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

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February 2025

Revised December 2025

Abstract

Research and policy analysis on labor market issues often rely on employment measures that capture only the direct-hire 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 microdata 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 more than 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.

JEL codes: L60, J40, J46

Key words: contract workers, staffing agencies, temporary help workers, PEOs, manufacturing employment

[1] We thank Claudia Macaluso, John Haltiwanger, Carol Corrado, Tim Bartik and attendees of the CRIW-NBER conference on The Changing Nature of Work, March 2025 for helpful comments and suggestions. 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 direct-hire 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 changes 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

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

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 data from the Current Population Survey (CPS) to impute workers in the staffing services industry to manufacturers. It 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 Bureau data on manufacturers' expenditures for staffing services and find that growth in its use since 2007 can explain a substantial share of the measured decline in job reallocations.[3]

[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.

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 (four-digit NAICS), occupation (six-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 less than 2 percent of workers in these core manufacturing occupations in 1990 and peaking at 10 percent in 2015. We estimate that the shift to contract work accounts 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

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

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 and present robustness checks on our estimates. 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 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 employ only 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.

Employers turn to temporary help staff for a variety of reasons. Employers commonly use temp staffing to increase workforce flexibility. Employers may have a short-term need for temp staff to fill in for an absent employee, to meet seasonal demand, or to work on a special project. Using temp staff allows employers to quickly adjust the size of their workforce. Screening workers for permanent employment is also a common reason for using temp agency workers. Speaking in 2012, a former Kelly Services CEO stated that "Companies' use of temporaries used to be a gap measure. Now the largest corporations have a specific model of how much of their workforce is going to be temporary. It's a critical path for companies to fill their talent needs" (Carl Camden, quoted in Rothschild 2012). Companies may hire a certain percentage of their workforce in certain occupations through a temp agency and then offer direct-hire jobs to the best workers in that pool as vacancies open up. Hiring through a third-party intermediary can make it easier for companies to try out a wide variety of candidates for a job and thus improve matches (Houseman, Kalleberg, and Erickcek 2003). Hiring through an intermediary during the probationary period also may reduce labor costs, because temp agency workers typically have few if any benefits and sometimes lower wages. Thus, temporary help agencies have become an important port-of-entry to permanent employment for many workers (Abraham 1990; Houseman 2001; Kalleberg, Reynolds, and Marsden 2003; and Ono and Sullivan 2006). Using administrative data from a large staffing firm, Houseman and Heinrich (2017) find that about 14

[5] Prior to the adoption of the NAICS industry coding system in the early 2000s, temporary help agencies and PEOs were combined in one industry.

percent of the workers who took assignments from the staffing agency during a five-year period were hired by a client company at some point.

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 economy-wide share of workers in manufacturing and employment services for selected broad occupational categories between 1990 and 2018.[6] Manufacturing 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 during those years. 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, for 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).

[6] Throughout the paper, when we refer to production and material mover occupations, we are only considering detailed occupations in these categories where the employment services share of total employment exceeds two percent at any point during our study period. For example, first-line supervisors of production and operating workers (SOC 51-1011) are infrequently employed in the employment services sector and are excluded from the production worker category.

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 report only employment, occupation, and wage information for W-2 employees. Organizations' use of contract labor is not collected in this survey, nor, 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 the 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 data on occupations come from the Occupational Employment and Wage Statistics (OEWS) survey, which is 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 three-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 semiannual survey that samples approximately 200,000 establishments in May and another 200,000 in November of each year.[7] The survey covers all workers, both full-time and part-time, in private nonagricultural 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.[8]

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

[7] Prior to November 2002, the program surveyed approximately 400,000 establishment in November of each year.
[8] 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.

categorize workers into roughly 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 and material-mover occupations at the six-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, the 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 four-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 four-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 four-digit NAICS) for each MSA/BOS.[9] These detailed occupation-by-industry-and-area estimates are, in essence, the product of the estimated staffing pattern using

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

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 to BLS protocol. 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.[10]

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*.

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

[10] The May 2019 OEWS data include data collected in November 2016, May and November 2017, May and November 2018, and May 2019, and so are more or less centered on May 2018, which coincides with the month we are using for the industry-area employment totals in the QCEW.

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

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

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 assume that industry *i's* demand for ES workers in occupation *j*, area *a*, and time *t* is proportionate to its employment of direct-hire workers in the occupation, which we directly observe in our data. In this case, an industry's total demand for workers in occupation j may be written as follows:

$$(3)\ \widetilde{E}_{jiat} = k^{p}_{jiat} E^{DH}_{jiat}$$

Within a specific area and time period, k^{p}, whose value is greater than one, captures the propensity to substitute employment services workers in a specific, detailed occupation for direct-hire workers in that occupation. We assume this propensity does not vary across industries within the area in time *t*: $k^{p}_{jiat} = k^{p}_{jat}, \forall i$. Substituting industry and total demand for occupation *j* into Equation (1) yields:

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

Simplifying this equation shows that, in the proportional-use approach, within an area and time period, ES workers in an occupation are assigned to a user industry in proportion to the industry's overall use of direct-hire workers of the occupation.

$$(4)\ \tilde{p}_{j|iat} = \frac{E^{DH}_{jiat}}{E^{DH}_{jat}}$$

One might be concerned, however, that if this proportional use assumption is violated, it could lead to biased estimates that worsen over time. For example, if manufacturers are more likely to substitute hand-material movers from staffing agencies for direct-hire workers in this occupation, then the more manufacturers use ES workers in this occupation relative to firms in other sectors, the fewer we would impute to manufacturing. And if the ES share of material movers 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

As a robustness check on the proportional use approach, 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 noncontract 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_{iat}^{NC} 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 current-period noncontract employment, the ratio of estimated total employment in a contract occupation to noncontract employment in the prior period, and an adjustment factor k_{jiat}^{m} , which allows for changes in the production function over time that affect the use of workers in a specific contracted occupation relative to workers in noncontracted occupations.

$$(5)\ \tilde{E}_{jiat} = k^m_{jiat} E^{NC}_{iat} \left(\frac{E^*_{jiat-1}}{E^{NC}_{iat-1}} \right)$$

To designate a PMM occupation as "noncontract," 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.[11] We assume that k^m does not vary across industries within the area in time t: $k^m_{jiat} = k^m_{jat}, \forall i$. Thus, while the ratio of employment in a contract occupation to employment in these designated noncontract occupations may change over time---for example, because of skill-biased technology adoption---the modeled approach assumes that, for a detailed PMM occupation, the rate of change is the same across industries in the MSA/BOS using that PMM worker. Substituting industry and total demand for occupation j from Equation (5) into Equation (1) and simplifying yields the following:

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

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 proportional-use approach.

