Diversity in Occupation by Skill Level: Overview of All Industries

Executive Summary

Background

Philadelphia has a diverse workforce. Building the talents of this workforce is the primary goal of the city's workforce strategy, *Fueling Philadelphia's Talent Engine.* To better understand Philadelphians currently at work, this report examines how working Philadelphia residents are distributed across occupations and skill levels. Philadelphia has a higher percentage of lower-skilled, poorly paid jobs than many other cities, partly due to the large hospitality industry tied to the Pennsylvania Convention Center and the large tourism industry. With a poverty rate of 25.9 percent (American Community Survey 2012 – 2016), we explore the demographics of workers who live in the city across different skill levels to better understand possibilities for career pathway approaches to provide on-ramps to residents looking to advance from low-wage unskilled jobs into middle skilled jobs with living wages. This is the first in a series of reports that will focus on questions of diversity and equity of opportunity. Following reports will focus on the 7 target sectors respectively: healthcare, retail & hospitality, early childhood education, technology services, business & financial services, construction & infrastructure, and manufacturing & logistics.

Our data for this report are from two major sources: the American Community Survey (ACS) Public Use Microdata Sample (PUMS) for 2011-2015 and EMSI Q2, 2017 staffing pattern data. ACS PUMS data are self-reported survey data from residents. These data provide demographic information of Philadelphia residents such as gender, race, age, and educational level. Also included are information on a resident's employment such as the wage earned in past 12 months, work location and working hours in a week. EMSI data are based on the Quarterly Census of Employment and Wages (QCEW) data collected by the states and delivered to the U.S. Bureau of Labor Statistics. These data are reported by employers and contain valuable information on the

entry level education and training, prior experience requirements and median hourly earnings for a specific occupation in a specific county. These two datasets both contain 6-digit Standard Occupational Codes (SOC) which allow us to merge them[1] to analyze the labor market from both the employees' and the employers' sides. This report focusses on residents of Philadelphia, that is, by city residence and not by work location.

Based on the entry level education and training requirements, occupations are classified into three skill levels:

1. *High-skill* occupations require a Bachelor's or higher degree.
2. *Middle-skill* occupations require an associate degree, postsecondary non-degree award, or some-college but no degree, or a high school degree and one of the following: long-term on-the-job training, moderate-term on-the-job training; or apprenticeship.
3. *Low-skill* occupations require less than a high-school degree; or a high school degree with short-term training or no training.

These categories are consistent with the literature on skill levels among occupations[2]. This report looks at the employment of Philadelphia residents – some of whom work outside the city. The merged data show that there were 638,956 Philadelphia residents employed in 2015, women made up more than half of the employed residents (52 percent). Breaking it down by race, white workers made up nearly half of the employed residents (49 percent), 37 percent were Black, and 14 percent were Other Minority[3]. In comparison, the working age population 16 years old and older in Philadelphia were 44 percent white, 41 percent Black and 14 percent were Other Minority.

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[1] Both PUMS and EMSI datasets contains 6-digit SOC code. 69% (125 out of 182) of the SOC can be matched. For those SOC that cannot be matched, we managed to match them based on 5-digit level.

[2] See "Industry Analytics for the City of Philadelphia's Workforce Strategy", Economy League of Greater Philadelphia, Nov 2017.
"Pennsylvania Middle-Skill Fact Sheet", National Skills Coalition, Feb 2017.
"Bridge the Gap: Rebuilding America's Middle Skills", HBS Research.

[3] Other minority include American Indian alone; Alaska Native alone; American Indian and Alaska Native tribes specified, or American Indian or Alaska Native, not specified and no other races; Asian alone; Native Hawaiian and Other Pacific Islander alone; Some Other Race alone; Two or More Races.

Figure 1
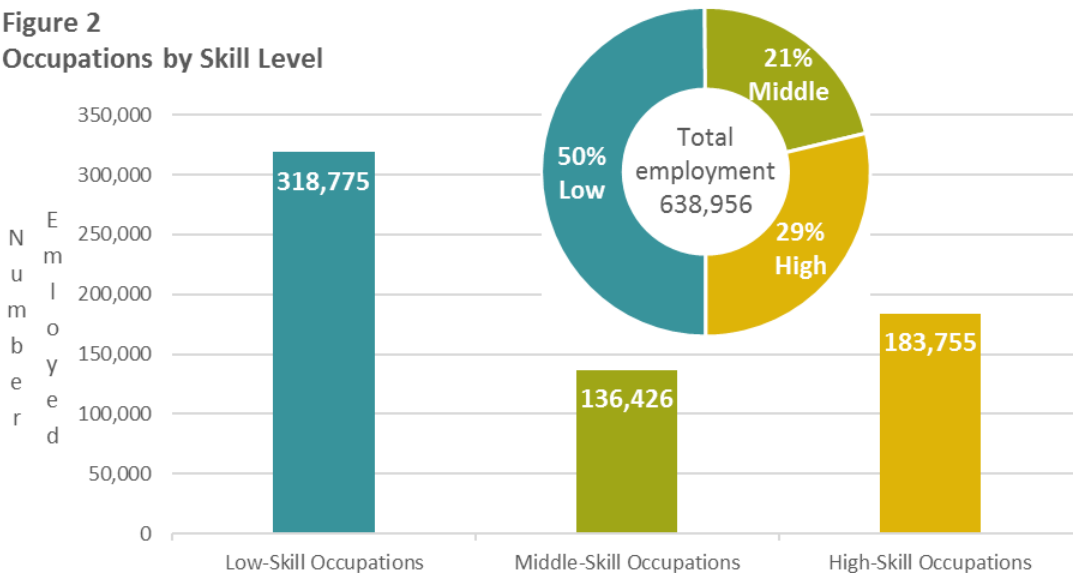### Women made up more than half of employed Phialdelphia residents

48% Men

52% Women
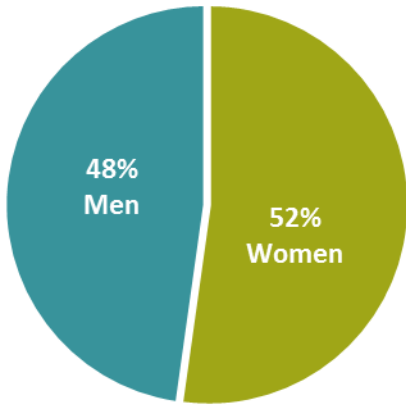
White workers made up nearly half of employed Philadelphia residents

14% Other Minority

49% White

37% Black
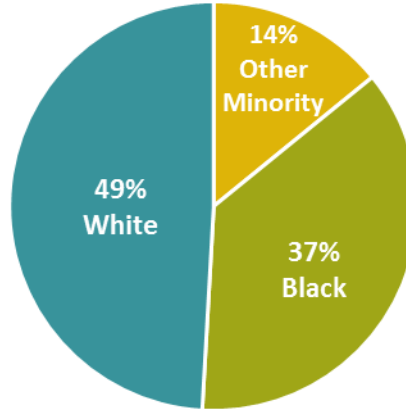
Source: ACS PUMS 2011-2015

By skill level, Philadelphia residents are employed in an unbalanced mix: low-skill jobs accounted for 50 percent of all jobs while middle-skill jobs only accounted for 21 percent. In contrast, 54 percent of jobs in 2015 were middle-skill jobs in Pennsylvania.[4]

Figure 2
Occupations by Skill Level

21% Middle

50% Low

Total employment 638,956

29% High

Number Employed

318,775

136,426

183,755

| Low-Skill Occupations | Middle-Skill Occupations | High-Skill Occupations |

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

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[4] "Pennsylvania Middle-Skill Fact Sheet", National Skills Coalition, Feb 2017.

Top Occupations by Skill Level

Table 1 lists the largest 15 occupations filled by Philadelphia residents. The top occupation was "Nursing, psychiatric, and home health aides" with a total employment of 20,039. Of these 15 largest occupations, there were no middle-skill jobs and only 4 high-skill jobs (registered nurses, miscellaneous managers, elementary/middle school teachers, and postsecondary teachers). All other 11 occupations were low-skill occupations.

Table 1. Largest 15 Occupations Filled by Philadelphia Residents

SOC	Occupation Title	Entry Skill Level	No. of Residents
311010	Nursing, psychiatric, and home health aides	Low	20039
412010	Cashiers	Low	18866
436010	Secretaries and administrative assistants	Low	14728
291141	Registered nurses	High	13689
37201X	Janitors and building cleaners	Low	12560
412031	Retail salespersons	Low	12047
372012	Maids and housekeeping cleaners	Low	11385
434051	Customer service representatives	Low	11331
533030	Driver/sales workers and truck drivers	Low	11115
411011	First-line supervisors of retail sales workers	Low	11051
119XXX	Miscellaneous managers*	High	10731
339030	Security guards and gaming surveillance officers	Low	10728
252020	Elementary and middle school teachers	High	10669
251000	Postsecondary teachers	High	10604
352010	Cooks	Low	9819

* Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131) , and all other managers (11-9199).

Source: SOC, Occupation Title, No. of Residents are from ACS PUMS 2011-2015, Entry Skill Level are from EMSI Q2, 2017 staffing pattern data.

Table 2 lists the largest 10 occupations for each skill level.

Table 2. Largest 10 Occupations by Skill Level

SOC	Occupation Title	No. of Residents
Low-Skill Jobs:		
311010	Nursing, psychiatric, and home health aides	20,039
412010	Cashiers	18,866
436010	Secretaries and administrative assistants	14,728
37201X	Janitors and building cleaners	12,560
412031	Retail salespersons	12,047
372012	Maids and housekeeping cleaners	11,385
434051	Customer service representatives	11,331
533030	Driver/sales workers and truck drivers	11,115
411011	First-line supervisors of retail sales workers	11,051
339030	Security guards and gaming surveillance officers	10,728
Middle-Skill Jobs:		
259041	Teacher assistants	5,212
333050	Police officers	5,127
433031	Bookkeeping, accounting, and auditing clerks	5,025
5191XX	Miscellaneous production workers*	4,605
292061	Licensed practical and licensed vocational nurses	4,502
472031	Carpenters	4,478
512090	Miscellaneous assemblers and fabricators	3,723
232011	Paralegals and legal assistants	3,473
395012	Hairdressers, hairstylists, and cosmetologists	3,334
433021	Billing and posting clerks	3,233
High-Skill Jobs:		
291141	Registered nurses	13,689
119XXX	Miscellaneous managers**	10,731
252020	Elementary and middle school teachers	10,669
251000	Postsecondary teachers	10,604
132011	Accountants and auditors	8,987
291060	Physicians and surgeons	7,143
2310XX	Lawyers, and judges, magistrates, and other judicial workers	6,987
211020	Social workers	6,981
211010	Counselors	5,885
119030	Education administrators	4,571

* Miscellaneous production workers include semiconductor processors (51-9141), cleaning, washing, and metal pickling equipment operators and tenders (51-9192), cooling and freezing equipment operators and tenders (51-9193), and all other Production workers (51-9199).

** Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131) , and all other managers (11-9199).

Source: Philadelphia Works analyis of ACS PUMS 2011-2015.

The gender composition for each skill level was relatively balanced. There were 6 percent more women than men in low-skill jobs and 12 percent more women in high-skill jobs. The reason is that there were significantly more women employed in the largest low-skill jobs as well as largest high-skill jobs. For example, 89 percent of home health aides and 93 percent of secretaries/administrative assistants (low-skill jobs) were women, 90 percent of registered nurses and 80 percent of elementary/middle school teachers (high-skill jobs) were women.

However, 8 percent more men than women worked in middle-skill jobs. There were significantly more men taking middle-skill jobs such as carpenters, automotive service technicians and mechanics, production workers, police officers, assemblers and fabricators. In total, 112 out of 165 middle-skill occupations were held by more men than women.

Figure 3. Gender by Skill Level
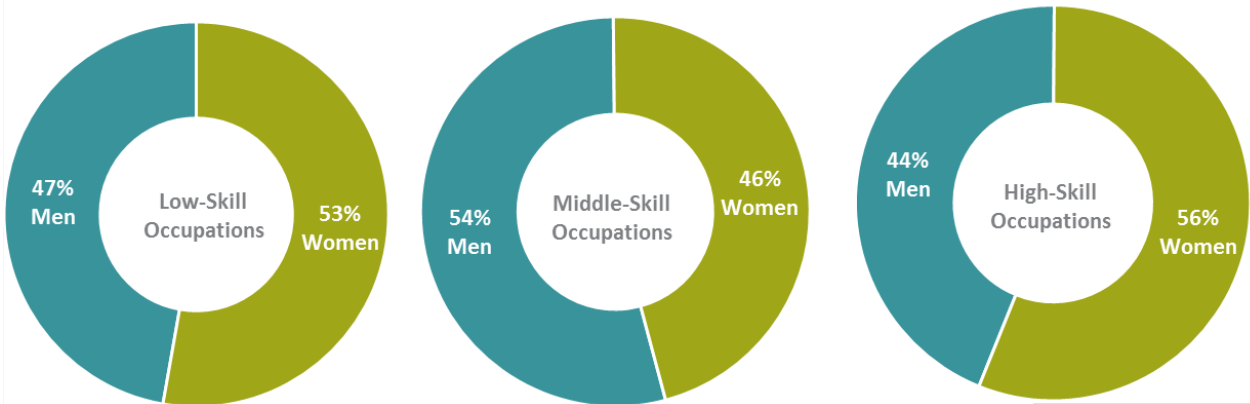
Source: Philadelphia Works analysis of ACS PUMS 2011-2015

Figure 4 shows an unbalanced race composition for all skill levels. We can see that the percentage of white employees increased from 41 percent to 62 percent as the job skill increased. On the contrary, the percentage of Black employees decreased from 45 percent to 25 percent as the skill level increased. For all three levels Other Minority residents only took up a small portion, ranging from 12 percent of employment to 16 percent.

Figure 4. Race by Skill Level

Whites ■ Blacks ■ Other Minority

Low-Skill Occupations
41% 45% 14%

Middle-Skill Occupations
50% 34% 16%

High-Skill Occupations
62% 25% 12%
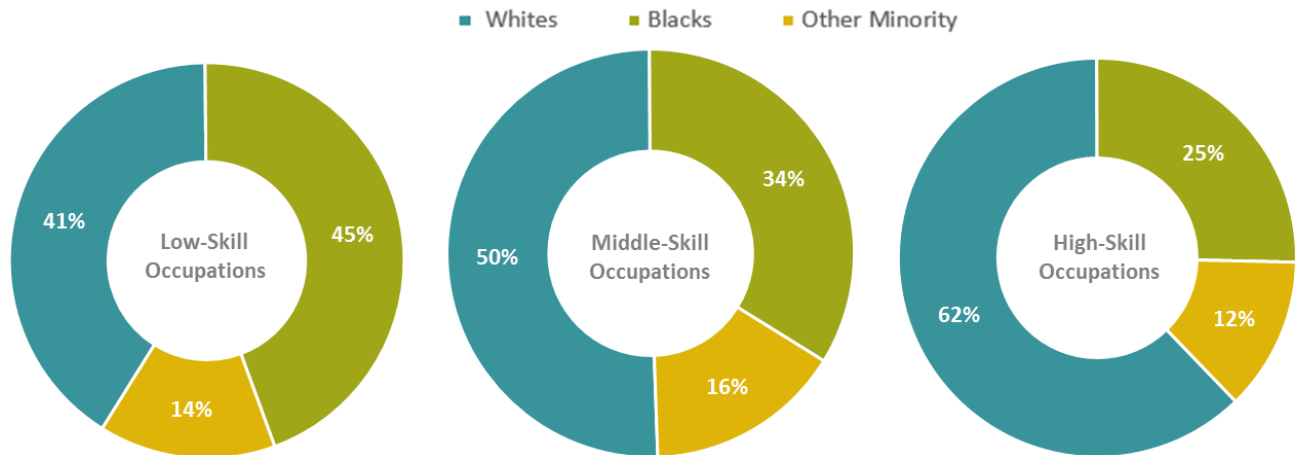
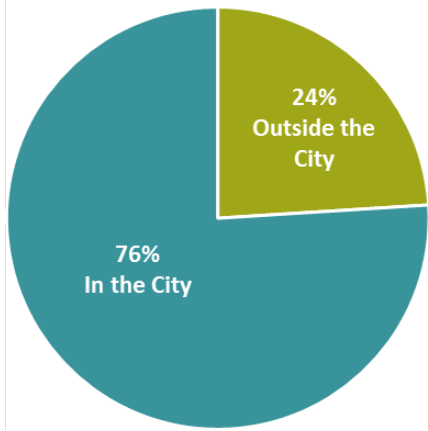*Source: Philadelphia Works analysis of ACS PUMS 2011-2015*

Employment of Philadelphians by Work Location

Overall, 76 percent of Philadelphia residents worked within the city[5]. Of those residents who did NOT work in the city, 58 percent worked in the adjoining Montgomery and Bucks Counties, 16 percent worked in Chester or Delaware Counties, 19 percent worked in counties that are in other states but in proximity to Philadelphia City such as Camden, Mercer and Burlington Counties in New Jersey. The rest of employed residents worked in other States or Countries[6]. Map 1 shows the distribution of Philadelphia residents who worked in nearby counties.

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[5] Among 638,956 working Philadelphia residents, 2.4 percent did no report their work location. Therefore, 623,340 residents are used in our analysis on commute patterns.
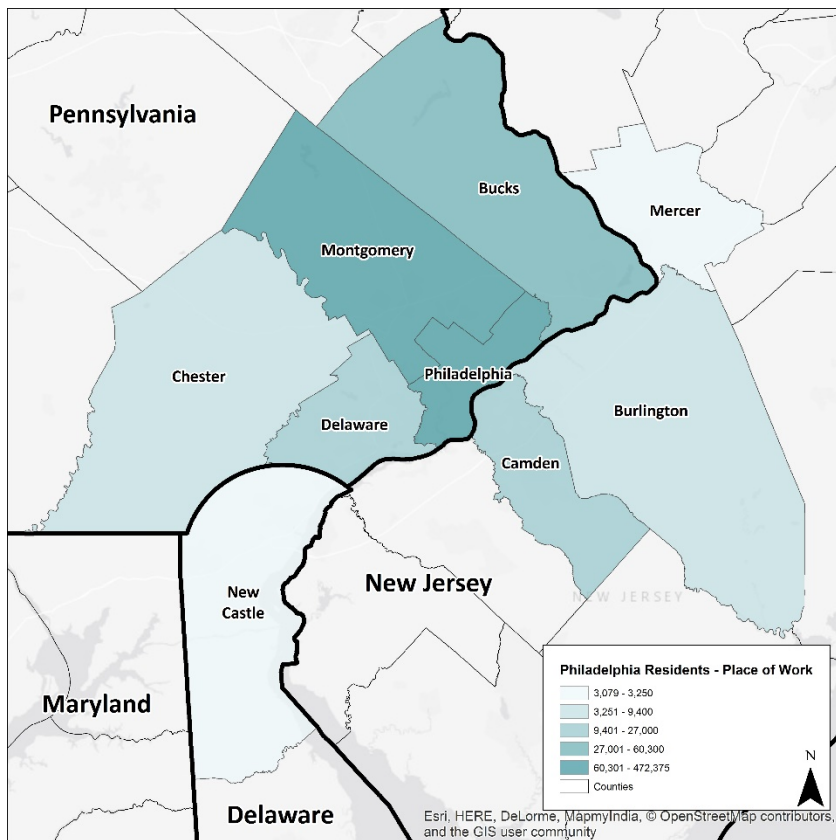
[6] This portion of residents may work remotely for companies that locate in other States or Countries.

Figure 5. Commuting Pattern

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

Map1. Philadelphia Residents' Place of Work

Source: Philadelphia Works analysis of ACS PUMS 2011-2015 and Census Bureau TIGER/Line shapefiles

Figure 6 shows that slightly more (6 percent) women worked in the city and slightly more (4 percent) men worked outside the city. Figure 7 shows that Philadelphia residents who worked in the city consisted of 48 percent white workers, 38 percent Black workers and 14 percent Other Minority workers. Of those commuting out of the city, the race composition was quite similar.

