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Noncitizen Employment and the Wages of Healthcare Support Workers in the US

Nicholas Hill[1] · Richard McGregory[2] · James Peoples[3]

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Abstract

This study examines the relative wages of citizens and noncitizens employed as healthcare support workers as well as examines the effect of noncitizen support worker employment on the wages of citizen support workers. Relative wage findings reveal noncitizen support workers with less than eight years of US residency receive a noncitizen-citizen wage discount statistically significantly greater than the legal maximum of 5% below the local prevailing wage. These low relative wage levels could contribute to lower wages for citizen support workers, however elasticity of substitution findings suggest noncitizen support workers are not close substitutes for healthcare support workers who are US citizens. In addition, wage effect findings do not reveal a negative influence of noncitizen employment on the wages of native born US citizen support workers, while these findings reveal a relatively small wage decline for naturalized support workers. These findings are consistent with the citizen status job heterogeneity hypothesis. Nonetheless, finding noncitizen-citizen wage differences does not allow for ruling out the possibility of weak enforcement of prevailing wage legislation and possible employment of undocumented workers.

Keywords Healthcare labor market · Immigration · Labor turnover · Elasticity of substitution

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✉ James Peoples
peoples@uwm.edu

[1] Department of Business Administration, Jackson State University, Jackson, MS, USA

[2] Accountability Department, Robbinsdale Area Schools, New Hope, MN, USA

[3] Economics Department, University of Wisconsin-Milwaukee, Milwaukee, WI, USA

Introduction

Growing demand for healthcare services in the US has contributed to an expanding workforce for individuals employed in this industry, especially for healthcare support workers (Carnevale et al., 2012).[1]However, healthcare employers face challenges maintaining employment continuity of certified nurses' aides (CNAs), home healthcare aides, and orderlies. Relatively low wages and physically demanding job responsibilities create a work environment that contributes to high turnover rates for these workers. Labor churn presents a challenge for the healthcare industry meeting the demand for their services without incurring high non-wage labor costs.[2]Past research reports that the turnover rate of home health aides who had been on the job for less than a year varied from 40 to 60% (PHI and IFAS, 2005).[3] Faced with the high turnover rate of healthcare support workers, previous studies reveal US employers have increasingly relied on the availability of foreign workers. For instance, Hess and Henrici (2013) report immigrants make up 28% of in-home health-care workers. Employing noncitizens to provide healthcare support services, though, can suppress wages of US citizens employed in this occupational group, especially if employers are able to hire noncitizens at relatively low wages.

This study explores whether noncitizen healthcare support workers are employed at wages below those paid to healthcare support workers who are US citizens. Our analysis includes estimation of noncitizen-citizen wage differentials as well as estimation of the substitutability among noncitizen and citizen healthcare support workers and estimation of wage levels in localities with high concentrations of noncitizen healthcare workers. Empirical analysis from previous studies has been provided on the wages of citizen and noncitizen nurses (Schumacher 2011; Kaushal and Kaestner 2015; McGregory and Peoples 2013). These studies find a noncitizen wage discount for nurses with few years of residency in the US, which is consistent with the notion that noncitizen healthcare workers are potential low-wage alternatives for healthcare workers who are citizens. These studies also find the noncitizen wage discount erodes with length of stay in the US. In addition, findings from these studies suggest the hypothesis that noncitizen nurses are substitutes for nurses who are citizens cannot be rejected. These wage findings and labor substitutability findings depict the type of labor market characteristics which contribute to a negative noncitizen effect on the wages on citizens. Indeed, these studies do find evidence suggesting the presence of non-citizen nurses decreases the earnings of nurses who are citizens, but the wage effects are small (Schumacher 2011). While these findings provide important insight on the healthcare labor market for citizen and noncitizen employees, there is a dearth of empirical analysis examining relative wages of healthcare support workers.

Estimating noncitizen-citizen healthcare support worker wage differentials and noncitizen healthcare support worker employment effects on citizen healthcare support worker

[1] Carnevale et al. (2012) predict a 26% increase from 3.6 to 4.6 million healthcare support jobs from 2010 to 2020.

[2] Such non-wage labor cost associated with high turnover rates include the cost of hiring a new employee, incurring low productivity associated with hiring a new employee and the cost of training new hires.

[3] Staff turnover in assisted living residences ranged from 21 to 135%, averaging 42% in 2002 (Maas and Buckwalter 2006).

wages is significant, in part, because it provides new labor market information on an occupational group that offers employment opportunities to workers without requiring these workers to attain a college education. Health care support jobs also constitute a large share of the health sector workforce, as the employment size of healthcare support workers is second only to that of nurses. As such, this occupation numbered 1,951,437 employees in 2015 (Source: unionstats.com). Further, examining the labor market for this group of workers contributes to our understanding of whether workers employed in low-skilled healthcare occupations are economically vulnerable to the employment of noncitizens in these occupations. Indeed, compared to registered nurses, healthcare support workers who are US citizens face greater labor market exposure to the employment of noncitizens given that 13. 3% of health care support workers are noncitizens in the US compared to only 3. 9% for registered nurses (Source: CPS files).

Labor Market for Healthcare Support Workers

The Bureau of Labor Statistics (BLS) classifies healthcare support occupations as including home healthcare aides, orderlies, and certified nursing aides (CNAs). The education requirement for home healthcare aides does not require a high school degree, while, by law, CNAs and orderlies must receive a high school diploma or equivalent and CNAs must complete a 75-h training program (Hernandez-Medina et al. 2006). The relatively short training period and low educational requirements present healthcare employers access to a large pool of potential employees and suggests an elastic labor supply curve for these support occupations. Commensurate with the skill requirements for these jobs, certified nurses' aides and orderlies receive a relatively low median annual salary of $25,710 and home healthcare support workers receive an even lower median annual salary of $21,920 compared to the national median of $51,939 for all workers in 2014.[4] Pay for healthcare support workers, though, does closely resemble the $25,376 annual salary of individuals who have not attained a high school diploma.[5] Negotiating wages above these levels is challenging for these support employees given the occupational characteristics that are consistent with an elastic labor supply curve. The lower median salary of home healthcare support workers compared to certified nurses' aides and orderlies is also consistent with the relative lack of educational requirements for home healthcare support workers.[6]

Arguably, the job requirements for this line of work could justify wages surpassing the median for individuals not attaining a high school diploma. Each of these occupations provides a basic level of support to the healthcare industry in hospitals, nursing homes, in-home elderly care and many other health services facilities. Serving under the direct supervision of nursing and medical staff, these healthcare support workers provide routine patient care as well as support to other medical professionals. Their work responsibilities are

[4] Healthcare support workers' median salary of $26,440 for 2014 is slightly higher than the official US poverty rate of $23,850 for a family of four.

[5] Source: The Bureau of Labor Statistics, (http://www.bls.gov/opub/ted/2015/median-weekly-earnings-by-education-gender-race-and-ethnicity-in-2014.htm)

[6] Source: Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2016–17 Edition, Home Health Aides, http://www.bls.gov/ooh/healthcare/home-health-aides.htm

categorized by the BLS as 'heavy' because the job often requires working long hours and assisting patients by providing personal services, such as, bathing, dressing, and grooming. For instance, certified nursing aides and orderlies, are required to: clean patients or residents; help patients use the toilet and dress; and turn, reposition, and transfer patients between beds and wheelchairs. Moreover, past research reports that healthcare support workers provide these services while often facing violent behavior from patients. Pompeii et al. (2013) provide evidence that shows a physical assault rate of 1. 75 per 100 full time events.[7]

Given the relatively low pay and dis-amenities associated with the job responsibilities of a healthcare support worker, it is not surprising that the labor market for these occupations is characterized by high turnover rates. For instance, the American Healthcare Association reports a turnover rate of 52% for CNAs in 2012.[8] In contrast, the turnover rate for the US labor market reached a maximum of 3. 3% for that year as reported by the BLS.[9]Such high turnover rates for healthcare support workers creates an incentive for healthcare employers to find an alternative source of low-wage support workers. Noncitizens are likely candidates to satisfy this employment need since, compared to US citizens, this group of workers' reservation wages are possibly relatively low given the significant percentage of these workers who arrive to the US from low-wage developing countries. For example, information presented in Table 1 shows US healthcare employers are much more likely to employ healthcare support workers from Mexico (12. 03%), the West Indies (27. 52%), Africa (18. 00%), South America (7. 74%) and the Philippines (10. 58%).

The willingness of foreign born healthcare support workers to accept wages below levels paid to US citizens, though, is likely to erode with residency tenure in the US, at least for those residing in the US legally. Past research shows that, over time, immigrants gain familiarity with the nuances of US culture and language usage, which enhances their ability to negotiate wages above their reservation wage (Chiswick and Miller 2010). Immigrants' negotiation leverage is further strengthened if their familiarity with US culture enhances their marketability and improves their ability to take advantage of good employment opportunities. In addition, noncitizens attaining longer length of residency in the US are more likely to hold a green card.[10]In contrast, temporary employment H-2B visas for low skilled occupations, such as healthcare support workers, llimit the visa holder's employment tenure in the US to an overall maximum of three years. Even though the H2-B visa is specifically intended to present US health care employers temporary access to support

[7] Full time event (FTE) is defined as 2000 h worked.

