and valleys of seasonal demand for their services.

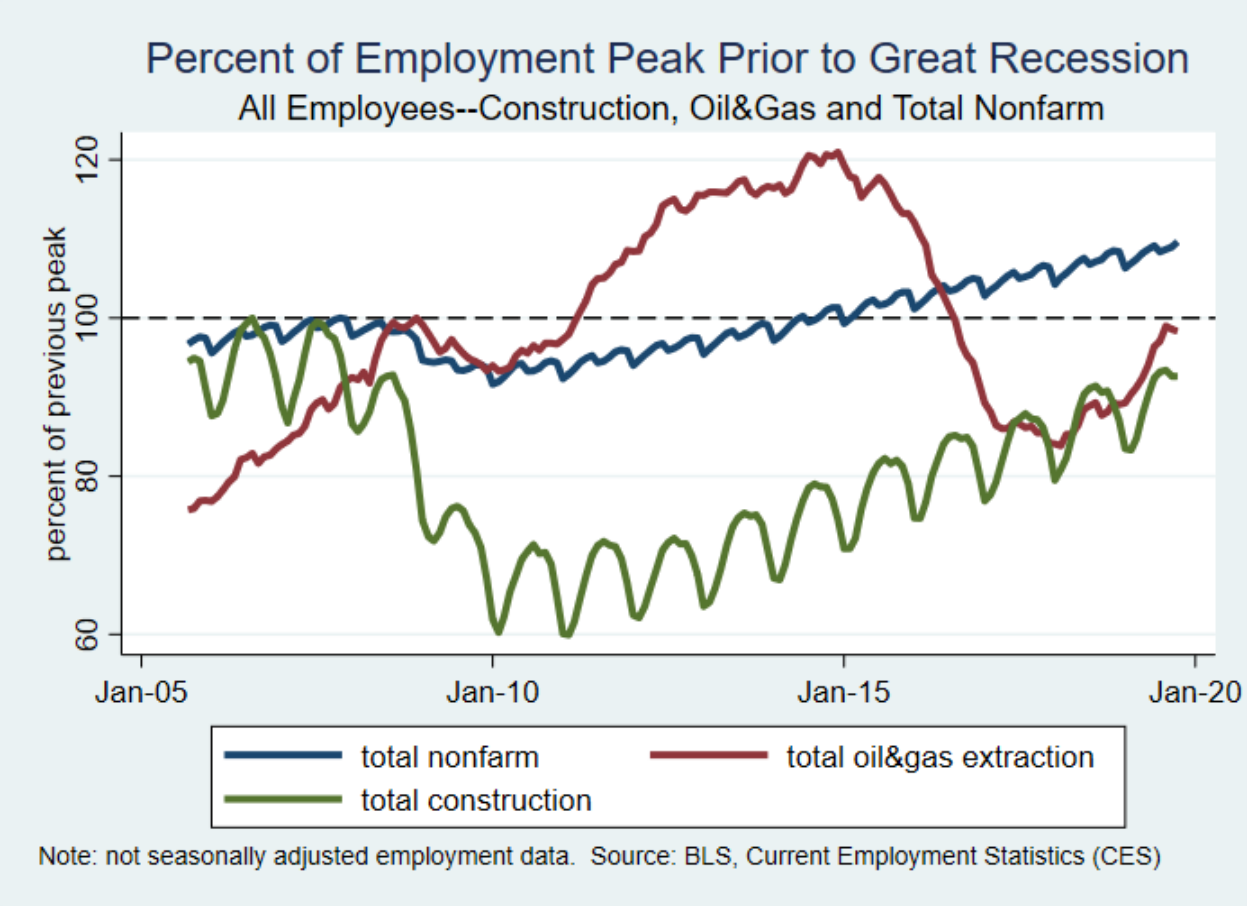


Figure 22: Employment through the Great Recession, construction, mining/oil&gas and total nonfarm employment (Dashed line marks employment at the peak prior to the Great Recession)

Construction: Turbulent Wages

Using peak employment prior to the Great Recession as a benchmark, Figure *23* traces construction wages and employment through the downturn and recovery, 2006 to 2019. Wages are the inflation-adjusted, average hourly wage rate for blue-collar workers in construction.

As the recession hits and employment falls, average wages rise. This is counterintuitive but not surprising. The hardest hit segment of construction was residential work. Residential work is the lowest paying segment of construction. When residential workers disproportionately lose their jobs, average construction wages rise. Also, when downturns hit in construction, younger workers are the first to leave the industry. When younger workers leave first, average wages rise. So, average wages rose as lower-wage construction workers were first to leave.

But within a year, as employment continued to fall, average wages stabilized and then fell. Even as the fall-off in employment hit bottom and began to slowly crawl back in 2011, average wages nonetheless continued to fall. The reason they continued to fall was because all those layoffs created a labor surplus in construction that put continued downward pressure on wages. That downward pressure increased even as employment began to recover as some out-of-work, former construction workers re-entered the construction labor market looking for the now (slowly) growing number of jobs.

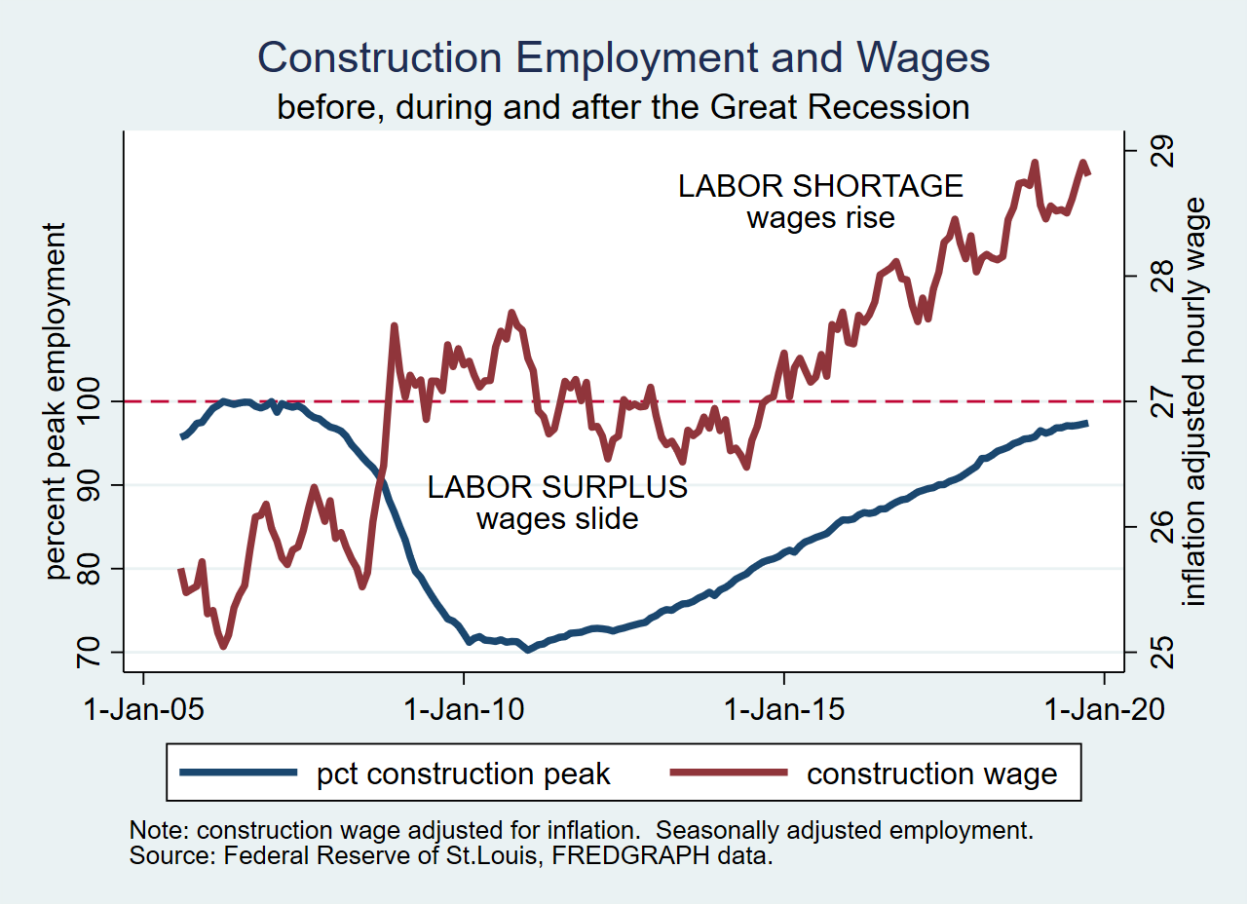


Figure 23: Employment and wages for construction workers through the Great Recession (Dashed line marks employment at the peak prior to the Great Recession)

In the middle of 2014, the balance of demand and supply for construction workers shifted. Construction demand and employment continued to grow, but the labor surpluses of the previous 5 years dried up. Labor shortages, particularly among the skilled trades, emerged. While former construction workers continued to re-enter the field, they did not do so fast enough to meet growing demand. Now real, inflation-adjusted wages started to rise. This tightening of the construction labor market occurred well before construction employment had re-attained its pre-recession level.

This contextualizes a common saying among career construction workers—"make hay while the sun shines." Having gone through multiple downturns, experienced construction workers know that there will be bad times where jobs are scarce, and wages are stagnant. But there will also be good times where jobs are plentiful and wages increasing. Workers make a career out of construction by recognizing the volatility of the industry and planning family finances accordingly. This can be achieved several ways, including through savings, or a second wage earner with steadier if often less well-paying employment.

Oil & Natural Gas: Follow the Action

The challenge for oil & natural gas workers is different. Construction work is everywhere. There is no Motor City or Silicon Valley in construction. But the Permian Basin and Eagle Ford Shale fields in Texas, the Bakken field in North Dakota, Prudhoe Bay in Alaska, the Wattenberg Gas field in Colorado and the

Sunset Oil Field in California are among the top oil fields in the US.[58] In oil & natural gas extraction and pipeline construction, you must go where the jobs are, when the jobs are.[59]

Localized Jobs

The left panel in Figure *24* shows that the oil & natural gas extraction jobs are not everywhere nor just anywhere. For example, oil & natural gas rotary drill operators are concentrated in a limited number of states. The Bureau of Labor Statistics calculates a "location quotient" to measure the relative importance of a specific occupation in a state's labor market. If a job is relatively more important in a local area compared to the US, the location quotient is above one. This means that relative to the overall US labor market, the job is over-represented in the local area. If the location quotient is less than one, that means that the job is under-represented. If the location quotient is equal to one, then the relative importance of the job in the local market mirrors exactly the relative importance of that job in the national labor market. On the map in Figure *24*, darker shades indicate that oil & natural gas rotary drill operators are over-represented in a state's labor market compared to the US labor market. Lighter shades indicate that drill operators are under-represented.[60] White means that there are few if any oil & natural gas rotary drill operators in that state. To be a rotary drill operator, you must go where the jobs are.

