

Measuring the Transportation Workforce Skills Gap Using New Indices and Survey of Employers and Workers

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Skills gap is a significant mismatch between the knowledge, skills, and abilities (KSAs) required by employers and those held by workers. This study proposes four innovative indices to measure such KSA-gaps and calculates them using data from a survey of transportation workers and employers. The results suggest that the workers' competencies do not match the employers' requirements. Areas of particularly extensive KSA-gaps include knowledge of transportation, distribution, and logistics; knowledge of machines, tools, and equipment; equipment operation, maintenance, repair, and troubleshooting skills; critical thinking and problem-solving skills; work prioritization and resource-management skills; and ability to apply knowledge.

INTRODUCTION

Concerns over a perceived skills gap have intensified over the last decade for three main reasons: first, in light of the 2007-2009 recession, the U.S. unemployment rate and average unemployment duration have increased; second, due to the ongoing massive retirement of baby boomers, employers have faced increasing challenges replacing the departing human capital; and third, due to technological developments, employers' workforce demands have changed. The U.S. unemployment rate has increased from 5% in December 2007 to its peak of 10% in October 2009, but so did the average unemployment duration, from 16.6 weeks in December 2007 to its peak of 40.7 weeks in July 2011 (U.S. Bureau of Labor Statistics 2017a). Proponents of the skills gap use these statistics to support their view, arguing that the unemployed workers cannot quickly find new jobs because they lack the skills demanded by employers. Skills gap opponents argue, however, that these statistics are simply a result of a particularly deep recession.

Whether the increase in unemployment and unemployment duration were structural or cyclical in nature may be debatable, but the demographic and technological changes are undeniable. On average, around 10,000 baby boomers currently retire every day, a trend that is expected to continue through 2031 (Social Security Administration 2011). Some industries are impacted by the retirement of baby boomers more than others, with agriculture, public administration, and transportation ranking as the top three aging sectors. Specifically, in 2016, median workers' age in these industries was 47.5 years in agriculture, 45.6 years in public administration, and 45.4 years in transportation (U.S. Bureau of Labor Statistics 2016). In 2016, transportation was the largest of these three sectors, accounting for 5.29% of the labor force; whereas, public administration and agriculture accounted for 4.53% and 1.62% of the labor force, respectively (U.S. Bureau of Labor Statistics 2016). Further, over 50% of workers in the transportation and warehousing industry will be eligible to retire over the next decade, which is double the retirement rate of the national workforce (U.S. Department of Transportation 2015). Not surprisingly, a labor market study of truck drivers by Costello and Suarez (2015) identified that baby boomers' retirement was the primary reason behind the labor shortages in transportation. According to the same study, the second factor behind the labor shortages was industry growth. Employment in the transportation and warehousing industry has grown from 4.5 million in 2007 to 5 million in 2017 (U.S. Bureau of Labor Statistics 2017b). These trends, along with the workforce turnover, create several hundred thousand transportation and warehousing job

openings annually (U.S. Bureau of Labor Statistics 2017c). Many of these vacancies require new skill sets to match the technological developments in the industry. The PWC (2012) report calls these the “e-skills” or the information-communication-technology skills, such as traffic management, driver assistance, and car-to-infrastructure system operation skills.

Due to the above factors, many transportation and warehousing industry employers have been reporting difficulties filling job vacancies, attributing their hiring challenges to the skills gap phenomenon (Cronin 2014). Skills gap opponents argue, however, that the perceived skills gap explanation behind hiring challenges lacks empirical support, as employers truly facing the skills gap would have increased wages to attract qualified candidates. Empirical evidence shows, however, that mean real wages have stayed nearly constant for over a decade now (Holzer 2012; Rothstein 2012; Levine 2013).

Given the conflicting views on skills gap and demographic changes expected to take place in the transportation and warehousing industry, the objective of this research is to answer the following questions: Is there a skills gap in the transportation and materials moving occupations?¹ If so, what competencies, or knowledge, skills, and abilities (KSAs), do the workers lack and to what extent? What KSAs do the unemployed lack? What KSAs do the employed lack, if any? What proportion of vacancies are difficult to fill because of the skills gap? Answers to these questions can help the transportation stakeholders identify and address the specific KSA-gaps facing the industry. This study’s approach, key research findings, and contributions to current literature are summarized below.

Skills gap can be defined as a shortfall or a mismatch of skills (Shimer 2007; Sahin et al. 2011; Cappelli 2015; Deloitte 2015). Skills can be measured using various proxies, including educational attainment, IQ tests, SAT scores, and occupational competencies (Manacorda and Petrongolo 1999; Handel 2003). All of these measures aim to proxy human capital. As described in the literature review though, use of different proxies often leads to different findings and conclusions. Generally, since human capital reflects the knowledge, skills, and abilities embodied in a worker, this study defines skills gap as a significant mismatch between the KSAs required by employers and those actually held by workers. We adapt the mismatch definition, as opposed to the shortage approach, because any misalignment in KSAs can lead to unfilled vacancies, long-term unemployment, decreased worker productivity, labor turnover, and foregone business revenue. In turn, through economic linkages, skills gap in a given occupation and industry can negatively impact other industries and the economy as a whole. To mitigate these negative effects of skills gap, it is important to understand what specific KSAs employers require, what KSAs workers actually possess and what they lack, and the extent of these KSA gaps. Since KSAs, as opposed to education or IQ scores, are directly linked to the occupational requirements, identifying the exact KSA gaps, if any, is the first step in developing effective skills gap mitigation policies and programs aimed at minimizing the identified competency gaps.