[8] The 2012 CNA turnover information is taken from Table-1 of the American Healthcare Association 2012 Staffing Report, which is located at the following link: https://www.ahcancal.org/research_data/staffing/Documents/2012_Staffing_Report.pdf

[9] Monthly national turnover rates for 2012 are taken from Table-3 Column (7) of the monthly publications posted in the site labeled "2013 Job Openings and Labor Turnover" located at the following Bureau of Labor Statistics link:
https://www.bls.gov/bls/news-release/jolts.htm#2012. An alternative site posted by Compensation Force reports a turnover rate of 15.2%, http://www.compensationforce.com/2012/09/2012-turnover-rates-by-industry.html. Both rates are appreciably below the rate reported for CNAs.

[10] A green card holder is a noncitizen who has been granted authorization to live and work in the United States on a permanent basis. In general, to meet the requirements for a green card, a noncitizen must: be eligible for one of the immigrant categories established in the Immigration and Nationality Act (INA); have a qualifying immigrant petition filed and approved (PERM); have an immigrant visa immediately available; and be admissible to the US." *Source*: https://my.uscis.gov/exploremyoptions/green_card_eligibility

Table 1 Noncitizen healthcare support worker workforce share by country of Origin

Country of origin	*Proportion of noncitizen healthcare support workers*
Canada	0. 0084
Mexico	0. 1203
Rest of N America	0. 0474
Jamaica	0. 0702
Haiti	0. 0791
Rest of West Indies	0. 1259
South America	0. 0774
Nigeria	0. 0340
Rest of Africa	0. 1460
Philippines	0. 1058
India	0. 0150
Rest of Asia	0. 0279
England	0. 0100
Germany	0. 0078
Rest of Europe	0. 0747
Other Countries	0. 0501
Total number of observations	**1795**

Source: 1996–2012 CPS-ORG files

workers, most of these workers are unlikely to attain this type of visa and are more likely to receive family reunification visas, which makes it easier for them to petition for (and obtain) a green card. These reunification visas are part of the *immediate relative* (*IR)* series.[11]Immigrants holding *IR* visas are placed at the top of the list for receiving green cards. As such, they are quickly able to obtain this residency visa. Further, an unlimited number of green cards are available for these immigrants if their US citizen relatives are willing to petition for them.[12]Consistent with the notion that immigrant healthcare support workers are unlikely to apply for the H-2B visa, evidence presented in Panel-A of Table 2 shows a negligible number of noncitizen healthcare support workers attain this type of visa.

The large numbers of noncitizens employed in these occupations without H-2B visas, and the employment advantages associated with family reunification visas, suggest the possibility of a nontrivial share of these individuals seeking and securing green card visas. Indeed, column-1 of Panel-B reveals, compared to noncitizen

[11] The immediate relative immigrant visas include five categories *IR-1* to *IR-5*, that are available to immigrant who are spouses, children and parents of US citizens. Source: https://travel.state.gov/content/travel/en/us-visas/immigrate/family-immigration/family-based-immigrant-visas.html. The US also provides a limited number of family preference immigrant visas for more distant relatives of US citizens. This is the *F* visa series. Immigrants qualifying for an F series visa are also immediately eligible to petition for a green card.

[12] Immigrant healthcare support workers are also eligible for the EB-3 employment-based visa. However, compared to the reunification visas relatively few of these visas are available to prospective immigrants.

Table 2 Panel -A Certified Visas for Certified Nurses' Aides and Home Healthcare Support Workers by Year

	(1)	(2)
Year	*PERM Petition*[a]	*H-2B*[b]
2008	512	10
2009	199	6
2010	404	4
2011	154	2
2012	86	2
2013	31	1
2014	65	1

Source: Source: United States Department of Labor Employment and Training Administration, Office of Foreign Labor Certification, https://www. foreignlaborcert. doleta. gov/performancedata. cfm

[a] Receiving a Program Electronic Review Management (PERM) petition is the first step for many employment-based green card cases and is required for applicants applying to employment-based preference visas

[b] The H-2B temporary nonagricultural program permits employers who meet the program requirements to hire nonimmigrant workers to temporarily come to the U. S. and perform nonagricultural services or labor based on the employer's temporary need

healthcare workers securing an H-2B visa, workers employed in these occupations are more than 44 times as likely to have received Program Electronic Review Management (PERM) petitions.[13] Obtaining a PERM is the first step for many noncitizens applying for their green card. Given that the visa distribution among these occupations is skewed toward green card holders, healthcare employees are likely to face challenges paying noncitizen support workers below market wages since noncitizens tend to have acquired traits associated with higher pay that accrue when attaining long residency tenure (Chiswick and Miller 2010).

Immigration legislation prohibiting domestic employers of visa card holders from paying wages 5% below the local average for a given occupation should further limit the ability of these employers to pay low wages to noncitizens.[14]However, evidence of weak enforcement of prevailing wage laws by the Department of Labor (DOL) and Immigration Naturalization Services (INS) suggests the possibility of a citizen-noncitizen wage gap (GAO, 2000; Cornell Institute for Public Affairs 2011). That

[13] The purpose of the labor certification process is to protect the employment and working conditions of US workers. This process requires employers to test the local labor market to evaluate whether there's a supply of qualified US workers available to fill the proposed position. Source: http://www.antaoandchuang.com/en/permanent-residency-green-cards/schedule-b-occupations

[14] The Immigration and Nationality Act (INA) requires that the hiring of a foreign worker will not adversely affect the wages and working conditions of U.S. workers working in the occupation in the intended employment area. To comply with the statute, the Department's regulations require the wages offered to a foreign worker must be the prevailing wage rate for the occupational classification in the geographical area of employment. Noncitizens with a PERM certificate, green card, H-2B or E-B3 visa are examples of visas requiring adherence to the prevailing wage guidelines. Source: https://www.foreignlaborcert.doleta.gov/pwscreens.cfm

research observes the DOL has limited authority to ensure that employers are (actually) complying with the prevailing legislation requirements once workers holding temporary employment visas are employed in the United States (GAO, 2000). While such limitations could be addressed by the INS, research observes that staff at this agency also encounter challenges accessing specific case-related information which would assist in accurately evaluating the merit of employers' wage determination (Cornell Institute for Public Affairs 2011). Given evidence of weak enforcement, it is not surprising these studies find individuals holding temporary visas are paid significantly less than an occupation's prevailing wage, and are not paid for overtime hours worked (Cornell Institute for Public Affairs 2011).[15]These findings, though, do suggest that, while the majority of citizen-noncitizen wage differences were statistically significantly different, these differences were not statistically significantly outside the 5% prevailing wage range.

These past findings showing low citizen-noncitizen wage differences may underestimate the true wage differentials by not accounting for citizen-noncitizen differences in educational attainment. Noncitizen healthcare support workers such as certified nurses' aides are required to have received training as a registered nurse and pass the Certified Graduates of Foreign Nursing School exam. In contrast, CNAs who are US citizens are only required to complete high school or receive a GED. Hence, wage differentials greater than 5% can arise for healthcare support workers, all else equal, if employers pay experienced foreign healthcare support workers entry level wages offered to US citizens with less formal education. Furthermore, the possibility of employment of illegal immigrants as healthcare support workers suggests a supply source of low wage foreign workers who are susceptible to receiving wages more than 5% below the wages paid to US citizens employed as healthcare support workers. Hess and Henrici (2013) report an estimated one in five immigrant in-home healthcare support workers are undocumented. Low wages for undocumented healthcare support workers could occur because this group of workers lacks basic labor protections (Glenn 2010). Their lack of negotiation leverage limits their ability to achieve wage parity associated with the acquisition of valuable work experience derived from accruing long residency tenure in the US.

Noncitizen healthcare support workers could serve as a potential source of downward pressure on local wages of US citizens employed in these occupations if employers are able to pay wages below local labor market wages for jobs requiring low educational attainment. For instance, standard labor theory suggests relatively low local wages occur in areas populated with large percentages of noncitizens if they possess low reservation wages, even if local prevailing wage laws are enforced. The concentration of workers from low wage countries acts as a constraint on local wage levels if the reservation wage of these workers is relatively low. The availability of these noncitizen workers also suggests an elastic labor supply curve if they perceive limited

[15] The GAO (2000) finds local prevailing wages are determined by using several methods that include previously negotiated collective bargaining agreements, employer-provided surveys of local firms in an employer's respective industry, and wage levels by profession determined by the Bureau of Labor Statistics (BLS). This research reveals that these methods, especially employer-provided surveys, allow employers to choose the lowest wage of the three methods as a prevailing wage and might not reliably predict the local market wage for a specific occupation.

employment options. The extent of local wage differences depends on noncitizen-citizen labor substitutability, as greater substitutability facilitates greater downward pressure on the wages of workers who are citizens. Relatively low skill content and low educational requirements for healthcare support workers depicts the characteristics of an occupation susceptible to high labor substitutability from low-wage alternative sources.

