Conference Draft

THE RISE OF THE CONTRACT WORKFORCE IN U.S. MANUFACTURING[1]

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Abstract

Research and policy analysis on labor market issues often relies on employment measures that only capture employees of firms. Although prior studies have pointed to high and growing levels of contract labor in some segments of the economy, lack of data has hampered research into the size of this workforce and its broader implications for workers and labor market analyses. We help fill this data gap with a study U.S. manufacturers' use of contract workers. Using micro data from the Occupational Employment and Wage Statistics program and the Quarterly Census of Employment and Wages, we develop a new method for imputing staffing services workers in core manufacturing occupations to manufacturing industries and other sectors by detailed industry, occupation, and area from 1990 to 2018. We estimate that the share of contract workers in the manufacturing sector's core occupations rose from 1.7 percent in 1990 to 5.8 percent in 1997. The contract share continued to grow in the 2000s, even as direct-hire employment in manufacturing declined sharply, peaking at 10.0 percent in 2015 before declining slightly. We estimate that the shift to contract workers can explain over 22 percent of the employment decline in core manufacturing jobs from 1990 to 2018 and 10 percent of the employment decline from 1997 to 2018. We find that the share of contract use varies considerably across industries and areas. The time series data we have created on contract use by occupation, industry, and area may help shed light on why firms outsource labor, the implications for workers, and potential biases in some analyses whose labor measures omit contract workers.

[1] Any opinions and conclusions herein are those of the authors and do not necessarily reflect the views or policies of the U.S. Bureau of Labor Statistics.

INTRODUCTION

Research and policy analysis on labor market issues often rely on employment measures derived from administrative data or employer surveys. With rare exceptions, however, these employment measures only capture employees of firms. Studies conducted at the firm or industry level typically miss contract workers who are hired from other firms or as independent contractors; even studies using aggregated data for the economy may miss workers hired as independent contractors. If the contract workforce used by firms is large or changing over time, their omission from labor input measures could substantially bias findings of studies on a variety of issues, such as firms' adjustment of labor to demand shocks, industry and firm productivity levels and growth, the industrial composition of national and regional economies, and industry skills demand. Being able to link contract workers to the clients using them is also important for understanding the implications of outsourcing for the contract workforce and for the employees of the user organizations. Through a study of U.S. manufacturers' use of contract workers in blue-collar occupations, we develop a new method for imputing contract workers to user industries and illustrate the potential importance of capturing such contract work.

Although prior studies—many based on case studies—have pointed to high and growing levels of contract labor in various segments of the economy,[2] the dearth of data has stymied research into the size of the contract workforce and its broader implications for labor markets. The challenge is that in administrative filings and employer surveys, firms generally report employment for only their W-2 employees. In cases where firms use workers from contract companies (e.g., cleaning companies, food services companies, or temporary help agencies), the workers are employees of the contract companies and are recorded in the industries of these companies, even when they work at the client's worksite. Although the Census Bureau collects information on firms' expenditures to track input use, there are large gaps and poor detail in the data collected for purchased services, which include most purchases for contract labor.

Using a variety of methods, several studies have sought to overcome data obstacles and impute contract workers to user industries, primarily in manufacturing. An early paper by Segal and Sullivan (1997) employed CPS data to impute workers in the staffing services industry to manufacturers and showed the dramatic growth of these contract workers in manufacturing in the 1990s. Dey, Houseman, and Polivka (2012, 2017) used data from the Contingent Worker Supplement to the CPS, the Occupational Employment and Statistics (OEWS) program, and the Current Employment Statistics program to impute staffing services workers to the manufacturing sector, showing that the use of staffing services led to substantial underestimates of manufacturing labor productivity growth during recessions and overestimates during recoveries. In a study based on the evolution of the input-output structure of the U.S. economy, Berlingieri (2014) estimates that the growth of outsourcing to professional and business services accounts for 35 percent of the rise in service sector employment and 25 percent of the decline in manufacturing employment over the 1948-2002 period. More recently, Atencio de Leon, Macaluso, and Yeh (2023) exploit Census data on manufacturers' expenditures for staffing

[2] See Bernhardt (2017) et al. for a review of the research evidence on the size and growth of contract work.

services and find that growth in its use since 2007 can explain a substantial share of the measured decline in job reallocations.[3]

In the absence of direct information on firms' use of workers from other companies, researchers must identify the set of industries using contract workers and the industries supplying workers to these industries (Dey, Houseman, and Polivka 2010). In this study, we improve upon our prior methods and focus on estimating contract workers in production and material moving occupations hired through staffing services companies. Production and material mover (PMM) occupations constitute the core occupations in the manufacturing sector, accounting for about 60 percent of all direct-hire employment in the sector, and the employment services industry[4] is the only identifiable industry supplying substantial numbers of contract workers in these occupations. Additionally, we extend the period of coverage from 1990 through 2018 and estimate the use of contract workers by detailed industry (4-digit NAICS), occupation (6-digit SOC), and area (metropolitan statistical and balance of state areas).

We find that the size of the contract workforce in manufacturing grew steadily over the period even as direct-hire employment in the sector fell precipitously in the 2000s, accounting nationally for under 2 percent of workers in these core manufacturing occupations in 1990 and peaking at 10 percent in 2015. The shift to contract work can account for 22.5 percent of the decline in the manufacturing workforce in these core blue-collar occupations between 1990 and 2018. Our estimates also show substantial variation in use across manufacturing industries, across regions and metropolitan areas, and between urban and rural areas.

In the remainder of the paper, we begin by providing background on the employment services industry and its expansion into production and material mover occupations over our period of study. We next discuss the data and methods for imputing workers by detailed occupation and area from the employment services industry to user industries. We then present our findings on the size and growth of manufacturing's contract workforce in these core occupations. We close with a discussion of future research and the broader implications of our findings.

BACKGROUND ON THE EMPLOYMENT SERVICES INDUSTRY

The employment services (ES) or staffing industry is composed of three subindustries: employment placement agencies, temporary help agencies, and professional employer organizations (PEOs). The last two are particularly relevant for our work. Temporary help agencies place workers with client organizations for a fixed term. Professional employer organizations take over some or all of the human resources functions for a portion or all of a client's workforce. Although clients and staffing agencies legally have joint employer

[3] A recent line of research has used 1099 filings in tax data to study independent contracting and online platform workers, who are usually independent contractors (Jackson et al. 2017; Collins et al. 2019; Lim et al. 2019; Garin, Jackson, and Koustas 2021). These data potentially can be used to link companies to their use of independent contractors.

[4] We use staffing services and employment services interchangeably in this paper.

responsibilities, the staffing agency is the employer of record and workers' employment and wages are reported under the temporary help agency's or PEO's employer identification number. Employment placement agencies help businesses find employees, and generally they only employ administrative staff for this purpose. In other words, the workers they place with a client become the client's employees. A small number of workers in production and material mover occupations are employed in establishments coded as employment placement agencies, however, which likely means that these establishments also operate a temporary help or PEO business or that the industry of record for these establishments is miscoded. In this paper, we report estimates of PMM workers assigned to manufacturing from the three subindustries, combined.[5] Temporary help agencies account for the large majority of these workers over the period studied.