To answer the research questions posed above, we developed four innovative indices and measured them using data from a survey of transportation workers and employers. Due to funding sources, our data collection was limited to 10 counties in northwest Wisconsin. Hence, the results are not representative of the national labor market. However, the study’s findings offer interesting insights to transportation stakeholders. Further, the study’s methodology can be replicated in other areas.

The main finding of this study is that the competencies of transportation workers do not match the employers’ requirements. For example, workers reported having no KSA gaps in equipment operation and maintenance skills, whereas employers reported workers as having severe KSA gaps in this area. These divergent views on the occupational KSA gaps illustrate that workers are pursuing the wrong KSAs, from the employers’ point of view. This, in turn, explains the employers’ complaints about the skills gap. This mismatch in KSAs between the transportation and materials moving employers and workers was found to be particularly extensive in the following areas: knowledge of

transportation, distribution, and logistics; knowledge of machines, tools, and equipment; equipment operation, maintenance, repair, and troubleshooting skills; critical thinking and problem-solving skills; work prioritization and resource-management skills; and ability to apply knowledge.

The research presented in this paper contributes to the existing literature on skills gap and the transportation labor market in several ways. First, most existing studies on skills gap survey only employers (Deloitte 2015), then attribute the reported hiring difficulties to the skills gap. To accurately assess the occupational skills gap, however, it is important to compare workers' qualifications with employers' requirements. Such comparison can help address the criticism that employers facing hiring difficulties do so not because of the workers' skills gap, but because these employers are overly selective in their hiring choices, do not properly screen applicants, or simply do not pay fair wages (Holzer 2012; Levine 2013).² One study that did examine the occupational competencies possessed by workers and those required by employers found that a significant proportion of workers reported a mismatch between the skills they possess and those required for their jobs (OECD 2013). Similarly, our study contributes to the existing literature by surveying both workers and employers. Second, existing studies on labor mismatch tend to focus solely on the unemployed (Sahin et al. 2014). Focus on the unemployed, however, misses the effects of productivity losses arising from the employed workers having KSA gaps. According to the OECD (2016) study, labor force skills gap is one of the reasons behind a significant decline in labor productivity growth in developed economies. Hence, our study contributes to the existing literature by quantifying the skills gap not only among the unemployed, but also among the employed. Third, current literature mostly utilizes aggregate level data, with very few studies using micro-level data. This observation led Holzer (1994) to call for more micro-economic studies that examine the mismatch between the jobs' skill requirements and workers' skill levels. Handel (2003) also noted that few studies actually identify the specific skills that workers lack. This study helps fill this gap by analyzing the microeconomic data on vacancies and worker competencies, which allows us to identify the specific KSA gaps.

The rest of the paper is organized as follows: the literature review outlines several theoretical labor market models that can be linked to skills gap, followed by a discussion of relevant empirical studies. The proposed skills gap indicators are described next, followed by a description of survey methodology, findings, and conclusions.

LITERATURE REVIEW

Theoretical Models

The standard neoclassical model of a competitive labor market predicts that labor markets, such as the one illustrated in Figure 1, always clear over time. In this model, wage serves as the adjustment mechanism that equates the labor supply and demand. Disequilibrium states, such as labor surplus or labor shortage, can occur temporarily if wages start out above or below the equilibrium. Over time, as wages adjust, markets would clear again. This market clearing prediction is subject to several critical neoclassical assumptions: there are many workers and employers, wages and prices are flexible, information is perfect and symmetrically distributed, and nobody has market power. If these assumptions hold, there would be no surplus of labor, i.e., no unemployment, and no labor shortages, i.e., no vacancies.

The neoclassical labor market model is frequently criticized for being unrealistic in its assumptions, as labor market inefficiencies and other factors keep the markets from clearing. Further, this model cannot explain the coexistence of unemployment and labor shortages that manifested in the post 2007-period. Review of literature for models that can explain such simultaneous existence of unemployment and vacancies revealed a strand of alternative models studying the labor markets with search frictions (Pissarides 1985, 2011; Shimer 2007; Daly et al. 2012). A simple graphical