Even though skill content and educational attainment requirements are likely to contribute to low employment barriers to individuals from low reservation wage countries, high labor substitutability is not certain among citizen and noncitizen healthcare support workers, a priori. Employment patterns among noncitizen healthcare support workers suggest a segmented labor market such that noncitizens are more likely to be employed as home healthcare support workers rather than as certified nurses' aides. For instance, information in Panel-B of Table 3 shows 86. 63% of noncitizen healthcare support workers are employed as home healthcare aides, while the remaining 13. 37% are employed as certified nurses' aides. Such employment distribution within the healthcare support employment sector suggests citizen status job heterogeneity, since noncitizens are disproportionately employed as home healthcare support workers. Job heterogeneity suggests noncitizens are not directly competing with a large segment of the healthcare support population, and hence might not serve as close substitutes for support workers who are citizens. This type of job heterogeneity also contributes to noncitizen-citizen wage differentiation since home healthcare support workers are paid markedly less than support workers employed as nurses' aides. Indeed, wage information presented in Panel-C of Table 4 reveals hourly nurses' aides-home healthcare aides pay offer differentials of 33. 29% for support workers with PERM visas. The differential for support workers receiving a yearly wage offer is 17. 92% for PERM visa recipients.[16]

Noncitizen job heterogeneity for healthcare support workers seems unique for healthcare occupations. By way of comparison, unlike the occupational specialization distribution for healthcare support workers presented in Panel B, the occupational specialization distribution for noncitizen registered nurses resembles that of registered nurses who are US citizens. Healthcare employment distribution information presented in Panel D of Table 5 shows 59. 8% of noncitizen registered nurses are employed as staff nurses compared to 59. 5% of all registered nurses employed in California. Registered nurses employed as managers is the second largest employment group for noncitizens and all registered nurses. Registered nurses' specialization occupational shares are much smaller for noncitizens and all registered nurses. It is possible, then, that wage results for healthcare support workers would differ from wage results reported in past research on registered nurses given the lack of any apparent noncitizen job status heterogeneity for registered nurses. The contents of Panels A and D reveal further differences in the labor market characteristics of noncitizens employed as healthcare support workers and registered nurses. In contrast to the types of visas

[16] The sample size for nurse's assistants with H2B visas is too small to allow for reliable examination of support occupation wage differentials for this group of noncitizens. It should also be noted that the employment of H2B workers could contribute to the high turnover rate for healthcare support workers because their visa is granted for immigrants applying for work on a temporary basis. Nonetheless, their small employment numbers do not suggest the possibility of a measurable overall turnover rate. In addition, H2 visa holders can still attain lengthy employment by renewing the visa to continue working with the same employer.

Table 3 Panel-B Number of Noncitizen Healthcare Support Workers Employed by Detailed Occupation (2008–2014)

	(1)	(2)
Occupation	*PERM Petition*	*H2-B*
Care Giver	181	4
Certified Nurses' Aide	7	0
Home Attendant	6	1
Nursing Aide	171	0
Home Healthcare Aide	1036	26

Source: Source: United States Department of Labor Employment and Training Administration, Office of Foreign Labor Certification, https://www. foreignlaborcert. doleta. gov/performancedata. cfm

granted to noncitizen healthcare support workers, noncitizen registered nurses are much more likely to attain temporary employment visas (H-1B), rather than obtaining a green card. The relatively large numbers of healthcare support workers applying for green cards presents healthcare employers with a pool of noncitizens who are eligible for long residency tenure in the US, which is an attractive attribute for employers attempting to address high turnover rates.

In sum, analysis within this labor supply elasticity conceptual framework does not provide a definitive prediction on noncitizen-citizen wage differentials and on noncitizen wage effects. On the one hand, the high probability noncitizen healthcare support workers hold green cards suggests employers have difficulty paying them wages below their counterparts who are citizens. On the other hand, evidence on prevailing wage compliance by domestic employers (in general) suggests the possibility noncitizen healthcare support workers receive wages close to 5% below the local market rate. Furthermore, the potential practice of employing undocumented home healthcare support workers presents employers leverage negotiating wages at or below the 5% maximum citizen-noncitizen pay differential. Indeed, Borjas (2017) finds

Table 4 Panel-C Mean Wage Offers for Foreign Healthcare Support Workers with PERM and H2B visas

	PERM Petition		*H-2B*	
	(1) *Home Healthcare Aide*	*(2)* *Nurses' Aides*	*(3)* *Home Healthcare Aide*	*(4)* *Nurses' Aides*
Hourly Wage	$9. 37	$12. 49	$9. 87	$7. 86
Offer ($2012)	(1. 202)	(2. 601)	(1. 943)	(0. 000)
# of Obs.	$N = 957$	$N = 186$	$N = 25$	$N = 4$
Yearly Salary	$19,842	$23,898	$19,682	$25,636
Offer ($2012)	(2359)	(2987)	(3987)	(5325)
# of obs.	$N = 300$	$N = 86$	N = 18	N = 3

Source: United States Department of Labor Employment and Training Administration, Office of Foreign Labor Certification, https://www. foreignlaborcert. doleta. gov/performancedata. cfm

Standard deviations presented in parentheses

Table 5 Panel-D: Employment Distribution of Registered Nurses by Specialty

Job Title	*Noncitizens (2008–2012)*		*Citizens (California) (2008, 2010, 1012)*
	(1)	*(2)*	*(3)*
	H1-B	PERM	
Staff Nurse	59. 77%	0	59. 5%
Management	8. 63	0	17. 9
Clinical Nurse	4. 26	0	3. 2
Nurse Educator	1. 15	0	3. 3
Case Manager	1. 07	0	4. 5
Nurse Practitioner	2. 83	0	1. 8
Other RNs	22. 29	0	9. 8%
Sample Size	2978		16,943

Source: Columns (1) and (2):United States Department of Labor Employment and Training Administration, Office of Foreign Labor Certification, https://www. foreignlaborcert. doleta. gov/performancedata. cfm

Source: Column (3): Joanne Spetz, Dennis Keane, Lela Chu and Lisel Blash, "California Board of Registered Nursing, 2012 Survey of Registered Nurses, Table 6," October 18, 2013

undocumented workers (in general) receive a 9. 9% wage penalty, all else equal, for his 2012–2013 sample observation period. Those findings support the notion undocumented workers present employers a pool of workers willing to work at wages below the legal minimum. Even without wage pressure from undocumented workers, wage differentials may arise due to citizen status job heterogeneity. The source of noncitizen-citizen wage differences, if they exist, is important since differentials due to prevailing wage noncompliance and employment of undocumented workers has the potential to suppress wages of support workers who are citizens. In contrast, if wage differences are more likely to occur due to citizen status job heterogeneity, then a lack of noncitizen substitutability does not support the notion of downward wage pressure for a large segment of support workers who are citizens. The labor supply elasticity framework used for this study's analysis indicates the need to consider residency tenure as well as elasticity of substitution when empirically examining the relative wages of citizen and noncitizen healthcare support workers and empirically examining the effect of noncitizen employment on citizen wages for workers employed in this occupation.

Data and Empirical Approach

Data

Individual worker information is taken from the 1996–2012 Current Population Survey-Outgoing Rotation Group (CPS-ORG) files to examine wage compensation patterns of noncitizen healthcare support workers and healthcare support workers who are citizens. Even though information on citizenship status is available for 1994 and 1995, including labor earnings for these two observation years introduces match bias, which has been shown to contribute to misleading wage results (Hirsch and

Schumacher 2004).[17]We further removed all observations reporting as having wages imputed by using the allocation flag in the CPS for 1996–2012.[18]Information taken from the 1996–2012 files includes individuals' hourly earnings, ethnicity, gender, age, level of educational attainment, marital status, full-time status, hours worked per week, central city residency status, regional residency, metropolitan statistical area residency location and size, occupation of employment, industry of employment, origin of birth, citizenship status and noncitizen workers' years of tenure in the US. Information on foreign healthcare support workers' years of tenure in the US is also included in the CPS files in two-year intervals. The population sample taken from these files is stacked over time rather than reported as a true panel data set. Therefore, each observation presents information for a unique individual healthcare support worker for each observation year.

The sample employed in this study is limited to employed healthcare support workers. A sample of 11,837 native born citizens, 1515 naturalized citizens and 1795 noncitizen healthcare support workers is obtained when satisfying the selection criteria reported above.[19] Although these sample sizes are relatively large, sample sizes for noncitizen healthcare support workers shrink substantially when grouping samples by year. Hence, healthcare support worker data are pooled for the entire sample observation period to maintain a relatively large population for wage analysis.

The CPS also allows for distinguishing naturalized and non-naturalized healthcare support workers who are born abroad. Making this distinction is significant because wages for these two groups of foreign born workers may differ because healthcare employers might not view naturalized support workers as "foreign", and naturalized citizens may not see themselves as "foreign", especially if they were naturalized at young ages. Thus, naturalized healthcare support workers are more likely to receive wages that resemble those paid to native-born health care support workers.[20]

A shortcoming associated with the use of CPS files is the inability to distinguish noncitizens who have attained green cards from noncitizens securing other types of visas. Holders of green cards have indefinite residency status and thus enjoy greater mobility than other noncitizens. Thus, they are not required to leave the US after a

[17] Hirsch and Schumacher (2004), explain match bias by indicating that the US Census allocates earnings using a "hot deck" imputation method that matches each non-respondent to an individual or "donor" whose characteristics are identical. The donor's reported earnings are then assigned to the non-respondent. Hence, wage distortion arises due to the use of imputed wages rather than actual reported wages.

[18] Excluding individuals not reporting their actual wage could introduce selection bias. Hence, as a robustness check, we estimated wage equations presented below for the full sample and obtained results that closely resemble the results reported in this study. Findings for the full sample are available upon request.