Prior research has pointed to the rapid growth of the employment services sector in the 1990s, and to the fact that much of that growth occurred in production and related blue-collar occupations. Table 1 shows the evolution of the economywide share of workers in manufacturing and employment services for selected broad occupational categories between 1990 and 2018. Manufacturing has accounted for the large majority of workers in production occupations throughout the period, but that share fell by 4 percentage points from 75.1 percent to 71.2 percent between 1990 and 2018. At the same time, the share of production workers employed in employment services rose from just 1.5 percent in 1990 to 8.9 percent in 2015 before dropping slightly to 8.2 percent in 2018, a 6.8 percentage point gain over the entire period.

The fall in manufacturing's share and the growth in the employment services industry's share of workers in material mover occupations has been even more dramatic. In 1990, the manufacturing sector accounted for about a quarter of workers in material mover occupations but that share dropped by about 12 percentage points over the period. At the same time, the share of workers in material mover occupations employed in employment services rose by nearly 9 percentage points to 13.8 percent in 2018. There has been little increase in the employment services industry's share of workers in all other occupations over the period, although there has been some shift in the composition of employment in the industry away from office and administrative support toward professional occupations (Dey et al. 2012).

Table 1 reports the shares by broad occupational categories, but within these broad categories employment services workers are concentrated in a small number of relatively low-wage occupations.

Establishments surveyed for the OEWS only report employment, occupation, and wage information for W-2 employees. Organizations' use of contract labor is not collected in this survey or, generally, in other business surveys and administrative data. The rapid rise of blue-collar workers in the staffing industry led researchers to hypothesize that many of these staffing workers are assigned to manufacturing clients, and several prior studies have sought to estimate that use (Segal and Sullivan 1997; Dey, Houseman, and Polivka 2012, 2017). The empirical work in this paper seeks to substantially improve upon these prior estimates by focusing on

[5] Prior to the adoption of NAICS industry coding system, temporary help agencies and PEOs were combined in one industry.

contracting out of workers in production and material mover occupations, which are the core occupations in factories and account for about 60 percent of direct-hire employment in the manufacturing sector during the period covered by this study. No industry outside of employment services systematically contracts out workers in production and material moving occupations to clients. Our empirical strategy, therefore, focuses on imputing contract workers from the employment services industry to user industries, which should capture most contract company workers in these core occupations. Our estimates of contract employment miss any independent contractors used by manufacturers, which may include workers hired through platforms.

DATA AND METHODS

Background on the OEWS

The occupation data come from the Occupational Employment and Wage Statistics (OEWS) survey conducted by the Bureau of Labor Statistics (BLS). The OEWS program (originally the Occupational Employment Statistics, or OES, program) first began collecting data in 1988. In the early years of the program's history, data were collected for specific sectors each year, with data collected for all sectors over a 3-year cycle. Thus, 1990 was the first year for which occupational data existed for all sectors in the economy. The goal in these early years was to generate national estimates of the occupational distribution of employment for detailed industries. The sample design for the OEWS underwent a major change in 1996, with the collection of data for all industries every year and an increase in the sample size to support estimates of the occupational distribution of employment for metropolitan statistical areas (MSAs) and balance of state (BOS) areas.

Today, the OEWS program fields a semi-annual survey that samples approximately 200,000 establishments in May and another 200,000 in November of each year.[6] The survey covers all workers, both full-time and part-time, in private non-agricultural industries. The survey instrument asks establishments to provide what amounts to a complete payroll record for the pay period that includes the 12th of the sample month. Respondents report occupation and wage information for all their employees.[7]

In the 1990s, the OEWS survey categorized occupations according to its own coding system. Since 1999, the OEWS survey has used the Office of Management and Budget's (OMB) occupational classification system, the Standard Occupational Classification (SOC), to categorize workers into around 800 detailed occupations. The SOC system provides much more occupational detail than most other surveys that include information about occupation. We developed a crosswalk between the SOC and OEWS occupation codes that captures production

[6] Prior to November 2002, the program surveyed approximately 400,000 establishment in November of each year.
[7] Wages for the OEWS survey represent straight-time, gross pay, exclusive of premium pay. Base rate, cost-of-living allowances, guaranteed pay, hazardous-duty pay, incentive pay including commissions and production bonuses, tips, and on-call pay are included while back pay, jury duty pay, overtime pay, severance pay, shift differentials, non-production bonuses, employer cost for supplementary benefits, and tuition reimbursements are excluded from the reported wage.

and material mover occupations at the 6-digit SOC level (about 150 occupations) for the 1990-2018 period. The OEWS used the SIC industry coding system prior to 2002, but around the time of the change, BLS dual coded establishments. We employ these dual codes in developing a crosswalk between SIC and NAICS.

The OEWS samples establishments no more than once every three years, and the sample is designed to be representative of a detailed industry-area by combining three years (6 waves) of data. For example, official estimates of the occupational distribution of employment by industry and area for May 2018 combine OEWS data collected in May 2018, May and November 2017, May and November 2016, and November 2015. The OEWS sampling and weighting methods guarantee that total weighted employment equals the BLS frame – the Quarterly Census of Employment and Wages (QCEW) – employment at the metropolitan statistical area (MSA) level for urban areas and the balance of state (BOS) areas for rural areas. Beginning with May 2021, OEWS estimates have been based on an approach developed by Dey, Piccone, and Miller (2019), which imputes occupational distributions for the entire universe of QCEW establishments.

Methods for imputing contract workers to manufacturing industries

To impute contract workers in production and material moving occupations to manufacturers, we exploit the granular data in the OEWS on geography, industry, and occupational composition of U.S. establishments, including manufacturing and staffing industry establishments. Staffing agency workers are assigned to a client and work at the client's worksite alongside direct-hire employees. Consequently, staffing agencies are located in close geographic proximity to their clients.

We generate estimates of manufacturers' use of contract workers in production and material moving occupations by 4-digit NAICS industry and MSA/BOS areas for selected years: 1990, 1997, 2003, 2006, 2012, 2015, and 2018. We begin in 1990 to capture the strong growth in production and material moving occupations in employment services in the 1990s although, as is discussed below, the imputation methods we use differ for our 1990 estimates owing to differences in the OEWS data during the early years of the program. Because our imputation methods rely on three years of data collection, and the occupational distribution within manufacturing and staffing agencies servicing manufacturing clients fluctuates over the business cycle, we avoid recession years in this analysis.

Conceptually, the process for imputing contract workers in production and material moving occupations to manufacturing and other sectors involves two steps: 1) estimating the occupational distribution of employment for 4-digit NAICS industries at the MSA/BOS areas by year and 2) within each MSA/BOS year, imputing workers from production and material moving in employment services industries to user industries.

Estimating the occupational distribution of employment by industry and area

The OEWS sample design supports producing occupational employment estimates by detailed industry (typically 4-digit NAICS) for each MSA/BOS.[8] One could think of occupational employment estimates as the product of the estimated staffing pattern using OEWS data and employment levels from the Quarterly Census of Employment and Wages (QCEW) at the detailed industry and MSA/BOS level. For all years except 1990 (discussed below), we use this concept of industry-area estimates with one modification. Our modification takes advantage of the fact that this is a research series and not a production series. Thus, the timeliness of the estimates is not a concern, and we are able to center the panels used to generate estimates on the year of interest. For example, our occupation-industry-area employment estimates for (May) 2018 utilize OEWS data from (May) 2019 to estimate the May 2018 staffing pattern as well as the May 2018 QCEW industry-area employment totals.