Figure 6. Gender by Work Location
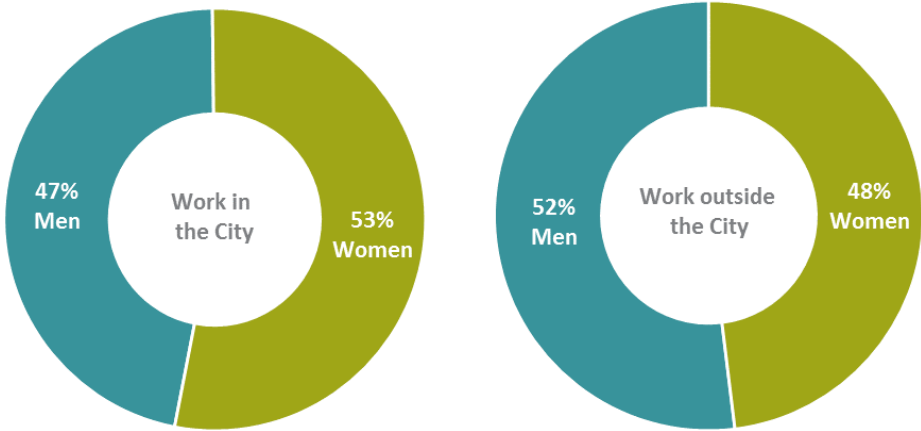
Source: Philadelphia Works analysis of ACS PUMS 2011-2015

Figure 7. Race by Work Location
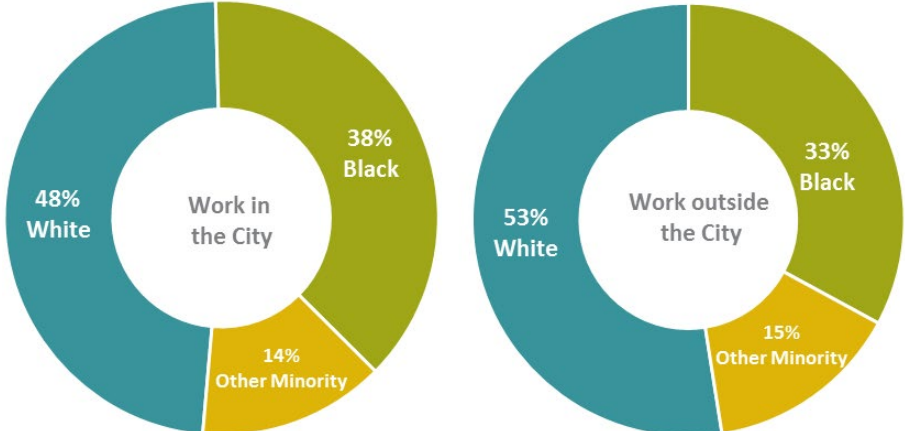
Source: Philadelphia Works analysis of ACS PUMS 2011-2015

Table 3 lists the largest 10 occupations inside and outside of the city respectively. 3 high-skill occupations fell into the largest 10 in-the-city occupations: registered nurse, elementary/middle

school teachers and postsecondary teachers. However, only 1 high-skill occupation fell into the largest 10 outside-the-city occupational list, which was miscellaneous managers.

Table 3. Largest 10 Occupations by Place of Work

SOC	Occupation	Entry Skill Level	No. of Residents
Jobs in the city			
311010	Nursing, psychiatric, and home health aides	low	14714
412010	Cashiers	low	14609
436010	Secretaries and administrative assistants	low	11677
291141	Registered nurses	high	10938
37201X	Janitors and building cleaners	low	9336
372012	Maids and housekeeping cleaners	low	9248
251000	Postsecondary teachers	high	8660
412031	Retail salespersons	low	8387
252020	Elementary and middle school teachers	high	8380
339030	Security guards and gaming surveillance officers	low	8371
Jobs outside the city			
311010	Nursing, psychiatric, and home health aides	low	4731
412010	Cashiers	low	3818
411011	First-line supervisors of retail sales workers	low	3385
434051	Customer service representatives	low	3272
412031	Retail salespersons	low	3267
119XXX	Miscellaneous managers*	high	3137
533030	Driver/sales workers and truck drivers	low	3083
37201X	Janitors and building cleaners	low	2894
537062	Laborers and freight, stock, and material movers, hand	low	2853
436010	Secretaries and administrative assistants	low	2680

* Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131) , and all other managers (11-9199).

Data Source: SOC, Occupation Titles, No. of Residents are from ACS PUMS 2011-2015, Entry Skill Level are from EMSI Q2, 2017 staffing pattern data.

The Wages Philadelphians Earn

Of the 638,956 employed Philadelphia residents in our data set, there were part-time as well as full-time workers. There were also people working for less than a full year during the past 12 months when surveyed. Since the wage variable includes all these possibilities, and workers can be employed at multiple jobs, the following wage analysis used only wages that are for full-time, full-year workers to be consistent and more accurate[7]. After excluding workers who worked part-

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[7] In ACS PUMS data, wage variable indicates wage or salary income from ALL jobs for past 12 months when the survey was filled. Unfortunately, ACS data don't allow us to exclude residents who had more than one job.

time or less than 50 weeks during past 12 months, 467,035 employed residents are included in the wage analysis.

The median hourly wage[8] of all jobs was $18.56. The median hourly wage for low skill jobs was $14.40; median hourly wages increased to $19.43 for middle-skill jobs and to $26.50 for high-skill jobs.

Table 4. Median Wage by Skill Levels

Entry Skill Level	Median Wage
Low-skill	$14.40
Middle-skill	$19.43
High-skill	$26.50

Source: ACS PUMS 2011-2015

Table 5 and Figure 8 show that for low-skill jobs the median hourly wage of full-time female workers were 96 percent of male workers' median hourly wage, implying a gap of 4 percent. The earning gap raised to 10 percent for middle-skill jobs and to 12 percent for high-skill jobs.

Table 5. Wage Gap between Gender

Entry Skill Level	Men	Women	Gap
Low-skill	$14.73	$14.14	4%
Middle-skill	$20.10	$18.09	10%
High-skill	$28.63	$25.30	12%

Source: ACS PUMS 2011-2015

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[8] All wages are adjusted to 2015 dollars to account for inflation.

Figure 8. Wage Gaps Between Men and Women
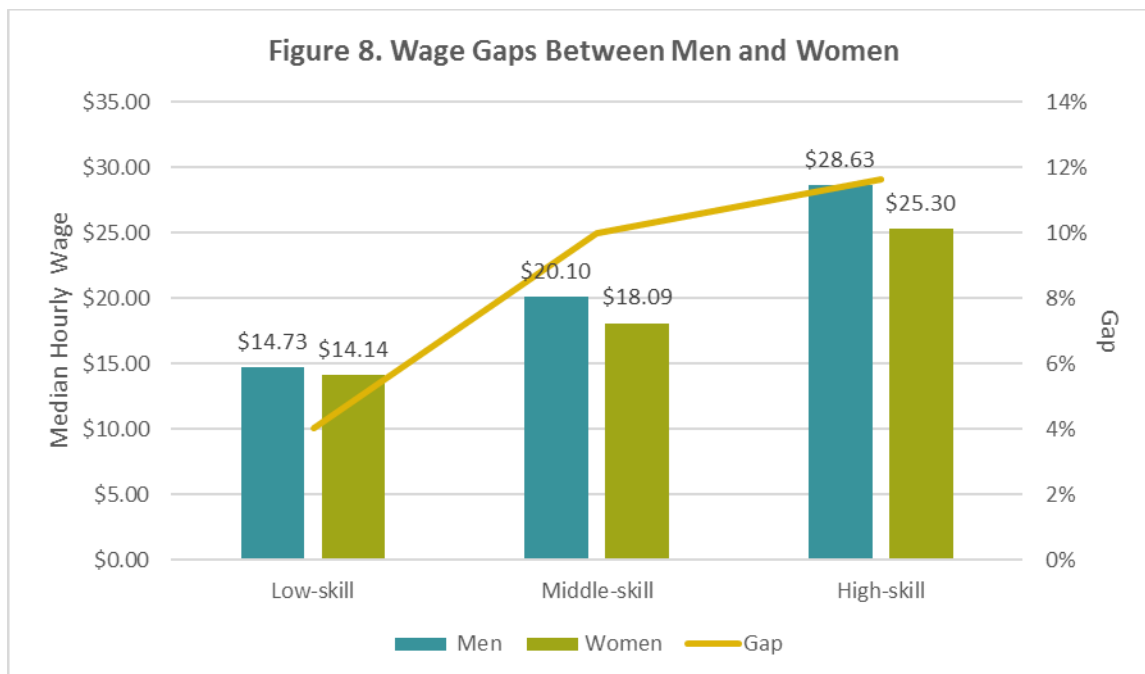
Source: Philadelphia Works analysis of ACS PUMS 2011-2015

For all skill levels, white workers had the highest median hourly wage. For low-skill jobs, the median hourly wage of Black workers was 94 percent of the white workers' median hourly wage, implying a gap of 6 percent. The wage gap increased to 10 percent for middle-skill jobs and tripled to 18 percent for high-skill jobs.

The wage gap between white and other minority shows a reverse trend from low skill to high skill jobs. For low skill jobs the wage gap was quite large at 29 percent. The wage gap was 30 percent for middle-skill jobs and decreased to 13 percent for high-skill jobs.

Table 6. Wage Gap between Race

Entry Skill Level	White	Black	Other Minority	Gap White vs Black	Gap White vs Other Minority
Low-skill	$15.58	$14.58	$11.01	6%	29%
Middle-skill	$20.79	$18.81	$14.52	10%	30%
High-skill	$28.51	$23.36	$24.87	18%	13%

Source: ACS PUMS 2011-2015

Figure 9. Wage Gaps between Race
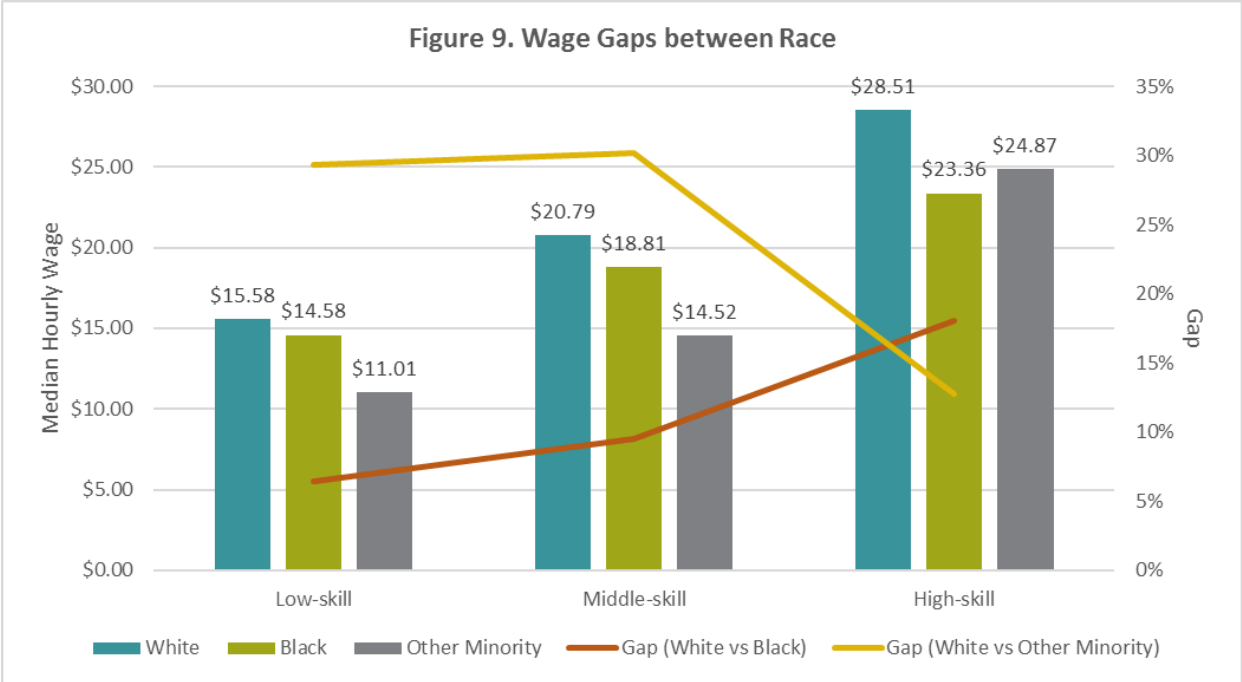
Source: Philadelphia Works analysis of ACS PUMS 2011-2015

Educational Requirements Across Occupations

We noticed that there is a disconnect between the entry level of education required for an occupation and employees' actual educational attainments. This disconnect exits in 4 occupations in the 10 largest low-skill occupations: 1. retail sales persons 2. first-line supervisors of retail sales workers 3. secretaries and administrative assistants, and 4. customer service representatives.