[19] CPS files provide information on a much larger sample of healthcare support workers than the sample used in this study. The smaller sample arises because a nontrivial portion of the entire sample do not report their local residency. Selecting individuals reporting residency location is required when comparing citizen wages across localities. Adhering to this selection criterion does not noticeably change findings when examining descriptive statistics and citizen-noncitizen wage differences. These results using the full sample are available from the authors on request.

[20] In order to be naturalized, an applicant must first meet all eligibility requirements for citizenship. Then, he or she must complete an application (the N-400 form), attend an interview, and pass an English and a civics test. Upon successful completion of these steps, the applicant takes an oath of loyalty, and becomes a citizen. Source: https://www.uscis.gov/citizenship/learners/apply-citizenship

specified time. Past research finds these green card advantages contribute to this group of noncitizens receiving higher wages than other noncitizens (Kandilov, 2007; Mukhopadhyay and Oxborrow, 2012). CPS files, though, do provide information on residency tenure. Given their indefinite residency status, focusing on residency tenure provides important insights regarding noncitizen likely visa status when making citizen-noncitizen comparative wage analysis. An additional data source limitation is the CPS coding of the three healthcare occupations (CNAs, orderlies and home healthcare support workers) into one category. Hence, while it is possible to analyze citizen and noncitizen wage patterns at the 3-digit census code level used to identify healthcare support workers, analysis at a more detailed occupation level is not possible. Special emphasis is given to the analysis of the elasticity of substitution results due to this shortcoming.

Descriptive statistics derived from using CPS-ORG data are presented in Table 6. Findings reported in this table reveal noncitizen healthcare support workers receive mean wages below those paid to US citizens. For instance, in 2012 dollars, noncitizen healthcare support works receive a mean wage of $12. 00 an hour compared to $12. 54 for native born citizens and $13. 20 for naturalized citizens. The non-citizen wage discount below the wages paid to native born works is 4. 41%, which is within the acceptable prevailing wage range. Interestingly, this mean wage discount arises even though noncitizen health care support workers possess traits that are associated with higher wages. Compared to native born healthcare support workers, these workers are substantially more likely to: belong to a union; live in the high wage New England, Mid-Atlantic and Pacific regions; secure employment in private for-profit companies; secure a full-time position; reside in a highly populated urban area; and earn a Bachelor's degree or higher. Of these noncitizen healthcare worker traits associated with higher wages, the finding that this group of support workers is nearly three times as likely to have earned a Bachelor's degree or higher is especially significant. Noncitizen healthcare support workers have relatively high educational attainment, which is consistent with the immigration law mentioned earlier requiring this group of foreign workers to receive training as a registered nurse, whereas citizen CNAs are only required to complete high school or receive a general education development degree (GED).

Evidence presented in Table 6 also indicates noncitizens possess traits that are not associated with higher wages. For instance, noncitizen support workers are substantially less likely to identify themselves as white and are much more likely to work in healthcare facilities other than clinics, hospitals and nursing homes. Most of these other facilities are home healthcare services, which generally pay lower wages. In comparison to nontrivial differences in mean traits with native born support worker, noncitizen support workers share many similar traits with naturalized citizens. In addition, these two support worker groups reside in localities with similar percentages of noncitizen support workers as a share of the local support work workforce and this measure is more than twice the percentage level for native born support workers. Differences

[0] In order to be naturalized, an applicant must first meet all eligibility requirements for citizenship. Then, he or she must complete an application (the N-400 form), attend an interview, and pass an English and a civics test. Upon successful completion of these steps, the applicant takes an oath of loyalty, and becomes a citizen. Source: https://www.uscis.gov/citizenship/learners/apply-citizenship

Table 6 Descriptive Statistics for Healthcare Support Workers (1996–2012)

Variable	U. S. Born Citizens	Naturalized Citizens	Noncitizens
Real Hourly Wage ($2012)	$12. 538 (5. 013)	$13. 200 (5. 549)	$12. 003 (4. 568)
Hours	34. 605 (12. 758)	36. 811 (12. 527)	36. 798 (12. 825)
Unionized	0. 121 (0. 327)	0. 254 (0. 436)	0. 179 (0. 384)
Age	37. 994 (13. 482)	45. 272 (11. 281)	39. 686 (11. 324)
Mid-Atlantic	0. 140 (0. 347)	0. 316 (0. 465)	0. 271 (0. 445)
New England	0. 122 (0. 327)	0. 163 (0. 370)	0. 143 (0. 350)
East North Central	0. 196 (0. 397)	0. 039 (0. 194)	0. 068 (0. 252)
West North Central	0. 099 (0. 299)	0. 022 (0. 148)	0. 046 (0. 209)
South Atlantic	0. 146 (0. 353)	0. 145 (0. 352)	0. 165 (0. 372)
East South Central	0. 040 (0. 196)	0. 008 (0. 089)	0. 006 (0. 078)
West South Central	0. 099 (0. 298)	0. 038 (0. 192)	0. 065 (0. 247)
Mountain	0. 072 (0. 259)	0. 035 (0. 184)	0. 038 (0. 192)
Pacific	0. 086 (0. 281)	0. 235 (0. 424)	0. 197 (0. 398)
Public	0. 107 (0. 309)	0. 092 (0. 289)	0. 068 (0. 252)
Private-For-Profit	0. 721 (0. 449)	0. 800 (0. 400)	0. 826 (0. 380)
Private-Non-Profit	0. 172 (0. 378)	0. 108 (0. 311)	0. 106 (0. 308)
Full-time	0. 607 (0. 488)	0. 688 (0. 463)	0. 674 (0. 469)
Married	0. 373 (0. 484)	0. 565 (0. 496)	0. 550 (0. 498)
Female	0. 894 (0. 307)	0. 898 (0. 303)	0. 848 (0. 359)
Black	0. 310 (0. 463)	0. 381 (0. 486)	0. 421 (0. 494)
White	0. 577 (0. 494)	0. 165 (0. 371)	0. 147 (0. 354)
Hispanic	0. 091 (0. 287)	0. 289 (0. 453)	0. 308 (0. 462)
Other Race	0. 032 (0. 175)	0. 204 (0. 403)	0. 159 (0. 366)
Elementary	0. 016 (0. 126)	0. 083 (0. 275)	0. 084 (0. 277)
Some High School	0. 124 (0. 329)	0. 106 (0. 308)	0. 125 (0. 331)
High School Diploma	0. 556 (0. 495)	0. 384 (0. 486)	0. 359 (0. 480)
Some College	0. 297 (0. 457)	0. 203 (0. 402)	0. 207 (0. 405)
Associate's Degree	0. 085 (0. 278)	0. 099 (0. 299)	0. 076 (0. 266)
Bachelor's Degree	0. 041 (0. 199)	0. 110 (0. 313)	0. 124 (0. 329)
Graduate Degree	0. 005 (0. 073)	0. 015 (0. 122)	0. 026 (0. 160)
Employed in Clinic	0. 035 (0. 184)	0. 024 (0. 154)	0. 021 (0. 140)
Employed in Hospital	0. 225 (0. 418)	0. 211 (0. 408)	0. 161 (0. 368)
Employed in Nursing Home	0. 397 (0. 489)	0. 335 (0. 472)	0. 391 (0. 488)
Employed in Healthcare N. E. C.	0. 224 (0. 417)	0. 293 (0. 455)	0. 321 (0. 467)
MSA 100,000–249,999	0. 143 (0. 350)	0. 027 (0. 162)	0. 044 (0. 205)
MSA 250,000–499,999	0. 157 (0. 364)	0. 042 (0. 201)	0. 048 (0. 214)
MSA 500,000 – 999,999	0. 157 (0. 364)	0. 112 (0. 316)	0. 090 (0. 287)
MSA 1,000,000 – 2,499,999	0. 237 (0. 426)	0. 192 (0. 394)	0. 184 (0. 387)
MSA 2,500,000 – 4,999,999	0. 106 (0. 308)	0. 110 (0. 313)	0. 125 (0. 331)
MSA 5,000,000 +	0. 178 (0. 383)	0. 492 (0. 500)	0. 484 (0. 500)
U. S. Tenure 0–4 years	n/a	0. 027 (0. 162)	0. 173 (0. 379)

Table 6 (continued)

Variable	U. S. Born Citizens	Naturalized Citizens	Noncitizens
U. S. Tenure 4–8 years	n/a	0. 063 (0. 244)	0. 232 (0. 422)
U. S. Tenure 8–12 years	n/a	0. 127 (0. 334)	0. 184 (0. 388)
U. S. Tenure 12–16 years	n/a	0. 138 (0. 345)	0. 143 (0. 350)
U. S. Tenure 16–20 years	n/a	0. 161 (0. 368)	0. 096 (0. 295)
U. S. Tenure 20 + years	n/a	0. 483 (0. 500)	0. 170 (0. 376)
Unemployment Rate in Location of Employment	5. 625 (2. 342)	6. 335 (2. 403)	6. 108 (2. 529)
Noncitizen concentration (%)	8. 34 (9. 03)	21. 9 (11. 6)	23. 1 (11. 8)
Number of Observations	11,837	1515	1795

Source: 1996–2012 Current Population Survey Outgoing Rotation Group Files

Standard errors presented in parentheses

among naturalized and noncitizen support workers, though, do arise when comparing their mean ages and residency tenures in the US. Compared to noncitizen support workers, naturalized support workers are appreciably older and much more likely to reside in the US for a lengthy time. Naturalized support workers are on average 45. 27 years old, and 64. 4% of these workers have lived in the US for 16 years or more. In contrast, non-citizen support workers are on average 39. 68 years old, and only 26. 6% of these workers have lived in the US for 16 years or more. These trait differences likely contribute to an inflated mean wage premium for naturalized citizens compared to noncitizen support workers. This variation in worker characteristics by citizenship highlights the need to employ multivariable estimation approaches to provide greater insight on the wage patterns of citizen and noncitizen healthcare support workers.