Figure 1: Neoclassical Model of a Competitive Labor Market

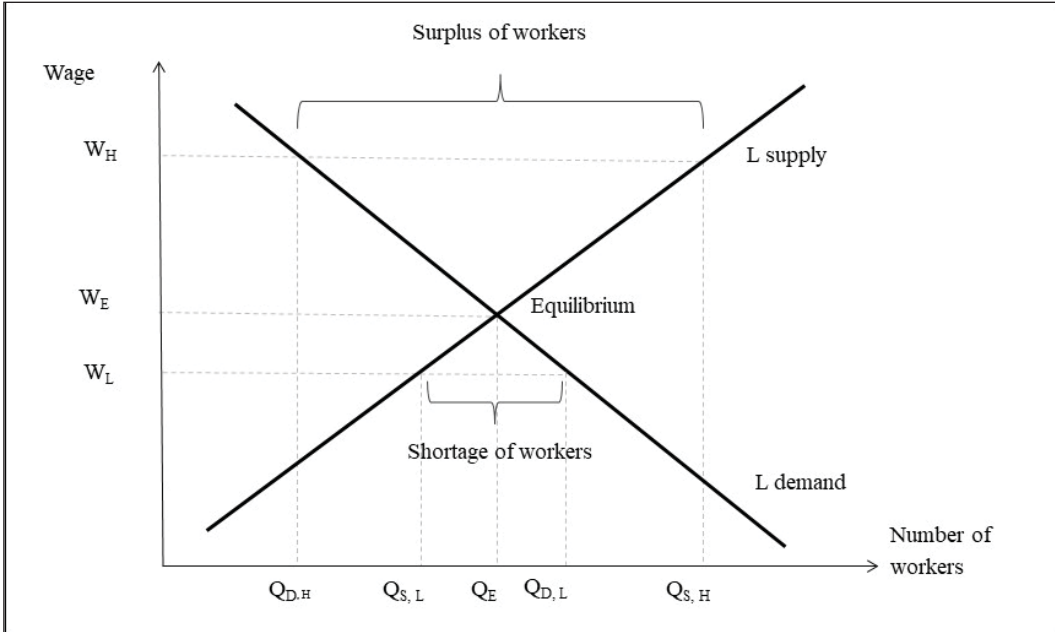
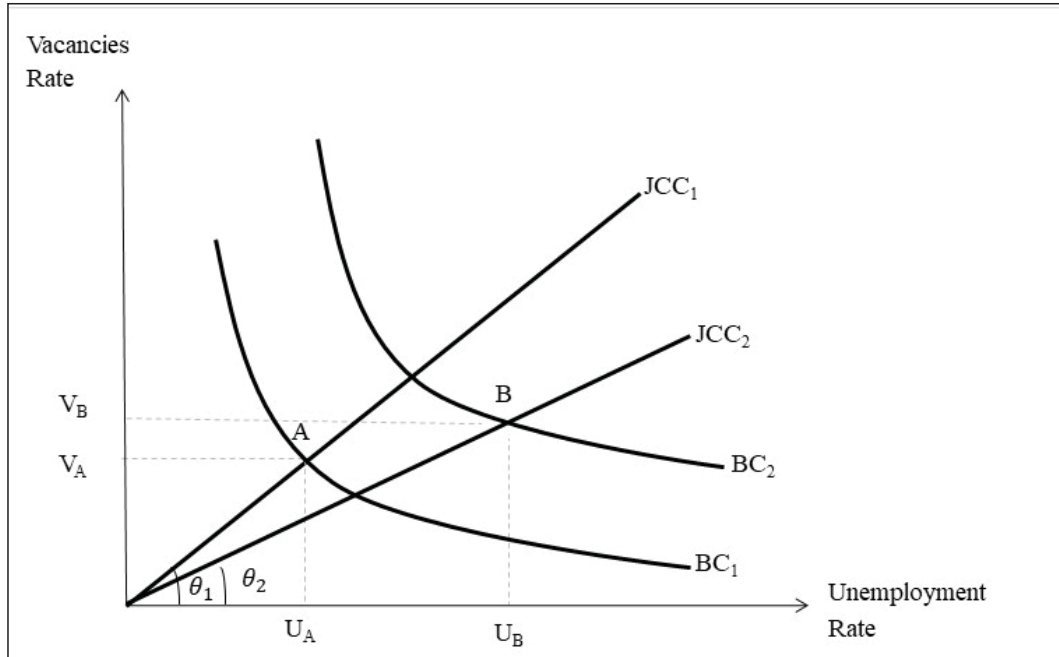


illustration behind the mathematics of these alternative models, as presented in Pissarides (2011), is replicated in Figure 2.

Figure 2 illustrates two curves, the Beveridge Curve (BC) and the Job Creation Curve (JCC), the latter named by Pissarides (2011). The point of intersection of these two curves determines the equilibrium vacancy and the equilibrium unemployment rate. The downward-sloping BC, as developed by Dow and Dicks-Mireaux (1958), represents an aggregate relationship between the unemployment and vacancies rate. Over the course of a business cycle, the economy moves along the BC, while labor market frictions and structural changes shift the BC (Diamond 2013). The JCC represents the employers' decisions to hire and can be viewed as an aggregate labor demand curve. The JCC slopes upward because a higher unemployment rate raises the employer's likelihood of filling a job (Daly et al. 2012). The JCC's slope, tangent of θ , also represents the labor market tightness and the workers' bargaining power over wages (Pissarides 2011). During recessions, declining aggregate demand lowers the marginal product of labor and the value of job creation, so the JCC would rotate to the right, the labor market would become less tight, and the workers' bargaining power over wages would weaken. The opposite would be true during an expansionary phase of a business cycle. The first intersection of the two curves, point A in Figure 2, describes the initial equilibrium vacancy and unemployment rate in the labor market. If the labor market becomes less efficient, i.e., frictional or structural unemployment increases, and the economy falls in a recession, the BC would shift to the right and the JCC would rotate to the right, leading to a new equilibrium point B. Under these circumstances, the new equilibrium would reflect a significantly higher unemployment rate, while the vacancies rate may be higher or lower than the initial level, depending on the extent of the BC's shift. On the contrary, if active labor market policies are implemented and can completely resolve all frictions and structural labor market challenges, while aggregate economic activity and the JCC remain the same, the BC would shift toward the origin, eliminating the vacancy rate and the unemployment rate. Empirically, however, unemployment and vacancies have historically persisted. Hence, the labor market model with search frictions explains the reality better than the neoclassical labor market model.