[11] 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 noncontract group. First-line supervisors of production workers constitute an example of a non--contracted out production occupation, because it is rarely outsourced.

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, in its early years 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 nonemployment 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, so 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 occupation *j's* share of employment in industry *i,* as 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, so 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:

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

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 proportional-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 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 Appendix Table A1. We favor the proportional-use approach over the modeled-demand approach mainly because of the data requirements of the latter.[12] Reassuringly, we find that our results are similar using either of the two methods. Changing the

[12] We are particularly concerned about estimates for 2003, which in the modeled-demand approach, utilize data from noncontracted occupations at the detailed-industry level in 1997 and 2003 to estimate demand for production and material-moving workers by detailed occupation and industry in 2003. In the six-year period from 1997 to 2003, the manufacturing industry underwent a severe contraction. Such structural changes could have differentially affected the relative demand of contract v. noncontracted occupations across industries and hence the accuracy of our estimates. Moreover, during this period, there was a shift in industry codes from SIC to NAICS and a shift in occupation codes from internal OES codes to SOC-based ones. We are less confident in the estimates for this period, given the code changes.

base year in the modeled-demand approach has almost no effect on subsequent estimates. Comparing the proportional-use and modeled-demand approaches, we find that 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 they are nearly identical.

Additionally, for two years during our study period, 2010 and 2011, we have data from a large U.S.-based staffing company on the industry in which it placed temporary-help workers in production and material-moving occupations. These data also have information on the start and end dates of each assignment, enabling us to compute the weekly shares of workers in production and material-mover occupations going to manufacturing and other sectors. The share of production and material movers assigned to manufacturing in this company is closely comparable to our estimates for that time period. We elaborate on this robustness check in the appendix to this paper as well.

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 that 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 Bureau 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 percentage of PMM manufacturing workers who are contract 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 it had lost during the Great Recession, and as a result, 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 that the number of PMM contract workers in manufacturing was stable and then rose through 2015 before declining

slightly.[13] 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 21 three-digit NAICS manufacturing industries.[14] 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

[13] We do not know the reason behind the modest relative decline of temporary-help use in PMM, especially production occupations. One possible explanation is the tightening of labor markets toward the end of our period. Temporary help agencies likely have a harder time than other employers recruiting workers, because most workers desire permanent, stable work. Another potential explanation is the advent of "gig" platforms. While the rapid growth of rideshare platforms like Uber and Lyft have received more attention among researchers and policymakers, during this time similar models were developing to place workers into blue-collar occupations. Workers are usually classified as independent contractors in the platform business model. Thus, unlike temp agency workers who are hired as W-2 workers by agencies, platform workers usually are not captured by OEWS and QCEW data.

[14] As noted above, we estimate contract use at the four-digit NAICS level, which is aggregated to show contract use for three-digit NAICS industries, displayed in Table 2.

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 three-digit NAICS manufacturing industry. The first panel displays these figures for the entire period, 1990--2018, while the second panel shows these estimates from 1997 to 2018. Figures 3a and 3b compare the percent change in 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, between 1990 and 2018, direct-hire employment in PMM occupations grew in just two industries, food and beverage and tobacco products. Adjusting for contract use suggests that employment growth in these occupations 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 PMM employment 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.

Figure 3B and the second panel of Table 2 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 if we account for 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 employment in these occupations in several industries. These industries 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. The greatest differential occurs 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 the 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 there was one of the few in the country to

experience a net increase in direct-hire manufacturing employment since 1990. It 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 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.

HOURS AND DAYS WORKED OF TEMPORARY HELP AND DIRECT-HIRE WORKERS

The OEWS measures workers employed in ES and other industries during a specific week in the month surveyed. A possible concern with the estimates presented above is that our imputations of ES workers to user industries may overstate the amount of contract labor relative to direct-hire labor if contract workers systematically work fewer hours per week than direct-hire workers.

We expect that any differences in hours would be concentrated among temporary help workers, who account for most ES workers in production and material-moving occupations and are assigned to clients for limited time periods—not among PEO workers, who are assigned for an indefinite period to clients. Additionally, because workers in production and material-moving occupations tend to work for set shifts, we believe that differences in daily hours of temporary

and direct-hire workers are likely to be minimal. There are two potential problems, however. First, temporary help workers may be assigned to a client for a partial week. Second, temporary workers may be more likely to quit or be fired for cause mid-week than their direct-hire counterparts. Possibly countering these factors is that temporary help workers rarely receive paid time off and generally only accept assignments for times when they are available. For this reason, we might expect that they would be less likely than their direct-hire counterparts to be absent from work during the week because they are on vacation or taking other leave. We use two data sources—the CPS and proprietary data from a large staffing company—to test for possible differences in hours or days worked by agency staff compared to direct-hire manufacturing workers in production and material-mover occupations.