Empirical Approach

Equation (1) listed below is estimated to analyze noncitizen-citizen wage differentials of healthcare support workers employed in the US.[21]

$$\begin{aligned} ln\, \boldsymbol{W_{it}} = {} & \beta_0 + \beta_1 \boldsymbol{X_{it}} + \beta_2 \boldsymbol{TENURE\_0{-}4_{it}} + \beta_3 \boldsymbol{TENURE\_4{-}8_{it}} \\ & + \beta_4 \boldsymbol{TENURE\_8{-}12_{it}} + \beta_5 \boldsymbol{TENURE\_12{-}16_{it}} \\ & + \beta_6 \boldsymbol{TENURE\_16{-}20_{it}} + \beta_7 \boldsymbol{TENURE\_20PLUS_{it}} \\ & + \beta_8 \boldsymbol{NATURAL_{it}} + \beta_9 \boldsymbol{TIME_t} + \varepsilon_{it} \end{aligned} \quad (1)$$

where $ln\ W_{it}$ is the natural log of real hourly earnings adjusting for inflation using the consumer price index, the matrix X_{it} contains a set of observable healthcare support job

[21] The specification of wage equation (1) resembles that used by Schumacher (2011), except he interacts the foreign (noncitizen) status dummy with residency length dummies to estimate citizen-noncitizen log wage differentials.

and demographic characteristics for individual *i*, and observation year *t*. Variables included in the matrix of individual worker characteristics identify workers' public sector employment status, healthcare sector employment status, full-time employment status, level of education, gender, race, marital status, US regional residency, and union membership status. The matrix X_{it} also includes variables measuring metropolitan area annual unemployment rates and the size of the local area where the worker resides. These local residency variables are included to account for labor market characteristics varying by metropolitan statistical area (MSA) and year.[22] **NATURAL** is a dummy equaling 1 if the healthcare support worker is a naturalized citizen and its parameter estimate depicts the native-naturalization citizen log wage differential. *TIME* is a set of year dummies that is included to account for potential annual changes in wages. The remaining six dummies identify noncitizen workers' years of residency in the US. These dummies group noncitizen workers by four-year tenure increments, such that the dummy *TENURE_04* identifies noncitizen workers with the least amount of years residing in the US, and assigns the value 1 if a noncitizen worker has resided in the US for less than 4 years.[23]The last tenure dummy, *TENURE_20PLUS,* reported in Eq. (1) identifies noncitizens attaining the highest amount of years and assigns a value of 1 if a noncitizen worker has resided in the US for 20 or more years. The omitted comparison group is healthcare support workers who are native born US citizens. Hence, the estimated coefficients for these dummy variables depict the citizen-noncitizen log wage differential for each length of stay-noncitizen group. These coefficients could be converted into percentage differentials by using the formula $(\exp^{\beta}\text{-}1) \times 100$, however, interpreting findings derived from making this conversion might be problematic if heteroscedasticity is associated with the log-transformed specification (Baser, 2007; Ai and Norton 2000). Distorted estimated earnings differentials arise due to the introduction of enhanced bias that is associated with the anti-log transformation when heteroscedasticity is present. A Breusch-Pagan test for the log-earnings estimate for this study rejects the hypothesis of homoscedasticity as the chi-squared value is 123. 25, which is statistically significant at the 0. 01 level. Given the presence of heteroscedasticity, a gamma based generalized linear method (GLM) is used to estimate the log-wage equation to compute consistent estimates (Manning and Mullahy, 2001).[24]

Given the importance of understanding the level of citizen-noncitizen substitutability when examining wages for these two groups of healthcare support workers, this study provides an empirical estimation of the elasticity of substitution between citizen and noncitizen support workers. A two-step estimation process is incorporated, which is similar to that used by Ottaviano and Peri (2012) and Murthy (2008). The initial step estimates Eq. (2) to provide information on healthcare support worker wage variation across metropolitan statistical areas.

[22] Annual MSA unemployment rates are computed using annual CPS-ORG files.

[23] Four-year intervals for tenure residency are chosen to provide a reasonable sample size of noncitizens for each tenure group.

[24] The GLM procedure assuming error terms with Poisson, Gaussian, inverse Gaussian and binomial distributions was also used to estimate equation (1). The results using these distributions mirrors the results using the gamma distribution.

$$ln\ \boldsymbol{W_{it}} = \gamma_0 + \gamma_1 \boldsymbol{X_{it}} + \gamma_{2a} \boldsymbol{NC_{it}} \times \boldsymbol{M_{iat}} + \gamma_3 \boldsymbol{TIME_t} + \varepsilon_{it} \quad (2)$$

where M is a vector of dummy variables identifying an individual support worker's metropolitan statistical residence, NC is a vector of dummy variables equaling one if a support worker is not a US citizen and the symbol a indexes residency location. All other variables are the same as those presented in Eq. (1). The parameter estimates on the citizen status-MSA residency interaction term (γ_{2a}) depicts the noncitizen-citizen log wage differential for each MSA locality.

The second step of the process relies on a CES production function depicted by Eq. (3) to capture the relationship between healthcare support workers and the services they provide.

$$Q_m = A\left(\alpha C_m + (1-\alpha) NC_m^{\rho}\right)^{1/\rho} \quad (3)$$

where

$$Q_m \equiv Healthcare\ support\ worker\ service\ in\ metro\ area\ 'm'$$

$$C_m \equiv Number\ of\ citizen\ healthcare\ support\ workers\ who\ reside\ in\ metro\ area\ 'm'$$

$$NC_m \equiv Number\ of\ noncitizen\ healthcare\ support\ workers\ residing\ metro\ area\ 'm'$$

$$\rho = \left(1 - 1/\sigma\right)\ where\ \sigma\ denotes\ the\ elasticity\ of\ substitution$$

$$and\ \sigma = 1/(1-\rho)$$

For the production function described by Eq. (3) the respective marginal productivities for noncitizens ($MPNC_m$) and citizens (MPC_m) are depicted by eqs. (4) and (5)

$$MPNC_m = \partial Q_m / \partial NC_m = \frac{1}{\rho} A\left(\alpha C_m^{\rho} + (1-\alpha) NC_m^{\rho}\right)^{\rho-1/\rho} \rho (1-\alpha) NC_m^{\rho-1}$$

so

$$MPNC_m = \frac{1}{\rho} A\left(\alpha C_m^{\rho} + (1-\alpha) NC_m^{\rho}\right)^{\rho-1/\rho} (1-\alpha) NC_m^{\rho-1} \quad (4)$$

and

$$MPC_m = \frac{1}{\rho} A\left(\alpha C_m^{\rho} + (1-\alpha) NC_m^{\rho}\right)^{\rho-1/\rho} \alpha C_m^{\rho-1} \quad (5)$$

where α is the share parameter, which depicts domestic healthcare workers' employment share that arises when the domestic/foreign healthcare worker ratio has a value of unity. The symbol A is the factor productivity parameter for labor inputs.

Assuming cost minimization gives

$$\frac{w_{NC_m}}{w_{C_m}} = \frac{\partial Q_m / \partial NC_m}{\partial Q_m / \partial C_m} = \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{NC_m}{C_m}\right)^{\rho-1}$$

Taking the natural log of this equation gives Eq. (6) below.

$$\ln(w_{nc}) - \ln(w_c) \equiv \ln(\ w_{nc}/w_c\ ) = \ln((1-\alpha)/\alpha) + (\rho-1)\ln\left((NC_m/C_m)\right. \quad (6)$$

In addition, the estimated coefficient on the local residence parameter presented in Eq. (2) (γ_{2a}) denotes $\partial(\ln(W_{it})/\partial\ln(\mathrm{NC} \times M_{i,at})$. Given that the dependent variable for Eq. (2) is the wage of workers who are US citizens residing in location '*a*' at time '*t*', the term $\partial(\ln(W_{it})/\partial\ln(\mathrm{NC} \times M_{i,at})$ is the log wage difference in noncitizen and citizen workers' wages across metropolitan residences (i. e. $\partial(\ln(W_{it})/\partial\ln(\mathrm{NC} \times M_{i,at}) = \ln(w_{nc})$- $\ln(w_c)$ for each metropolitan area at time *t*). Noting that $\partial(\ln(W_{it})/\partial\ln(\mathrm{NC} \times M_{i,at}) = \ln(w_{nc})$-$\ln(w_c)$, Eq. (6) can be specified as follows:

$$\partial\Big(\ln(W_{it})/\partial\ln\big(NC \times M_{i,at}\big) = \ln(\,w_{nc}\,) - \ln(w_c) \equiv \ln(\,w_{nc}/w_c\,)$$

$$= \ln((1-\alpha)/\alpha) + (\rho-1)\ln\Big((NC_c/C_c)\Big) \tag{7}$$

Setting $(\rho\text{-}1) = \lambda_1$, and therefore $\rho = \lambda_1 + 1$, and also setting $\lambda_0 = \ln((1\text{-}\alpha)/\alpha)$, and therefore $\exp^{\lambda 0} = (1\text{-}\alpha)/\alpha$, and noting that the estimate of $\partial(\ln(W_{it})/\partial\ln(\mathrm{NC} \times M_{i,at})$ is$(\hat{\gamma}_{2a})$from Eq. (2) gives the following equation:

$$\hat{\gamma}_{2a} = \lambda 0 + \lambda 1[\boldsymbol{ln}\ (\boldsymbol{NC}/\boldsymbol{C})\boldsymbol{m}] + \varepsilon_a \tag{8}$$

The estimated coefficient λ_1 is then used to compute the elasticity of substitution between noncitizen healthcare support workers and citizen healthcare workers, and λ_0 is used to calculate workers who are US citizens' labor share if the citizen/noncitizen employment ratio were equal to one. The elasticity of substitution is calculated using the following equation, $\sigma = -1/\ \lambda_1$. The formula $(1/(\exp^{\lambda 0} + 1)) = \alpha$ denotes workers who are US citizens' labor share if the citizen/noncitizen employment ratio were equal to one. The value derived when computing this formula allows testing whether the estimation results depict an accurate representation of the citizen/noncitizen labor share ratios.