For 1997, 2003, 2006, 2015 and 2018, we have estimates of the number of workers employed in employment services for each MSA/BOS area by detailed occupation. The next step is to impute ES workers in production and material moving occupations *j* in area *a* to user industries located in area *a.* Staffing agency PMM workers are assigned to a client and work at the client's worksite alongside direct-hire employees. Consequently, staffing agencies are located in close geographic proximity to their clients, and our imputation assumes that all ES workers in PMM occupations are assigned to clients in the same area. Denoting $\tilde{E}_{jiat}$ as industry *i* in area *a's* demand for workers in occupation *j* and $\tilde{E}_{jat}$ as the demand for workers in occupation j across all industries in area *a*, we assume that client industries in area *a* use ES workers in occupation *j* in proportion to their demand for workers in occupation *j*.

$$(1)\ \tilde{p}_{i|jat} = \frac{\tilde{E}_{jiat}}{\tilde{E}_{jat}}$$

The employment level adjusted for contractor use is the industry's observed direct-hire employment (DH) plus its use of ES workers can be written:

$$(2)\ E^{*}_{jiat} = E^{DH}_{jiat} + \tilde{p}_{i|jat} ES_{jat}$$

We employ two approaches for estimating user industry demand for occupation *j,* one we call the "proportional use" approach and the other the "modeled demand" approach.

Proportional Use Approach

In the proportional use approach, we simply use an industry *i's* employment of direct-hire workers in occupation *j*, area *a*, year *t* as a proxy for its overall demand for workers in occupation j.

[8] Because of disclosure risk, BLS only publishes these estimates by 4-digit NAICS at the national level and by MSA/BOS for all industries.

$$\tilde{E}_{jiat} = E^{DH}_{jiat}$$

In this case, equation 1, showing the proportion of workers ES workers in an occupation and area assigned to industry *i* in period *t*, is the ratio of direct hire workers in occupation *j* hired by the industry *i* divided by all direct-hire workers in that occupation and area in the period.

$$\tilde{p}_{k|jgt} = \frac{E^{DH}_{jiat}}{E^{DH}_{jat}}$$

This method assumes that the propensity to use contract workers does not vary across industries within an area or year.

One might be concerned, however, that if this assumption is violated, it could lead to biased estimates that worsen over time. For example, if manufacturers are more likely to use production workers from staffing agencies, the more manufacturers use ES production workers relative to firms in other sectors, the fewer we would impute to manufacturing, and if the ES share of production workers in an area is growing, so too would the bias in our estimates. In the limit, one could imagine a situation in which an industry outsources all workers in a production or material moving occupation, but in the proportionate use approach, no ES workers in that occupation would be imputed to the industry.

Modeled Demand Approach

To address this concern, we develop a model that incorporates our estimates of an industry's use of contract workers in period *t-1* and the industry's growth in occupations that are *not* contracted out between period *t-1* and *t* to estimate the industry's demand for contract workers in period *t*. In identifying the non-contract workforce in an industry, we exploit the fact that there is little or no contracting out of workers in many detailed PMM and non-PMM occupations.

Denote E^{NC}_{iat} as employment in industry *i*, area *a*, period *t* of a subset of occupations that *are not* contracted out. Using this approach, demand for workers in contract occupation *j*, industry *i*, area *a*, and year *t* may be written as the product of the prior period's employment, adjusted for contract use, multiplied by the growth in non-contract employment in industry *i*, area *a* between *t-1* and *t*.

$$\tilde{E}_{jiat} = E^{*}_{jiat-1}\left(\frac{E^{NC}_{iat}}{E^{NC}_{iat-1}}\right)$$

To designate a PMM occupation as "non-contract," we require that the employment services industry's share of the national employment in the occupation be less than 2 percent throughout our period of study. We designate non-PMM occupations as not contracted out if the national share in the Business and Professional Services sector is less than 2 percent throughout

our period.[9] While the ratio of employment in a contract occupation to employment in these designated non-contract occupations may change over time, the modeled approach assumes that the rate of change is the same across industries in the MSA/BOS using PMM worker.

Our modeled demand approach requires an estimate of an industry's use of contract employment in the prior period, which we do not have in the initial year. When we take 1997 as the base year, we use direct-hire employment as the indicator of demand for occupation *j* in an industry-area. Therefore, the estimate in this base year is the same as that in the proportionate use approach.

Imputing ES workers to industry-area cells in 1990

Production and material moving occupations grew rapidly in the 1990s, and we would like to capture this ramp-up. Using data from the early years of the OEWS's operation presents special challenges, however, and we must use a different, cruder method for our imputations. Specifically, while we have estimates of occupation by industry at the national level, at the time, the OEWS was not designed to generate occupational estimates by detailed industry by MSA/BOS. To generate these occupation-industry-area estimates, we use QCEW data, from which we can derive total employment by detailed industry at the MSA/BOS level, and we assume that the occupational distribution for all non-employment services industries in 1990 is the same in each MSA/BOS as that observed at the national level in the OEWS data.

Clearly, this assumption is not suitable for the employment services industry, because its occupational distribution depends on its client base, and hence on the industry composition of the area. We begin by assuming that for all non-ES industries, the local staffing pattern follows the national staffing pattern such that

$$\tilde{E}_{jai} = E_{ai}^{QCEW} \cdot \frac{E_{ji}}{E_i}$$

where E_{ai}^{QCEW} indicates QCEW employment in area a and industry i and $\frac{E_{ji}}{E_i}$ represents the staffing pattern observed in the 1990 OEWS data, nationally. Using the above estimates, we can generate the local non-ES demand for occupation j by summing over all industries such that

$$\tilde{E}_{ja} = \sum_i \tilde{E}_{jai}$$

We then distribute national ES employment in occupation j according to the importance of area a to national occupation j employment

$$\tilde{E}_{ja}^{ES} = E_j^{ES} \cdot \frac{\tilde{E}_{ja}}{\tilde{E}_j}$$

[9] For example, non-PMM occupations such as lawyers, accountants, buildings and grounds workers, and administrative assistants are commonly contracted out and would not be counted in the non-contract group. First-line supervisors of production workers is an example of a non-contracted out production occupation, because it is rarely outsourced.

where E_j^{ES} is the OEWS national, occupation j employment level within the ES sector and $\frac{\tilde{E}_{ja}}{\tilde{E}_j}$ gives the estimated importance of area a to the occupation j employment.

Finally, to correct for the fact that this estimate of ES employment in area a may differ from that measured in the QCEW, which we denote as $E_a^{ES\_QCEW}$, we ratio adjust each estimate of an area's use of occupation j to guarantee that our imputations sum to total area ES employment in the QCEW:

$$\hat{E}_{ja}^{ES} = \tilde{E}_{ja}^{ES} \cdot \frac{E_a^{ES\_QCEW}}{\tilde{E}_a^{ES}}$$

Because our imputations for 1990 require stronger assumptions than in later years, we alternately use 1990 and 1997 as base years for our modeled demand approach. For the proportionate use approach, we report 1990 estimates but note that in this method, the 1990 imputations have no effect on estimates in subsequent years.