Evidence from the CPS

We use monthly CPS data to test for weekly differences in hours worked between employment services and direct-hire workers. The CPS does not break out temporary help services from the more aggregated employment services industry, which also includes PEOs and employment placement agencies. We expect, however, that most if not all of these workers are employed by temporary help agencies.[15] The CPS collects information from respondents, who report for themselves and other household members their actual weekly hours and the industry and occupation of employment. We use information on workers' main job. Because of changes

[15]This is because temp help services account for most of the PMM workers in the employment services industry. Also, as we discuss below, while it is known that many temporary help workers misreport their client as their employer in household surveys, the problem is likely to be greater for PEO workers, who are permanently leased to a client. As evidence, the BLS does not collect information on PEOs in the Contingent Worker Supplement (CWS) to the CPS because it was felt that respondents could not reliably provide the information. Although, in theory, using information from the CWS (which collects information on whether a worker is employed by a temporary help agency and the industry to which that worker is assigned) would have been better suited to our purposes, sample sizes from the CWS are too small to support our analyses.

in occupation and industry coding, we use data for workers in production and material-moving occupations for those working in manufacturing or employment services industries between 2003 and 2019.

Table 5 reports the ratio of average actual hours worked by workers employed in employment services to that of workers employed in manufacturing separately for production and material-moving occupations, by year. The ratio is somewhat higher for production workers and relatively constant over time, ranging from 0.88 to 0.92. For material-mover occupations, the ratio is lowest at 0.78 in 2009, which coincides with the Great Recession. Otherwise, the ratio ranges from 0.82 to 0.88.

Although Table 5 separates production from material-moving occupations, there is considerable heterogeneity in skill levels within these occupational groupings. In Table 6, we examine the ratio of actual hours of ES to manufacturing workers for the largest production and material-moving occupations. Because sample sizes for employment-services workers by detailed occupation tend to be very small for individual years, we pool data across years. The ratios range from 0.84 for laborers and hand-material movers to 0.95 for welders.

Although the CPS data measure the right concept for our purposes, they suffer from known quality issues. Most important for our study is the fact that employees of staffing agencies often report the client for whom they perform their work, rather than the staffing agency, as their employer.[16] As a result, their industry of employment is likely to be misreported as the client industry, rather than employment services. It is reasonable to suppose that agency workers on

[16] In recognition of this problem, the CWS, which includes questions about work for temporary help agencies, asks respondents who report working for a temporary help agency whether, in the main CPS, the employer they reported was the temp agency or the client where they were assigned. Across the five CWS supplements administered between 1995 and 2017, a weighted average of 63 percent answered that they reported the client rather than the temp agency as their employer.

long assignments are most likely to report the client industry as their employer. If agency workers who are on assignment for part of the week are less likely to misreport their industry than those workers on longer assignments, the hours ratio estimates reported in Tables 5 and 6 would be downwardly biased.

Evidence from a large staffing company

As complementary evidence on possible differences in hours worked by temp agency workers assigned to manufacturing and direct-hire manufacturing workers, we utilize proprietary data from a large U.S.-based staffing company. For temporary-help assignments made by this company in the United States in 2010 and 2011, we have information on the start and end dates of each assignment, the worker's detailed occupation, and the industry to which the worker was assigned. An advantage of these data is the large number of assignments we observe for workers in production and material-moving occupations assigned to manufacturers. The number of production workers on assignment with U.S. manufacturers typically exceeded 10,000 in a week and peaked at more than 18,000 in some weeks. The number of material movers assigned to manufacturers typically ranged between 4,000 and 6,000 a week.

While we do not have the weekly hours worked by the temp agency worker and direct-hire workers, we can tell the number of days in a given week that each temp agency worker in a production and material-moving occupation was on a specific assignment with a manufacturing establishment. We assume that the typical direct-hire worker in these occupations works five days per week and that temp agency staff work the same number of hours per day as direct-hire workers. The latter assumption is reasonable, we argue, given that temp staff in production and material-moving occupations primarily work shifts alongside direct-hire workers. For each week (Sunday to Saturday) during this two-year period, we use workers' start and end dates for the

assignment to compute the number of days that they were on assignment. For workers on an assignment for multiple weeks, that number may be seven. We count workers on assignment for five to seven days as working a full work week; we count those on assignment for four days, three days, two days, and one day during the week as working 80 percent, 60 percent, 40 percent, and 20 percent of a work week, respectively. The distribution of assignment lengths for workers in production and material-moving occupations is approximately a week at the 25th percentile, three weeks for those at the 50th percentile, three months for those at the 75th percentile, and six months for those at the 90th percentile. This distribution implies that, in any given week, most temp work will be done by workers on assignment for the full week. In these data, on average, 92 percent of temporary help workers in production occupations and 90 percent in material-mover occupations assigned to manufacturing are on assignment for the full week.

Figure 6 plots the average percentage of a full work week worked by temp agency workers in production and material-moving occupations assigned to a manufacturer over the period.[17] The percentages are high and stable throughout the period—ranging from 94 to 99 percent for production workers and from 93 to 98 percent for material movers. We have computed these statistics for temp agency staff in production and material-moving occupations who are assigned to other sectors and find similar results.

These calculations may somewhat overstate or understate the amount worked by temp agency staff relative to direct-hire staff. On the one hand, the calculation assumes that temp staff work a full day if they are on assignment for the day. Thus, it will overestimate the percentage of

[17] We drop the first six months of data because the industry of assignment for workers starting assignments prior to January 1, 2010, is not recorded in our data. Consequently, in the initial months of our data, the percentages reported in the figures would be artificially lowered by the fact that they do not capture long-tenured temporary-help workers on assignment. Based on the assignment-length distributions in our data, after six months, our figures should capture at least 90 percent of workers on assignment in any given week.

the work week worked if, for example, temp agency workers quit or are fired in the middle of a workday or are absent for health or other reasons. On the other hand, the comparison to direct-hire staff implicitly assumes that direct hires always work a full week. Yet they may work partial days or be absent for the same reasons temp staff are. And, because temp agency staff rarely enjoy paid time off, they may be less likely than direct hires to be absent.