As defined at the beginning of report, low-skill jobs only require a high school education or less. However, over 50 percent of employees in these 4 occupations had post-secondary degrees and over 20 percent of employees had bachelor or higher degrees, as showed in Table 7 and Figure 10.

Table 7. Education Distribution across Occupations

SOC	Occupation	Entry Skill Level	% of Postsecondary Degree	% of BA and Above
372012	Maids and housekeeping cleaners	Low	20%	4%
37201X	Janitors and building cleaners	Low	23%	4%
533030	Driver/sales workers and truck drivers	Low	32%	7%
311010	Nursing, psychiatric, and home health aides	Low	39%	7%
412010	Cashiers	Low	42%	7%
339030	Security guards and gaming surveillance offic	Low	44%	6%
412031	Retail salespersons	Low	59%	21%
411011	First-line supervisors of retail sales workers	Low	64%	30%
436010	Secretaries and administrative assistants	Low	66%	21%
434051	Customer service representatives	Low	66%	27%

Source: SOC, Occupation, % of Postsecondary Degree, % of BA and above are from ACS PUMS 2011-2015; Entry Skill Levels are from EMSI Q2, 2017 staffing pattern data.

Figure 10. % of Postsecondary Degree Employees for Low-Skill Jobs

Customer service representatives	66%
Secretaries and administrative assistants	66%
First-line supervisors of retail sales workers	64%
Retail salespersons	59%
Security guards and gaming surveillance officers	44%
Cashiers	42%
Nursing, psychiatric, and home health aides	39%
Driver/sales workers and truck drivers	32%
Janitors and building cleaners	23%
Maids and housekeeping cleaners	20%

Source: Philadelphia Works analysis of ACS PUMS 2011-2015.

Several possible reasons might explain the fact that there were more high-educated employees working in low-skill occupations than might be expected.

One is that educational requirement varies across different industries for these occupations: for example, retail sales persons in clothing or grocery stores may need less than a high school diploma, while retail sales persons in electronics stores or pharmaceutical stores may require higher education to handle technical inquiries from their customers.

It is also possible that highly educated employees worked part-time or were currently enrolled in school. From the data showed in Table 8, however, the percentage of workers with postsecondary degrees working part-time was not necessarily higher than workers with only high school degree or less education. Take "customer service representatives" for example, 12 percent of employees with bachelor or higher degree worked part time while 18 percent of employees with a high school diploma or less education worked part time.

School enrollment may explain the disconnect. The last column of Table 8 shows the percentage of workers enrolled in school. For all the 4 occupations, the percentage of enrollment was much higher for workers with a postsecondary degree compared to those without. The disparity is especially obvious for workers with some college. For example, 46 percent of retail sales persons with some college or an associate degree were currently enrolled in school while only 13 percent of lesser-educated workers were enrolled.
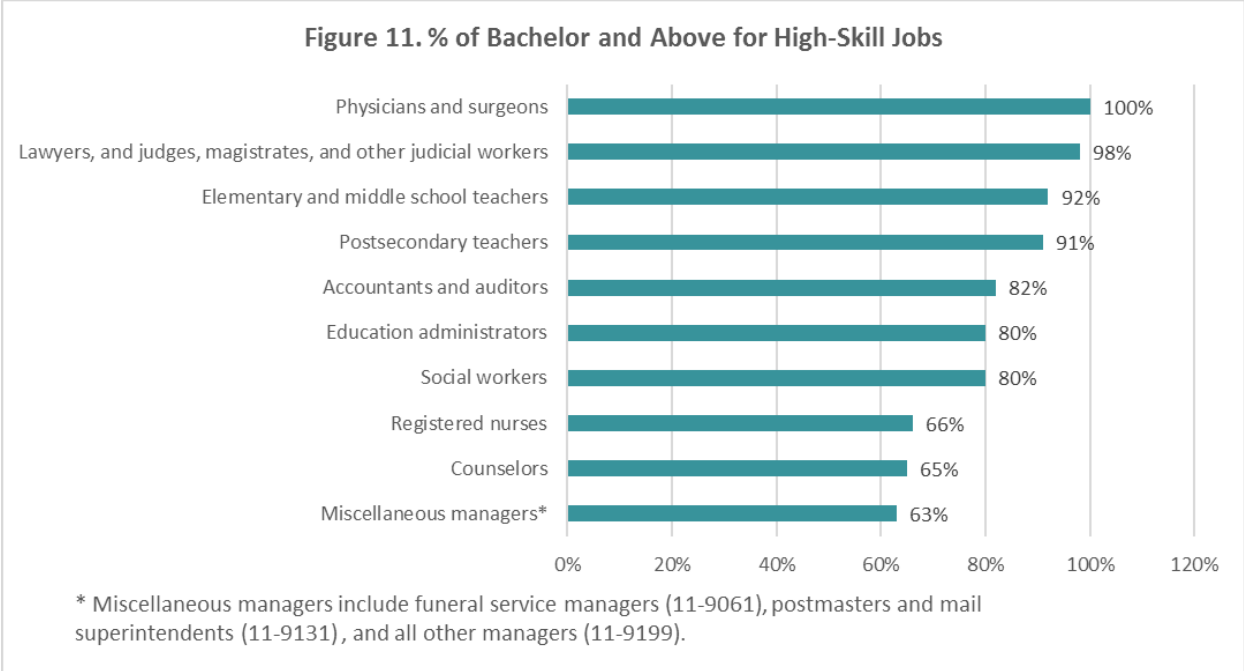
The data show a trend that the percentage of school enrollment was highest among middle-educated workers, followed by high-educated workers and then lesser-educated workers.

Table 8. Working Status and School Enrollment by Education

SOC	Occupation	Education	% Part-Time	% Enrolled in School
412031	Retail sales persons	>= BA	20%	20%
		some college	39%	46%
		<= high school	36%	13%
411011	First-line supervisors of retail sales workers	>= BA	3%	5%
		some college	6%	17%
		<= high school	3%	1%
436010	Secretaries and administrative assistants	>= BA	16%	19%
		some college	13%	20%
		<= high school	9%	4%
434051	Customer service representatives	>= BA	12%	12%
		some college	9%	13%
		<= high school	18%	6%

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

The disconnect does not happen in the largest high-skill occupations where all of these had more than 60 percent highly educated employees.

Figure 11. % of Bachelor and Above for High-Skill Jobs

Occupation	Percentage
Physicians and surgeons	100%
Lawyers, and judges, magistrates, and other judicial workers	98%
Elementary and middle school teachers	92%
Postsecondary teachers	91%
Accountants and auditors	82%
Education administrators	80%
Social workers	80%
Registered nurses	66%
Counselors	65%
Miscellaneous managers*	63%

* Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131), and all other managers (11-9199).

Source: Philadelphia Works analysis of ACS PUMS 2011-2015.

Full-Time and Part-Time Employees:

Depending on the hours an employee worked per week during the past 12 months, employees are classified into full-time workers who worked equal to or more than 30 hours per week and part-time workers who worked less than 30 hours per week. Figure 12 shows that 84 percent of employed Philadelphia residents worked full time and 16 percent worked part time.
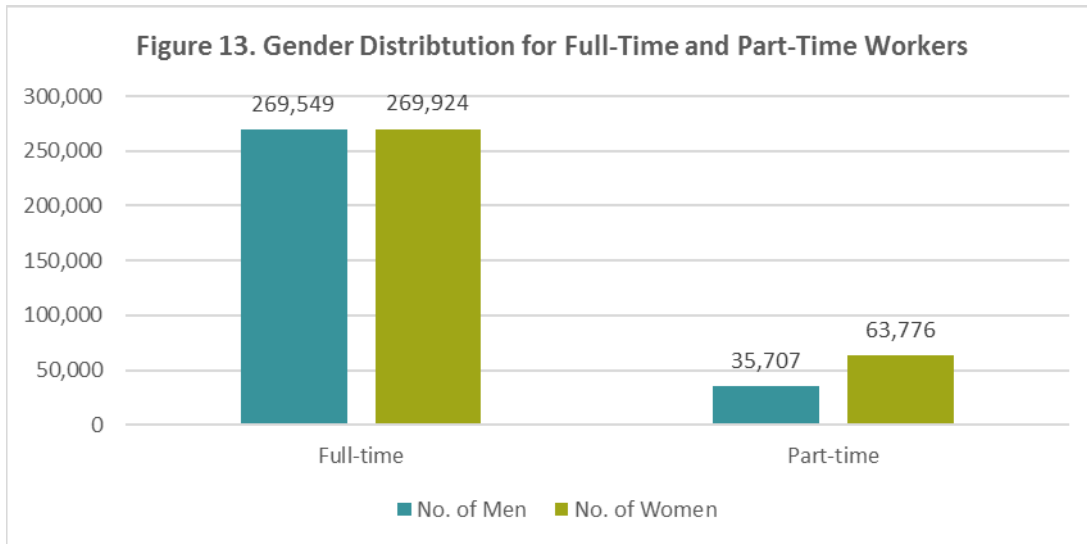
Figure 12. Full-time v.s. Part-time
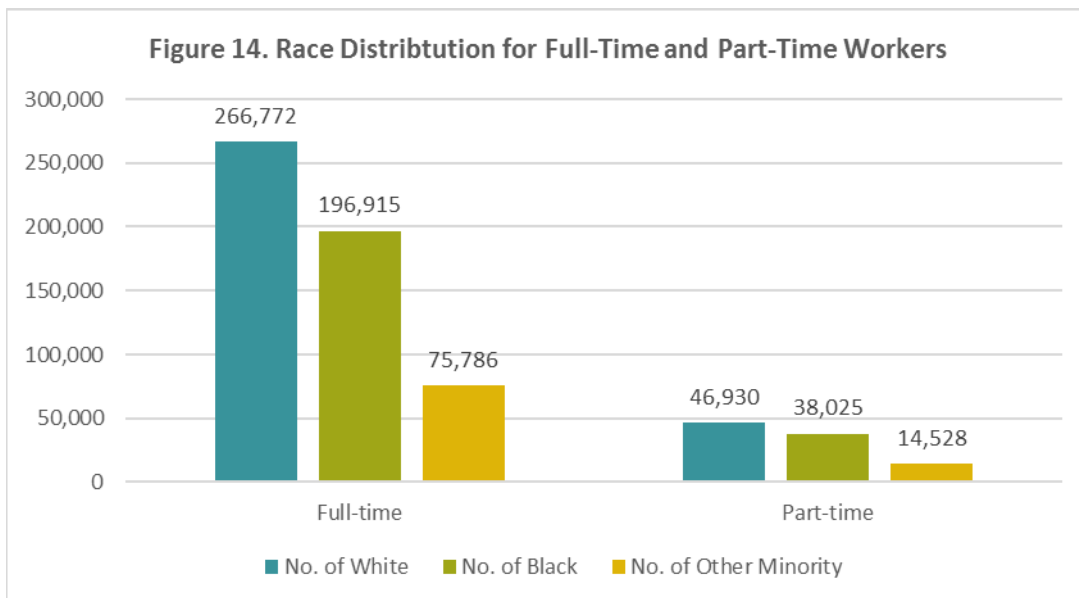