Boomtime Wages

Rotary drill operators are a typical upstream oil & natural gas occupation. Rotary drill operations are concentrated in Pennsylvania, West Virginia and in a belt of states running north from Louisiana and Texas up to North Dakota. (Figure *24* left panel) In 2017, to be a better-paid rotary drill operator, you had to go to these places. Wages were best in the states where rotary drill operators were the most over-represented.

In the right panel of Figure *24*, a scatter of points relates the over-representation or under-representation of rotary drill operators to wages paid. The dashed line in Figure *24* marks the boundary between over-representation to the right and under-representation to the left. Where rotary drill operators were under-represented or just barely mirrored national patterns, drill operators were paid less. In the action states, where rotary drill operators were an over-represented part of the state labor force, workers were paid more.

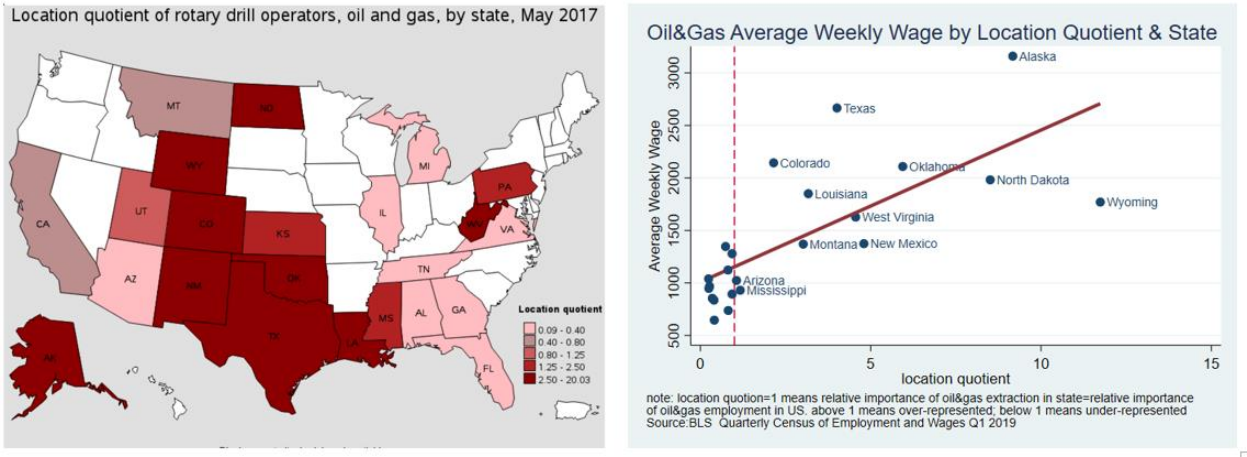


Figure 24: Location quotient and wages for rotary drill operators in the oil and gas extraction [61] (Dashed line in the right panel marks the boundary between under-representation and over-representation of rotary drill operators in a local area).

The trend line in the right panel of Figure 24 shows that in general, rotary drill operators were paid three times more in weekly wages in the most active areas compared to older fields. This is probably due to both higher hourly wage rates and also more abundant overtime. To follow the money, drill operators had to follow the action.[62] In construction, turbulent labor markets require workers to ride out the downturns and surf the booms. In oil & natural gas extraction it is best to be where the action is.

Unemployment

Workers riding out the booms and busts of the seasonal and business cycles in construction endure much higher levels of unemployment compared to similar high school graduates going where the action is in upstream oil & natural gas extraction or downstream oil refinery work. Figure 25 shows that the average monthly unemployment rate for high school graduates in the overall US labor market from 2003 to 2018 was 7.6 percent. In contrast, high school graduates in the construction industry, on average over these 15 years, experienced a 12.9 percent monthly unemployment rate. Midstream oil & natural gas pipeline construction had a similar unemployment rate to the overall construction unemployment rate—10.5 percent.

In contrast, refinery work—which is stable work rooted in place and not moving around—had an unemployment rate of 6.6 percent, one full percentage point below the national average for all high school graduates. Thus, the unemployment rate for construction work, in general, was almost twice that of refinery work, and those building oil & natural gas pipelines had an unemployment rate that was more than 50% higher than the high school workers in refineries.

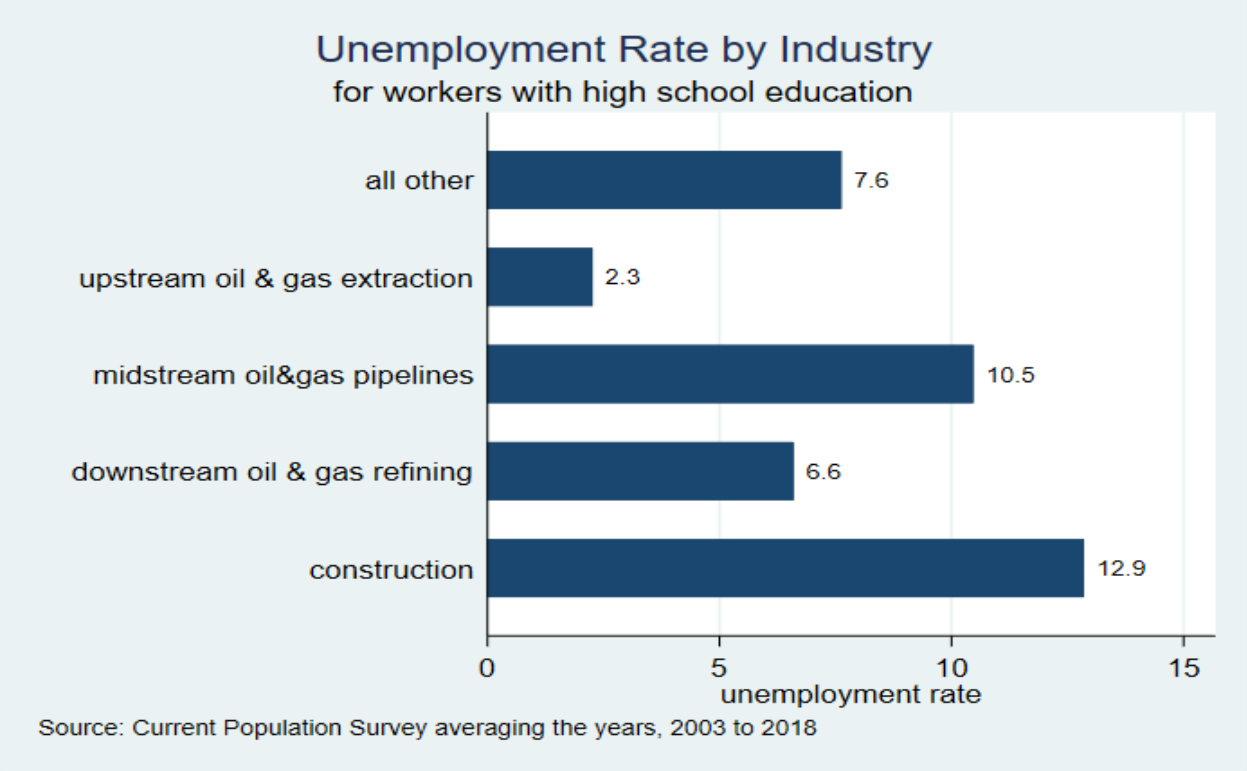


Figure 25: Average unemployment rate for high-school graduates in upstream, midstream and downstream oil&gas and construction, 2003 to 2018

High school workers in oil & natural gas fields—roustabouts, drillers and derrick operators—experienced, on average, an unemployment rate of just 2.3 percent over a 15-year period that included the Great Recession. Why was the unemployment rate for these oil field workers one-third the national average and one-fifth the average for construction workers?

Upstream oil & natural gas work marches to its own drummer. The Great Recession was a minor influence on the waxing and waning of upstream oil & natural gas work. International prices for oil and the opening or expansion of oil and gas fields drive employment. Between 2003 and 2015 employment in upstream oil & natural gas was expanding rapidly with only a minor and delayed dip in the later stages of the Great Recession. (Figure *21* above) When employment is expanding so rapidly, unemployment rates will be low.

But there is a related reason associated with going where the action is. In "Boom Times and Fresh Starts," *New York Times* reporter Clifford Kraus tells the story of one hot shot truck driver who, deep in consumer debt and with his marriage failing, moved with his daughter to the Permian Basin in 2017 to get a new start. While the Permian Basin was once a major source of oil, by 2005, production had sharply declined, and people had left. Fracking technologies rejuvenated well drilling, and now the Permian Basin accounts for one-third of all crude oil extracted in the US. "I have to make money, and this is the best way I can make money," the hot shot truck driver told the *New York Times*. Having worked as a barber and a hot tub installer, this trucker can now earn $1,500 per week. He eventually hopes to qualify as a heavy haul truck driver and potentially earn $4,000 per week. "If you're not educated and have a good work ethic, you can come out here and still make six figures," he said.[63]

This truck driver is not unemployed because 1) he went to where there was plenty of work, 2) his family economic and educational background and perhaps his personality compelled him to work hard and long, 3) if the work did play out, he would probably leave the area following the action elsewhere, or leave the area and the industry. In either case, he would not be counted as unemployed in upstream oil & natural gas. In trying to carve out a career in turbulent upstream oil & natural gas work, the volatility of work is not absorbed by unemployment. It is absorbed by pulling up stakes and going where the action is.[64]

Construction Separations—a Different Kind of Unemployment

In construction, workers absorb the turbulence of volatile demand through unemployment. But that unemployment is different than the unemployment experienced in most of the labor market. The high unemployment rates in construction shown in Figure *25* are related to total separation rates shown in Figure 26.

Total separations measure when workers and employers part ways. Workers can quit. They can be laid-off. They can be fired. They can retire. The ways in which workers and employers leave each other varies across industries. Not surprisingly, given the high unemployment rate for construction, construction has a high separation rate. When a worker and employer part ways, if the worker wants to keep on working, almost always there is a spell of unemployment while the worker seeks a new job. We explore this through a set of box-and-whiskers graphs comparing construction to other industries.