Given the 2007-2009 recession, the above-depicted model suggests that the JCC would rotate to the right, from JCC_1 to JCC_2 , and the economy would move along the BC_1 . This would lower the

Figure 2: Labor Market with Frictions and Mismatch

Source: Adapted from Pissarides (2011).

Notes: Vacancies Rate = Number of Vacancies/Labor Force; Unemployment Rate = Number of Unemployed/Labor Force.

vacancy rate and raise the unemployment rate, a prediction that is consistent with the 2007-2009 empirical data (FRED 2017). Is it possible that the BC has shifted to the right during that time as well? If so, the model predicts that a simultaneous rightward rotation of the JCC and a rightward shift of the BC would produce a substantially higher unemployment rate and an ambiguous change in the vacancies rate. Empirical studies suggest that the BC did shift to the right (Daly et al. 2012; Diamond and Sahin 2014), as illustrated in Figure 2, by a shift from BC_1 to BC_2 . According to the literature, the reasons behind this BC's outward shift included wage rigidity, mismatch between the competencies sought by employers and those actually possessed by the unemployed, differences in the geographical location of employers and prospective workers, information dissemination problems, coordination failures, unemployment insurance, and uncertainty over economic conditions (Pissarides 2011; Rothstein 2012; Daly et al. 2012). All of these factors effectively question the validity of the neoclassical assumptions and support the alternative theory of labor markets filled with frictions and structural mismatches.

Empirical Studies

Review of empirical studies on human capital shortages and mismatch between the supply and demand for labor, generalized here as the skills gap literature, revealed two distinct types of findings: some studies find evidence of skills gap, while others find no evidence of it. Partly, these divergent findings result from using different empirical measures of skills gap, such as educational attainment (Carnevale, Smith, and Strohl 2010; Cappelli 2015), wages (Holzer 2012; Levine 2013), outward shift of the Beveridge Curve (Daly et al. 2012; Davis, Faberman, and Haltiwanger 2013), competency mapping (Gurdjian and Triebel 2017), and surveys of employers reporting hiring difficulties (Career Builder 2017).

Educational attainment has been long-used as a proxy for human capital. Hence, studies that compare the workers' educational attainment to the jobs' educational requirements can shed some light on the skills gap debate. Carnevale, Smith, and Strohl (2010) estimate that by 2018 there will be a shortage of about three million workers with post-secondary degrees. This finding suggests that the U.S. economy is experiencing a human capital shortage. Cappelli (2015), however, makes an opposite conclusion and asserts that "overeducation remains the persistent and even growing condition of the U.S. labor force with respect to skills" (p. 251). Other opponents also argue that if skills gap was a real phenomenon, real wages would rise (Holzer 2012; Levine 2013). This, however, has not been the case, as mean real wages have remained stable since 2005 (Rothstein 2012).

Literature studying the Beveridge Curve shifts also yields mixed evidence of skills gap. On one side, the post-2007 increase in unemployment, unemployment duration, and vacancies intuitively support the skills gap hypothesis: unemployed workers cannot quickly find jobs because they lack the necessary skills, while companies cannot easily fill jobs because of a lack of qualified applicants. On the other side, empirical studies show that the increase in natural unemployment at the time was largely a result of the extension of unemployment insurance benefits, with skills gap playing only a very limited role (Daly et al. 2012). Studies examining the increase in unemployment by sector, occupation, and geographic location (Sahin et al. 2011) found that the labor mismatch across industries and occupations was a statistically significant factor behind the higher unemployment rate, while the geographical mismatch was statistically insignificant. Nevertheless, Daly et al. (2012) emphasized that the recent increase in natural unemployment was transitory in nature. Hence, the rise in natural unemployment was caused by frictional and not structural factors. It is structural unemployment, however, that is linked to the skills gap. This deeper investigation into the causes of natural unemployment growth suggests that the observed BC shifts were not directly linked to skills gap.

Numerous employer-driven studies consistently support the skills gap hypothesis (Deloitte 2015; Manyika et al. 2017; Career Builder 2017). For example, according to Career Builder (2017), 55% of employers reported that skills gap was negatively affecting their businesses, primarily by reducing workers' productivity, increasing employee turnover, and lowering morale and quality of work. According to Manyika et al. (2017), by 2020, the U.S. will have a shortage of 1.5 million workers with college degrees and a shortage of six million workers with a high school diploma. Further, Deloitte (2015) predicts that "over the next decade, nearly three and a half million manufacturing jobs likely need to be filled and the skills gap is expected to result in two million of those jobs going unfilled" (p. 2). These employer-based studies, however, are often criticized for being biased and not being scientifically designed (Cappelli 2015). Neutral, scientifically designed studies are scarce though. Also, extensive review of the literature for studies that looked at both, competencies held by workers and those required by employers, revealed only two such studies (OECD 2013; Weaver and Osterman 2017). An OECD (2013) report examined the occupational competencies possessed by workers and those required by employers and found that a significant proportion of workers reported a mismatch between the skills they possess and those required for their jobs. Weaver and Osterman (2017) carried out a scientifically designed national survey of manufacturing employers and workers and found that, at most, 16% to 25% of manufacturing firms face the skills gap.