16% Part-Time
84% Full-Time
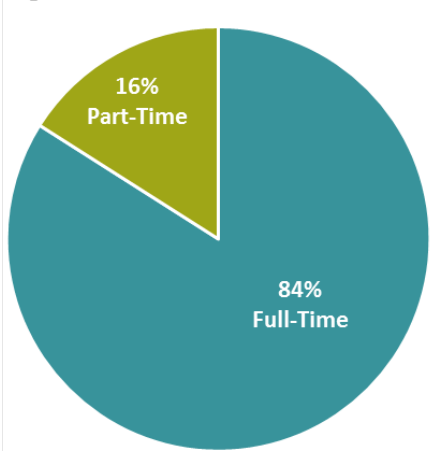
Source: ACS PUMS 2011-2015

Of full-time workers, 50 percent were men, and 50 percent were women. Of part-time workers, 64 percent were women, and 36 percent were men. The race composition was quite similar between full-time workers and part-time workers:49 percent of full-time workers were white, 37 percent were Black, 14 percent were Other Minority; while 47 percent of part-time workers were white, 38 percent were Black, and 15 percent were Other Minority.

Figure 13. Gender Distribtution for Full-Time and Part-Time Workers

Source: ACS PUMS 2011-2015

Figure 14. Race Distribtution for Full-Time and Part-Time Workers

Source: ACS PUMS 2011-2015

A binary logistic analysis was conducted to predict the probability whether an employee will work full-time using 4 categories of demographic variables (gender, race, age, education) as predictors. A summary of statistics of all the variables used in the logistics model is listed in Table 9. Model results are provided in Table 10.

A test of the full model against a constant-only model was statistically significant (likelihood ratio χ^2=49536.275, P<0.001 with df=7), indicating that the predictions as a set reliably distinguished between working full-time and part-time. The estimated odds ratios indicate that female, younger workers (16-24), and older workers (55+) were less likely to work full time, while residents with a bachelor or higher degree were almost twice as likely to work full time. All odds ratios discussed above are statistically significant at 0.01 significance level.

Table 9. Distribution of Categorical Variables in Logistic Regression Models

Variable	Percentage
Working status (dependent variable)	
Full-time	84%
Part-time	16%
Gender	
Male	48%
Female	52%
Race	
White	49%
Black	37%
Other Minority	14%
Age	
Prime age (25-55)	69%
Young age (16-24)	13%
Old age (55+)	18%
Education	
High school degree or lower	39%
Some college or associate degree	27%
Bachelor's degree or higher	34%
Total observations	638,956

Table 10. Logit Regression Predicting Working Status

Demographic Predictors	β	P-Value	exp(β) Odds Ratio	95% Wald CI for Odds Ratio Lower	Higher
Gender (male is reference)					
Female	-0.606	0.000	0.5 ***	0.5	0.6
Race (white is reference)					
Other Minority	-0.005	0.645	1.0	1.0	1.0
Black	0.127	0.000	1.0 ***	1.1	1.2
Age (prime-age is reference)					
Old-age (55+)	-0.597	0.000	0.6 ***	0.5	0.6
Young-age (16-24)	-1.644	0.000	0.2 ***	0.2	0.2
Education (≤ high school is reference)					
BA and above	0.611	0.000	1.8 ***	1.8	1.9
Some college	0.016	0.058	1.0 *	1.0	1.0
Constant	2.246	0.000	9.5 ***	9.3	9.6
No. of observations			638956		

***P<0.01, **P<0.05, *P<0.1

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

Wage and Education Dispersion of Philadelphians

Investigation on the wage and education dispersion for each occupation can provide useful information regarding building career pathways[9]. An occupation will provide opportunities to advance within the skill set if there is more variation in wage and education levels.

The interquartile range (IQR) measures the wage variability, which equals to the difference between the 75th percentiles and 25th percentiles of the wage distribution. Table 11 shows the IQR of wage for the largest 10 occupations for each skill level. In general, wage dispersion increases with skill level. 6 low-skill jobs and 4 middle-skill jobs had wage IQR higher than $10. All of the 4 aforementioned low-skill jobs where disconnect existed had wage IQR higher than $10. High-skill jobs generally had higher wage IQR, as 9 out 10 high-skill occupations had wage IQR higher than $10 and 4 high-skill jobs had wage IQR higher than 20. Lawyers and Physicians have especially high wage IQR: $34 and $56 respectively.

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[9] As defined in the Workforce Innovation and Opportunity Act (WIOA), "career pathway" means a combination of rigorous and high-quality education, training, and other services that …. (G) helps an individual enter or advance within a specific occupation or occupational cluster.

Boxplots 15A to 15C give a good visualization of IQR, with the bottom of the box indicating the 25th percentile and the top of the box representing the 75th percentile. So IQR is equal to the length of the box: occupations with longer box (higher wage IQR) have more varied hourly wages. The dark line in the middle of the boxes is the median hourly wage.

For each skill level, the boxplot is ordered from short box to long box, that is, from occupations with less varied hourly wages to those of more varied hourly wages.

Table 11. Wage Dispersion for Top 10 Occupations By Skil Level

SOC	Occupation Title	Median Hourly Wage	IQR of Hourly Wage
Low-Skill Jobs			
372012	Maids and housekeeping cleaners	$11	$6
37201X	Janitors and building cleaners	$12	$7
311010	Nursing, psychiatric, and home health aides	$14	$8
412010	Cashiers	$9	$9
436010	Secretaries and administrative assistants	$18	$10
434051	Customer service representatives	$17	$11
533030	Driver/sales workers and truck drivers	$16	$11
339030	Security guards and gaming surveillance officers	$16	$11
412031	Retail salespersons	$13	$12
411011	First-line supervisors of retail sales workers	$16	$13
Middle -Skill Jobs			
259041	Teacher assistants	$13	$8
433021	Billing and posting clerks	$18	$8
333050	Police officers	$33	$8
433031	Bookkeeping, accounting, and auditing clerks	$18	$8
512090	Miscellaneous assemblers and fabricators	$11	$8
5191XX	Miscellaneous production workers*	$15	$9
232011	Paralegals and legal assistants	$21	$12
292061	Licensed practical and licensed vocational nurses	$21	$13
395012	Hairdressers, hairstylists, and cosmetologists	$10	$13
472031	Carpenters	$16	$14
High-Skill Jobs			
211020	Social workers	$20	$8
211010	Counselors	$20	$10
132011	Accountants and auditors	$27	$13
252020	Elementary and middle school teachers	$24	$14
291141	Registered nurses	$34	$15
119030	Education administrators	$25	$18
119XXX	Miscellaneous managers**	$31	$21
251000	Postsecondary teachers	$25	$26
2310XX	Lawyers, and judges, magistrates, and other judicial workers	$38	$33
291060	Physicians and surgeons	$25	$56

* Miscellaneous production workers include semiconductor processors (51-9141),cleaning, washing, and metal pickling equipment operators and tenders (51-9192), cooling and freezing equipment operators and tenders (51-9193), and all other Production workers (51-9199).

** Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131) , and all other managers (11-9199).

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

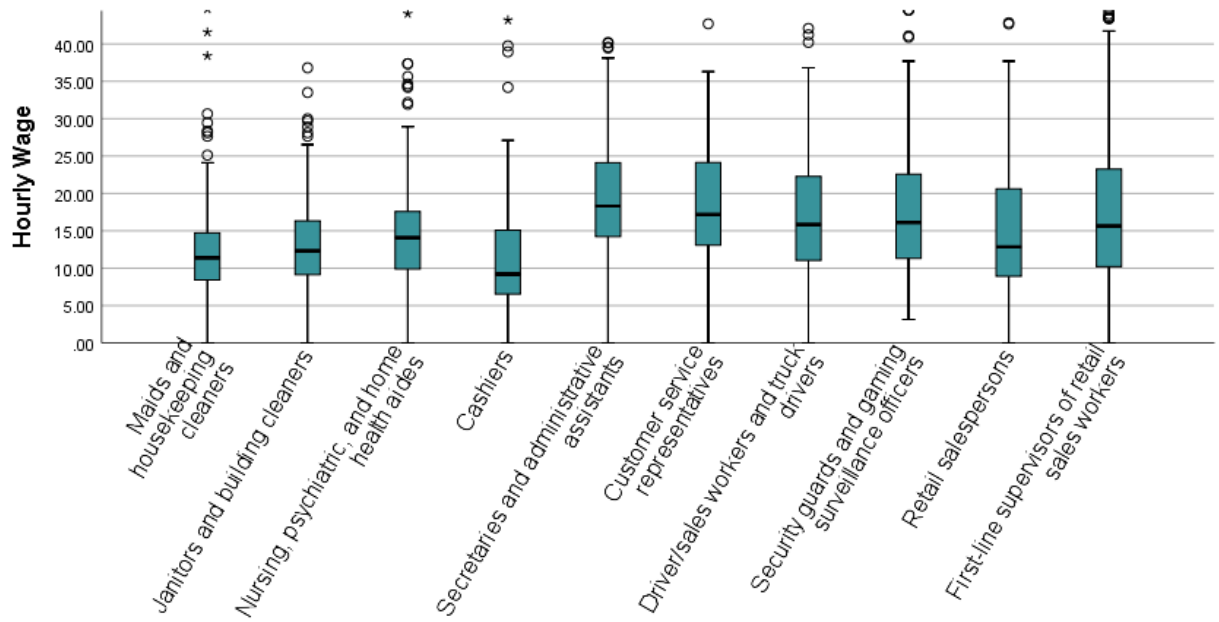Figure 15A. Boxplot of Hourly Wage for Low-Skill Occupations