Following the estimation of elasticity of substitution, the impact of employing noncitizen workers on the wage of healthcare support workers who are US citizens is examined using the results derived from estimating Eq. (9).

$$\begin{aligned} ln\ \boldsymbol{W_{it}} = {} & \theta_0 + \theta_1 \boldsymbol{X_{it}} + \theta_1\ (\%\boldsymbol{NONUSCIT}_{\boldsymbol{at}}) \\ & + \theta_2\Big(\%\boldsymbol{NONUSCIT}_{\boldsymbol{at}}{}^{*}\ \boldsymbol{NATURAL_{it}}\Big) \\ & + \theta_3 \boldsymbol{NATURAL_{it}} + \theta_4\ \boldsymbol{TIME_t} + \varepsilon_{it} \end{aligned} \tag{9}$$

The specification of Eq. (9) resembles that used in past research using cross sectional analysis to examine the citizen wage effect of immigrant workers (Altonji and Card 1991; Butcher and Card 1991; LaLonde and Topel 1991; and Schoeni 1997). The sample used for this analysis is restricted to healthcare support workers who are US citizens since the objective is to examine inter-metropolitan wage differences for this group of workers. The vector of variables presented in matrix ***X***, the dummy ***Natural***, and the set of year dummies ***TIME*** are the same as those reported in eqs. (1) and (2). The variable ***%NONUSCIT*** measures foreign workers' share of all healthcare support workers for each metropolitan statistical area. Its parameter estimate depicts the inter-metropolitan differences in native born citizen healthcare support worker wages

associated with differences in the local concentration of non-citizen healthcare support workers. The sum of the parameter estimates on the naturalization dummy and the interaction term depicts the native born- naturalized wage differential for these two groups residing in metropolitan areas that do not employ noncitizen support workers. Using different concentration levels for this calculation allows for computing the native born- naturalization wage differential for different metropolitan locations.

Using the standard empirical approach to estimate the wages might introduce bias and inconsistency if noncitizens' share of the local healthcare support labor market is determined endogenously. For instance, Borjas and Katz (2007), and Altonji and Card (1991) suggest the potential presence of location endogeneity due in part to the possibility that foreign workers seek jobs in high wage localities. While local economic conditions such as competitive local wages for relatively low skilled healthcare support workers may influence immigration trends, Bartel's (1989) findings suggest that immigrants are mainly attracted to cities with large concentrations of previous immigrants from the same country. Given this immigration location pattern, research examining the wage effect of immigration commonly uses instruments that measure the fraction of immigrants in a city prior to the observation years (Altonji and Card 1991; Dustmann et al. 2013). These studies argue that immigrant inflows are strongly correlated with the initial fraction of immigrants in a city, and variables depicting such inflows are reasonably strong predictors of differences in immigrant concentration.

This study incorporates each of the instruments of Altonji and Card (1991) and Dustmann et al. (2013). The local noncitizen-citizen wage differential for all low skilled workers is a replication of the instrument used by Altonji and Card (1991), and the 1994 ratio of noncitizens to citizens of all occupations interacted with dummies for each year from 1996 to 2012 are taken from Dustmann et al. (2013). The Dustmann et al. instruments are used to capture 1996–2012 immigration inflows associated with the fraction of immigrants in an MSA prior to those years. The results of a test to examine whether these 18 variables are too weak to be used as valid instruments support their use for addressing potential location endogeneity.[25] A Durbin-Wu-Hausman test of the relevancy of location endogeneity, however, generates an *F*-score of only 1. 6264, which lacks significance at the 10% level. This lack of statistical significance at standard levels supports not rejecting the null hypothesis that noncitizen location concentration is exogenous and validates the use of non-adjusted residency location levels. The same GLM procedure used when estimating Eq. (1) is used to estimate Eq. (9).

[25] Seventeen of the eighteen variables arise from constructing a measure of the noncitizen/citizen ratio for the 1994 population reporting as being in the labor force, and then interacting this ratio with one-year dummy variables (year dummies for each of the years 1996–2012). These variables mimic those used by Dustmann et al. (2013). The remaining instrument mimic that used by Altonji and Card (1991). The test of weak instruments suggests that the minimum eigenvalue statistic is 436.166, which exceeds the critical value of 21.34 for relative bias value at the 5% level and exceeds the critical values of 57.53 and 3.20 for the 5% two-state least square size nominal Wald test and LIML size nominal Wald test pertaining to Stock and Yogo's (2005) second characterization of weak instruments. In addition, the test for over-identification reveals a Sargan score (chi2(17)) of 18.9076 and *p* value of 0.3339, which suggests we cannot reject the null hypothesis that our instruments are valid at the standard levels of statistical significance.

Results

Information in Table 7 presents the wage results of noncitizen healthcare support workers compared to support workers who are US citizens when estimating Eq. (1). Findings for the control variables are largely consistent with standard economic theory. Statistically significantly higher wages are associated with belonging to a union, marriage, recipient of a college degree, older, working full-time, residing in a metropolitan area with relatively low local unemployment, residing in a metropolitan area with a population over 1 million residents, and residing in the New England region of the US. Findings specific to the healthcare profession suggest healthcare support workers employed in hospitals, nursing homes, and clinics received higher wage payments compared to support workers employed in the not-for- profit sector. Findings on ethnic wage differentials show white support workers receive wages that are not statistically significantly different from the wage paid to of nonblack-nonHispanic minority support workers. In contrast, black and Hispanic support workers receive wages that are significantly less than wages paid to nonblack-nonHispanic minorities.

The estimated coefficients of the parameter on the key variables of interest are the measures of noncitizen support workers' length of stay in the US. Findings on these estimated coefficients suggest wage discounts that are statistically significantly greater than zero at conventional confidence interval levels. Using the estimated parameters on the tenure dummies and their standard errors to calculate whether noncitizen support workers receive wages statistically significantly below the 5% prevailing wage maximum indicates that noncitizens with less than 8 years of residency in the US do indeed receive wages statistically significantly below the legal minimum wage. However, the discount declines successively for each of the four-year US residency intervals starting at 10. 92% for noncitizens with four or less years of residency until reaching a wage discount low of 2. 27% for noncitizen support workers residing in the US for twenty or more years. This erosion of the noncitizen-citizen wage discount comports well with the hypothesis that gaining experience in the US enhances noncitizen workers' ability to attain wages that more closely resemble that of citizens employed in the same occupation (Borjas 2001; Chiswick and Miller 2010).

Another key finding of interest is the estimated coefficient on the naturalization dummy. This wage result suggests naturalized support workers receive a 2. 123% premium above the hourly wage paid to noncitizen support workers, all else equal, which reveals the 10% mean wage differential for these two support worker groups presented in Table 6 is indeed inflated. It is also interesting to note that taking the sum of the estimated coefficient on the naturalization and residency tenure dummies suggest naturalized support workers residing in the US for 20 or more years receive hourly wages which closely mirror those of native born support workers. This group of naturalized citizens account for an overwhelming share of 49. 24% of the sample population of naturalized support workers as depicted in Table 6.