Parting Ways

Figure 26 is a "box and whiskers" graph.[65] This graph describes a distribution of monthly separation rates for construction, mining/oil & natural gas extraction and other industries. The rectangle is the

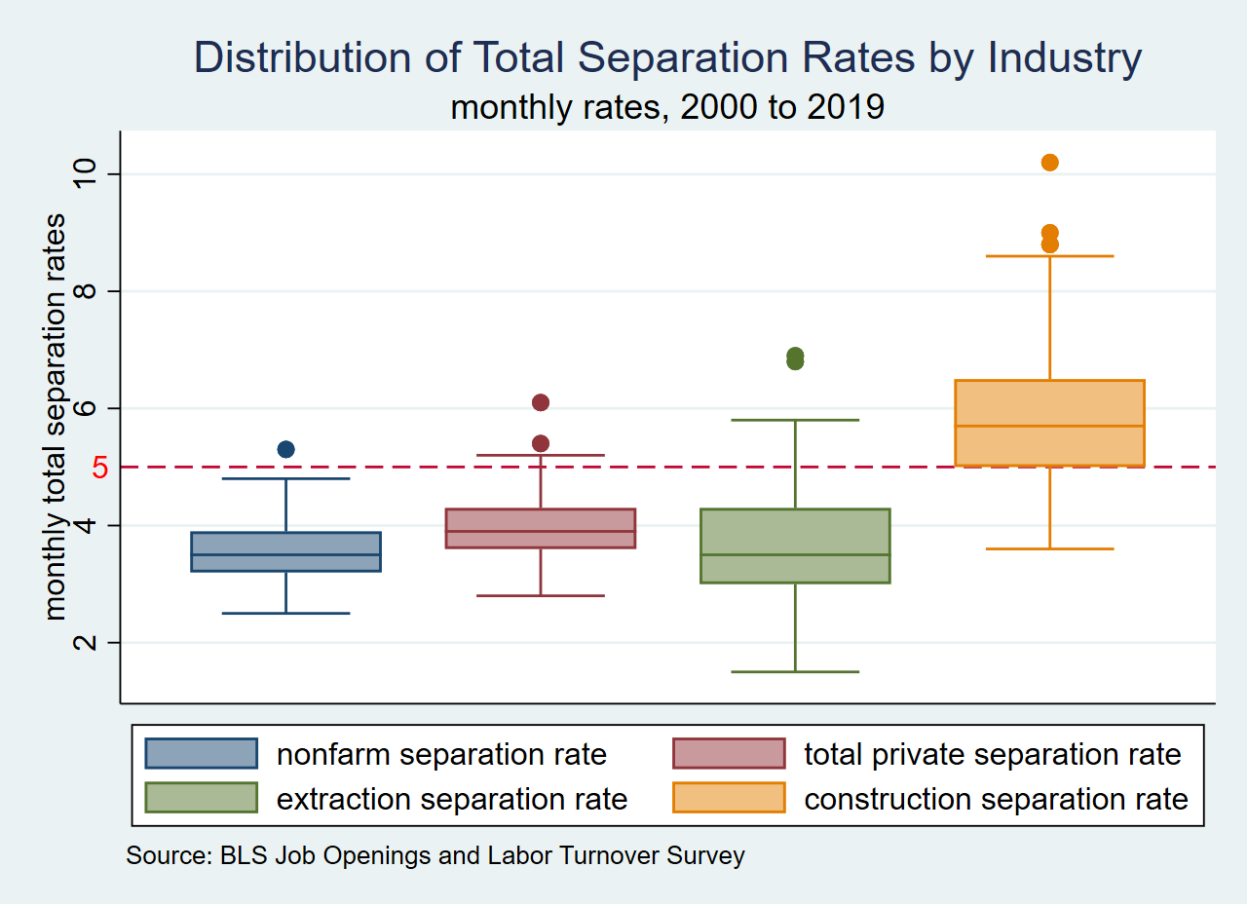


Figure 26: Distribution of monthly total separation rates (quits, discharges, layoffs etc.) for the overall labor market, mining-oil&gas extraction and construction, 2000 to 2019 (Dashed line shows that 75 percent of the monthly separation rates in construction are higher than almost all of the separation rates in extraction or the overall labor market.)

"box" and it contains half of all the observations in a distribution. The "whiskers" outside the box capture the 25 percent of observations that are above those in the box, and the 25 percent of observations that are below the box. So, half in the box, one-quarter above the box, and one quarter below the box. This picture quickly identifies distributions of monthly separation rates that are spread out or concentrated as well as overall relatively high or low. We can quickly see in Figure 26 which industry has the highest and most spread out distribution of rates of separation between workers and employers. Comparing the lines in the boxes to each other helps us compare industries. The line in each box identifies the median observation of that distribution. Half of all observations are above the median and half are below the median.

There are also a few dots that are either above the whiskers or below the whiskers. These are outlier observations at the far end of the tails of a distribution. Outliers are not common, but high outliers indicate some really bad months where numerous workers and employers had to part ways.

Figure 26 shows the monthly total separation rates from 2000 to 2019 for the overall US labor market, mining/oil & natural gas extraction and construction. The median construction total separation rate is almost 6. For the overall labor market and the extraction industry, the median is below 4. Indeed, 75 percent of monthly separation rates for construction are above 5 while almost all monthly separation

rates in the overall labor market and in mining/oil & natural gas extraction are below 5. This is shown by the dashed in in the figure.

This means that workers and employers part ways in construction to a much greater extent than elsewhere. When workers leave a job for whatever reason, if they want another job they are likely to go through a spell of unemployment. That is why construction has a higher unemployment rate than other industries. But why are construction workers leaving their employers in droves?

It is not because construction workers quit their jobs any more than other workers. The median quit rate in construction is just around the median for the overall labor market.

The left panel in Figure *27* shows that layoffs and discharges are much higher in construction than in the overall market or in the extraction industries. When a construction project ends, blue-collar construction workers are laid-off or discharged. Layoffs imply that the contractor will call them back when that contractor wins another job. This sometimes happens in construction. But because the prospects of winning a new project are uncertain, often the worker is discharged and free to look elsewhere rather than wait for a call-back. In either case, for three-fourths of the months between 2000 and 2018, the layoff-discharge rate in construction was above 2.7 while in the overall labor market it was virtually always below 2.7. In the extraction industries roughly 95 percent of the time the discharge rate was below 2.7. In construction, workers are cut loose with the waning of projects.

However, construction workers are brought onto new projects, often with new contractors, at a much higher rate than elsewhere in the labor market. The right panel in Figure *27* shows that over the 19 years between 2000 through 2018, 75 percent of the monthly hire rates in construction were above 4.8. New hires in construction were absorbing both quits and discharges. The median quit rate was 2. The median discharge rate was 3.3 and the median hire rate was 5.7. So those who quit or were discharged (2+3.3=5.3) were reabsorbed through hiring (5.7). The excess in hires (5.7 hire rate>5.3 quit + discharge rate) reflects growth in the size of construction. But was this reabsorption of unemployed construction workers quick or delayed?

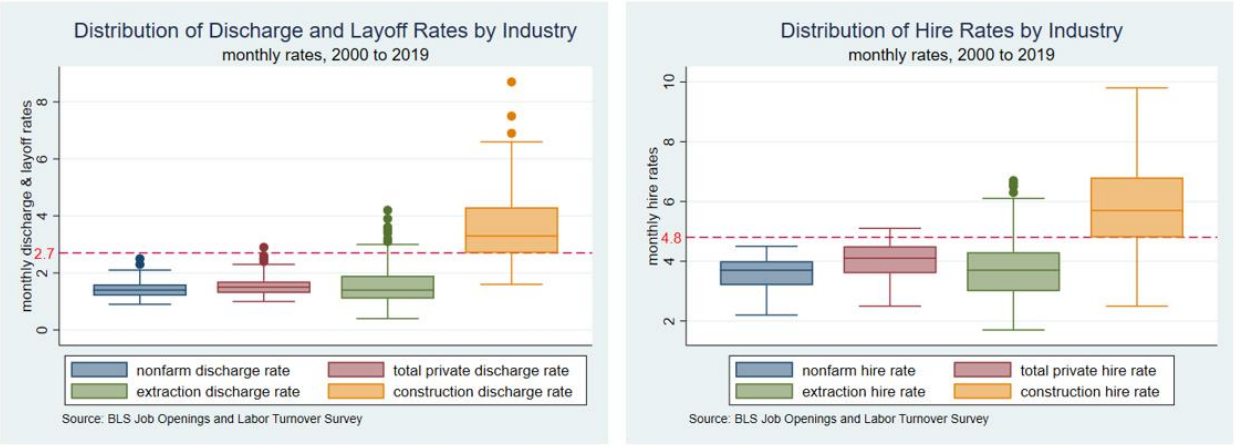


Figure 27: Distribution of monthly discharge and hire rates for the overall labor market, mining-oil&gas extraction and construction, 2000 to 2019