Empirical studies on the transportation skills gap are even more limited. The literature review revealed one study by the U.S. Department of Education (2015). The study utilized the U.S. Bureau of Labor Statistics data and the Economic Modelling Specialists International reports to analyze skills gap in the transportation industry. According to this study, from 2012-2022, growth in the transportation sector and job separations would lead to the hiring of 4.6 million transportation workers. Most of these jobs, 4.2 million to be exact, would be a result of retirements and occupational transfers, as 53% of U.S. transportation workers are currently 45 years or older. The study projects

that the highest demand for transportation workers will be in the operation and maintenance field. Further, the study estimates that the annual job openings in the transportation sector will be 68% higher than the number of college graduates with relevant degrees. All of these facts point to significant skill shortages in the industry and explain the calls for developing a trained and qualified workforce for the transportation sector. As a solution to these skills gap challenges, the study recommends using the Career Pathways Models, a collaboration among educational institutions, business community, and workers. The idea is to build the education and training strategies that would help individuals obtain the industry-related certifications and employment. The Employment and Training Administration (2007) has supported this recommendation by investing around \$80 million in various training programs related to the transportation industry.

SKILLS GAP INDICATORS

In line with the labor market model with search frictions, in which unemployment and vacancies co-exist, in this section we propose four new skills gap indicators that identify and measure the extent of KSA gaps among the transportation and materials moving workers and assess the impact of KSA gaps on employers. While the above-described model with search frictions (Pissarides 2011) focused on the initial matching of the unemployed with vacancies, this paper extends this theory by matching the skills of all workers, employed and unemployed, with jobs. Specifically, the view presented in this paper is that job matching is a continuous process. As jobs evolve, even the employed workers may develop skill gaps, so they may no longer meet the job requirements but may be maintained by their employer due to labor contracts and other reasons. Such skills gap among the employed, however, can also cause productivity losses and other negative effects mentioned earlier. Hence, this paper argues that skills gap is not only a problem applicable to the unemployed, but also those employed as well. Further, we argue that not all of the unemployed lack the KSAs needed for a job, but they may remain unemployed because of inefficiencies in the labor market matching process, as some may be looking in a wrong location, industry, or occupation. Hence, due to such inefficiencies, the unemployed and jobs may be simply mismatched.

As stated earlier, skills gap is defined in this study as a significant or severe mismatch between the KSAs required by employers and those actually held by workers. Our indices are designed with a theoretical framework in mind similar to Shimer (2007): “Many local labor markets, each of which represents a particular geographic location and a particular occupation. The wage clears each market at each instant, but there may be unemployed workers in one market and job vacancies in another” (p. 1075), as “two wages [are] paid, $w(t)$ to workers in markets with vacancies and z to all other workers” (p. 1097). Likewise, we do not aggregate the labor market; instead we focus on the transportation and materials moving occupational labor market within a specific geographic location, northwest Wisconsin, with the goal of identifying which KSAs are lacking in the market and to what extent. Further, similar to the labor market model with search frictions, we do not attribute all vacancies to the structural or skills gap factors. Instead, we differentiate and identify the proportion of vacancies that were difficult to fill due to the skills gap, with the rest attributed to low wages and labor market inefficiencies. Low wages can actually perpetuate a vicious cycle: if wages offered by the employers are set too low, current workers with the necessary skills would not apply for the open positions, while prospective workers would not have the incentives to pursue the KSAs needed for this occupation. The ensuing lack of applicants, however, should not be immediately interpreted as evidence of skills gap, as higher wages would have attracted the qualified applicants. Hence, before confirming the skills gap, it is important to know whether the employers with vacancies offered higher wages to prospective workers or not. To differentiate between the vacancies that were difficult to fill due to low wages and skills gap, we build in wage questions in our survey of employers and workers.

Finally, while many existing studies proxy the skills gap by surveying only employers and documenting the percentage of respondents who reported facing hiring difficulties or by citing the number of jobs that allegedly went unfilled because of skills gap (Deloitte 2015; Career Builder 2017), this study uses data from a survey of both employers and workers to quantitatively assess the exact competencies or KSAs lacking in the transportation workforce. Hence, the indices proposed below communicate information from both sides of the labor market, workers and employers:

$$\text{Occupational skills gap } j = \frac{\text{Labor force lacking } j}{\text{Labor force}}$$

$$\text{Employed skills gap } j = \frac{\text{Employed lacking } j}{\text{Labor force}}$$

$$\text{Unemployed skills gap } j = \frac{\text{Unemployed lacking } j}{\text{Labor force}}$$

$$\text{Vacancy skills gap } j = \frac{\text{Vacancies with applicants lacking } j}{\text{Total vacancies}}$$

In the indices proposed above, *j* stands for the occupational knowledge, skill, or ability. The exact classification of *j*-KSAs follows the Occupational Information Network (O-NET) classification of occupational competencies.³ Generally, the higher the index value the higher the extent of a respective *j*-KSA gap. The details of each index are explained below:

- The occupational skills gap index measures the percentage of labor force within the occupation that has a major or severe lack of *j*-KSA.⁴ This index is estimated using data from the survey of workers. The purpose of this index is to identify the specific KSAs that all transportation and materials moving workers lack, regardless of whether they are employed or unemployed, and the extent of the specific *j*-KSA gap. By identifying these specific KSA gaps, this study contributes to the existing literature, as recommended by Handel (2003).
- The employed skills gap index measures how many employed as the percentage of labor force have a major or severe lack of *j*-KSA. This index is estimated using data from the survey of workers. The purpose of the index is to proxy productivity losses resulting from having a less than qualified worker performing a job. Hence, this index contributes to the existing literature by extending the skills gap analysis beyond the unemployed.
- The unemployed skills gap index measures how many unemployed as the percentage of labor force have a major or severe lack of *j*-KSA. This index is estimated using data from the survey of workers. The purpose of the index is to identify the specific *j*-KSAs that are lacking among the unemployed and the extent of such gaps.
- The vacancy skills gap index measures the percentage of vacancies within the occupation that were difficult to fill because the applicants had a major or severe lack of *j*-KSA. This index is estimated using data from the survey of employers. The purpose of the index is to identify the specific *j*-KSAs that are severely lacking among the workers, from the employers' point of view, and measure the impacts of these skill shortages on the employers.