For the main results reported in this paper, we report estimates using the proportional use approach, and we report selected results using the modeled demand approach, alternately using 1990 and 1997 as the base year, in the appendix. Reassuringly, we find that our results are very similar using the two methods. Changing the base year in the modeled demand approach has almost no effect on subsequent estimates. Comparing the proportional use and modeled demand approaches, we find our estimates of the share of contract employment in manufacturing initially grow more quickly in the former than in the latter, but starting in 2006 are nearly identical.

A special note on PEO imputations

Imputations for PEO workers are complicated by the fact that during the period of our study, BLS was working with states to reclassify workers in PEO establishments to the industry of the client organization (see Dey, Houseman, and Polivka 2010). As a result, the number of PEO workers in production and material mover occupations steadily dropped over our period of study and was about a quarter of the size in 2018 as it was in 1997. Although, in reassigning PEO workers to user industries, the BLS's goal, like the goal of this paper, is to better understand the industries where workers are working, the reassignment process has been incomplete and has been phased in over many years, making the time series data inconsistent. Additionally, PEO workers are not reassigned to user industries in Census data, which often are used in research and policy analysis. To make the treatment of PEO workers more consistent over time in the OEWS data and more consistent with their treatment in Census data, we use PEO employer identification numbers to flag workers who have been reassigned to manufacturing industries and classify them as contract workers. For PEO workers in production and material mover occupations who have not been assigned to a user industry, we apply the same method used to impute temporary help workers to client industries.

RESULTS

Figure 1 displays an index of PMM direct-hire employment (orange line) and PMM employment adjusted for contract use (blue line) in the manufacturing sector for selected years from 1990 to 2018 (left scale). The percent of PMM contract manufacturing workers (green line) is also shown (right scale).

Direct-hire manufacturing employment rose in the first part of the 1990s, peaking in 1997. After 1997, manufacturing employment declined dramatically. From 1997 to 2006, direct-hire PMM workers in manufacturing declined by about 19 percent and by 34 percent from 1997 to 2012. Manufacturing regained some of the employment lost during the Great Recession, and in 2018 direct-hire PMM employment was 31 percent lower than in 1997.

Mirroring the dramatic rise in PMM workers in the ES industry in the 1990s (Table 1), we estimate that the share of contract workers in PMM occupations in manufacturing rose from 1.7 percent in 1990 to 5.4 percent in 1997. Strikingly, while the number of direct-hire contract workers in manufacturing declined sharply following 1997, we estimate the number of PMM contract workers in manufacturing was stable and then rose through 2015 before declining slightly. Correspondingly, the share of contract PMM employment steadily rose from 5.5 percent in 1997 to 10.0 percent in 2015, before dropping to 9.5 percent in 2018. From 1997 to 2018, while direct-hire PMM employment declined by 31 percent from 1997 to 2006, the estimated number of contract PMM workers rose by 26 percent.

Our estimates indicate that the shift to contract workers can account for more than 22 percent of the decline in PMM employment in manufacturing between 1990 and 2018 and for about 10 percent of the decline between 1997 and 2018.

Variation in contract use by manufacturing industries

The prevalence of contract workers varies considerably across manufacturing industries. Figure 2 displays our estimates of the contract share for each of the twenty-one 3-digit NAICS manufacturing industries.[10] The blue bar shows the estimated share in 1990, the orange bar shows the percentage point change between 1990 and 1997, the green bar shows the percentage point change between 1997 and 2018, and the three bars combined show the contract share in 2018. Estimates of the contract share in 2018 range from 4.6 percent in petroleum and coal to 12.5 percent in beverages and tobacco. The 2018 contract share tends to be the lowest in industries that experienced the greatest relative declines in employment (45 percent or more) over the period. These include the printing, textile mills, textile product mills, leather, and apparel industries. Notably, however, the estimated contract share expanded in every period in every industry.

Table 2 shows the percent change in PMM direct-hire employment and in PMM employment adjusted for contract use by 3-digit NAICS manufacturing industry. The first panel displays these figures for the entire period, 1990-2018, while the second panel shows these

[10] As noted above, we estimate contract use at the 4-digit NAICS level.

estimates from 1997 to 2018. Figures 3a and 3b compare the percent changes for direct-hire and adjusted PMM employment over the two periods for selected industries. Omitted from these figures are industries that hire relatively few workers and industries that experienced the largest employment declines, for which the shift to contract employment can account for less than 10 percent of the industry's employment decline between 1997 and 2018.

As the left panel of Table 2 and Figure 3a show, direct-hire employment grew in just two industries, food and beverage and tobacco products between 1990 and 2018. Adjusting for contract use suggests that employment growth was about 150 percent and 50 percent higher in beverage and tobacco and in food, respectively, between 1990 and 2018. In the chemicals, plastics and rubber, fabricated metals, and transportation industries direct-hire PMM employment declined, but adjusted employment rose. In several industries experiencing moderately large declines in employment, the shift to contract work can account for a sizable share of the decline. For example, our estimates indicate that the shift to contract workers accounts for 33 percent of the 19 percent decline in wood products, 22 percent of the 29 percent decline in nonmetallic mineral products, 29 percent of the 24 percent decline in machinery, 16 percent of the 36 percent decline in furniture, and 48 percent of the 19 percent decline in miscellaneous manufacturing.

The second panel of Table 2 and Figure 3b display corresponding numbers over the 1997 to 2018 period. Again, direct-hire PMM employment grew in only food (9 percent) and beverage and tobacco products (13 percent), and our estimates indicate that, accounting the shift to contract workers in these industries employment growth is 45 percent and 18 percent higher, respectively. Although employment declines were concentrated in this period and the growth of contract labor slowed somewhat after the 1990s, the shift to contract PMM workers still accounts for a sizable share of the decline in several industries. These include miscellaneous manufacturing (14 percent of the 28 percent decline), plastics and rubber (18 percent of the 23 percent decline), fabricated metals (20 percent of the 15 percent decline), chemicals (23 percent of the 19 percent decline), and transportation (27 percent of the 17 percent decline).

Regional variation in contract use

The prevalence of contract work in PMM occupations in manufacturing also varies considerably across regions. Figure 4 displays the estimated share of ES workers in manufacturing PMM occupations by region. As in Figure 2, the blue bar shows the estimated share in 1990, the orange bar shows the percentage point change between 1990 and 1997, the green bar shows the percentage point change between 1997 and 2018, and the three bars combined show the contract share in 2018. In 2018, estimated contract use was particularly high in the Southwest (11.9 percent), the Southeast (10.9 percent), and the Great Lakes (10.1 percent) regions.

Given the high variation in contract use by industry displayed in Figure 2, one might expect that the regional variation largely reflects differences in the industry composition of manufacturing across regions. Industry variation appears to play a relatively small role in explaining regional variation, however. Table 3 shows 2018 estimates of the actual and predicted

share along with the ratio of actual to predicted, by region. We estimate the predicted share by assuming that the share of contract workers in each industry within a region equals the national average for that industry. In regions where the estimated PMM contract shares are the highest (the Southwest, Southeast, and Great Lakes), the predicted shares are considerably lower and in the other regions the predicted shares are higher than actual, with the greatest differential in the region with the lowest share of contract PMM workers, the Plains. Thus, the actual variation across regions in the share of contract PMM workers in manufacturing, depicted in Figure 5a, is far greater than the predicted variation across regions, shown in Figure 5b.