Our findings using administrative data from a large staffing company are consistent with earlier evidence based on these data and reported in Houseman and Heinrich (2017, Table 2). That study uses data on hours, which are available over the length of the assignment, to examine the share of total hours that was accounted for by workers in assignments of varying lengths. Although the length of most temporary assignments is relatively short, long assignments account for the bulk of the hours worked. For example, for light industrial occupations (which are made up primarily of production and material-mover occupations), nearly 60 percent of assignments last under a month, but assignments lasting over a month account for 91 percent of hours worked in these occupations.

Taken together, evidence from the CPS and administrative data from a staffing company indicate that weekly hours differences between temp and direct-hire staff are likely modest. CPS data suggest that average weekly hours of temp production workers are typically about 10 percent less than their direct-hire counterparts, while the difference is somewhat larger—about 15 percent—for workers in material-mover occupations. Administrative data from a large staffing company suggest that differences in time worked between temp and direct-hire staff are smaller—under 10 percent—if they exist at all. Additionally, it bears noting that these analyses pertain to temp agency workers; in 2018, PEO workers in production and material-moving occupations accounted for about 12 percent of contract workers in these occupations in

manufacturing. We have no reason to believe that PEO workers, who are assigned on an indefinite basis to the client, work fewer hours than do direct-hire employees.

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 nearly three-decade 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 but as much as 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, both 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 in 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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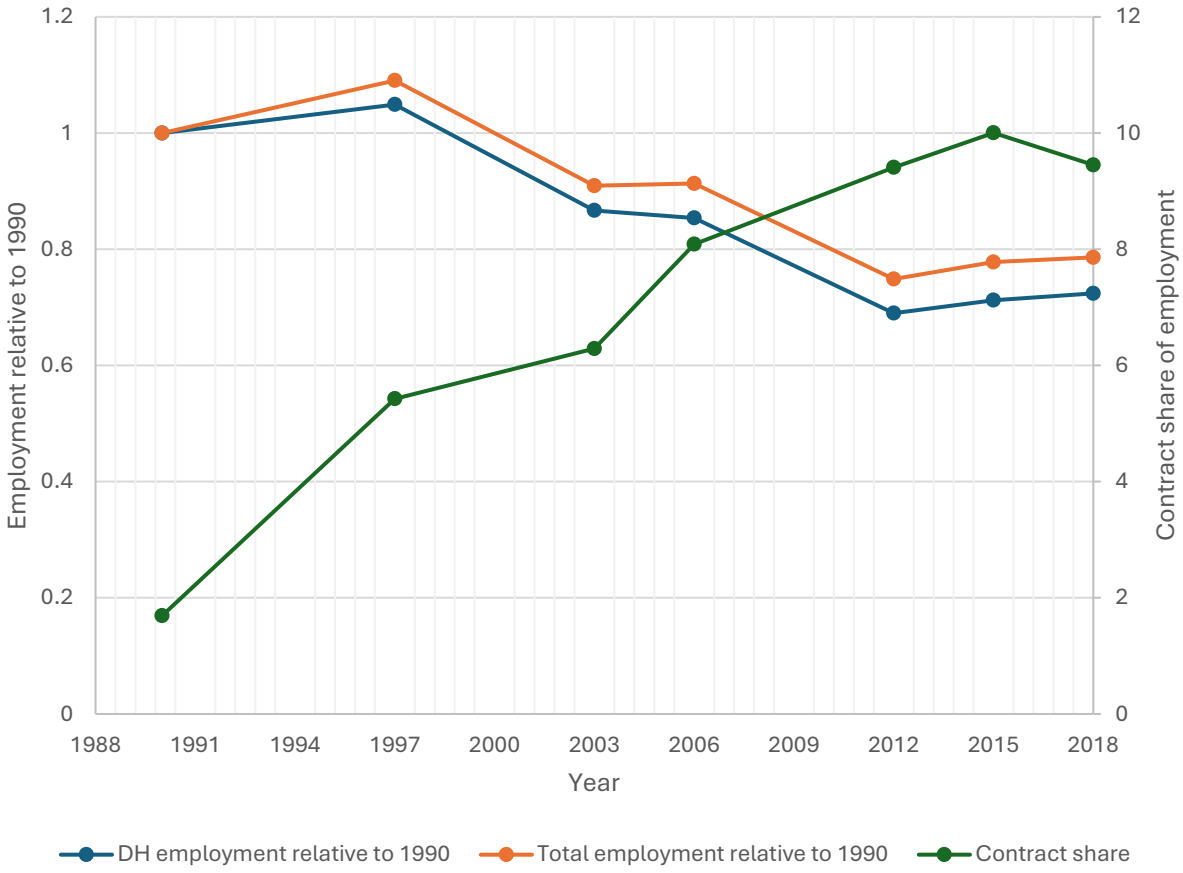
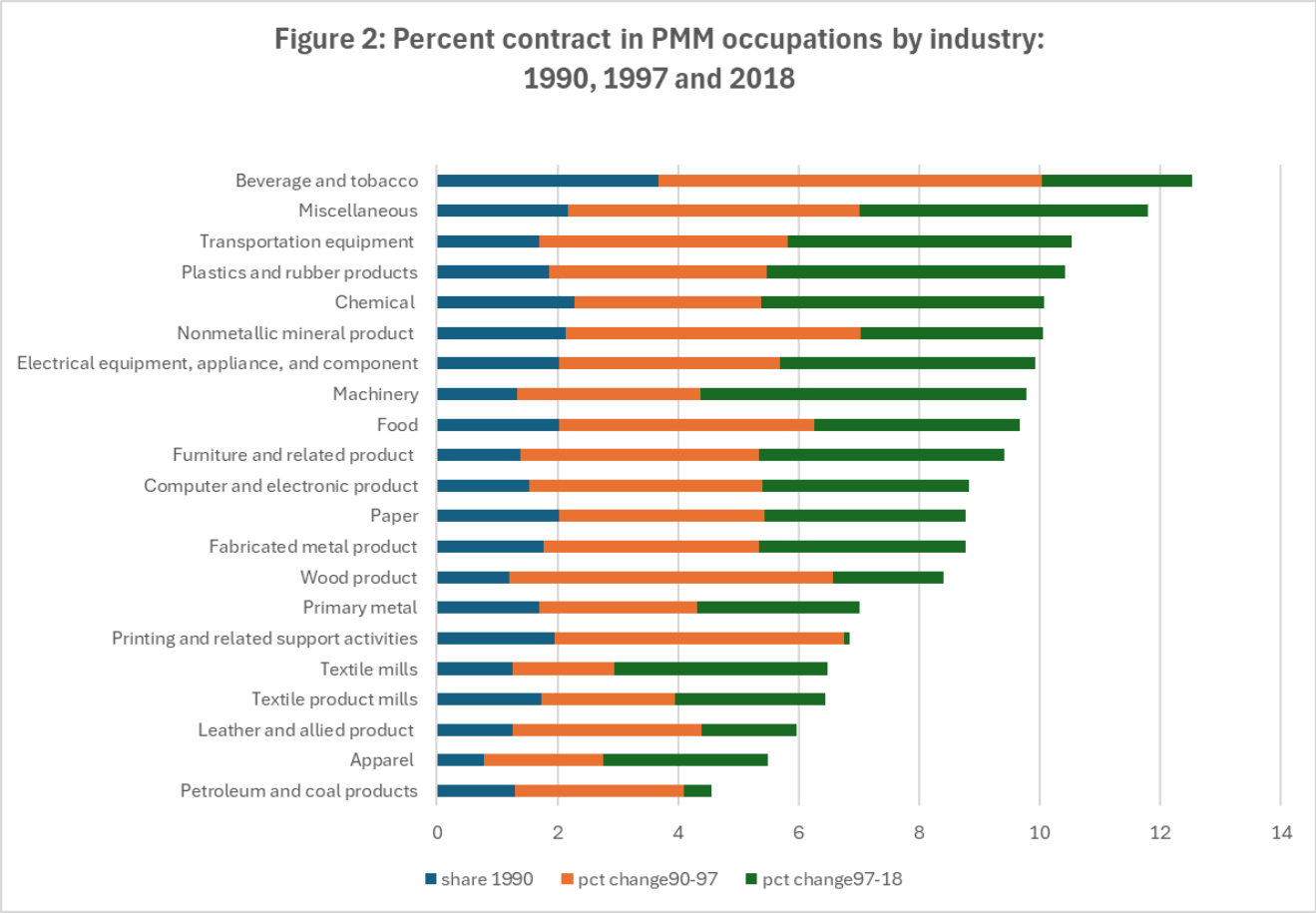
Figure 1: Index of Employment in Production and Material-Mover Occupations in Manufacturing, Direct Hires and Adjusted for Contract Use, and Share of Contract Employment, 1990-2018