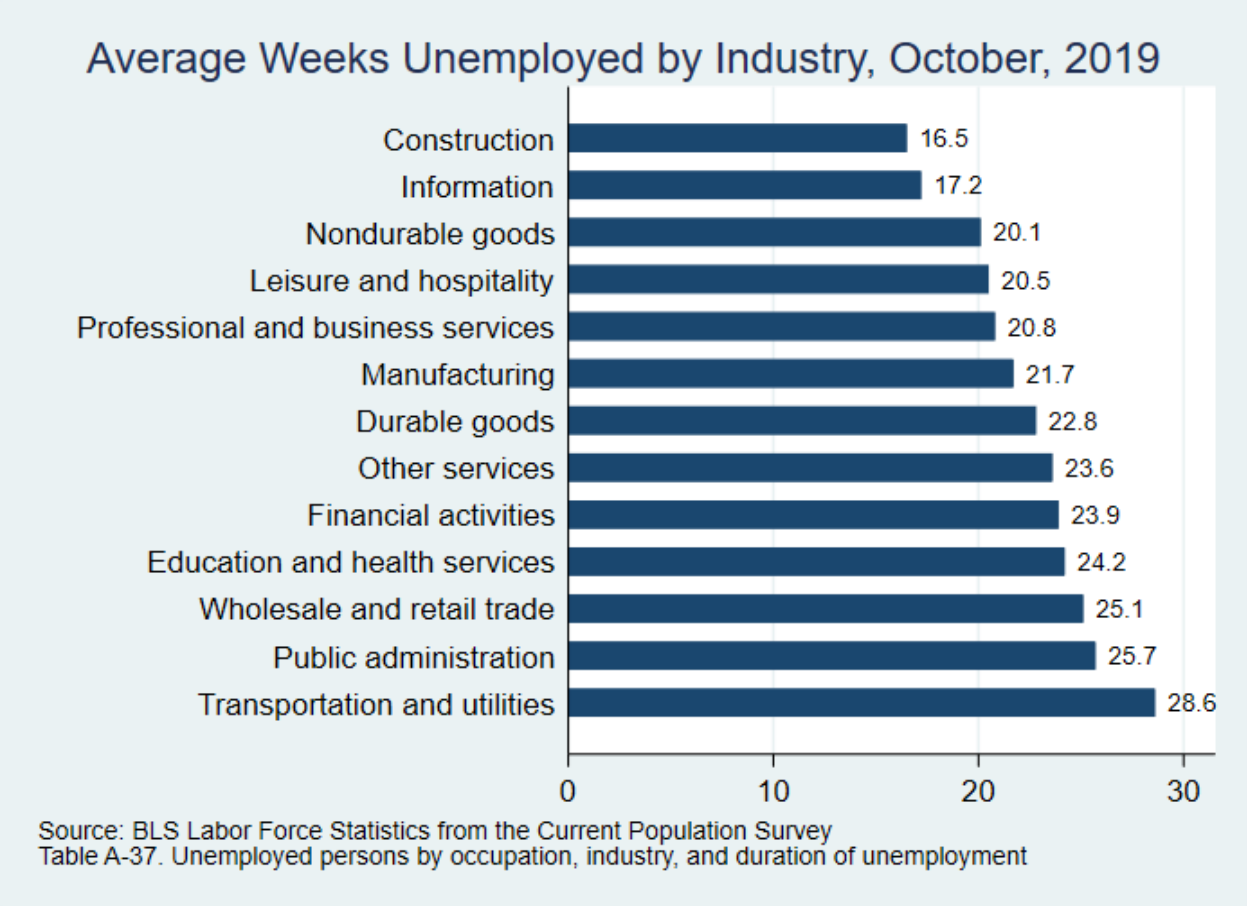


Figure 28: Average weeks unemployed by industry, October 2019

Here there is both good news and bad news for construction workers. Unemployment rates (Figure *25*) show that construction workers are more commonly unemployed. But Figure *28* shows that among the unemployed, construction workers make it back to work quicker than in other industries. Indeed, an unemployed utility worker can expect to be out-of-work twice as long as a construction worker. Construction workers navigate frequent but relatively short periods of unemployment. Some handle this challenge better than others. This is reflected in the fact that while the average weeks unemployed for a construction worker in October 2019 was 16.5, the median weeks unemployed was 8. That means that half the unemployed construction workers were finding work in less than 8 weeks while some were having a tough time pulling out the average to more than twice the median. Some workers are better at making hay while the sun shines than others.

Conclusions About Job Security

It can be daunting to build a career out of a turbulent industry, whatever the cause of that turbulence, yet millions of people do it.

In oil & natural gas extraction, workers must be willing to move; if they are willing to go where the action is, they can expect better wages and low unemployment. In refinery work, the work is steady. Job security is a matter of doing your job. If workers do their job well they can expect to have a career in one refinery, in one location that typically is not remote.

In construction, workers must plan for rainy days, down seasons and down years. Though unemployment is common in construction, the silver lining is that spells of unemployment are uncommonly short. Hopping between projects and switching contractors ARE a way of life. Seasonal unemployment is also a way of life. That is why construction workers not only have to make hay when the sun shines, but they also must put some of that hay in the barn for winter.

Section 4: Opportunities

Those limited to a high school education often must start at the bottom of the labor market. But in some jobs the constraint of a high school education does not keep workers at the bottom. The accumulation of work experience, classroom, online and on-the-job training lifts workers.

Upward Earnings in Oil & Natural Gas

In upstream oil & natural gas, accumulating work experience is the first step needed to move up the ladder. To advance to a crew-leader, foreman or supervisor position, formal training in well drilling, operations and safety are also important. There are many short (3-to-10-day) face-to-face and online courses available from privately operated drilling schools that help drillers and derrick operators refine their drilling, well control, well servicing and safety skills.[66]

Safety training complements work efficiency. Injuries and fatalities are tragedies in themselves, but they are also markers of inadequate and inefficient work practices. Both the Occupational Safety and Health Administration and industry organizations such as the National Fire Protection Association, the Steel Tank Institute and the American Petroleum Institute interact with OSHA in developing sound and safe workplace practices. The American Petroleum Institute (API) is an accredited Standards Developing Organization that meets the due process requirements of the American National Standards Institute (ANSI).[67] API maintains more than 700 standards and recommended practices that form the basis for skills and safety curricula.[68]

These safety skills can be learned both online and in formal classroom settings.[69] Workers with high school degrees who combine short-course formal training with work experience after high school have plentiful opportunities to advance in oil & natural gas upstream work.

Figure *29* shows that as workers with a high school education in the oil & natural gas industry gain experience from about age 20 to age 40, their hourly wages rise from about $15 per hour to about $30. This doubling of their wage in real, inflation-adjusted terms, reflects the value of their work experience and the short courses many of them have taken to more safely and effectively work on and around wells. Indeed, the upward trajectory for high school graduates in oil & natural gas rises faster over ages 20 to 40 than for either construction or all other industries.

With a starting high school graduate's wage comparable to starting wages in construction, oil & natural gas workers end up earning 20 percent more per hour than construction workers by the time they are 40 and one-third more than high school graduates in the overall labor market. This is partly due to more abundant overtime. By going where the action is, upstream oil & natural gas workers face fewer spells of unemployment and more abundant overtime opportunities.

High school graduates in upstream oil & natural gas double their inflation-adjusted wage over the first 20 years of their work in the industry. Like most industries, once workers are in their prime working years (40 to 60), wages adjusted for inflation level off, but because of the steep incline during their earlier years, upstream oil & natural gas workers' wages level off, on average, at $30 per hour compared to $20 per hour in all-other-industries and about $28 in construction. In construction, that average hides marked differences between construction workers that have gone through apprenticeships and those who have not.

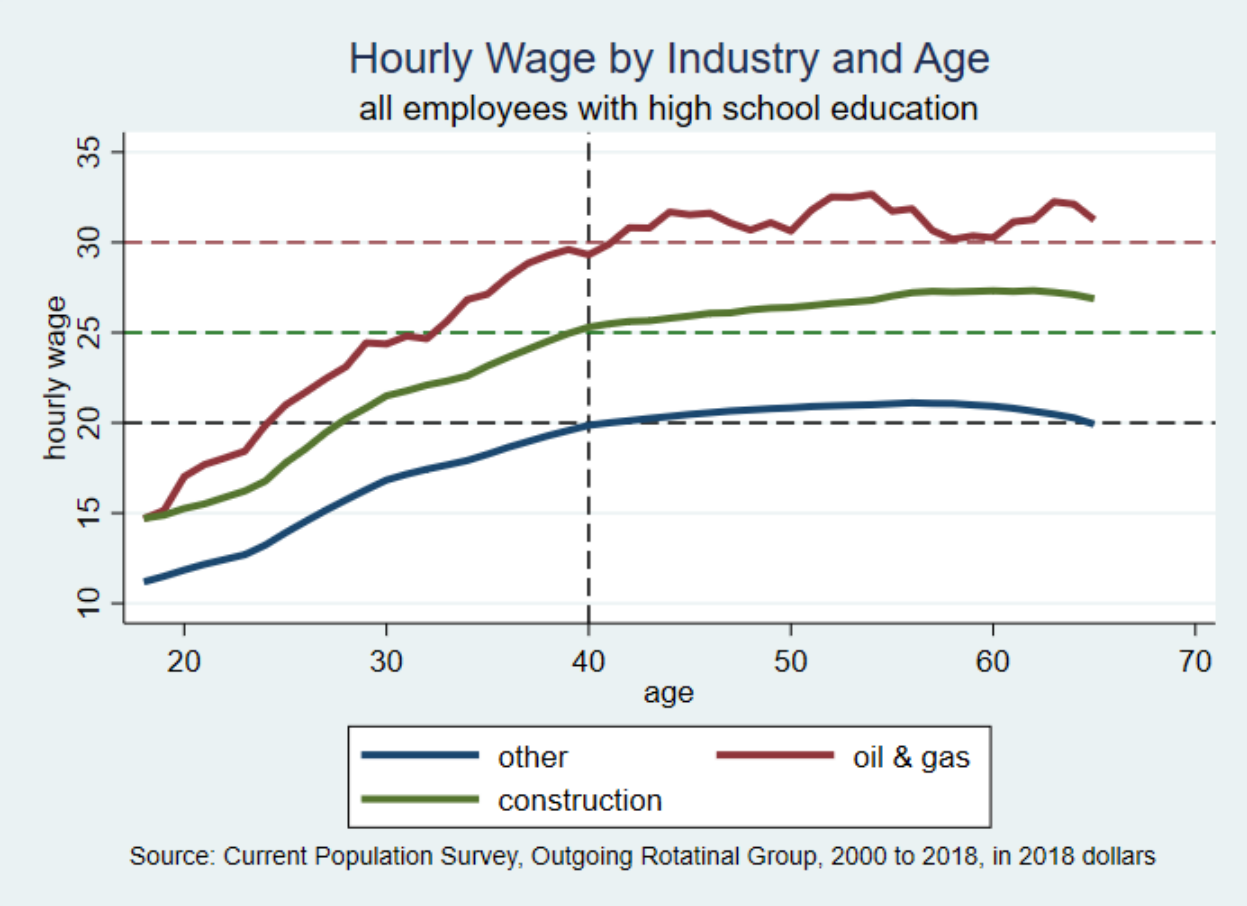


Figure 29: Age-earnings profiles for oil&gas, construction and all other industries, 2000 to 2018 in inflation adjusted 2018 dollars[70] (Vertical dashed line marks the beginning of stabilized prime-age wages. Horizontal lines mark the stabilizedaverage prime-age wages for each industry)

Upward Earnings in Construction

While short-course skill and safety training are both available in construction, the main avenue for advancement in construction is through extended apprenticeship training. The construction industry uses apprenticeship training more than any other industry in the US. Outside the military [71] in 2018, construction accounted for 68 percent of all active apprentices. Of the top 30 occupations using apprenticeship training, construction crafts accounted for 88 percent of all apprentices and 23 of the top 30 occupations. Electrician apprenticeship programs have the most active apprentices followed by carpenters, laborers, plumbers, and pipefitters.

Midstream oil & natural gas work also takes advantage of these apprenticeship programs. There were 8,500 pipefitter apprentices in 2018, many of whom worked in midstream oil & natural gas pipeline construction. There were 4,000 operating engineer apprentices, some of whom also worked in pipeline construction.[72]

While often in oil & natural gas workers themselves pay for the short courses that complement their work experiences, construction apprenticeship programs are too long and costly to expect the apprentices themselves to directly pay upfront for most of their training. In fact, because construction

apprentices are working while they go to classes at night or on the weekends, their paychecks help pay for their living expenses, while often in the nonunion sector and typically in the union sector, contractors foot the bill for classroom instruction. Through collective bargaining, union experienced journeymen agree that part of their total package of remuneration goes into paying for the training of current apprentices.

Construction apprenticeship programs can last from two to five years and entail hundreds of hours of classroom instruction and thousands of hours of supervised and mentored on-the-job work. For instance, the joint union-management electrical apprenticeship program in Alameda County, California lasts five years, requires 900 hours of classroom training, 8000 hours of on-the-job training, $620 in books (the first year) and $500 in tools.[73]

The Western Electrical Contractors Association of nonunion contractors in California offers a commercial inside wireman apprenticeship program with similar requirements to the union electrical program.[74] The nonunion sector accounts for about half of all graduating electrician and plumbing apprentices. In all other construction crafts, however, the union sector accounts for more than 90 percent of the graduating apprentices. (Table 1)

Extensive apprenticeship training supercharges the accumulation of skills through the planned integration of formal workshop and classroom training with supervised, hands-on training at work. This can be seen by comparing the wages of electrical apprentices to the average wage of solar panel installers. Solar panel installers assemble photovoltaic modules and racks, typically on residential and commercial rooftops. The work involves lifting and assembling typically at height and often on slopes. Installers do not connect solar panels and converters to the building's main power supply or to the grid; solar installers work around electricity but do not receive the training electrical apprentices get. Figure *30* shows what this means for wages.