Note that we only impute temporary help and unassigned PEO workers in PMM occupations to user industries, and in our predicted measure we continue to reassign PEO workers to the industry to which they are assigned in BLS data. By 2018, these assigned PEO workers account for an estimated 9.4 percent of all estimated employment services PMM workers in manufacturing. While it is possible that regional variation in the use of these PEO workers could account for some of regional variation we observe, removing these workers from both our imputed and predicted estimates of the contract share does not alter the picture.

There also is considerable variation in manufacturers' use of contract PMM workers across MSAs within regions. Table 4, which presents our estimates of contract use in 2018 for seven MSAs in the Great Lakes region with a relatively large manufacturing presence, illustrates this within-region variation. The estimated share of PMM contract workers assigned to manufacturing in the Detroit and Cincinnati MSAs is below the national average, while the share in the Chicago, Grand Rapids, Indianapolis, and Milwaukee MSAs is considerable higher. The case of Grand Rapids is notable because the MSA was one of the few in the country to experience a net increase in direct-hire manufacturing employment since 1990 and is widely regarded as being one of the most, if not the most, successful MSAs at rebuilding its manufacturing base since the Great Recession (Atkins 2011, Bartik 2018). Our data indicate, however, that that this success was accompanied by a great expansion of contract work in factories.

Interestingly, we also find that in all regions the prevalence of contract use by manufacturers is higher among those located in urban areas compared to those located in rural areas. This pattern could reflect the fact that temporary help agencies assign workers on a short-term basis to different clients when they need them. The temp help model, to some degree, relies on there being a variety of businesses that demand their services at different times during the year. The lack of economic diversification in rural areas may mean that temporary help agencies are less likely to locate there.

CONCLUSION

In lieu of hiring workers as employees, organizations commonly use independent contractors or contract workers who are employees of other companies to perform certain tasks. This contract workforce is often not well measured, and even when it is, information linking contract workers to the organizations for whom they perform tasks is often poor. Such data gaps may have significant implications for many types of research and policy analysis.

In this paper, we develop a new method for imputing contract company workers to manufacturing industries over a two-to-three-decade time period, substantially improving upon prior methods. Our analysis focuses on workers in production and material mover occupations, which comprise the core occupations in factories and are of considerable policy interest. The employment services industry accounts for nearly all contract company workers in these occupations in the U.S. economy, and the use of workers in these occupations is concentrated in manufacturing and a small number of other sectors. These facts, we believe, lend credibility to our strategy for assigning contract workers in these occupations to user industries.

We find that manufacturers' use of contract PMM workers grew rapidly over our period of study, accounting for less than 2 percent of all PMM workers in 1990 to 10 percent by 2015. Notably, the share of the contract workforce continued to rise sharply in the 2000s, even when manufacturing registered steep declines in the number of direct-hire employees in these core occupations. Consequently, the shift to contract workers accounts for a sizable share of the decline in employment in these core occupations for the sector overall and for many manufacturing industries, which has implications for our understanding of the shifting structure of employment in the economy.

Accounting for the shift to contract workers has potentially significant implications for other economic and policy analyses. For example, changes in the use of contract workers in manufacturing biases labor productivity measures and, if the adoption of new technology and the use of contract workers are correlated, could bias the results from studies that estimate the effects of automation on employment. Our data suggest that within production and material mover occupations, manufacturers primarily contracted out low-skill occupations, which could bias estimates of the changing demand for skills in the sector. Understanding the use of contract labor in manufacturing is important for economic development policy as well. Cities and states often offer manufacturers large incentive packages to locate factories in their area. The benefit-cost calculations performed to justify these incentive packages typically use regional economic models to generate a multiplier effect from the additional factory jobs. If, however, many of the promised jobs are with staffing agencies, regional economic multipliers will overstate the economic benefits in benefit-cost calculations.

A key product of our research is a new data set that, for detailed production and material mover occupations, supplements OEWS estimates of direct-hire employment with estimates of the use of contract workers by detailed industry (manufacturing and other sectors) and region (MSA/BOS) over time. In future research, these data could help inform our understanding of the drivers of contracting out and the implications of contracting out for workers.

In closing, while our study has focused on the case of manufacturers' use of contract workers core occupations, this case is not unique. Our study points to a larger need for better data that link contract workers with those using their services to improve economic and policy research on a wide range of issues.

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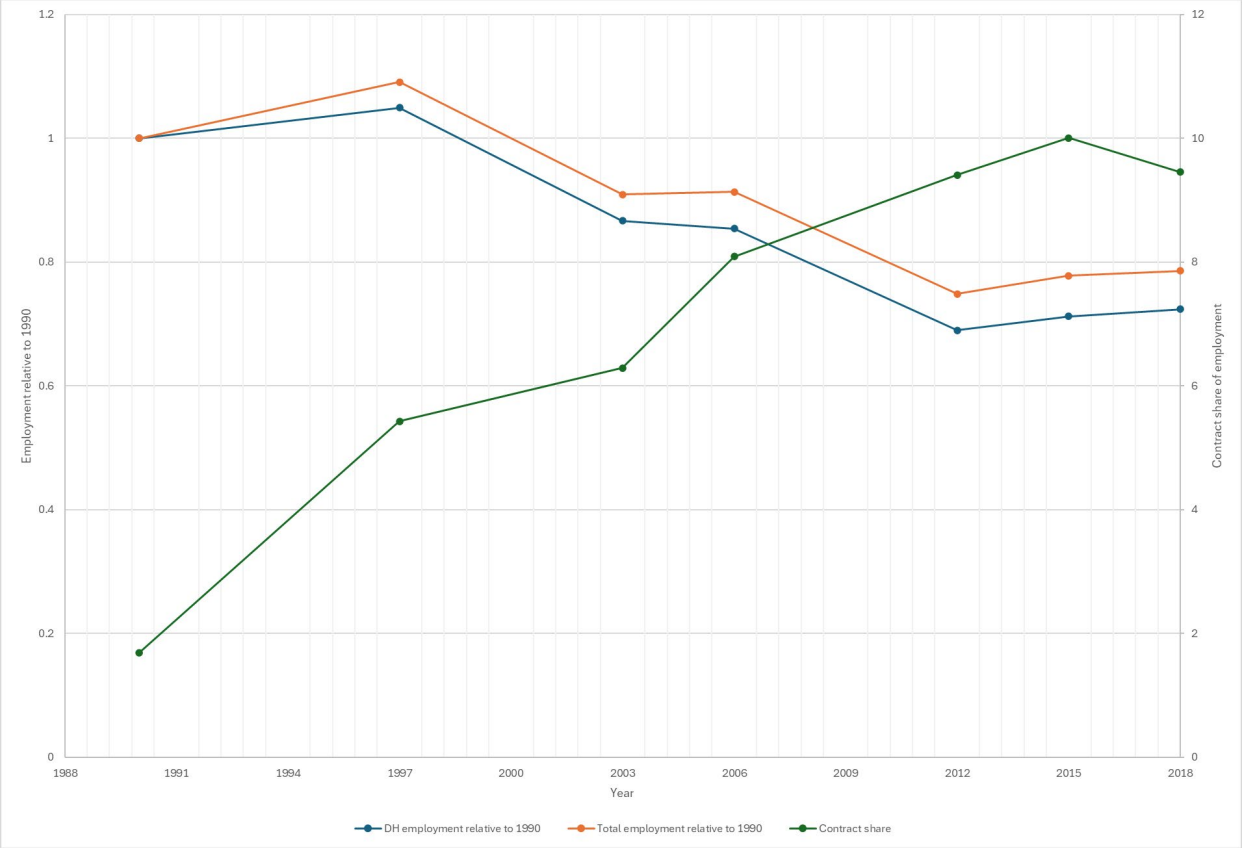
Table 1: Economywide Share of Workers in Manufacturing and Employment Services, by Broad Occupation, 1990-2018