NOTE: 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; values are shown on the right axis.



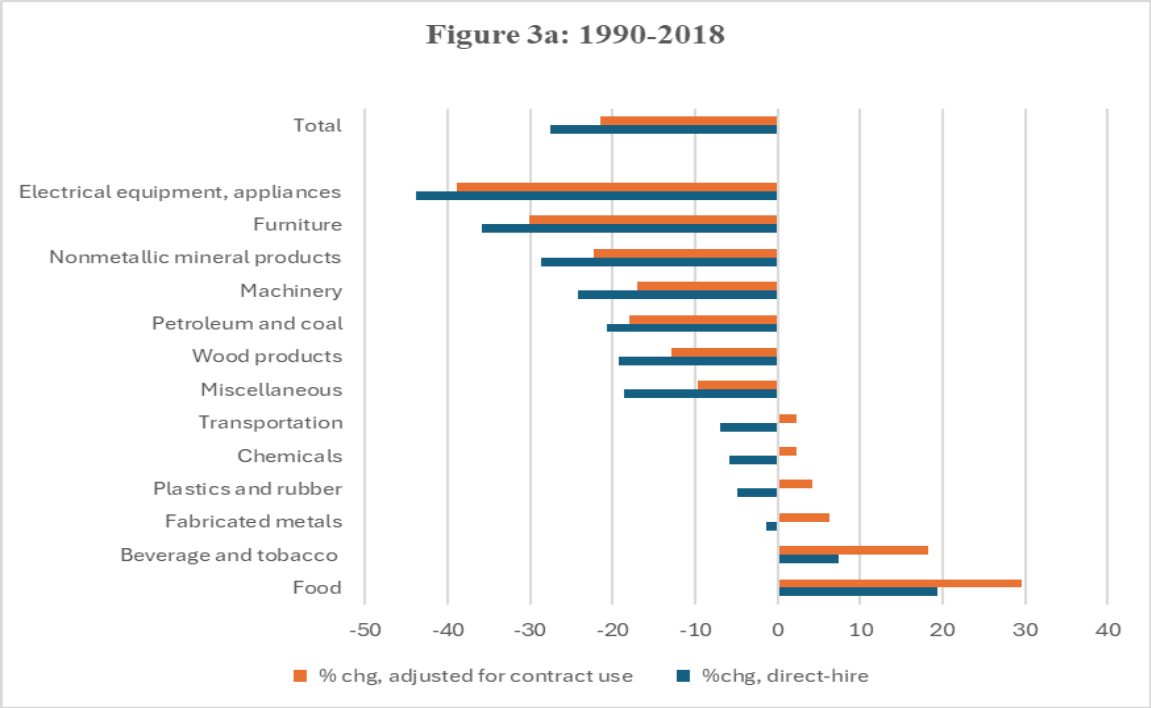
NOTE: The blue bar shows the percentage of contract workers in production and material-mover occupations in 1990 by industry, the orange bar shows the percentage point increase in the share who are contract workers from 1990 to 1997, and the green bar shows the percentage point increase in contract workers from 1997 to 2018. The length of the three bars together shows the percentage of contract workers in these occupations by industry in 2018.