SURVEY METHODOLOGY

This paper's survey data and methodology are based on a larger skills gap study by Simkins et al. (2015). Due to funding sources, the study's data collection was limited to 10 counties in northwest Wisconsin, namely Ashland, Bayfield, Burnett, Douglas, Iron, Price, Rusk, Sawyer, Taylor, and Washburn. The original survey covered 16 industries, 20 occupations, and 29 KSAs. The methodology behind this original study is described below.

Simkins et al. (2015) survey data were generated by surveying both employers and workers.⁵ Survey respondents were drawn randomly from the ReferenceUSA database.⁶ To collect data, survey packets were mailed to 2,000 businesses and 1,000 workers in the study area.⁷ Both respondent groups, workers and employers, were asked to complete the survey and return it by mail or by answering a web-based version of the survey. All survey responses were kept anonymous. To encourage participation, survey incentives were offered five randomly selected \$50 Amazon gift cards for businesses and 100 randomly selected Redbox movie rental codes for workers. Survey responses were collected from March 2015 through mid-May 2015, with survey reminders sent several weeks after the initial surveys were mailed. Of the 2,000 business surveys distributed, 236 were returned as undeliverable and 126 surveys were completed, which yielded a response rate of 7.14% and a theoretical margin of error of 8.63%.⁸ Of the 1,000 worker surveys distributed, 113 surveys were completed, which yielded a response rate of 11.3% and a theoretical margin of error of 9.21%.⁹ The collected data were then processed as follows: first, to categorize and code all employers and industries appropriately, reported industry information was validated and write-in responses were re-coded; second, BLS two-digit occupational classification codes were used to categorize all reported workers' occupations; finally, labor force status and other entries were verified for data entry errors and corrected as appropriate.

This paper draws on a subset of data from the above-described, original survey by focusing on the transportation and materials moving occupations. Specifically, the indices presented below were computed using data from 21 employers, who reported having 23 vacancies in transportation and materials moving occupations, and seven workers who reported transportation and materials moving as their occupational classification. Given these small sample sizes, skills gap indicator results discussed below should be interpreted with caution, as they are not representative of the national labor market. However, the study's findings offer several interesting insights to the transportation stakeholders.

SKILLS GAP INDICATOR RESULTS AND ANALYSIS

Table 1 illustrates the computed skills gap indices for the transportation and materials moving occupations. When considering these results, keep in mind that the first two indices were computed using the workers' survey responses, while the last index, the vacancy skills gap index, was computed using the employers' survey responses. The unemployed skills gap index could not be computed because there were no unemployed transportation and materials moving workers among those who responded to the survey. Also, the occupational and the employed skills gap indices returned the same value because there were no unemployed captured in the survey.

A review and analysis of the occupational and the employed skills gap indices reported in Table 1 reveal that the transportation and materials moving workers are primarily concerned with knowledge gaps. In select knowledge areas, e.g., knowledge of business management, marketing and sales, computers and information technology, and audio/video technology and communications, 75% of the responding occupational labor force reported having major and severe gaps. In contrast, according to the vacancy skills gap index, employers reported more concerns over the workers' skill gaps, as opposed to the knowledge gaps. Specifically, employers reported that 38% of their occupational vacancies were difficult to fill because the applicants had major and severe gaps in the equipment operation skills. Also, 24% of occupational vacancies were difficult to fill because the applicants had major and severe gaps in equipment maintenance, repair, and troubleshooting skills. A comparison between the employer-reported vacancy skills gap index and the worker-reported occupational skills gap index revealed that employers reported KSAs as being particularly difficult to find in applicants, but workers reported having no gaps. For example, employers reported that 19% of their vacancies were difficult to fill because the applicants had major and severe gaps in knowledge of transportation, distribution, and logistics. At the same time, 0% of workers reported