		1990	1997	2003	2006	2012	2015	2018	PPT chg, 1990-2018
Production	Manufacturing	75.1	72.8	73.9	73.2	71.0	70.6	71.2	-4.0
	Employment Svcs	1.5	5.3	5.5	7.3	8.3	8.9	8.2	6.8
Material movers	Manufacturing	25.7	21.0	20.0	17.9	14.7	13.4	13.6	-12.1
	Employment Svcs	4.9	9.2	11.8	11.7	12.3	13.3	13.8	8.9
All other	Manufacturing	9.0	7.2	5.4	5.0	4.4	4.3	4.3	-4.7
	Employment Svcs	1.3	1.9	1.6	1.8	1.5	1.5	1.5	0.2

Source: OEWS

Figure 1: Index of employment in production and material mover occupations, direct-hires and adjusted for contract use, and share of contract employment, 1990-2018



Notes: The blue and orange lines depict an index of manufacturing employment (1990=1) for direct-hire manufacturing PMM workers and manufacturing PMM workers adjusted for contract workers, respectively. The index vales are shown on the left axis. The green line shows the share of contract workers in manufacturing PMM employment.

Figure 2: Percent contract in PMM occupations by industry: 1990, 1997 and 2018

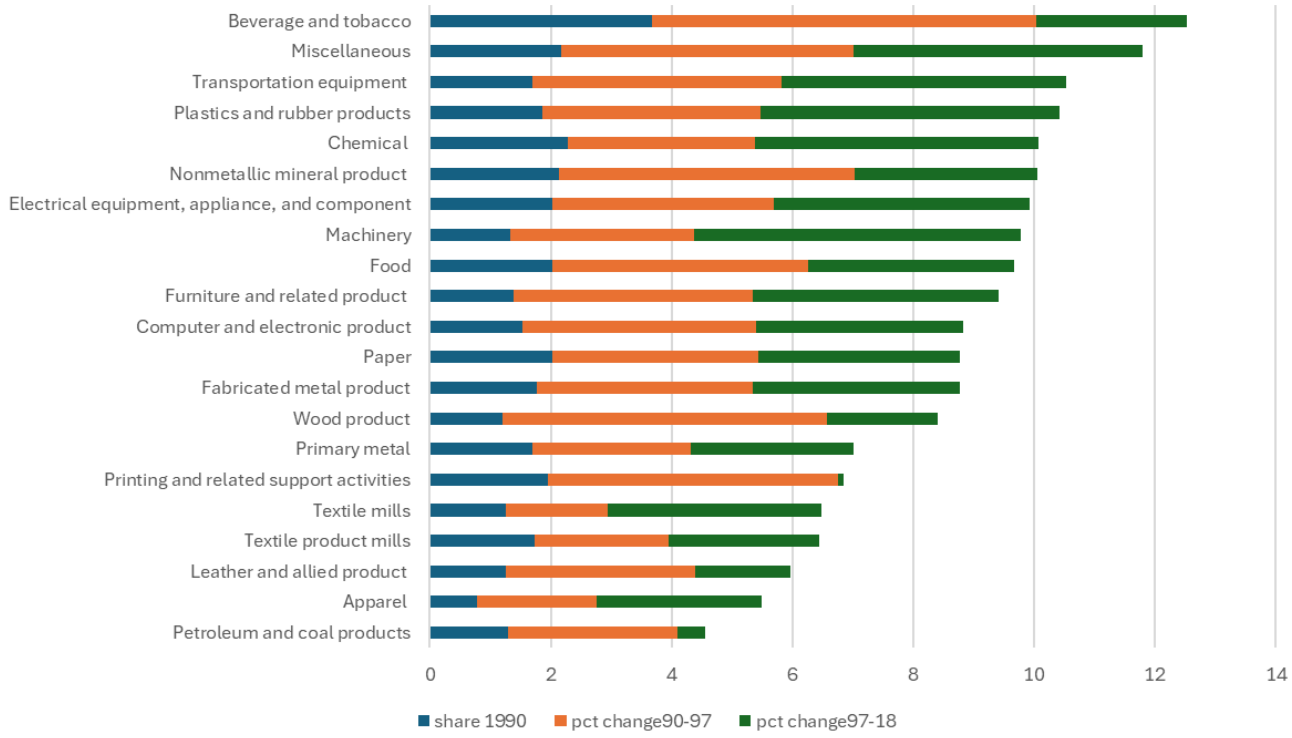
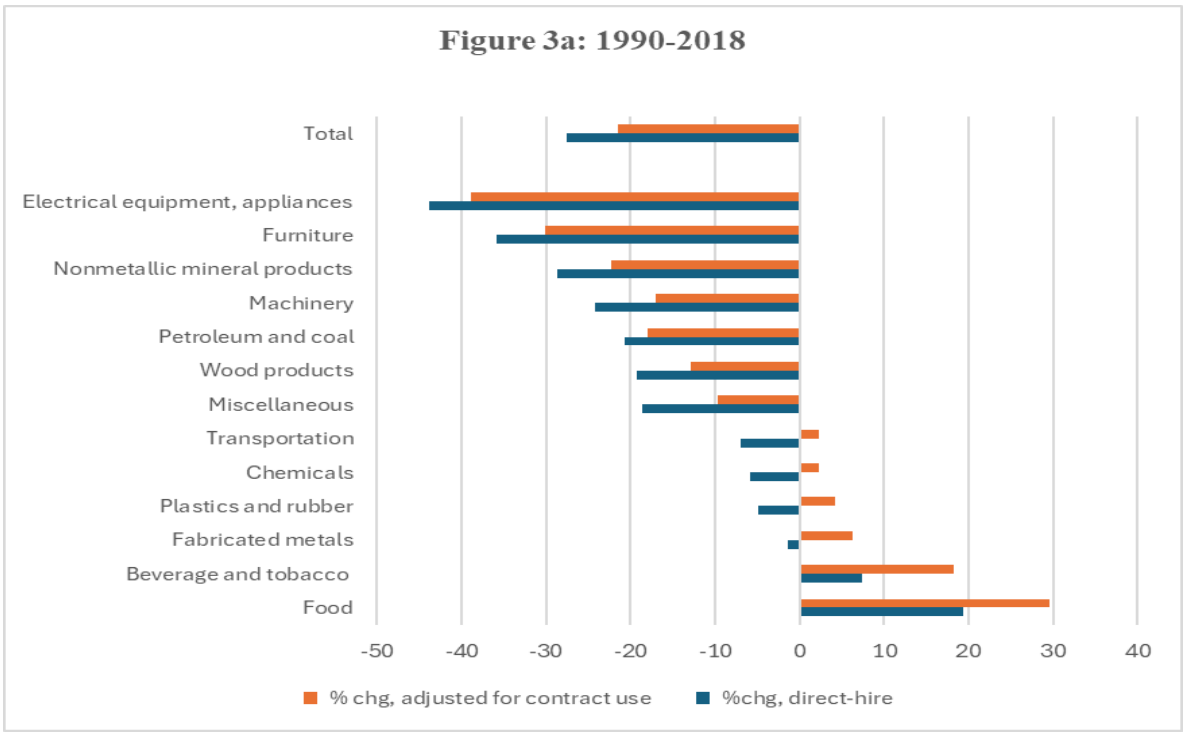