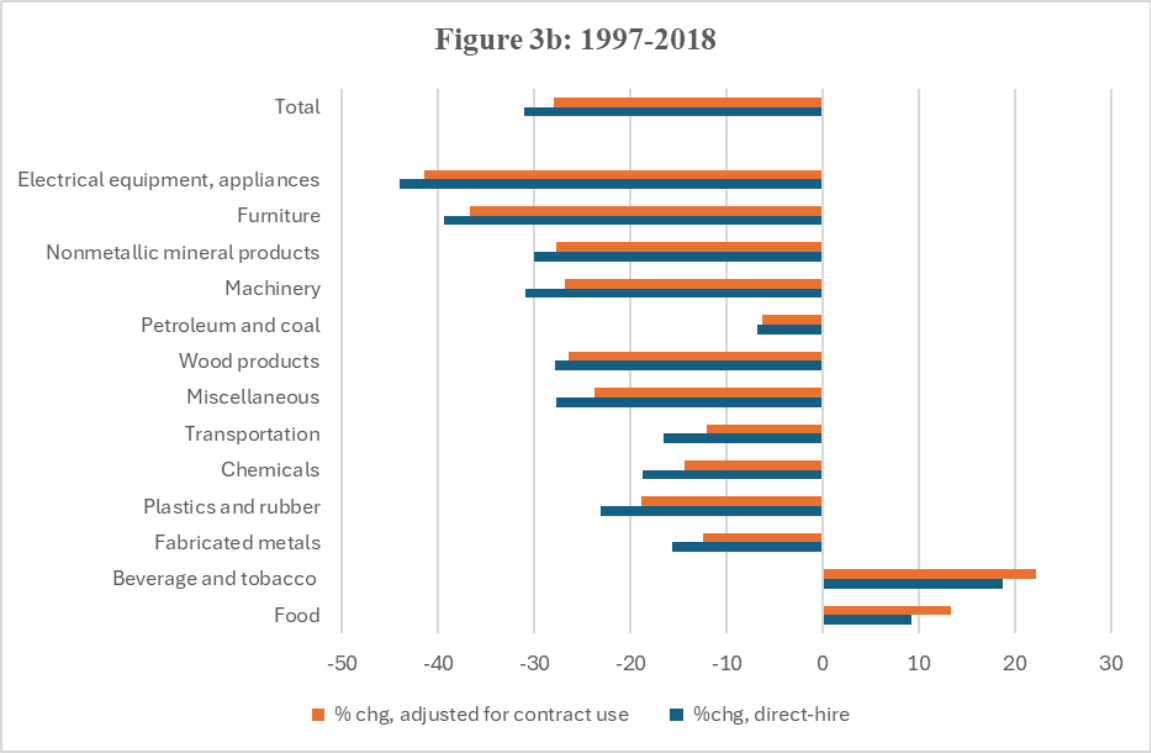
Table 2: Percent change in employment in production and material mover occupations, direct-hires and adjusted for contract use

	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

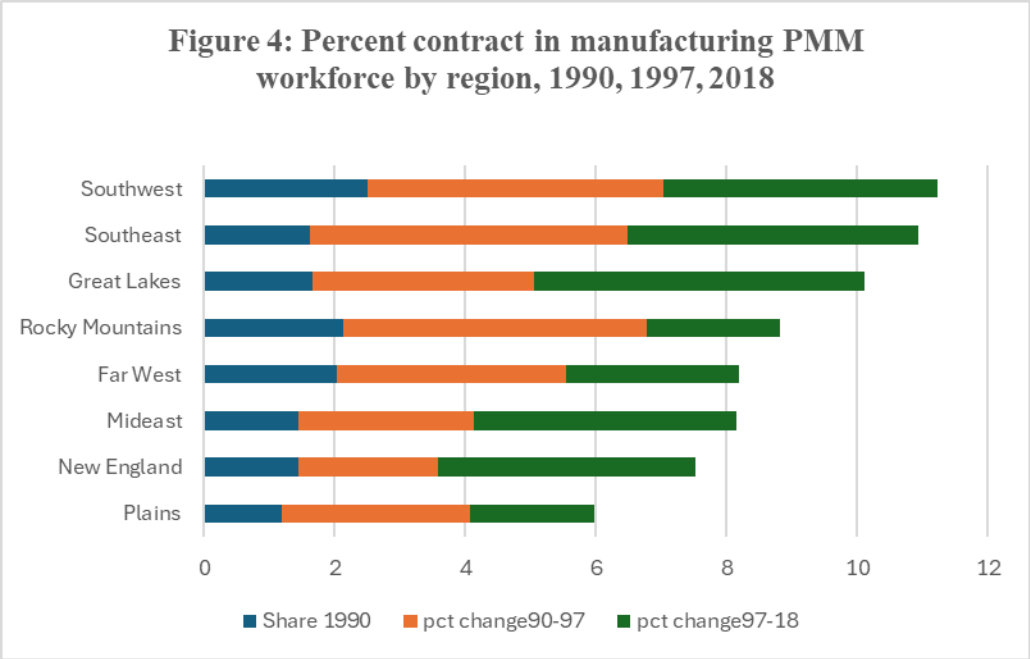
NOTE: Authors' calculations; see text.

Figure 3: Percentage Change in Direct-Hire and Adjusted PMM Employment, Selected Industries





NOTE: Authors' calculations; see text.