Table 1: Number of union graduating apprentices, 2000 to 2016 and the union share of all graduating apprentices, selected crafts, 2000 to 2016[75]

Occupations	Number of Union Apprentice Graduates	% of Union Graduates Among All Graduates
Carpenter	26,112	94.90%
Electrician	23,162	51.57%
Pipe Fitter	10,673	90.54%
Laborer	9,297	91.32%
Plumber	8,999	50.75%
Boilermaker	6,401	99.92%
Roofer	6,415	94.70%
Painter	5,371	96.05%
Operating Engineer	5,364	94.47%

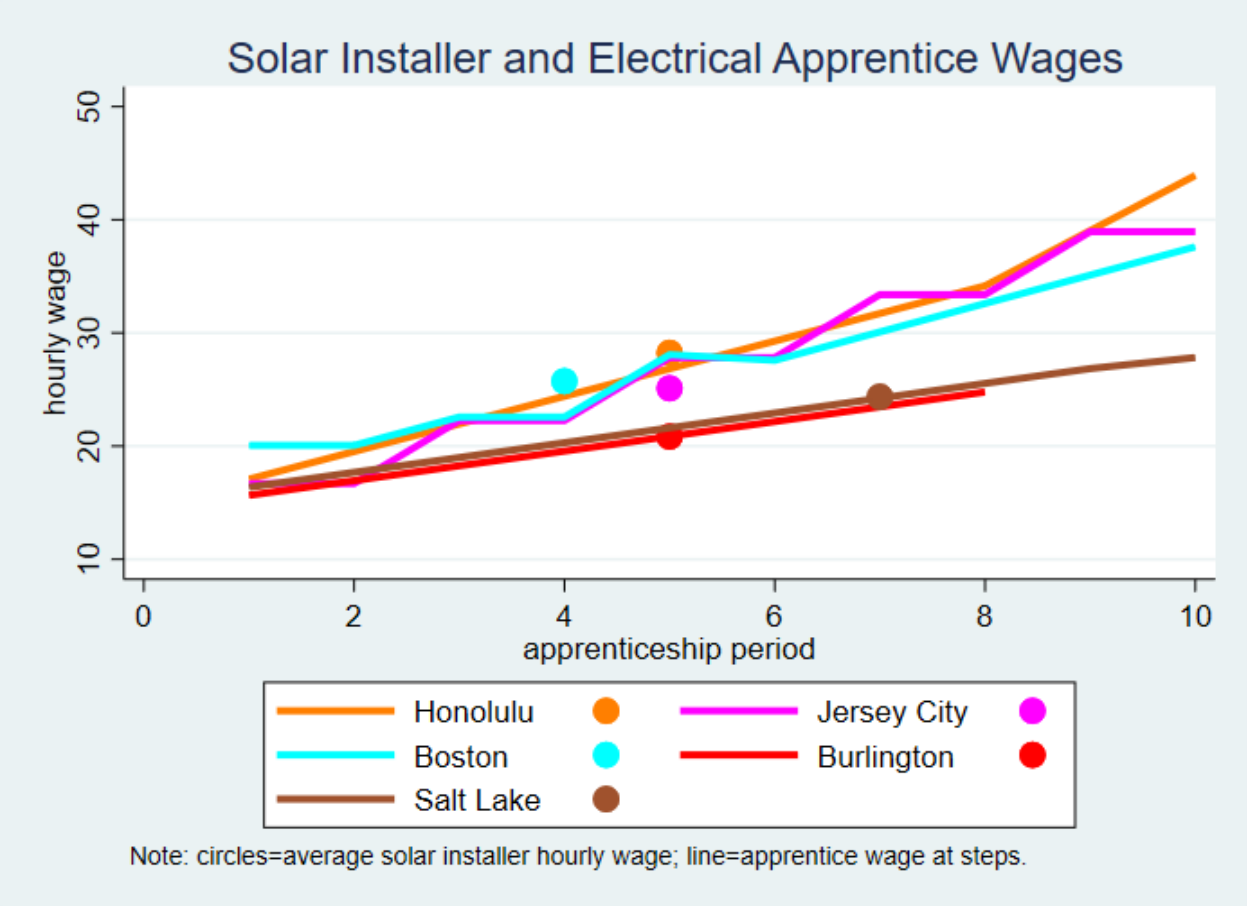


Figure 30: Five-city comparison of wages for union electrician apprentices and primarily nonunion solar panel installers, 2018[76]

Electrical Apprentices Catchup and Then Pass Solar Installers

The lines in Figure *30* trace the rise in wages for electrician apprentices in five cities as they move through the half-year periods of their 5-year apprenticeships.[77] Associated with each line is a circle that marks the average wage for solar installers in the area. The solar installer wages represent a mix of both new and mostly experienced workers. The new electrician apprentice begins earning less than the average solar installer, but after two to three years in an electrical apprenticeship, these apprentices match the earnings of the average solar installer. Towards the end of the five-year apprenticeship, the electrical apprentice earns about one-third more than the solar installer. Once the apprentice turns out as a journeyworker, that electrician will take home about 50 percent more than a solar installer.

The pattern comparing solar installers to electrical apprentices is found more broadly when comparing the age-earnings profiles of nonunion and union construction workers. Figure *31* shows that after high school, the average hourly wages of nonunion and union construction workers are almost the same ($15 compared to $16). But almost immediately, the wages of young union construction workers begin to rise much faster than the wages of young nonunion workers. By the time these workers are 30 years old, union construction workers, on average, are earning 50 percent more than nonunion construction workers. After age 30, increases in inflation-adjusted wages slow down for both groups leveling off after about age 40. In their prime years between ages 40 and 60, union construction workers, earn, on

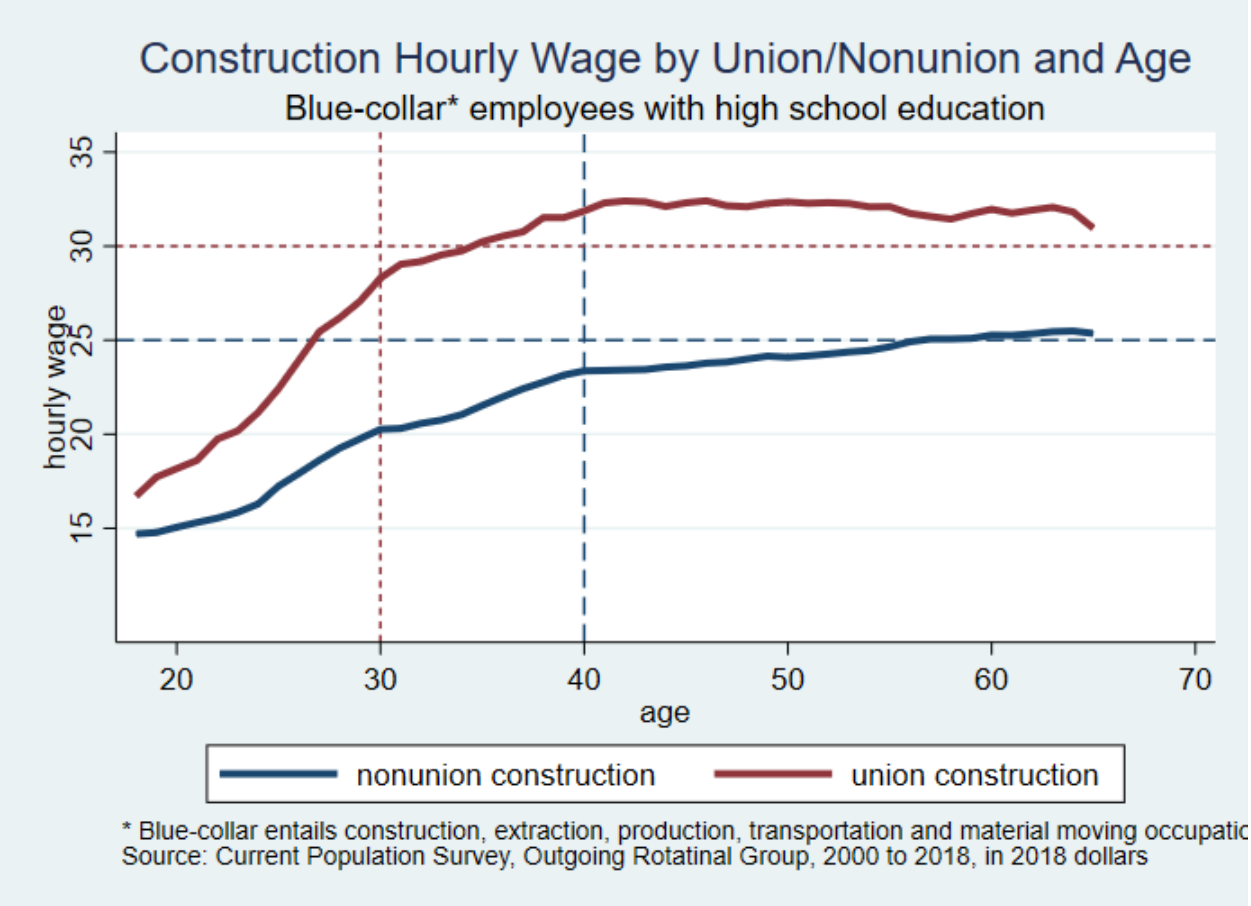


Figure 31: Age earnings profiles for union and nonunion workers in construction (Vertical dashed lines mark the ends of wage run-ups for workers in their 20s and 30s. Horizontal dashed lines mark approximately the stabilized wages for prime-age workers after age 40)

average, about 20 to 25 percent more.[78] Union workers in construction with high school education earn about the same as workers with high school education in oil & natural gas. (Compare Figure *31* with Figure *30*.)

Apprenticeship training in construction is an earn-while-you-learn system. Apprentices work while going to school. In some nonunion settings and in most union settings, classroom and workshop instruction is paid for mostly by the contractor or contractor group. On the union side, collectively bargained contracts specify how much each contractor must contribute to the jointly managed union/contractor program. These contributions are based on the number of work hours each contractor does under the contract. In 2013, there was $2.9 billion worth of training facilities invested in construction apprenticeship programs, 90% of which was in joint union/contractor programs paid for under collectively bargained contracts based on work done by signatory contractors.[79] This industry investment overcomes the constraints imposed by limited formal education among construction workers. With this industry-based investment in training, contractors can rely upon an expanded skill base to work their projects. Workers can harvest the economic benefits of going on from high school through apprenticeship training on essentially a full scholarship. This training also sets the stage for some construction workers with high school diplomas to rise into supervision, management and even ownership positions.