Table 2: Percent change in employment in production and material mover occupations, direct-hires and adjusted for contract use

	1990-2018		1997-2018	
	%chg, direct-hire	% chg, adjusted	%chg, direct-hire	% chg, adjusted
Food	19.4	29.5	9.3	13.4
Beverage and tobacco	7.4	18.2	18.7	22.1
Wood products	-19.2	-12.8	-27.9	-26.4
Petroleum and coal	-20.6	-17.9	-6.7	-6.3
Chemicals	-5.8	2.4	-18.6	-14.4
Plastics and rubber	-4.9	4.2	-23.0	-18.8
Nonmetallic mineral products	-28.6	-22.3	-30.1	-27.7
Fabricated metals	-1.3	6.3	-15.6	-12.4
Machinery	-24.1	-17.0	-30.9	-26.8
Electrical equipment, appliances	-43.8	-38.9	-44.0	-41.4
Computer and electronics	-55.3	-51.7	-56.5	-54.9
Paper	-42.2	-37.9	-43.8	-41.7
Transportation	-6.9	2.3	-16.5	-12.1
Furniture	-35.8	-30.1	-39.3	-36.6
Primary metals	-40.6	-37.2	-40.5	-38.8
Printing	-47.2	-44.5	-46.7	-46.7
Textile mills	-78.3	-77.1	-75.4	-74.4
Textile product mills	-45.0	-42.2	-49.7	-48.4
Leather and allied products	-78.9	-77.9	-68.9	-68.4
Apparel	-89.8	-89.3	-85.8	-85.4
Miscellaneous	-18.6	-9.7	-27.6	-23.7
Total	-27.6	-21.4	-31.0	-27.9

Figure 3: Percent change in direct-hire and adjusted PMM employment, selected industries



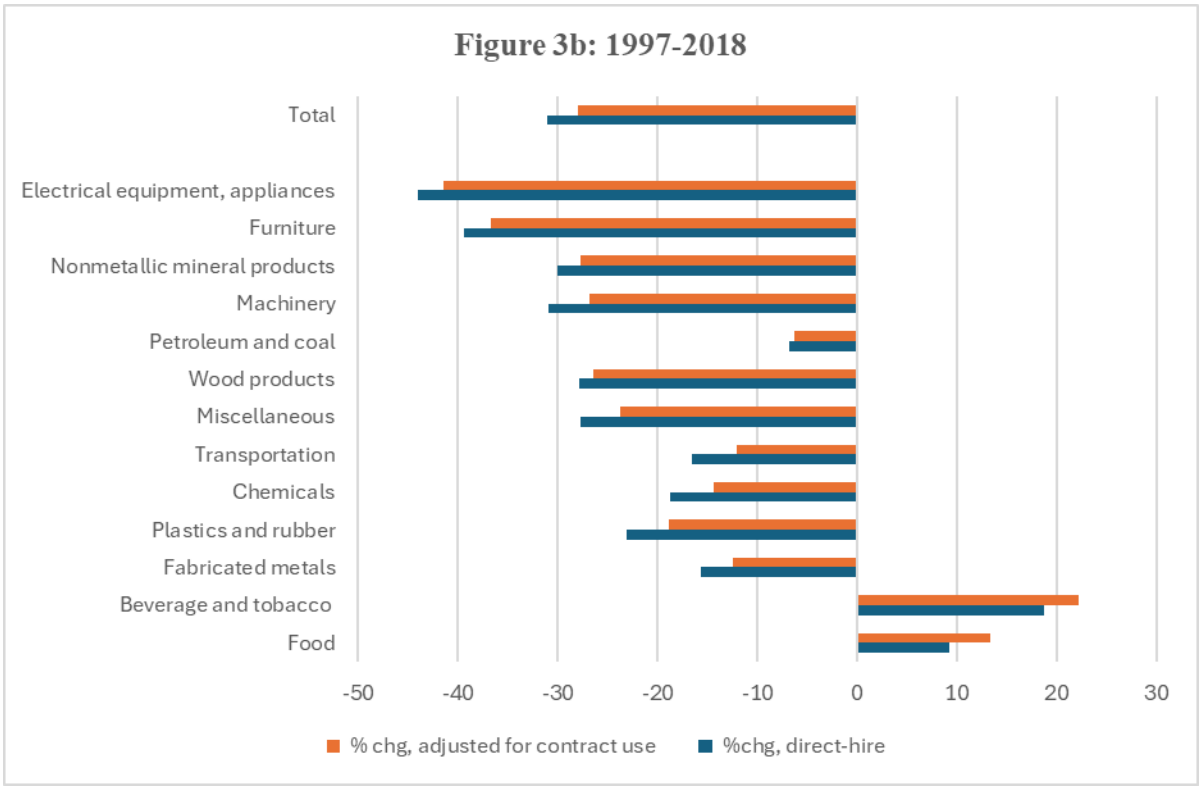


Figure 4: Percent contract in manufacturing PMM workforce by region, 1990, 1997, 2018