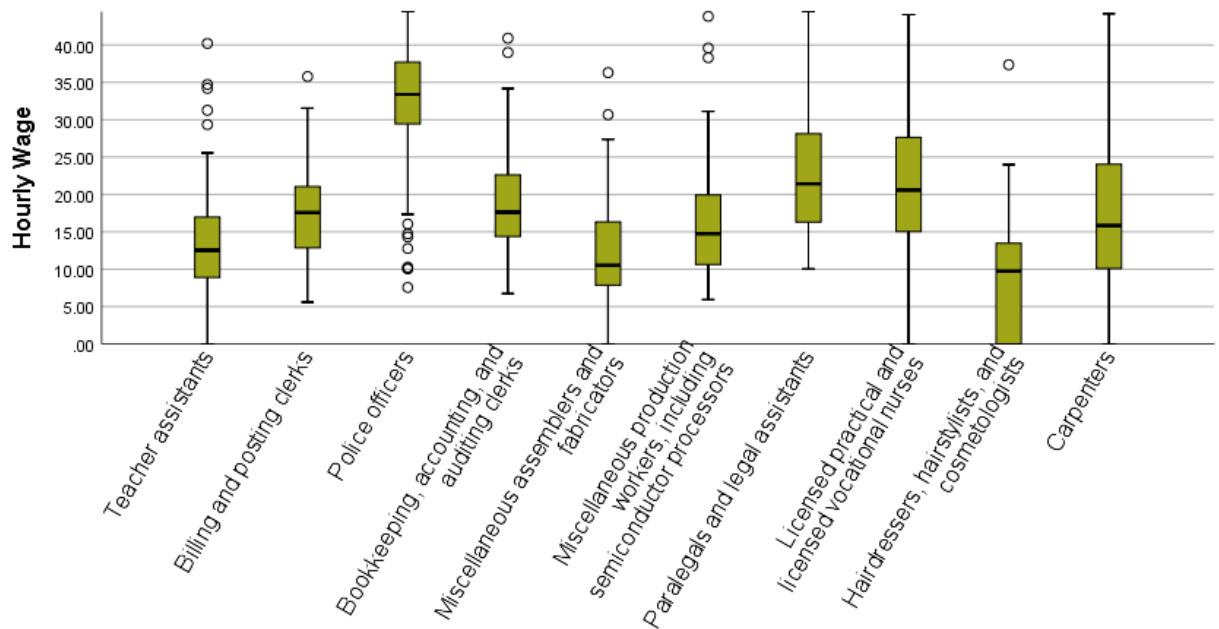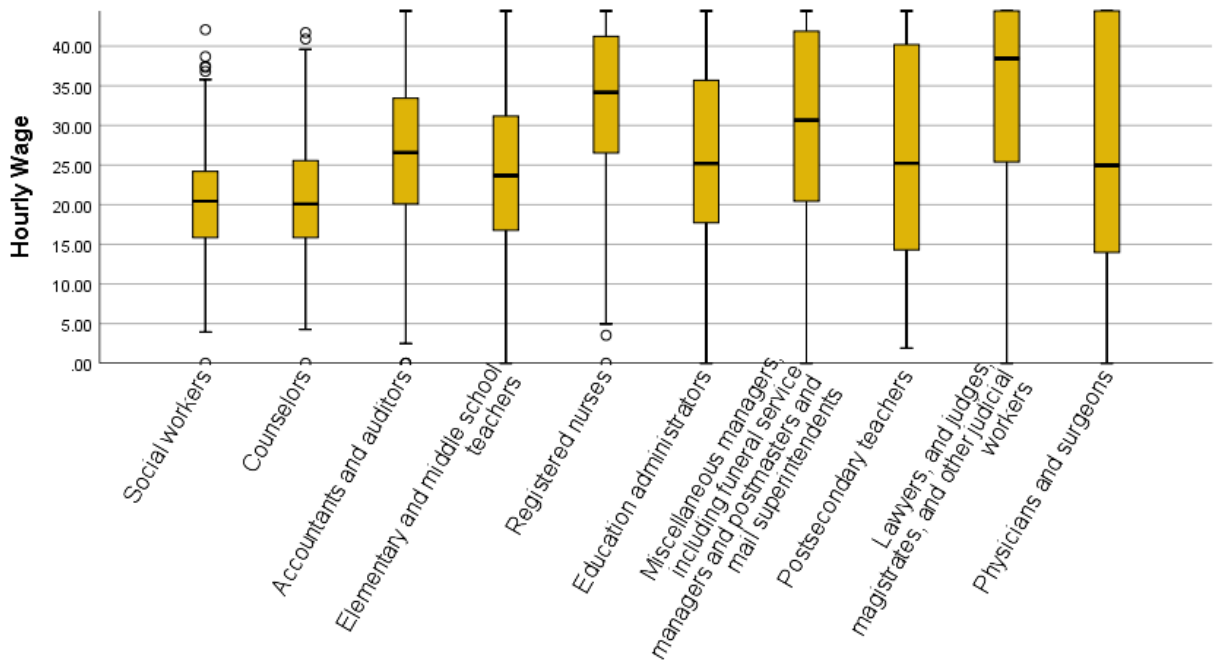Figure 15B. Boxplot of Hourly Wage for Middle-Skill Occupations

Figure 15C. Boxplot of Hourly Wage for High-Skill Occupations

Note: The scale was adjusted for consistancy. The last two boxes in Figure 15C were truncated due to the rescaling.

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

The dispersion across educational attainment is another important indicator that an occupation is promising for an employee to move forward in their career. Educational attainment is classified into 3 categories: 1. low education (equal or less than high school) 2. middle education (associate degree or some college), and 3 high education (bachelor or higher degree). In this case, we use another index to show dispersion of a categorical variable: Deviation from the Mode (DM)[10]. DM ranges from 0 to 1 and low values signify low variation and high values high variation. "*The measure can be thought of as an index of deviation from the modal frequency, analogous to the variance as a measure of deviation from the mean*".

Figure 16A and 16B show the two extreme distributions with DM=0 and DM=1 respectively. When DM=0, all the residents fall into one educational category (high school or lower as showed in the figure). At another extreme, residents are evenly distributed in the three categories and DM=1 if this happens.

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[10] For formula and more detail, see Wilcox, Allen R. (1973), "Indices of Qualitative Variation and Political Measurement", The Western Political Quarterly, 26 (2): 325–343.

Table 12 shows the DM of education for largest 10 occupations in each skill level: 4 low-skill occupations had DM value higher than 0.8, indicating high variation in educational attainment. These 4 occupations also coincide with the occupations where the disconnect happened (Over 50 percent of employees in these 4 low-skill occupations had a post-secondary degree and over 20 percent of employees had a bachelor or higher degree).

Of the largest 10 middle-skill occupations, only 3 middle-skill occupations had high variation in education: police officers, paralegals and legal assistants, and teacher assistants. All 10 high-skill occupations had low variation in education, and the variation was especially low for physicians, lawyers, elementary/middle school teachers, and postsecondary teachers as these occupations are governed by federal and state laws and regulations that give clear guidelines, regarding the education or training required for a given occupation.

Combined with the wage IQR analysis, occupations with both high wage dispersion and high educational attainment dispersion (mathematically i.e. IQR ≥ 10 and DM ≥ 0.8) are identified as having opportunities for upward mobility within the same occupation. 4 out of the largest 10 low-skill occupations satisfy both criteria: 1. Retail sales persons 2. First-line supervisors of retail sales workers 3. Secretaries and administrative assistants, and 4. Customer service representatives; Only 1 out of the largest 10 middle-skill occupations satisfy both criteria: Paralegals and legal assistants.

Figure 16A. Distribution of Education (DM=0, Low Variation)
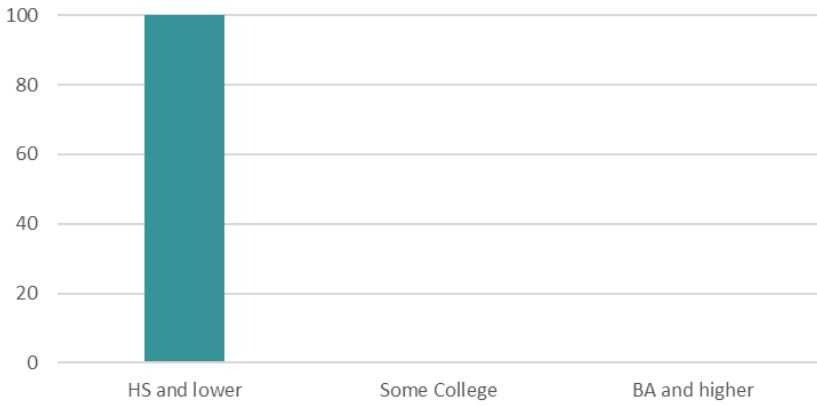
Figure 16B. Distribution of Education (DM=1, High Variation)
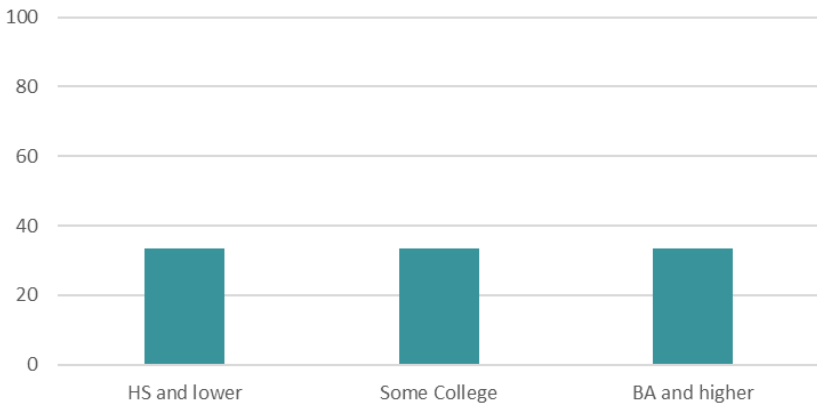
Table 12. Education Dispersion for Top 10 Occupations by Skill Level