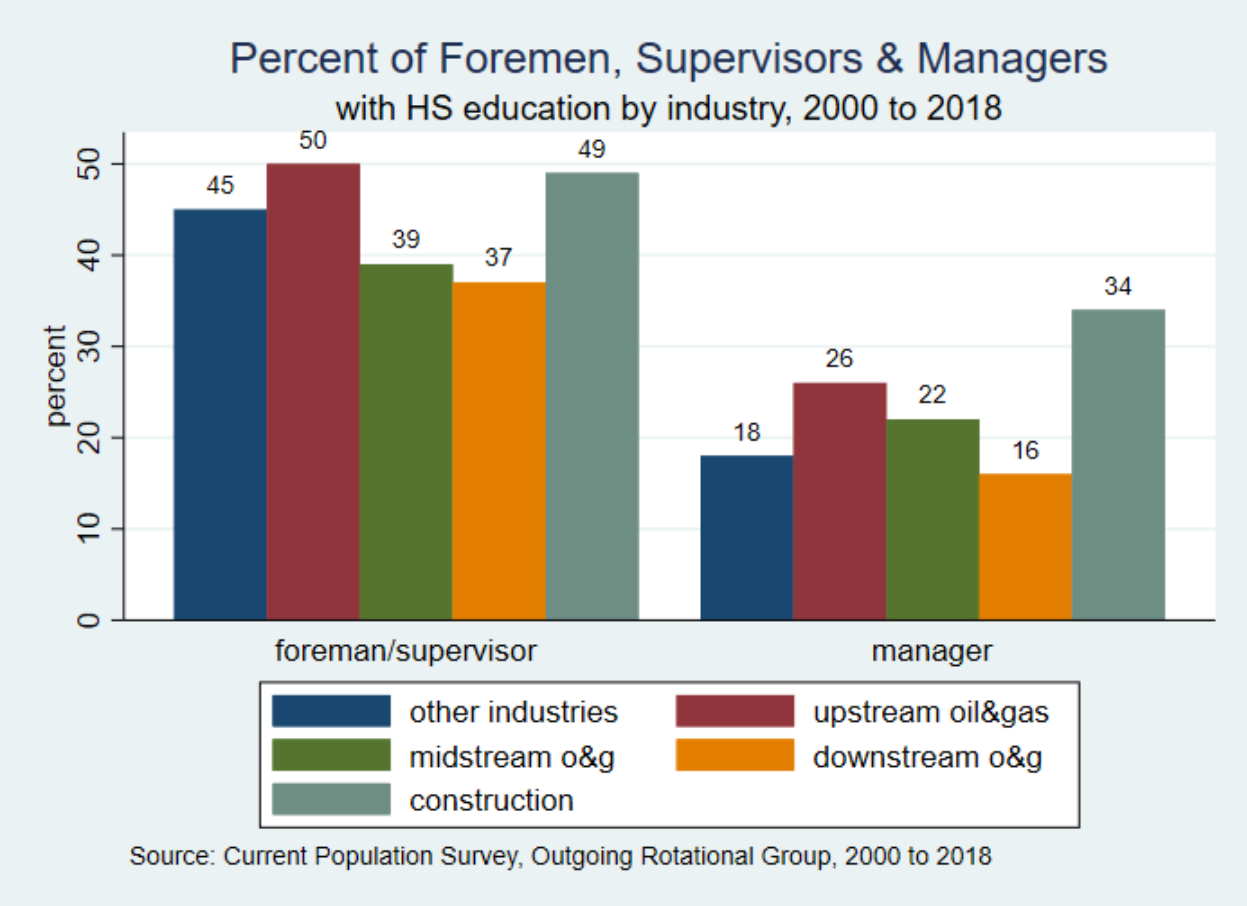


Figure 32: Percent of foremen and managers with a high-school education in construction, upstream, midstream, downstream oil and gas and all other industries, 2000 to 2018

Becoming a Foreman, Supervisor or Manager

Compared to the overall economy and downstream oil refinery work, construction and upstream oil & natural gas are more open to employing high school graduates as foremen, supervisors or managers. (Figure *32*) Half of the foremen and first-line supervisors in construction and upstream oil & natural gas extraction have only a high school diploma compared to 37 percent in downstream refinery work and 45 percent in the overall economy.

Thirty-four percent of managers in construction and 26 percent of managers in upstream oil & natural gas are high school graduates compared to 16 percent in refinery work and 18 percent in the overall economy.

Getting into Ownership

In the construction industry, the advancement path continues all the way to becoming an owner. Upfront investment in starting a contractor business is low; there is room for small contractors in the industry, and construction workers have industry and practical knowledge that give them advantages relative to other new contractors.

In most industries, most owners of companies have significant amounts of college education. Figure *33* shows that in the overall economy 17 percent of owners have a high school education and no more. In oil & natural gas, 22 percent of owners were high school educated. In construction 32 percent of

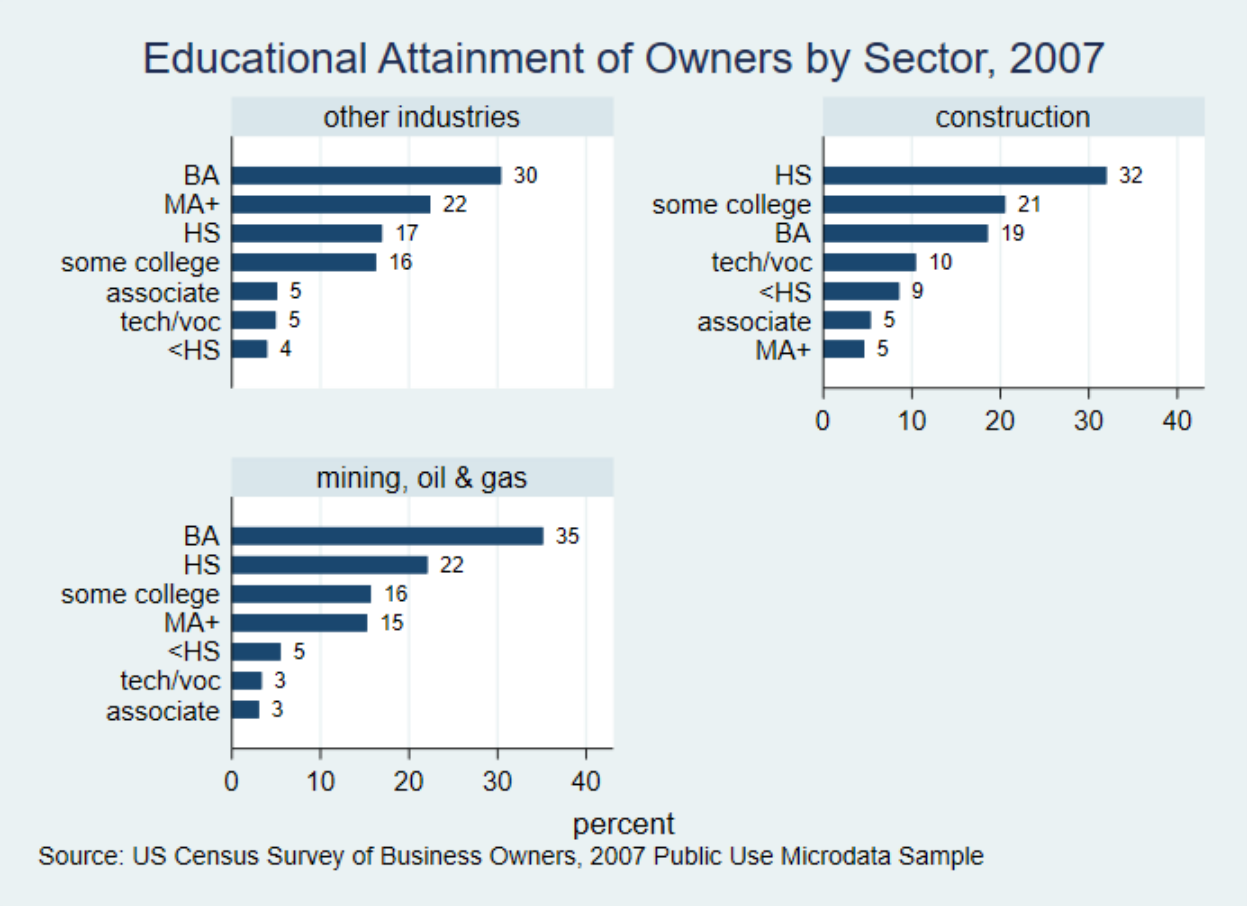


Figure 33: Educational attainment of owners in construction, oil&gas and all other industries, 2007

owners had high school degrees. In short, one-third of construction contractors were high school educated compared to one-sixth of owners in the overall economy.

A primary reason for the ability of construction workers with a high school degree to move on to ownership is the fact that many of the organizational and managerial skills required in running a contractor company are skills learned by doing or learned through apprenticeship and journeyman upgrade training. In addition, being a foreman, first-line supervisor or managing parts of a project or estimating a bid are excellent proving grounds for taking on contractor/ownership responsibilities in construction.

An additional reason for advancement into the ranks of ownership in construction is the low startup capital costs in construction. In the overall economy, 58 percent of owners began with less than $25,000 in capital while in construction, 70 percent of contractors started with less than $25,000 in initial capital investment. In mining, oil & natural gas, 46 percent began with that limited amount of capital.

Furthermore, construction contracting can be a young person's game. One third of all construction contractors are under the age of 45. Only 14 percent of the owners in mining, oil & natural gas are under 45 years old. Also, construction contractors can make up with sweat equity much of what they may lack in actual capital. In construction, 55 percent of contractors report regularly working more than 40 hours per week compared to 44 percent in the overall economy and 40 percent in mining, oil & natural gas. At

the other end of sweat equity, in the overall economy, 26 percent of owners report working less than 20 hours per week (5 percent none); 34 percent in mining, oil & natural gas report working less than 20 hours per week (9 percent none), while just 15 percent of contractors report working less than 20 hours per week (3 percent none).[80]

It takes more than capital to start a business—owners also must meet payroll. Because construction relies upon subcontracting, new contractors can develop business strategies that either limit the scope of work they will bid on, or rely upon other subcontractors to assume some of the scope of work they win. This enables contractors to limit the size of payroll they must meet.

Figure *34* shows that compared to the economy as a whole and the oil & natural gas industry, construction has a higher percentage of firms with fewer than 20 employees. More than one-third of construction contractors employ fewer than 20 workers. This compares with 17 percent in the overall economy, 14 percent in upstream oil & natural gas, and 4 percent in midstream oil & natural gas.[81]

With limited capital requirements to start up a construction company, the option to work long hours to make things go, and the option to limit the scope of work by using subcontractors, construction provides a wide avenue for advancement into the ranks of ownership for blue-collar workers with a high school education.