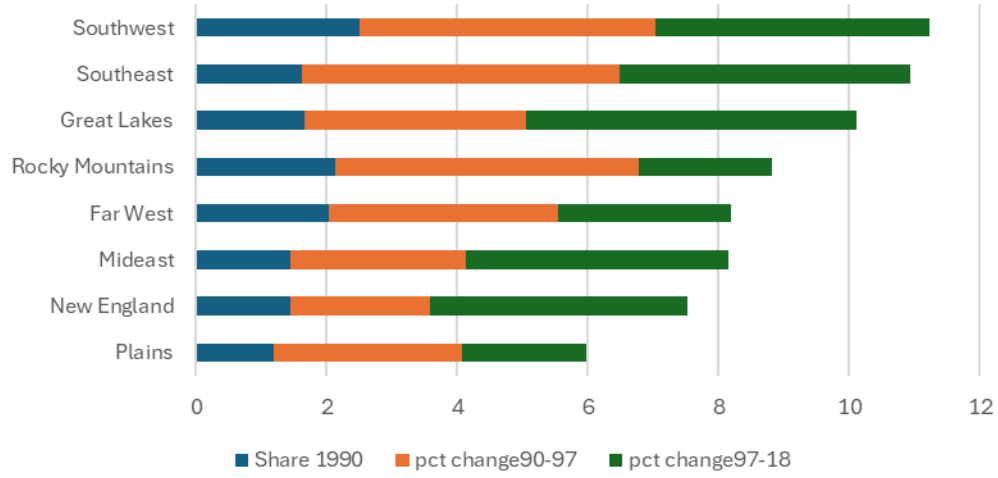
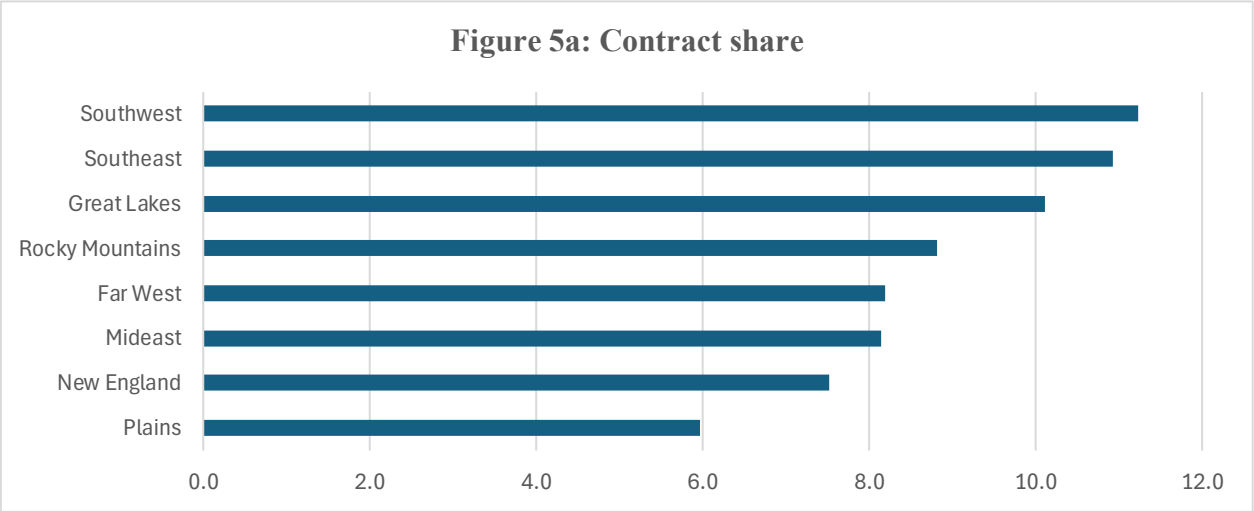


Table 3: Actual v. predicted share of contract PMM workers in manufacturing by region, 2018

	% contract	predicted % contract	ratio, actual/predicted
Plains	6.0	8.9	0.67
New England	7.5	8.7	0.86
Mideast	8.1	9.7	0.84
Far West	8.2	9.4	0.87
Rocky Mountai	8.8	9.3	0.95
Great Lakes	10.1	9.6	1.06
Southeast	10.9	9.8	1.12
Southwest	11.2	8.9	1.27

Figure 5: Actual v. predicted share of ES workers in production and material moving occupations in manufacturing, 2018



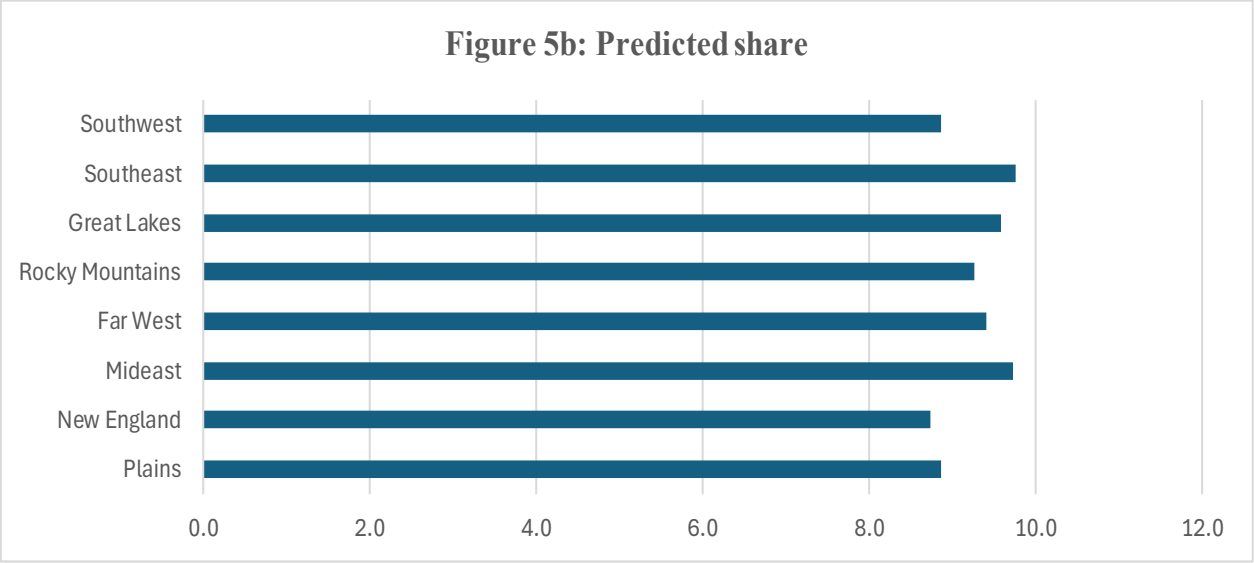


Table 4: Contract Workers in PMM Occupations, Selected Great Lakes Region MSA, 2018

	PMM direct hires	PMM contract workers	Percent contract
Chicago-Naperville-Elgin, IL-IN-WI	226,760	50,356	18.2
Cincinnati, OH-KY-IN	68,337	6,028	8.1
Cleveland-Elyria, OH	73,866	8,106	9.9
Detroit-Warren-Dearborn, MI	159,211	13,194	7.7
Grand Rapids-Wyoming, MI	72,314	21,656	23.0
Indianapolis-Carmel-Anderson, IN	50,571	12,648	20.0
Milwaukee-Waukesha-West Allis, WI	68,687	9,467	12.1

APPENDIX

The appendix table compares the share of workers in production occupations (top panel) and in material mover occupations (bottom panel) assigned to manufacturing industries by year for three imputation methods: the proportional use method, the model-based approach using 1990 as the base year, and the model-based approach using 1997 as the base year. For the two model-based approaches, the choice of base year has almost no effect on the probability of assignment to manufacturing for either worker type. For material movers, the probability of assignment to manufacturing is somewhat higher (3.7 percentage points) in the model-based approach than in the proportional use approach in 1997, but the assignment rate differential across imputation methods is small in subsequent years.

Differences are most significant between the proportional use and model-based approaches in the share of production workers assigned to manufacturing in 2003 (8.7 percentage points). The gap between the two sets of estimates narrows in 2006 and 2012 and by 2015 there is no substantive difference in assignment probabilities between approaches. We plan to explore possible reasons for the difference in assignment probabilities of production workers during the middle years of our data.

Appendix Table 1: Share of contract employment assigned to manufacturing in production and material moving occupations, by imputation method, 1990-2018

	1990	1997	2003	2006	2012	2015	2018
Workers in production occupations							
Proportional use	74.7	71.7	81.7	83.6	84.2	84.5	83.3
Modeled, 1990 base		70.1	73.0	80.3	81.8	84.1	83.6
Modeled, 1997 base			73.1	80.3	81.8	84.1	83.6
Workers in material mover occupations							
Proportional use	31.0	27.4	22.8	23.2	22.0	20.8	21.8
Modeled, 1990 base		31.1	23.2	24.0	22.3	21.4	21.3
Modeled, 1997 base			22.7	23.9	22.3	21.4	21.3