Table 1: Skills Gap Indices for Transportation and Materials Moving Occupations

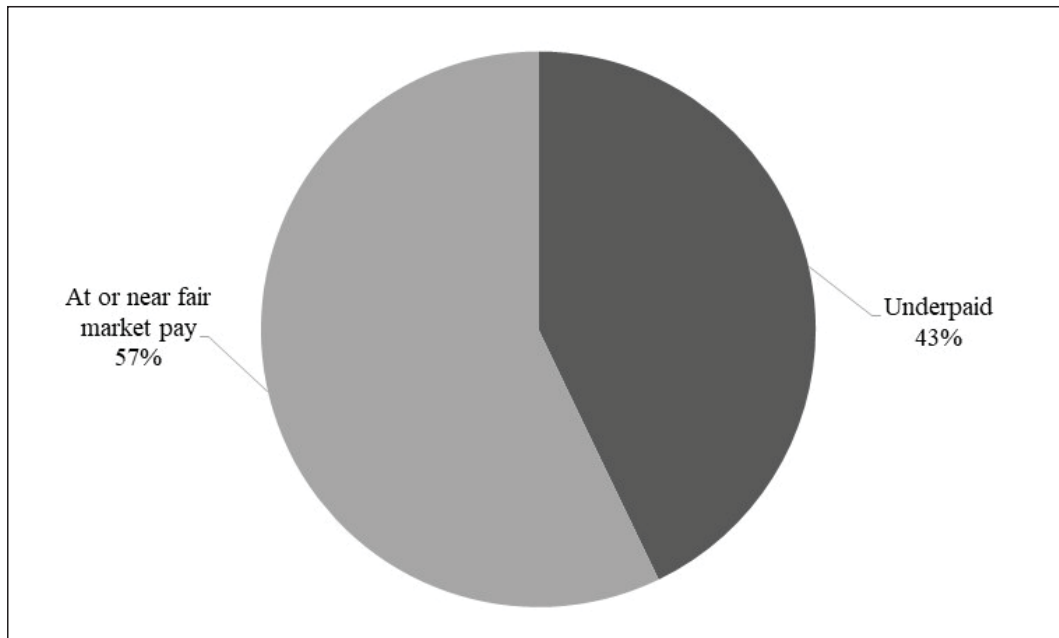
KSA	Occupational Index	Employed Index	Vacancy Index
Knowledge			
Knowledge of administrative rules and procedures	25%	25%	5%
Knowledge of business management, marketing and sales	75%	75%	10%
Knowledge of computers and information technology	75%	75%	10%
Knowledge of audio/video technology and communications	75%	75%	5%
Knowledge of machines, tools and equipment	0%	0%	19%
Knowledge of production processes and practices	25%	25%	10%
Knowledge of transportation, distribution and logistics	0%	0%	19%
Skills			
Business operation skills	25%	25%	10%
Judgment and decision-making skills	25%	25%	10%
Critical thinking and problem-solving skills	25%	25%	14%
Work prioritization and resource management skills	0%	0%	14%
Oral and written communication skills	50%	50%	5%
Listening and reading comprehension skills	25%	25%	5%
Customer service skills	0%	0%	5%
Interpersonal relations and teamwork skills	25%	25%	5%
Equipment maintenance, repair and troubleshooting skills	0%	0%	24%
Equipment operation skills	0%	0%	38%
Math and analytical skills	50%	50%	0%
Abilities			
Intellectual abilities (e.g., ability to apply knowledge)	0%	0%	9%
Physical abilities (e.g., strength and endurance)	25%	25%	5%
Psychomotor abilities (e.g., limb coordination, reaction time)	0%	0%	10%
Sensory abilities (e.g., hearing, vision)	25%	25%	10%

Source: Authors' calculations.

Notes: Unemployed skills gap index could not be computed because there were no unemployed transportation workers among those who responded to the survey.

having knowledge gaps in this area. Similarly, according to employers, 38% of vacancies were difficult to fill because the applicants had major and severe gaps in equipment operation skills, yet workers reported having no gaps in this specific skill set. These divergent views on occupational KSA gaps suggest that a mismatch in perceptions exists between the KSAs employers are looking for and the KSAs workers think they need for a given job. This mismatch in perceptions, in turn, explains why workers may be developing competencies different from those sought by employers, and why the employers' complaints about skills gap are not completely unsubstantiated.

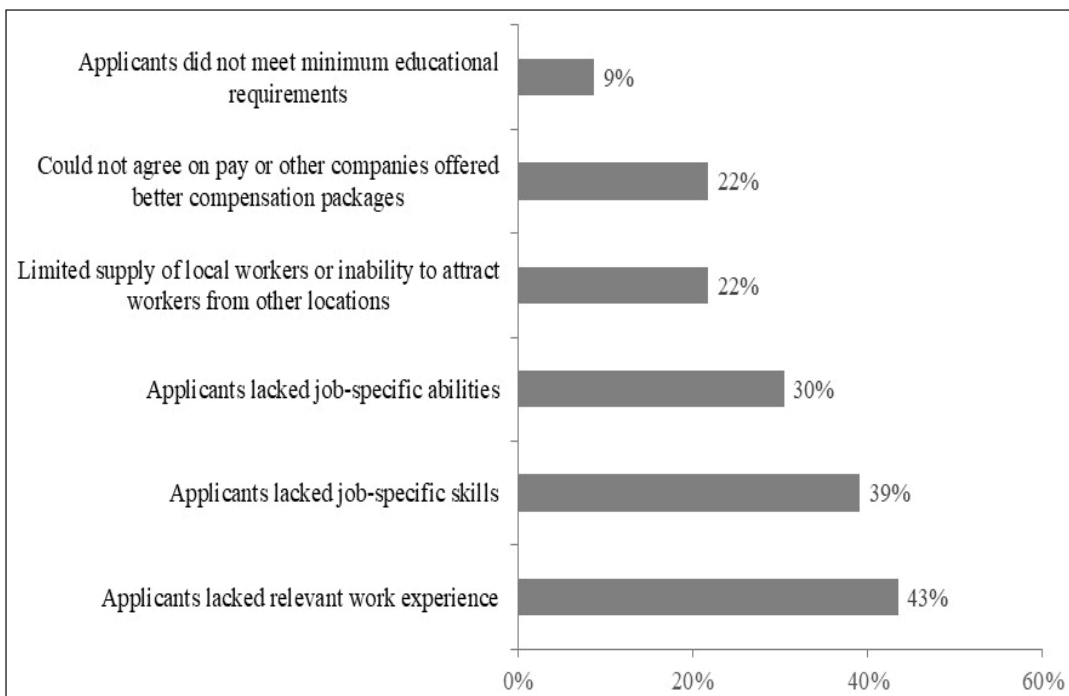
Figure 3: Transportation and Materials Moving Workers' Perceptions on Pay



Source: Authors' calculations.