Ownership in the construction and oil & natural gas industries is subject to the same cycles as employment in these industries, allowing for significant opportunity but also presenting challenges. The turbulence of the industry is an important consideration for those seeking to move into ownership opportunities, whatever industry they may be in.

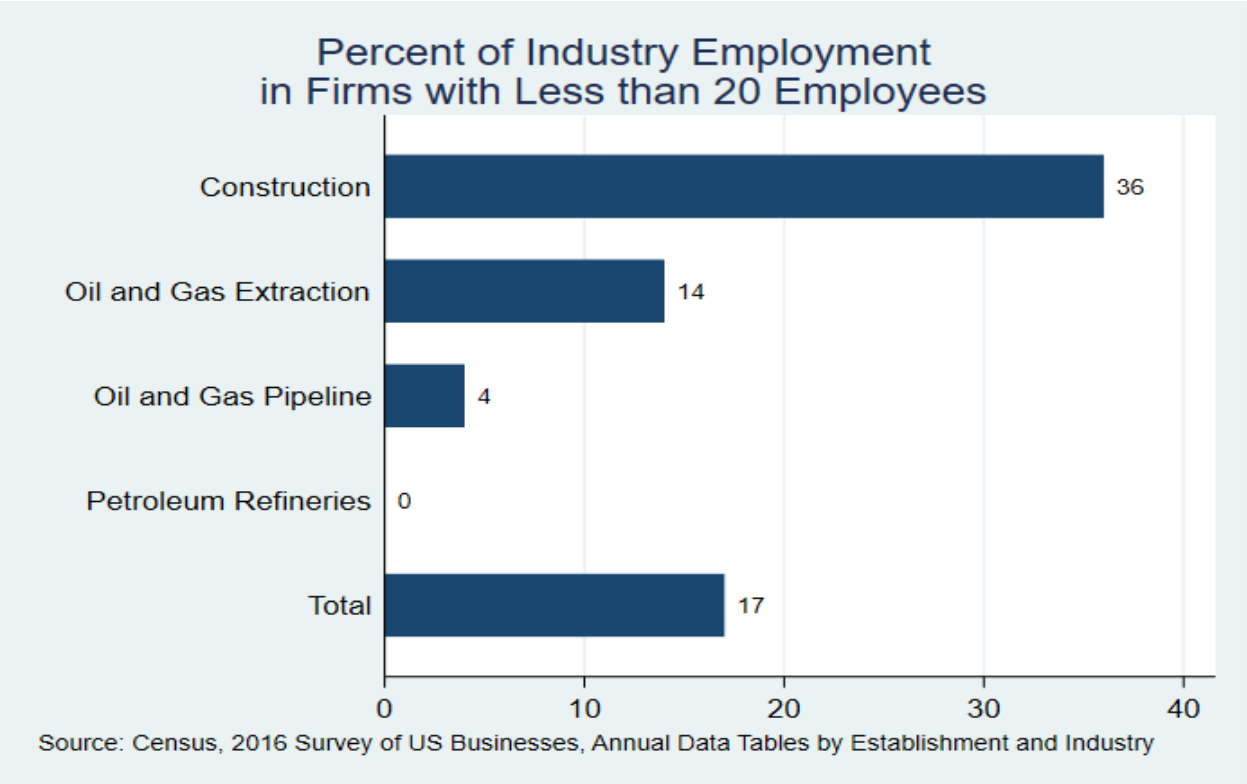


Figure 34: Percent of firms within industry with fewer than 20 employees, 2016

Conclusions About Opportunities

High school graduates entering the US labor market have limited options in a world where most good jobs emphasize formal educational attainment. But opportunities await in both the oil & natural gas and construction industries. For workers willing to go where the action is, upstream oil & natural gas work offers high wages and fast wage growth through the first 20 years of a career. Relatively short industry-specific training can qualify experienced oil & natural gas extraction workers for foreman and first-line supervisor jobs. Access to managerial positions without at least some college education is more limited in most sectors of oil & natural gas, particularly downstream refinery work, but is still more available than in the economy overall.

Advancement is also realistic prospect for high school educated construction workers. Advancement prospects are greatest for those going through apprenticeship training, which is common in the union sector and among nonunion electricians and plumbers. Construction workers with a high school degree have good prospects of becoming a foreman, first-line supervisor, estimator, manager or even owner. The openness of construction reflects the industry's unique turbulence that limits the size of firms, reduces managerial bureaucracies, focuses on industry financed and provided training, and organizes through subcontracting which allows for a mix-and-match approach to how the scope of work on a project is allocated.

Collective bargaining in construction allows each generation of experienced construction workers along with their contractors to finance the training of the next generation of construction workers. This builds and maintains the skill base within construction offsetting the eroding effects of turbulence and providing the underpinnings for opportunities and advancement within the industry.

Conclusions

The road to a productive and rewarding career need not go through a college education. Indeed, 25 percent of the workers in the US labor market are high school graduates with no college education. The construction and oil & natural gas industries rely heavily on high school graduates to staff about 45 percent of all the jobs in these two industries. Relative to other high school graduates with no college education, high school graduates in construction, oil & natural gas are paid better while receiving more health insurance and pension coverage. This is both true for blue-collar and white-collar high school graduates in these two industries. It is especially true of union workers in construction and oil & natural gas.

Safety is a top priority for a quality job. Both the construction and oil & natural gas industries seek to mitigate inherent safety risks through training and safety management.

The oil & natural gas industry through its various industry associations including the American Petroleum Institute partner with the Occupation Safety and Health Administration (OSHA) and the National Institute of Occupational Safety and Health (NIOSH) to develop safety standards and procedures to make workers safer in this industry. Injury rates are unusually low in oil & natural gas due to the online, face-to-face and on-the-job training that follows from the development of these standards and procedures. However, especially in upstream oil & natural gas support services, fatality rates are high reflecting both the inherent risks associated with work transportation activities and the need to continue developing and promulgating safety practices in this component of the industry.

In construction, the industry cooperates with OSHA and NIOSH while using apprenticeship training more than any other US industry. Three out of every four apprentices in the US are in construction. In electrical and plumbing apprenticeship programs, half of the apprentices are in nonunion shops. In the rest of construction, 90 to 95 percent of the apprentices are in union-management programs.

Apprenticeships promote safety skills and culture through extensive classroom/workshop training and on-the-job mentoring. Young workers who commit from 2 to 5 years to apprenticeship training and then attach themselves to construction become experienced, well-paid, well trained and safer workers. In construction—age, wage and unions matter in promoting jobsite safety. Nonetheless, the construction industry remains dangerous with both relatively high injury and fatality rates. While these rates are falling, being safe at work is a challenge any worker entering this industry must face.

Both the construction and oil & natural gas industries are turbulent with wide swings in employment. Construction is particularly sensitive to the overall economy's business cycle, while oil & natural gas extraction is sensitive to both domestic discoveries and international energy prices. In construction, workers who would make a career out of their craft must learn how to weather both seasonal and cyclical downturns. In oil & natural gas extraction, workers must go to the boom areas where new fields are opening up and older fields are expanding. There are ways to weather these booms and busts. In downstream oil refining, work is steadier, schools, shops and amenities typically close by, and the turbulence of construction and extraction absent.

In construction, while unemployment is typically higher than other industries, spells of unemployment are typically shorter. In unionized construction, health insurance and pension benefits that follow the worker from signatory contractor to signatory contractor helps soften the blow of leaving one union contractor after a project is completed to follow the work elsewhere. In oil & natural gas boomtowns, unemployment is low and overtime abundant.

Workers who stop at high school need not foreclose opportunities for advancement if they enter the construction or oil & natural gas industries. Beginning wages for teenage high school graduates, blue-collar and white-collar taken together, in construction and oil & natural gas are about $3 higher than those of other industries. But through their twenties and thirties, wages, adjusted for inflation, wages rise faster for high school graduates in construction and oil & natural gas compared to the overall economy. This is especially true in oil and natural gas.

There are also opportunities to advance into management. With the exception of downstream refining, the construction and oil & natural gas industries offer supervisory and managerial opportunities to a higher percentage of their employees who are high school graduates compared to the overall economy.

In construction, there is also another commonly traveled step up into ownership. Because the size of construction establishments is typically small, the barriers to starting up a construction contractor company are relatively low. Being an experienced construction worker, particularly one who has gone through an apprenticeship program, is a good proving ground for becoming a successful contractor.

However, ownership is not without its risks. The turbulence of construction demand means that construction contractors like their blue-collar counterparts, must know how to make hay when the sun shines and save for a rainy day. For those who ignore this lesson, bankruptcy becomes a looming risk.

All careers have challenges. In the service sector, and in many white-collar jobs in goods production, the way to meet many of those challenges is through ever-more college education. But in the construction and oil & natural gas industries, opportunities still wait for those with a high school degree and a willingness to meet the unique challenges of turbulent demand and workplace safety hazards. These challenges become more manageable as these two industries better mitigate their safety risks and develop the arrangements that lessen the downside of turbulent labor demand. Because these two industries leave open leadership places for experienced workers with high school degrees, this pool of high school leaders have the opportunity be part of these industries search for new solutions to the challenges of safety and turbulence. In construction and oil & natural gas, high school is not the end of the road but the beginning.

Note on Sources

Two key government surveys used in this study—the American Communities Survey and the Current Population Survey which includes the March Income Supplement and the Outgoing Rotational Group--require a harmonization of variables when comparing multiple years. This study used private party uniform extracts of these government surveys through: IPUMS-USA database by
Steven Ruggles, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas and Matthew Sobek. *IPUMS USA: Version 9.0* [dataset]. Minneapolis, MN: IPUMS, 2019.
https://doi.org/10.18128/D010.V9.0

and

CEPR Uniform Extracts of the CPS ORG from http://ceprdata.org/cps-uniform-data-extracts/cps-outgoing-rotation-group/cps-org-data/

Other government surveys including the US Census Bureau's Economic Census, the Bureau of Labor Statistics' Current Employment Statistics, Quarterly Census of Employment and Wages, Survey of Occupational Injuries, Illnesses and Fatalities and Job Openings and Labor Turnover Survey were taken directly from government sources.

Endnotes

[1] In a recent study, these factors were found to be the central determinants of job satisfaction among construction workers. Shan, Yongwei, Hamza Imran, Phil Lewis, and Dong Zhai. "Investigating the latent factors of quality of work-life affecting construction craft worker job satisfaction." *Journal of Construction Engineering and Management* 143, no. 5 (2016): 04016134. Similar conclusions in the case of offshore oil & gas workers were found in a study by Dickey, Heather, Verity Watson, and Alexandros Zangelidis. "Job satisfaction and quit intentions of offshore workers in the UK North Sea oil and gas industry." *Scottish Journal of Political Economy* 58, no. 5 (2011): 607-633.