SOC	Occupation Title	DM of Edcuation
Low-Skill Jobs		
372012	Maids and housekeeping cleaners	0.30
37201X	Janitors and building cleaners	0.34
533030	Driver/sales workers and truck drivers	0.47
311010	Nursing, psychiatric, and home health aides	0.60
412010	Cashiers	0.63
339030	Security guards and gaming surveillance officers	0.65
436010	Secretaries and administrative assistants	0.88
412031	Retail salespersons	0.89
434051	Customer service representatives	0.91
411011	First-line supervisors of retail sales workers	0.97
Middle-Skill Jobs		
5191XX	Miscellaneous production workers*	0.39
395012	Hairdressers, hairstylists, and cosmetologists	0.43
472031	Carpenters	0.45
512090	Miscellaneous assemblers and fabricators	0.45
292061	Licensed practical and licensed vocational nurses	0.64
433021	Billing and posting clerks	0.67
433031	Bookkeeping, accounting, and auditing clerks	0.75
333050	Police officers	0.80
232011	Paralegals and legal assistants	0.80
259041	Teacher assistants	0.86
High-Skill Jobs		
291060	Physicians and surgeons	0.01
2310XX	Lawyers, and judges, magistrates, and other judicial workers	0.03
252020	Elementary and middle school teachers	0.12
251000	Postsecondary teachers	0.13
132011	Accountants and auditors	0.26
119030	Education administrators	0.30
211020	Social workers	0.31
291141	Registered nurses	0.51
211010	Counselors	0.53
119XXX	Miscellaneous managers**	0.56

* Miscellaneous production workers include semiconductor processors (51-9141),cleaning, washing, and metal pickling equipment operators and tenders (51-9192), cooling and freezing equipment operators and tenders (51-9193), and all other Production workers (51-9199).

** Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131) , and all other managers (11-9199).

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

English Proficiency

English proficiency is classified into three categories: 1. A resident speaking only English at home is designated as a native speaker, 2. A resident not speaking English at home but speaking English very well or well is designated as a fluent speaker, and 3. A resident not speaking English well or not speaking at all is designated as a non-English speaker.

Figure 17 shows that 78 percent of Philadelphia residents were native speakers, 17 percent were fluent speakers and the remaining 5 percent of residents didn't speak English very well or didn't speak English at all.

Figure 17. Ability to Speak English
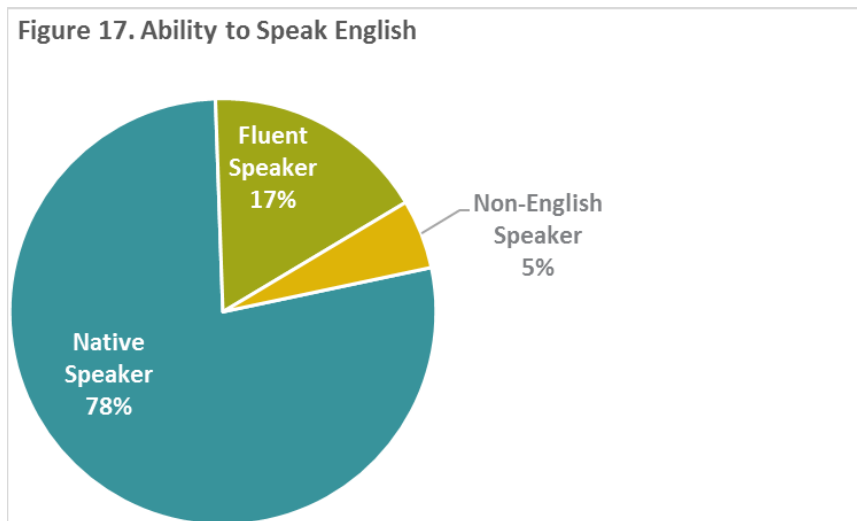
Source: ACS PUMS 2011-2015.

Looking at English proficiencies by skill level we find: 76 percent of residents holding low-skill jobs were native speakers, 17 percent were fluent speakers, and 7 percent were non-English speakers; employees in middle-skill jobs had a similar split. Of the residents holding high-skill jobs, however, more than 80 percent were native speakers and 1 percent were non-English speakers.
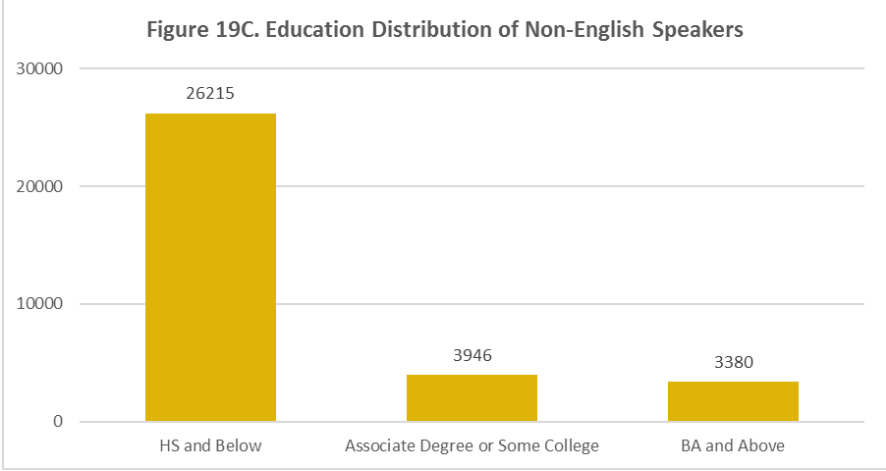
Figure 18. English Proficiency by Skill Level

Figure 18. English Proficiency by Skill Level
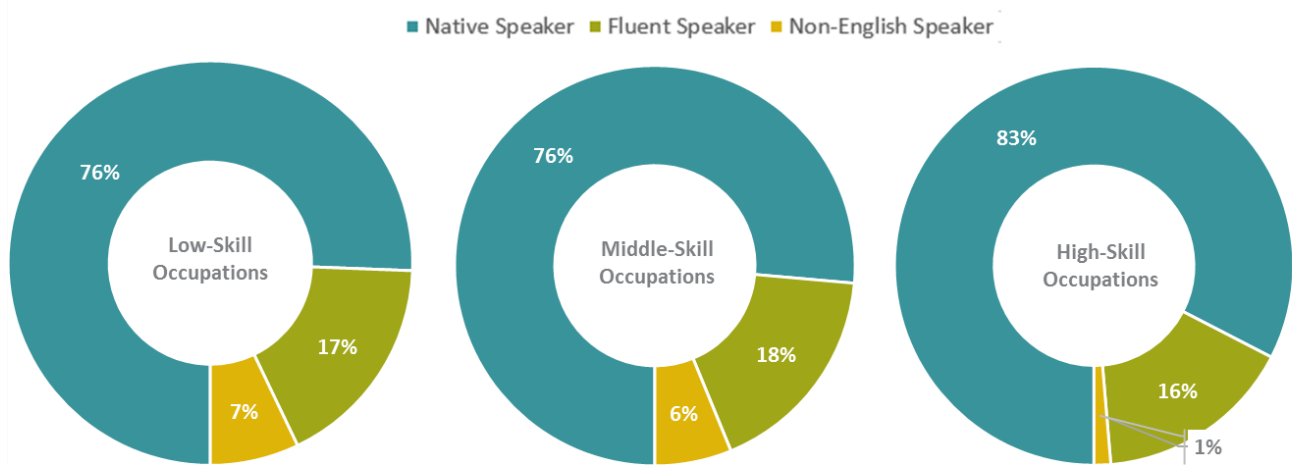
Source: ACS PUMS 2011-2015

Figure 19A and 19B show the education distribution for native speakers and fluent speakers, respectively. They share a similar distribution pattern across skill levels: there were relatively more low-educated and high-educated residents and less middle-educated residents.

Figure 19C shows that educational attainments of non-English speakers are less dispersed: 78 percent of non-English speakers had high school or lower degrees, only 11 percent had an associate degree or some college education, and 10 percent had a bachelor or higher degree.

Figure 19A. Education Distribution of Native Speakers

	HS and Below	Associate Degree or Some College	BA and Above
	178024	144600	174319

Figure 19B. Education Distribution of Fluent Speakers

	HS and Below	Associate Degree or Some College	BA and Above
	42813	26431	39228

Figure 19C. Education Distribution of Non-English Speakers

	HS and Below	Associate Degree or Some College	BA and Above
	26215	3946	3380

Source: ACS PUMS 2011-2015

What do these data help us understand?

Our goal was to explore how working Philadelphians were distributed across employment opportunities by skill levels regardless of where their workplace was located. By taking a closer look at the overall picture, we can begin to identify opportunities for building talent through for advancement and, later, when combined with business intelligence, identify the on-ramps for successful employment at higher skill levels and with living wages that sustain workers and their families' well-being and strengthen the city.

This first report focusses on all employed Philadelphians in all industries. The next reports will highlight each of the 7 industry groupings identified in the citywide workforce strategy, *Fueling Philadelphia's Talent Engine*.

Key Findings about Philadelphian workers:

1. ***Women*** made up more than half (***52 percent***) of the employed Philadelphia residents. ***White*** workers made up nearly half (***49 percent***) of the employed Philadelphia residents. ***50 percent*** of jobs Philadelphia residents hold were classified as ***low-skill jobs***.

2. Looking specifically at defined skill levels, 6 percent more women than men worked in low-skill jobs and 12 percent more women worked in high-skill jobs. However, 8 percent more men than women worked in middle-skill jobs. The percentage of ***white employees increased from 41 percent to 62 percent*** as the skill level increased. On the contrary, the percentage of ***Black employees decreased from 45 percent to 25 percent*** as the skill level increased. Other Minority residents only took up a small portion for all three skill levels.

3. ***76 percent*** of Philadelphia residents ***worked within the city***. Of those who did not work in the city, 58 percent worked in the adjoining counties of Montgomery and Bucks.

4. The ***median hourly wage*** for low-skill jobs was $14.40, it increased to $19.43 for middle-skill jobs and $26.50 for high-skill jobs.