As conventional theory suggests, the existence of a noncitizen-citizen wage discount is potentially harmful to citizen support workers if noncitizen support workers are close substitutes. Results from estimating Eq. (8) are used to measure the degree of substitutability between noncitizen and citizen healthcare support workers. The sample used to derive findings in column (1) of Table 8 only includes information for metropolitan statistical areas with a nonzero sample of noncitizen support workers' residents. These

Table 7 Results used to compare wages of noncitizen and citizen Healthcare Support Workers (estimation of Eq. (1))

Dependent Variable is Log of Hourly Wage ($2012)	
Explanatory Variables	
Intercept	5. 850 (164. 19)
Time Dummies	Yes
Naturalized	**0. 021 (2. 24)**
Foreign Tenure < 4 years	**−0. 116 (−8. 08)**
Foreign Tenure 4–8 years	**−0. 090 (−7. 41)**
Foreign Tenure 8–12 years	**−0. 050 (−4. 03)**
Foreign Tenure 12–16 years	**−0. 053 (−4. 03)**
Foreign Tenure 16–20 years	**−0. 059 (−4. 27)**
Foreign Tenure > 20 years	**−0. 023 (−2. 24)**
Log (weekly hours worked)	0. 019 (2. 59)
Union	0. 095 (14. 33)
Public Sector	−0. 039 (−4. 46)
Private for profit	−0. 026 (−4. 26)
Employed Fulltime	0. 029 (4. 71)
Age	0. 013 (13. 36)
Age Squared (× 1000)	−0. 138 (−11. 78)
Married	0. 036 (7. 94)
H. S. Diploma	−0. 056 (−8. 27)
Some College	0. 047 (9. 02)
Associate's Degree	0. 071 (8. 94)
Bachelor's Degree	0. 096 (9. 95)
Graduate Degree	0. 195 (8. 55)
White	0. 007 (0. 69)
Black	−0. 016 (−1. 75)
Hispanic	−0. 042 (−4. 31)
Male	0. 013 (1. 84)
New England	0. 105 (10. 05)
Mid-Atlantic	−0. 015 (−1. 35)
East North Central	−0. 035 (−3. 49)
West North Central	−0. 025 (−2. 23)
South Atlantic	−0. 052 (−5. 09)
East South Central	−0. 117 (−8. 10)
West South Central	−0. 186 (−16. 73)
Pacific	0. 016 (1. 46)
Unemployment Rate	−0. 012 (−8. 69)
Hospital	0. 141 (18. 23)
Nursing Home	0. 024 (3. 41)
Clinic	0. 116 (8. 75)
Healthcare N. E. C.	−0. 053 (−6. 92)
MSA 100,000–249,999	−0. 046 (−2. 44)

Table 7 (continued)

Dependent Variable is Log of Hourly Wage ($2012)	
MSA 250,000 - 499,999	−0. 028 (−1. 49)
MSA 500,000 - 999,999	−0. 003 (−0. 16)
MSA 1,000,000 – 2,499,999	0. 013 (0. 71)
MSA 2,500,000 – 4,999,999	0. 062 (3. 29)
MSA 5,000,000 +	0. 028 (1. 51)
Number of observations	15,147
Log-likelihood	−915. 337

Source: 1996–2012 Current Population Survey Outgoing Rotation Group Files

T-statistics presented in parentheses

findings suggest that the estimated intercept λ_0 from estimating Eq. (8) is −0. 02473. Taking the inverse of the exponent of this parameter estimate plus one depicts citizen support workers' employment share that arises when the citizen/noncitizen support worker ratio has a value of unity. Results derived from making this calculation suggest citizen workers would make up 0. 499 of the labor share if the citizen/noncitizen employment ratio were equal to one for the 1996–2012 sample. These calculations depict a reasonably accurate arithmetic representation of the citizen-noncitizen work force share when requiring this ratio to equal one. The parameter λ_1 is the estimate on the log of the noncitizen/citizen employment ratio parameter and is used to calculate the elasticity of substitution by taking the inverse of this parameter estimate. Findings in column (1) of Table 8 suggest that λ_1 has a value of 0. 00246 for the 1996–2012 sample. Taking the negative of the inverse of this value indicates σ equals −416. 67, suggesting that, for this limited MSA sample population, noncitizen support workers are complements for healthcare support workers who are citizens.

Table 8 Elasticity of Substitution Results From Estimating Eq. (8)

Variable	*Estimated Coefficients* (1)[a]	*Standard Errors*	*Estimated Coefficients* (2)[b]	*Standard Errors*
Intercept, λ_0	−0. 02473	0. 0544	−0. 0305	0. 03509
λ_1	0. 00246	0. 01964	−0. 00199*	0. 0013
$\rho = \lambda_1 + 1$	1. 00246		0. 99,801	
$\sigma = 1/(1-\rho) = -1/\lambda_1$	−406. 50		502. 51	
$\alpha = 1/(\exp(\lambda_0) + 1)$	0. 499		0. 50	
R-square	0. 0001		0. 0051	
F-value	0. 02		1. 41	
# of obs.	167		276	

Significant at the 10% level

Sample excluding MSAs reporting an absence of noncitizen healthcare support workers

Sample converting only the MSA zero values using the Box-Cox Transformation

While this elasticity result is insightful, the exclusion of observations due to an absence of noncitizens in some metropolitan areas limits the analysis to a relatively small share of the healthcare support worker population. In column (2) of Table 8, to allow the inclusion of all MSA locations in the elasticity of substitution analysis, values close to zero derived from using the Box-Cox transformation are assigned to the MSAs that were excluded from the sample used to derive estimates in column (1).[26] Findings reported in column (2) suggest, when accounting for residents in all US MSAs, noncitizen and citizen healthcare support workers are not complements. Rather, the estimated coefficient on the log of the noncitizen-citizen ratio is positive and statistically significant, suggesting noncitizen support workers are (actually) imperfect substitutes since the denominator of the elasticity of substitution measure is significantly different from zero. The lack of perfect substitutability suggests the possibility of citizen support workers avoiding a significant noncitizen wage effect. Findings presented in Table 9 report the findings from estimating Eq. (9) to allow examination of the effect of noncitizen support worker employment on the wages of support workers who are US citizens. The signs and statistical significance of the control variables tend to mirror those found when estimating the wage differential equation, even though the sample for the results presented in Table 9 only includes information on healthcare support workers who are US citizens. A key finding derived from estimating Eq. (9) suggests local concentration of noncitizen healthcare support workers is not associated with lower wages for native born citizen support workers, as the estimated coefficient on the noncitizen concentration parameter indicates wages for the group of support workers increases by 0. 15% for each 1 % increase in the local concentration of noncitizen support workers. Hence, for native born support workers residing in the location with mean concentration of 8. 34% for their employment group, the native-born support worker receives 1. 29% higher wages than native born support workers residing in locations that do not employ noncitizen support workers. Findings on the estimated coefficient for the naturalization dummy suggest naturalized support workers residing in locations that do not employ noncitizen support workers receive a 5. 47% premium over native-born citizens. However, the estimated coefficient on the noncitizen concentration-naturalization interaction term indicates that premium falls by 0. 45% as the concentration of noncitizen support workers increases by 1 %.[27]This decline is so small that for both groups of citizens residing in the mean noncitizen concentration location for native-born citizens, the naturalized citizens still receive a premium over native-born citizens that equals 1. 717%.[28]

[26] The Box-Cox transformation of the NC/C ratio is $((NC/C)' = [(NC/C)^{\theta} - 1]/\theta$, where the symbol θ is estimated using the profile likelihood function. For this estimation $\theta = 0.066109$.

[27] Note that percentage differences are exponential transformation of the individual parameter estimates.

[28] Wage equations (1) and (9) were also estimated including a dummy identifying whether a noncitizen possessed traits matching six of the nine undocumented worker characteristics proposed by Borjas (2017). The CPS-Org files do not allow for identifying the three remaining traits used by Borjas. These wage results mirror those presented in this study and are available from the authors upon request.

Table 9 Wage Effect of Noncitizen Employment Density on Wages of Citizens (estimation of Eq. (9))

Dependent Variable is Log of Hourly Wage ($2012)	
Explanatory Variables	
Intercept	5. 788 (153. 01)
Time Dummies	Yes
Naturalized	**0. 053 (3. 50)**
%Nonuscit	**0. 00155 (4. 57)**
%Nonuscit * Naturalized	**−0. 0045 (−6. 98)**
Log (weekly hours worked)	0. 019 (3. 09)
Union	0. 097 (13. 52)
Public Sector	−0. 031 (−3. 38)
Private for profit	−0. 024 (−3. 80)
Employed Fulltime	0. 027 (4. 24)
Age	0. 014 (13. 58)
Age Squared (× 1000)	−0. 144 (−11. 78)
Married	0. 039 (8. 01)
H. S. Diploma	−0. 058 (−7. 97)
Some College	0. 048 (8. 78)
Associate's Degree	0. 071 (8. 49)
Bachelor's Degree	0. 102 (9. 39)
Graduate Degree	0. 283 (10. 11)
White	0. 018 (1. 64)
Black	−0. 014 (−1. 30)
Hispanic	−0. 026 (−2. 26)
Male	0. 006 (0. 83)
New England	0. 098 (8. 94)
Mid-Atlantic	−0. 003 (−0. 30)
East North Central	−0. 024 (−2. 28)
West North Central	−0. 018 (−1. 58)
South Atlantic	−0. 047 (−4. 39)
East South Central	−0. 104 (−7. 10)
West South Central	−0. 180 (−15. 59)
Pacific	0. 018 (1. 53)
Unemployment Rate	−0. 013 (−8. 34)
Hospital	0. 140 (17. 23)
Nursing Home	0. 024 (3. 17)
Clinic	0. 123 (8. 98)
Healthcare N. E. C.	−0. 051 (−6. 33)
MSA 100,000–249,999	−0. 047 (−2. 33)
MSA 250,000 - 499,999	−0. 031 (−1. 56)
MSA 500,000 - 999,999	−0. 008 (−0. 40)
MSA 1,000,000 – 2,499,999	0. 008 (0. 42)
MSA 2,500,000 – 4,999,999	0. 049 (2. 41)
MSA 5,000,000 +	0. 027 (1. 36)

Table 9 (continued)

Dependent Variable is Log of Hourly Wage ($2012)	
Number of observations	13,352
Log-likelihood	−742. 771

Source: 1996–2012 Current Population Survey Outgoing Rotation Group Files

*T-statistics presented in parentheses

Concluding Remarks

The growing demand for affordable healthcare services in the US places pressure on domestic healthcare facilities hiring enough employees to meet these needs. Such pressure is especially acute for healthcare support workers, due in part to the high turnover rate among individuals employed in this occupation. Employing noncitizens presents an opportunity for healthcare employers to increase the pool of support workers. However, employing noncitizens can also limit the ability of citizens to attain wages high enough to reduce high turnover rates, especially if noncitizen healthcare support workers are paid wage rates that undercut wages paid to citizen healthcare support workers. This study compares the wages of citizen and noncitizen healthcare support workers, as well as examines the effect of noncitizen healthcare support worker employment on the wages of citizen support workers.