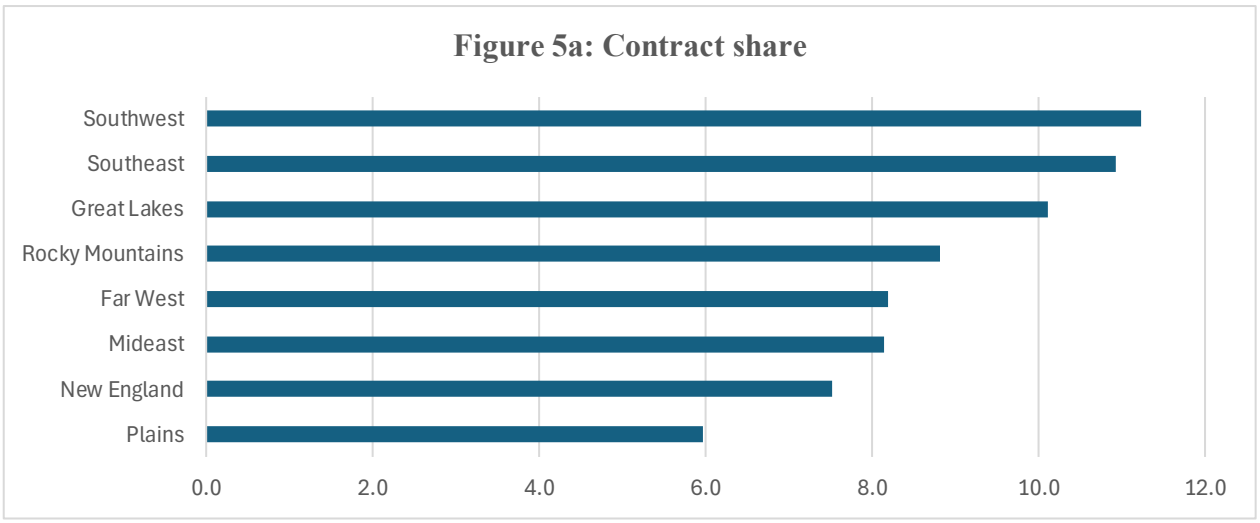
NOTE: The blue bar shows the percentage of contract workers in production and material mover occupations in 1990 by industry, the orange bar shows the percentage point increase in the share who are contract workers from 1990 to 1997, and the green bar shows the percentage point increase in contract workers from 1997 to 2018. The length of the three bars together shows the percentage of contract workers in these occupations by industry in 2018.

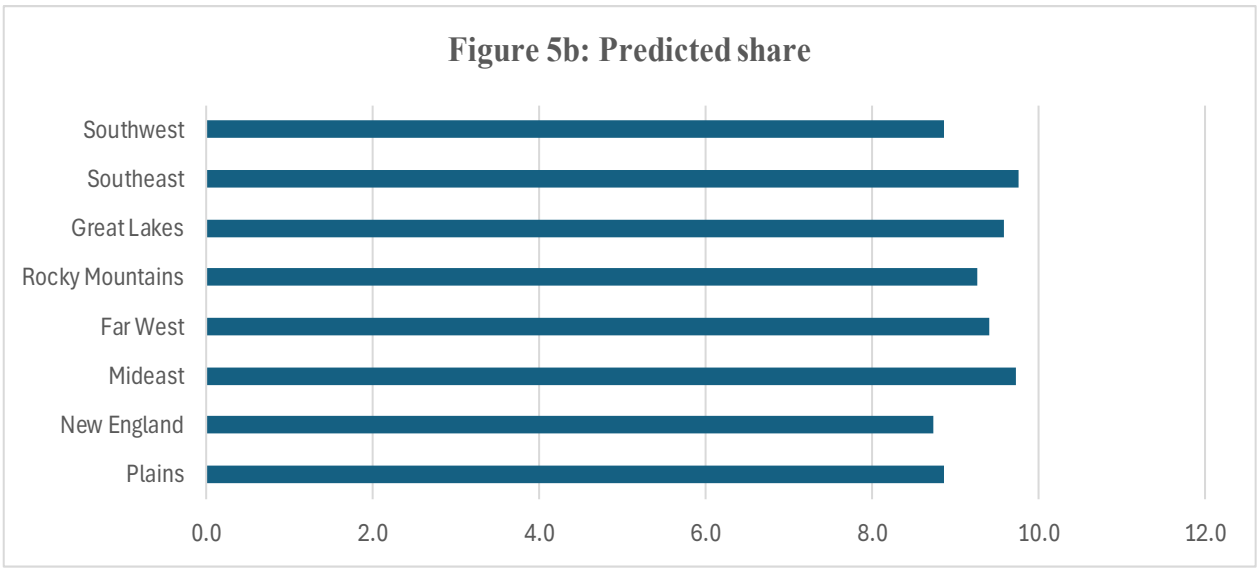
Table 3: Actual v. predicted share of contract PMM workers in manufacturing by region, 2018

	% 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 Mountains	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

NOTE: Authors' calculations. See text.

Figure 5: Actual v. Predicted Share of ES Workers in Production and Material-Moving Occupations in Manufacturing, 2018





NOTE: Authors' calculation; see text.

Table 4: Estimates of contract workers in manufacturing PMM occupations, selected Great Lakes region MSAs, 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

NOTE: Authors' calculations; see text.

Table 5: Ratio of Actual Hours Worked in Temp Help Services and Manufacturing, Production, and Material-Moving Occupations, 2003-2019

	Production occupations			Material-mover occupations		
	Frequency		Ratio ES/Mfg hours	Frequency		Ratio ES/Mfg hours
	ES	Mfg		ES	Mfg	
2003	497	38,607	0.88	544	4,664	0.85
2004	468	37,176	0.90	553	4,609	0.86
2005	526	35,954	0.89	584	4,525	0.84
2006	602	35,532	0.91	565	4,462	0.88
2007	502	34,788	0.89	533	4,288	0.82
2008	433	32,493	0.92	544	4,026	0.86
2009	351	27,816	0.88	358	3,530	0.78
2010	536	28,457	0.92	544	3,402	0.84
2011	520	28,419	0.89	565	3,444	0.84
2012	576	28,869	0.89	594	3,748	0.87
2013	558	28,913	0.90	654	3,511	0.87
2014	485	28,890	0.91	546	3,753	0.85
2015	479	28,226	0.89	552	3,705	0.84
2016	412	27,989	0.92	515	3,646	0.88
2017	350	27,416	0.92	481	3,562	0.86
2018	350	26,461	0.90	463	3,611	0.88
2019	218	25,785	0.89	386	3,594	0.88