As discussed in the literature review, skills gap opponents often argue that employers find it difficult to fill vacancies not because of the skills gap but because they do not pay fair wages. To determine whether wages have played a role in our study, we built in wage questions in the employer and worker survey. According to our survey findings, illustrated in Figure 3, 57% of workers engaged in the transportation and materials moving occupations reported being at or near their fair market pay, whereas the other 43% reported being underpaid. Further, as illustrated in Figure 4, employers reported that 22% of the transportation and materials moving vacancies were difficult to fill because they could not agree on pay with their candidates, or other companies offered better compensation packages to their preferred applicants. This finding is consistent with the larger data sample (Simkins et al. 2015), where 27% of employers reported inadequate pay as being one of the reasons behind their hiring challenges. Hence, while inadequate wages do account for a portion of hiring difficulties, the majority of difficult-to-fill transportation and materials moving vacancies were a result of gaps in job-specific KSAs and lack of relevant work experience (see Figure 4). According to Table 1, the transportation and materials moving workers' KSA gaps were found to be particularly extensive in the following areas: equipment operation, maintenance, repair and troubleshooting skills; knowledge of machines, tools, and equipment; knowledge of transportation, distribution, and logistics; ability to apply knowledge; critical thinking and problem-solving skills; and work prioritization and resource-management skills.

Figure 4: Employers' Reasons for Hiring Difficulties, % of Transportation Vacancies



Source: Authors' calculations.

CONCLUSION

This study quantitatively assessed the skills gap in transportation and materials moving occupations by using data from a survey of both employers and workers. Four innovative indices were used to quantify the transportation workforce skills gap. The results point to a misalignment in the occupational competency expectations: what employers are looking for is difficult to find because the workers' perceptions about KSAs needed for a job are different from those sought by the employers. Specifically, according to this study, employers reported that the transportation and materials moving occupation workers have particularly extensive KSA gaps in the following areas: knowledge of transportation, distribution, and logistics; knowledge of machines, tools, and equipment; equipment operation, maintenance, repair and troubleshooting skills; critical thinking and problem-solving skills; work prioritization and resource-management skills, and ability to apply knowledge. These KSA gaps explain the employers' difficulties filling vacancies. At the same time, workers reported competency gaps predominantly in the knowledge areas, which were also different from those reported by employers. This divergence in workers' and employers' perceptions of KSAs needed for a job illustrates that skills gap is a real phenomenon among transportation and materials moving workers. Unfortunately, we were unable to differentiate between the KSA gaps of the employed and the unemployed transportation and materials moving workers, as no unemployed transportation workers responded to our survey. Employer and worker survey responses suggest, however, that the KSA gaps are not the only reason behind the employers' hiring challenges. Inadequate pay accounted for about 22% of the difficult-to-fill transportation vacancies, and lack of relevant work experience accounted for about 43% of these vacancies. Unresolved skills gap arising from the differences in employers' and workers' perceptions about the KSAs needed for a job and inadequate pay can lead to larger skills shortages in the future.

Given the KSA gaps identified in this study and the analysis presented above, we recommend several approaches to lessen the transportation and materials moving occupations skills gap. First, it is critical to align the employers' and workers' expectations as to what KSAs are necessary to perform a given job. To do so, employers may want to partner with workforce development agencies, colleges, and similar organizations to develop the employer-specific KSA training programs that directly reflect their needs. Second, since certain skills are best developed through on-the-job training, employers may want to establish the ongoing apprenticeship programs and work with outside parties to develop real-world simulations for novice workers. Alternatively, employers may need to develop their own internal workforce training programs. Vinci (2008) describes a successful example of one such internal workforce training program, which was started by the Tri-County Metropolitan Transportation District of Oregon in 2008. Third, to reduce the labor market frictions and mismatches, active labor market policies, such as government-funded job-search assistance and employment incentives programs, should be explored. Finally, to avoid productivity losses associated with the employed lacking adequate skills, incentives need to be built in for workers to continue improving their KSAs.

Endnotes

1. The classification "transportation and materials moving" occupations was derived from the Occupational Information Network (O-NET) database.
2. Vaughan-Whitehead (2010) provides a comprehensive definition of a fair wage as a regular and full compensation for work that does not require longer hours and is based on education, skills, and experience (p. 66-67).
3. The detailed list of KSAs can be found in the survey questionnaire in Simkins et al. (2015).
4. Labor force in all indices is calculated as a sum of the employed and the unemployed within the occupation.
5. For survey questionnaires, see Simkins et al. (2015).
6. ReferenceUSA is a subscription-based database that contains records of 24 million U.S. businesses and 147 million U.S. residents.
7. Sample sizes were determined based on projected response rates and the goal to obtain a margin of error of about 5% for each survey group.
8. Margin of error was computed based on N=5,234 business establishments in 10 counties and n=126 completed business surveys. The calculations were based on a margin of error formula with finite population correction, 95% confidence level, and an equal split in opinions.
9. Margin of error was computed based on N=88,466 labor force in 10 counties and n=113 completed worker surveys. The calculations were based on a margin of error formula with finite population correction, 95% confidence level, and an equal split in opinions.

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