5. ***The Wage gap between men and women*** was 4 percent for low-skill jobs, it raised to 10 percent for middle-skill jobs and 12 percent for high-skill jobs. ***The Wage gap between white and Black*** workers was 6 percent for low-skill jobs, it increased to 10 percent for middle-skill jobs and 18 percent for high-skill jobs. ***The Wage gap between white and Other Minority*** workers was 29 percent for low-skill jobs, it stayed nearly the same at 30 percent for middle-skill jobs and decreased to 13 percent for high-skill jobs.

6. ***The Disconnect*** between the entry level of education required for an occupation and employees' actual educational attainments existed in 4 out of the largest 10 low-skill occupations: 1. Retail sales persons 2. First-line supervisors of retail sales workers 3. Secretaries and administrative assistants, and 4. Customer service representatives. Over

50 percent of employees in these 4 low-skill occupations had post-secondary degrees and over 20 percent had BA or higher degrees.

7. *84 percent* of employed Philadelphia residents worked *full time* and 16 percent worked part time. A binary logit model shows that female, younger workers (16-24), and older workers (55+) were less likely to work full time, while residents with BA or a higher degree were almost twice as likely to work full time. 32 percent of part-time workers were enrolled in school.

8. To identify *occupations with large dispersion across wage and educational attainment*, we look for those with an IQR (InterQuartile Range) of wage greater than 10 and DM (Deviation from the Mode) of education greater than 0.8. Occupations with high wage IQR and high education DM have opportunities for moving up within the same occupation. 4 out of the largest 10 low-skill occupations satisfy both criteria: 1. Retail sales persons 2. First-line supervisors of retail sales workers 3. Secretaries and administrative assistants, and 4. Customer service representatives; Only 1 out of the largest 10 middle-skill occupations satisfy both criteria: Paralegals and legal assistants.

9. **78 percent** of employed Philadelphia residents were **native speakers**, 17 percent were fluent speakers and the other **5 percent** of residents were **non-English speakers**. Most non-English speakers have low-levels of educational attainment and hold low-skill jobs.

Appendix

Since ACS PUMS data are obtained from a sample, we are uncertain that the sample is truly representative of the entire country and the estimates based on the sample may deviate from the true population value. This sampling error becomes more severe when the sample size is getting smaller. In order to check on the reliability of our data, we adopted two methods:

1. **County-level estimates**[11] were compared to estimates published on American Fact Finder (AFF) website to see if they are close enough to be reliable.

2. "Coefficient of Variance (CV)" was calculated for **occupation-level estimates** and a threshold was imposed on CV beyond which we need to use data with caution.

Total number of Philly residents and 5 categories of county-level estimates (employment status, gender, race, age, and education) were calculated using PUMS 2011-2015 5-year data and then compared to corresponding estimates published on AFF website. Table A1 shows that most PUMS estimates are within 90% confidence interval of AFF estimates and the percentage difference is very small if they are not in the confidence interval.

Tabe A1: Data Validataion against American Fact Finder (AFF)						
	5-year PUMS	AFF	MOE from AFF	Difference between PUMS and AFF	Within 90% CI	% Difference
Total Number of Philly Residents	1,555,299	1,555,072	*****	-227	N/A	0.0%
employment status:						
Population 16 years and over	1,246,398	1,246,606	+/-822	208	YES	0.0%
Employed (civillian labor force)	638,719	640,661	+/-4513	1,942	YES	0.3%
Unemployed	102,388	103,523	+/-2641	1,135	YES	1.1%
Not in Labor Force	505,054	502,169	+/-4193	-2,885	YES	-0.6%
gender:						
Male	734,904	734,521	+/-105	-383	NO	-0.1%
Female	820,395	820,551	+/-105	156	NO	0.0%
race:						
White Alone	648,647	648,032	+/-3677	-615	YES	-0.1%
Black Alone	666,324	664,911	+/-2436	-1,413	YES	-0.2%
Asian Alone	106,397	106,753	+/-990	356	YES	0.3%
age:						
Median Age	33	33.7	+/-0.1	0.7	NO	2.1%
education:						
Population 18 to 24 years	185,930	185,669	+/-91	-261	NO	-0.1%
High school graduate and less	81,750	82,390	+/-2369	640	YES	0.8%
Some college or associate's degree	79,988	79,886	+/-1938	-102	YES	-0.1%
BA degree or higher	24,192	23,393	+/-1164	-799	YES	-3.4%

Note: Certain estimates in the ACS are controlled to match the official population estimates. If this has occurred, then the MOE will have five stars instead of number.

Source: Philadelphia Works analysis of ACS PUMS 2011-2015

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[11] Refer to county-level estimates based on all Philadelphia residents, not only employed residents that are used in this report.

For occupation-level estimates based on small sample size, a measurement called the "coefficient of variation" (CV) is used to evaluate the level of reliability of an estimate. The CV is a ratio of an estimate's standard error to the actual estimate itself:

$$CV = \frac{SE}{Estimate} \times 100$$

Where SE is the square root of replication-based variance[12].

CVs are a standardized indicator of the reliability of an estimate and help us quickly gauge the usability of that estimate. The lower the CV, the more accurate the estimate-and the more confidence one should have that the estimate is close to the true value. The choice of an estimate's reliability or accuracy threshold is not standard and varies based on the application[13]. Here we used the thresholds that were employed in most studies:

- High reliability: CV less than 15%
- Medium reliability: CV between 15-30%
- Low reliability: CV over 30% - use with caution.

Table A2 shows the CVs for largest 15 occupations filled by Philadelphia residents. All CVs are well below 15% threshold, indicating high reliability of our estimates. In Table A3, CVs are calculated for the largest 10 occupations by skill level and all of them are below 15%. In general, as the sample size gets smaller CV gets higher. Because less middle-skill jobs are taken by Philadelphia residents, they have larger CVs compared to high and low-skill jobs.

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[12] For formula and details about variance and standard error calculation, see "ACS Design and Methodology – Chapter 12: Variance Estimation", Bureau of Labor Statistics, 2014.

[13] The Washington State Office of Financial Management (OFM) recommends the following classification scheme for assessing the reliability of an ACS estimate: good (CV <= 15%), fair (15% < CV <=30%), or use with caution (CV > 30%). (https://www.ofm.wa.gov/sites/default/files/public/legacy/pop/acs/ofm_acs_user_guide.pdf)

Housing Assistance Council (HAC) Rural Data Portal suggests using the following intervals: High reliability estimate (CV less than 15%), reliable estimate (CV between 15% and 29.9%), low reliability estimate (CV 30% or higher). (http://www.ruraldataportal.org/reliability.aspx)

An ESRI white paper on the American Community Survey suggests using CV threshold standards of 0-12 percent indicating high reliability, 12- 40 percent use with caution, and 40 percent and higher very unreliable. (http://www.esri.com/~/media/Files/Pdfs/library/whitepapers/pdfs/the-american-community-survey.pdf)

Missouri Census Data Center recommend the following intervals: CV less than 9.1% (most reliable)
CV between 9.1% and 21.2%, CV 21.2% or greater (least reliable).
(https://census.missouri.edu/acs/usage-notes.php#stats)

Table A2. Largest 15 Occupations Filled by Philadelphia Residents

SOC	Occupation Title	Entry Skill Level	No. of Residents	CV
311010	Nursing, psychiatric, and home health aides	Low	20039	5.4%
412010	Cashiers	Low	18866	5.2%
436010	Secretaries and administrative assistants	Low	14728	5.5%
291141	Registered nurses	High	13689	6.5%
37201X	Janitors and building cleaners	Low	12560	6.3%
412031	Retail salespersons	Low	12047	7.6%
372012	Maids and housekeeping cleaners	Low	11385	7.5%
434051	Customer service representatives	Low	11331	6.1%
533030	Driver/sales workers and truck drivers	Low	11115	7.6%
411011	First-line supervisors of retail sales workers	Low	11051	5.7%
119XXX	Miscellaneous managers*	High	10731	6.0%
339030	Security guards and gaming surveillance officers	Low	10728	7.9%
252020	Elementary and middle school teachers	High	10669	7.1%
251000	Postsecondary teachers	High	10604	6.5%
352010	Cooks	Low	9819	7.3%

* Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131) , and all other managers (11-9199).

Source: SOC, Occupation Title, No. of Residents are from ACS PUMS 2011-2015, Entry Skill Level are from EMSI Q2, 2017

Table A3. Largest 10 Occupations by Skill Level

SOC	Occupation Title	No. of Residents	CV
Low-Skill Jobs:			
311010	Nursing, psychiatric, and home health aides	20,039	5.4%
412010	Cashiers	18,866	5.2%
436010	Secretaries and administrative assistants	14,728	5.5%
37201X	Janitors and building cleaners	12,560	6.3%
412031	Retail salespersons	12,047	7.6%
372012	Maids and housekeeping cleaners	11,385	7.5%
434051	Customer service representatives	11,331	6.1%
533030	Driver/sales workers and truck drivers	11,115	7.6%
411011	First-line supervisors of retail sales workers	11,051	5.7%
339030	Security guards and gaming surveillance officers	10,728	7.9%
Middle-Skill Jobs:			
259041	Teacher assistants	5,212	9.9%
333050	Police officers	5,127	9.9%
433031	Bookkeeping, accounting, and auditing clerks	5,025	8.8%
5191XX	Miscellaneous production workers*	4,605	12.6%
292061	Licensed practical and licensed vocational nurses	4,502	9.3%
472031	Carpenters	4,478	13.5%
512090	Miscellaneous assemblers and fabricators	3,723	14.6%
232011	Paralegals and legal assistants	3,473	11.2%
395012	Hairdressers, hairstylists, and cosmetologists	3,334	11.5%
433021	Billing and posting clerks	3,233	14.0%
High-Skill Jobs:			
291141	Registered nurses	13,689	6.5%
119XXX	Miscellaneous managers**	10,731	6.0%
252020	Elementary and middle school teachers	10,669	7.1%
251000	Postsecondary teachers	10,604	6.5%
132011	Accountants and auditors	8,987	7.9%
291060	Physicians and surgeons	7,143	6.9%
2310XX	Lawyers, and judges, magistrates, and other judicial workers	6,987	8.3%
211020	Social workers	6,981	8.0%
211010	Counselors	5,885	9.3%
119030	Education administrators	4,571	10.1%

* Miscellaneous production workers include semiconductor processors (51-9141), cleaning, washing, and metal pickling equipment operators and tenders (51-9192), cooling and freezing equipment operators and tenders (51-9193), and all other Production workers (51-9199).

** Miscellaneous managers include funeral service managers (11-9061), postmasters and mail superintendents (11-9131) , and all other managers (11-9199).

Source: Philadelphia Works analyis of ACS PUMS 2011-2015.