Our analysis considers, on one hand, the labor market implications of past research reporting a lack of effective enforcement of prevailing wage legislation (GAO, 2000; Cornell Institute of Public Affairs, 2013) and employment of undocumented workers (Hess and Henrici 2013). On the other hand, we consider the possibility noncitizen healthcare support workers are likely to qualify for green card visas and to work primarily as home healthcare support workers and not as certified nurses' assistants. The long tenure residency status associated with a green card provides noncitizens the opportunity to assimilate to the point where they can command wages comparable to wages paid to US citizen support workers (Chiswick and Miller 2010). Disproportionate employment of noncitizens as healthcare support workers mutes downward wage pressure on the entire population of support workers who are citizens, since employment competition from noncitizens is not prevalent for all healthcare support occupations. Findings are consistent with the assimilation argument, as they reveal a declining wage discount that is statistically significantly below the legal maximum of 5% after 4 to 8 years of residency. Finding noncitizen wage discounts statistically significantly above the 5% maximum for workers with short tenure provides support for the weak enforcement of prevailing wage legislation and employment of undocumented workers hypotheses as well as support for the citizen status job heterogeneity hypothesis.

This study notes that citizen healthcare support workers' vulnerability to the employment of noncitizens is not solely dependent on significantly lower wages paid to noncitizen support workers. Wages for these citizens are also influenced by their substitutability with their noncitizen counterparts. Estimates of noncitizen-citizen healthcare support worker substitutability suggest noncitizen healthcare support workers are not close substitutes for support workers who are US citizens. This labor substitutability result comports well with the citizen status job heterogeneity hypothesis of limited competition from noncitizen workers. This substitutability result is also consistent with visa findings reporting a nontrivial

majority of noncitizen healthcare support workers are employed as home healthcare aides and care givers rather than employed in the much higher wage occupation of nurses' aides. The disproportionate employment of noncitizens in home healthcare support jobs can suppress the overall wage effect of immigration in this industry because, in general, this group of noncitizens are not in direct competition with the large group of relatively better paid certified nurses' assistants. Indeed, wage estimation findings do not reveal a negative wage effect of noncitizen employment on healthcare support workers who are native-born US citizens. Rather, the findings reveal a relatively small negative wage effect of noncitizen employment on naturalized healthcare support workers.

In sum, past research on the influence of noncitizen healthcare employment on the wages of healthcare workers who are US citizens has focused primarily on nurses (Schumacher 2011; Murthy 2008). Research, on healthcare labor markets, though, has not examined the labor market for healthcare support workers. This set of occupations provides employment for a nontrivial number of workers and is accessible to US citizens with limited formal education. Hence, these jobs provide an important employment opportunity to a vulnerable part of the US workforce. Findings revealing a declining noncitizen-citizen wage discount associated with length of residency is consistent with past findings for registered nurses (Schumacher 2011). Findings on noncitizen-citizen substitutability for healthcare support workers, however, do differ from past findings on substitutability for registered nurses as the latter group of health care workers are found to be perfect substitutes (Kaushal and Kaestner 2015). We attribute this substitutability difference to the presence of citizen status job heterogeneity for healthcare support workers which is not apparent for registered nursesConsistent with the findings of a lack of perfect substitutability among noncitizen and citizen healthcare support workers, findings from this study do not find a consequential wage effect due to the employment of noncitizen support workers. Nonetheless, findings of a nontrivial wage discount above the 5% maximum for noncitizen support workers with short residency tenure underscores the value of strictly enforcing immigration legislation intended to protect this vulnerable group of workers.

Appendix

Table 10 Results used to compare wages of "predicted undocumented" and citizen Healthcare Support Workers (estimation of Eq. (1))

Dependent Variable is Log of Hourly Wage ($2012)		
Explanatory Variables		
Intercept	5. 847,183	163. 90
Time Dummies	Yes	
Naturalized	**-. 0162844**	**−2. 08**
Foreign Tenure < 4 years	**-. 116,397**	**−7. 34**
Foreign Tenure 4–8 years	**-. 0801971**	**−5. 85**
Foreign Tenure 8–12 years	**-. 0399527**	**−2. 59**
Foreign Tenure 12–16 years	**-. 0392606**	**−2. 24**
Foreign Tenure 16–20 years	**-. 0629224**	**−2. 78**

Table 10 (continued)

Dependent Variable is Log of Hourly Wage ($2012)		
Foreign Tenure > 20 years	**-. 0181874**	**−0. 79**
Log (weekly hours worked)	. 0155104	2. 59
Union	. 0951379	14. 39
Public Sector	-. 0427908 -	4. 82
Private for profit	-. 0264235	−4. 34
Employed Fulltime	. 0284616	4. 66
Age	. 0131056	13. 26
Age Squared (× 1000)	-. 0001362	−11. 63
Married	. 0350834	7. 71
H. S. Diploma	-. 0555652	−8. 14
Some College	. 0470669	8. 98
Associate's Degree	. 0697513	8. 80
Bachelor's Degree	. 0926703	9. 64
Graduate Degree	. 1,899,471	8. 32
White	. 0112549	1. 20
Black	-. 0135044	−1. 44
Hispanic	-. 0442008	−4. 53
Male	. 0124177	1. 81
New England	. 102,477	9. 83
Mid-Atlantic	-. 016411	−1. 56
East North Central	-. 0350006	−3. 46
West North Central	-. 0259988	−2. 30
South Atlantic	-. 0536804	−5. 21
East South Central	-. 117,094	−8. 12
West South Central	-. 1,844,032	−16. 60
Pacific	. 0142969	1. 30
Unemployment Rate	-. 0120562	−8. 77
Hospital	. 1,421,687	18. 36
Nursing Home	. 0246633	3. 45
Clinic	. 1,178,066	8. 89
Healthcare N. E. C	-. 0528423	−6. 96
MSA 100,000–249,999	-. 0451549	−2. 41
MSA 250,000 - 499,999	-. 0268762	−1. 45
MSA 500,000 - 999,999	-. 0026701	−0. 14
MSA 1,000,000 – 2,499,999	. 0130461	0. 72
MSA 2,500,000 – 4,999,999	. 0612135	3. 23
MSA 5,000,000 +	. 0266705	1. 44
Log likelihood		−930. 7,947,994

Source: 1996–2012 Current Population Survey Population Survey-Outgoing Rotation Group files

T-Statistics presented in parentheses

Table 11 Wage Effect of "predicted nondocumented" employment density on wages of Citizens (estimation of Eq. (9))

Dependent Variable is Log of Hourly Wage ($2012)		
Explanatory Variables		
intercept	5. 797,449	153. 33
Time Dummies	Yes	
%undocumented	**. 0019535**	**5. 71**
naturalized	**. 0326784**	**2. 37**
%undocumented×naturalized	**-. 004213**	**−6. 42**
Log(weekly hours worked)	. 0187103	3. 00
union	. 0955577	13. 38
public sector	-. 0312987	−3. 41
private for profit	-. 0246478	−3. 89
fulltime	. 027378	4. 26
age	. 0140389	13. 65
age squared (× 1000)	-. 0001446	−11. 85
married	. 0390086	8. 05
H. S. diploma	-. 0579178	−8. 00
Some college	. 0485553	8. 85
Associate's degree	. 0712036	8. 52
Bachelor's degree	. 1,020,327	9. 40
Graduate degree	. 2,832,577	10. 11
White	. 0171477	1. 58
Black	-. 0148793	−1. 36
Hispanic	-. 0279924	−2. 44
male	. 006983	0. 94
new England	. 0983378	9. 02
mid-atlantic	-. 0038174	−0. 35
east north central	-. 0254167	−2. 42
west north central	-. 0195053	−1. 68
south atlantic	-. 0482821	−4. 49
east south central	-. 1,066,428	−7. 26
west south central	-. 1,797,063	−15. 56
pacific	. 0167016	1. 43
urate	-. 0121648	−8. 08
hospital	. 1,396,704	17. 20
nursing home	. 0244522	3. 24
clinic	. 1,241,515	9. 03
healcare nec	-. 0516316	−6. 40
MSA 100,000–249,999	-. 0519216	−2. 60
MSA 250,000–499,999	-. 0373149	−1. 88
MSA 500,000-999,999	-. 0149563	−0. 75
MSA 1,000,000-2,499,999	. 0001552	0. 01
MSA 2,500,000-4,999,999	. 0392345	1. 91

Table 11 (continued)

Dependent Variable is Log of Hourly Wage ($2012)		
MSA 5,000,000	0156608	0. 76
Log likelihood	−743. 166,562	

Source: 1996–2012 Current Population Survey Population Survey-Outgoing Rotation Group files

T-Statistics presented in parentheses

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