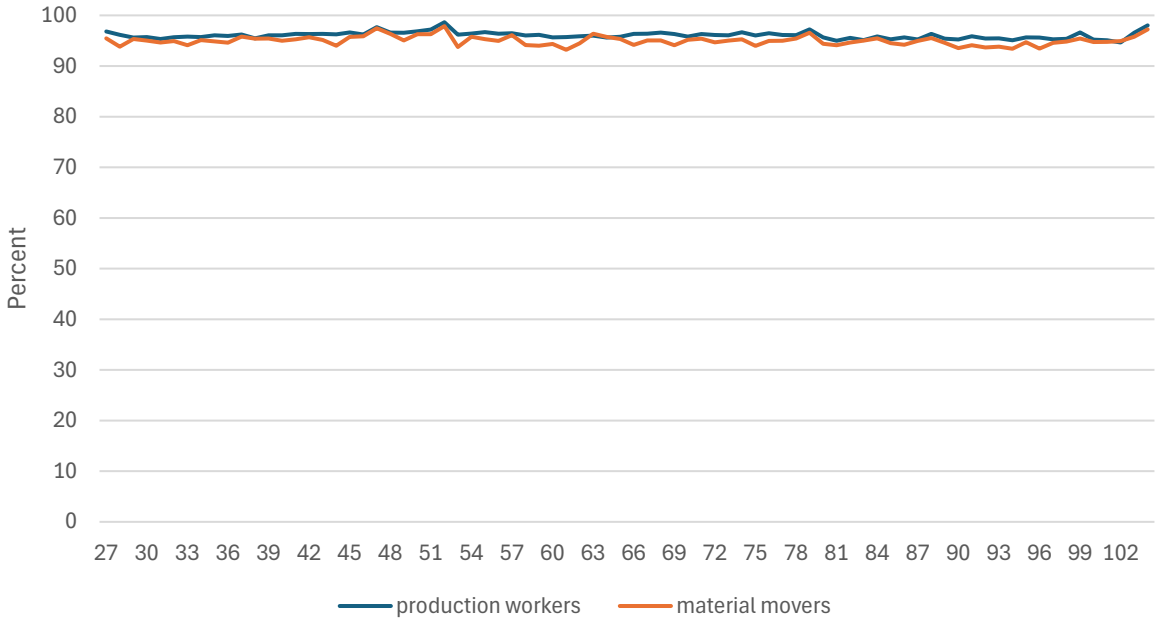
SOURCE: CPS. Data are pooled across months in the year. Ratios represent the ratio of actual hours worked, weighted.

Table 6: Ratio of Actual Hours Worked in Temp Help Services and Manufacturing, Selected Production, and Material-Moving Occupations, 2003-2019

	Frequency		Ratio ES/Mfg hours
	ES	Mfg	
Laborers, hand material movers	5,558	35,858	0.84
Stock clerks and order fillers	853	8,976	0.88
Other production workers	2,597	61,577	0.89
Packers and packagers, hand	2,247	12,240	0.90
Inspectors, testers, sorters	840	31,650	0.90
Assemblers and fabricators, nec	2,075	71,771	0.91
Electrical, electronics assemblers	194	13,195	0.91
Machinists	140	30,369	0.93
Welding, soldering workers	321	26,791	0.95

SOURCE: CPS. Data are pooled across years. Ratios represent the ratio of actual hours worked, weighted.

Figure 6: Average % of full work week worked by temp agency workers assigned to manufacturing



SOURCE: Proprietary data from large U.S.-based staffing company. See text for details.

APPENDIX

Comparison of Modeled and Proportional Use Estimates

Appendix Table 1 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: 1) the proportional use method, 2) the modeled demand approach using 1990 as the base year, and 3) the modeled demand 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. As noted above, the coding systems for both industries and occupations changed substantially between 1997 and 2003. Industry codes changed from SIC to NAICS codes. Occupation codes changed from internal OES codes to SOC-based codes. Although we attempt to make these codes time-consistent, there are industries and occupations that remain impossible to perfectly bridge over time. In addition, the manufacturing sector experienced a precipitous, nearly 17 percent decline in employment between 1997 and 2003. Given the upheaval in this sector, both within and

between industries, the assumptions underlying the modeled-demand approach are likely to be violated.

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

Comparison of Our Estimates with Data from a Staffing Company

We also use propriety data from a large U.S.-based staffing company to check the reasonableness of our estimates. As noted in the main text, for temporary help assignments made by this company in the United States in 2010 and 2011, we have information on the start and end date of each assignment, the worker's detailed occupation, and the industry to which the worker was assigned, enabling us to compute for each week the number of workers in production and material-moving occupations assigned to manufacturing and other sectors. In any given week during the period, the number of production and material-mover workers on assignment through this company ranged from 26,000 to 38,000.

We find that the share of production workers assigned to manufacturers by this company during 2010 and 211 is about 81 percent, nearly identical to our estimates of the share of production workers assigned to manufacturing in 2012, displayed in Appendix Table 1. For

material movers, however, we find that this staffing company's share of assignments of material movers to retail is considerably lower than our estimates (8 percent compared to 25 percent in 2012), while the share of material movers assigned to manufacturing and other sectors is considerably higher. These differences could result if the company's client base for material movers is not representative of the client base for temp staff in material-mover occupations overall, but they also could result if an assumption embedded in our models is violated—namely, the assumption that, within metro areas, industries use temp help workers in a given occupation in proportion to their employment of direct-hire workers in that occupation. If retailers are less likely to staff with temporary help workers than manufacturers and companies in other sectors, our estimates understate the share of contract labor in material-moving occupations in manufacturing.

As a rough check of our estimates, we assume that the share of ES material movers assigned to retail is fixed at 8 percent (as in our company data) and reassign the remaining 17 percent to other sectors in proportion to their direct-hire workforce in material moving occupations. Under this scenario, the share of ES material-mover workers in manufacturing rises by between 2 and 3 percentage points in 2012. However, because production workers are a far larger share of the workforce in factories, the effect on the temp share of all PMM workers is small—less than a half a percentage point.