[2] US Department of Labor, Apprenticeship Toolkit, https://www.dol.gov/apprenticeship/toolkit/toolkitfaq.htm (accessed December 11, 2019); also see, Reed, Debbie, Albert Yung-Hsu Liu, Rebecca Kleinman, Annalisa Mastri, Davin Reed, Samina Sattar, and Jessica Ziegler. An effectiveness assessment and cost-benefit analysis of registered apprenticeship in 10 states. No. 1b5795d01e8a42239b3c98dcc1e1161a. Mathematica Policy Research, 2012.

[3] Oil & natural gas extraction and related support services are a subset of mining. In the following analysis, we exclude mining while focusing on oil & natural gas extraction, pipeline construction and refining along with overall construction.

[4] In a recent study, these factors were found to be the central determinants of job satisfaction among construction workers. Shan, Yongwei, Hamza Imran, Phil Lewis, and Dong Zhai. "Investigating the latent factors of quality of work-life affecting construction craft worker job satisfaction." *Journal of Construction Engineering and Management* 143, no. 5 (2016): 04016134. Similar conclusions in the case of off-shore oil & gas workers were found in a study by Dickey, Heather, Verity Watson, and Alexandros Zangelidis. "Job satisfaction and quit intentions of offshore workers in the UK North Sea oil and gas industry." *Scottish Journal of Political Economy* 58, no. 5 (2011): 607-633.

[5] US Bureau of Labor Statistics, Current Employment Statistics (CES), 2018 https://www.bls.gov/ces/data/home.htm (accessed December 26, 2019) These data include direct employment in oil & natural gas extraction, related support activity, oil refineries, natural gas & crude oil pipeline transportation, and construction. They exclude natural gas utilities, manufacturing with petroleum products (e.g. asphalt shingles, lubricants or asphalt paving mixtures), and gasoline stations. Indirect employment related to providing inputs to or using outputs from these industries are excluded. Also excluded is employment induced by the incomes spent by workers in construction, oil& natural gas on consumer needs.

For a different approach that includes indirect and induced employment related to the oil & natural gas industry see: "Impacts of the Natural Gas and Oil Industry on The Us Economy In 2015," American Petroleum Institute, July, 2017. https://www.api.org/~/media/Files/Policy/Jobs/Oil-and-Gas-2015-Economic-Impacts-Final-Cover-07-17-2017.pdf (accessed December 26, 2019)

[6] White-collar jobs are all jobs except those in production, construction, mining, oil and gas extraction, transportation and material movement and handling. The service sector is everything outside of goods production and the military. Goods production entails agriculture, forestry, fisheries, construction, mining, oil and gas extraction and manufacturing.

[7] This ranking of industry wages persists when disaggregated by union status, gender or both. Below, when not comparing the 13 major industrial categories, we disaggregate oil and natural gas excluding mining and including natural gas and oil pipelines as well as oil refining.

[8] BLS, Survey of Occupational Injuries and Fatalities, TABLE 1. Incidence rates(1)of nonfatal occupational injuries and illnesses by industry and case types, 2018 https://www.bls.gov/iif/oshwc/osh/os/summ1_00_2018.xlsx (accessed January 5, 2020); Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries by selected worker characteristics, occupations, and industries, civilian workers, 2018 https://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2018hb.xlsx (accessed January 5, 2020)

[9] Occupational Safety and Health Administration (OSHA) is an agency of the United States Department of Labor; National Institute of Occupational Health and Safety (NIOSH) NIOSH is part of the Centers for Disease Control and Prevention (CDC) within the U.S. Department of Health and Human Services. https://en.wikipedia.org/wiki/Occupational_Safety_and_Health_Administration (accessed December 27, 2019) https://en.wikipedia.org/wiki/National_Institute_for_Occupational_Safety_and_Health (accessed December 27, 2019)

[10] US Bureau of Labor Statistics, Current Employment Statistics obtained from the federal Reserve of St. Louis FREDGRAPH data (see *Figure 21*)

[11] This ranking of industry wages persists when disaggregated by union status, gender or both. Below, when not comparing the 13 major industrial categories, we disaggregate oil and natural gas excluding mining and including natural gas and oil pipelines as well as oil refining.

[12] Share of total non-farm employment excluding the armed services.

[13] White-collar work entails management, professional, service, sales and office work. Blue-collar work involves production, extraction, construction, maintenance, and transportation.

[14] High school degree includes GED's. Asults are defined as 25 years or older. Sources: US Decennial Census and American Communities Survey extracted from Steven Ruggles, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas and Matthew Sobek. IPUMS USA: Version 9.0 [dataset]. Minneapolis, MN: IPUMS, 2019. https://doi.org/10.18128/D010.V9.0 (accessed December 14, 2019);
US Census, Educational Attainment in the United States: 2018 Table 2. Educational Attainment of the Population 25 Years and Over, by Selected Characteristics: 2018 https://www.census.gov/data/tables/2018/demo/education-attainment/cps-detailed-tables.html (accessed December 14, 2019)

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[22] US Department of Labor, Apprenticeship Toolkit, https://www.dol.gov/apprenticeship/toolkit/toolkitfaq.htm (accessed December 11, 2019); also see, Reed, Debbie, Albert Yung-Hsu Liu, Rebecca Kleinman, Annalisa Mastri, Davin Reed, Samina Sattar, and Jessica Ziegler. An effectiveness assessment and cost-benefit analysis of registered apprenticeship in 10 states. No. 1b5795d01e8a42239b3c98dcc1e1161a. Mathematica Policy Research, 2012.

[23] US Census Bureau, Economic Census, Construction, 2017 ECNBASIC2017 https://www2.census.gov/programs-surveys/economic-census/data/2017/ (accessed December 28, 2019)

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[25] Because the oil & natural gas sector is smaller, survey sample sizes for this sector are too small to answer who gets hurt in oil & natural gas.

[26] We will also consider below other measures of an accident's seriousness including hospitalization and fatality rates.

[27] Similar low serious injury rates are found in oil & natural gas well drilling (41.7) and support services (33.6).

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[35] One recent study speculates that the divergence between low injury rates and high fatality rates in oil and natural gas extraction may be due to an under-reporting of injuries in this sector. "The industry occupational fatality rate is 2.5 times higher than the construction industry and 7 times higher than general industry; however injury rates are lower than the construction industry, suggesting injuries are not being reported." Witter, Roxana Z., Liliana Tenney, Suzanne Clark, and Lee S. Newman. "Occupational exposures in the oil and gas extraction industry: State of the science and research recommendations." *American journal of industrial medicine* 57, no. 7 (2014): 847-856. Injury under-reporting is also common in construction. Taylor Moore, Jeffery, Konstantin P. Cigularov, Julie M. Sampson, John C. Rosecrance, and Peter Y. Chen. "Construction workers' reasons for not reporting work-related injuries: an exploratory study." *International journal of occupational safety and ergonomics* 19, no. 1 (2013): 97-105. Dong, Xiuwen S., Alissa Fujimoto, Knut Ringen, Erich Stafford, James W. Platner, Janie L. Gittleman, and Xuanwen Wang. "Injury underreporting among small establishments in the construction industry." *American journal of industrial medicine* 54, no. 5 (2011): 339-349.

[36] These data technically include illnesses as well, but few if any illnesses are caused by these events.

[37] For instance, all 15 fatalities associated with a 2005 refinery explosion were contract workers and not refinery employees. U.S. Chemical Safety and Hazard Investigation Board, Investigation Report, Report No. 2005-04-I-Tx, Refinery Explosion and Fire (15 Killed, 180 Injured), March 20, 2007 p. 22 https://www.csb.gov/file.aspx?DocumentId=5612 (accessed December 27, 2019)

[38] A study of who gets killed in oil and natural gas extraction concluded that "increases in oil and gas extraction activity were correlated with an increase in the rate of fatal occupational injuries in this industry, with an annual fatality rate of 30.5 per 100,000 workers (404 fatalities) during 2003-2006, approximately seven times the rate for all workers (4.0 per 100,000 workers). Nearly half of all fatal injuries among these workers were attributed to highway motor-vehicle crashes and workers being struck by machinery or equipment."
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[47] Wood entails NAICS 238130 - Framing Contractors entails establishments primarily engaged in structural framing and sheathing using materials other than structural steel or concrete. Steel entails 238120 - Structural Steel Contractors erecting and assembling structural building parts made from steel or precast concrete. https://www.naics.com/naics-code-description/?code=238130 (accessed November 23, 2018) and https://www.naics.com/naics-code-description/?code=238120 (accessed November 23, 2018)

[48] It may be that framers are on the young side for carpenters, but our data limitations cannot test this.

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[54] Because of its size, construction employment data is reported by itself while the smaller oil & natural gas extraction sector is combined with mining.

[55] Gold, Russell, "Back to the Future? Oil Replays 1980s Bust". Wall Street Journal. January 13, 2015, https://www.wsj.com/articles/back-to-the-future-oil-replays-1980s-bust-1421196361 (accessed December 29, 2019)

[56] BLS State and Area Employment, Hours and Earnings from the CES, series id SMU32298202000000001 https://www.bls.gov/sae/data/home.htm (accessed December 31, 2019)

[57] These data are not seasonally adjusted. In seasonally adjusted data the loss is about 6 percent.

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[67] OSHA, Oil and Gas Well Drilling, Servicing and Storage, https://www.osha.gov/SLTC/storagetank/standards.html (accessed December 27, 2019)

[68] American Petroleum Institue, Standards, https://www.api.org/Standards/ (accessed December 27, 2019)

[69] For instance, OSHAcademy https://www.oshatrain.org/courses/mods/901e.html (accessed December 8, 2019)

[70] This hourly wage averages straight and overtime pay.

[71] Apprenticeship training is important in the military. Many coming out of military apprenticeships transition into construction jobs through programs such as Helmets to Hardhats. See https://helmetstohardhats.org/ (accessed December 14, 2019)

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https://www.bls.gov/oes/current/oes472231.htm#%282%29
https://www.mass.gov/files/documents/2017/12/12/2018-003%20Prevailing%20Wages%20Lowell.pdf
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(all accessed December 7, 2019)
[77] The program is 4 years in the case of Burlington, Vermont.
[78] Government data do not permit a comparable comparison of differences in health and pension benefits.
[79] Author's calculation from Form 990s submitted by union and nonunion apprenticeship programs using ProPublica's Nonprofit Explorer, https://projects.propublica.org/nonprofits/ (accessed December 8, 2019)
[80] US Census, 2007 Survey of Business Owners Public Use Microdata Sample https://www.census.gov/data/datasets/2007/econ/sbo/2007-sbo-pums.html (accessed December 8, 2019)
[81]In downstream oil & natural gas, no oil refinery employs fewer than 20 workers.