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Gender Diversity in the Aviation Workplace

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Abstract

In the past 90 years, the workforce has been diversified in many fields yet gender diversity for occupations in the aviation domain (e.g., pilots, air traffic controllers, aircraft maintenance technicians) has grown slowly. To explore this issue, the objective of this archival study was to examine the increase in the number of females and males from 2005 to 2018 for six aviation occupations in the private sector (civilian) in the United States: aircraft pilot and flight engineer; air traffic controller and airfield operations specialist; aerospace engineer; avionics technician; aircraft mechanic and service technician; and aircraft structure, surfaces, rigging, and systems assembler. Data were obtained from the American Community Survey using Public Use Microdata Sample from the United States Census Bureau. Results revealed females still comprise a very small percentage of the total workforce across aviation occupations. Change across the years was shown to be more erratic for females, compared to males. Further research is warranted to investigate the underlying causes for these erratic trends in the female aviation workforce in order to help solve the severe labor shortage affecting the entire aviation industry.

Keywords: aviation, diversity, gender, labor shortage

Introduction

Although women have been flying since the 1930s, few pilots today are female (Luedtke, 2011). Of the 130,000 airline pilots worldwide, 4,000 are female, with only 450 in the position of Captain (McCarthy, Budd, & Ison, 2015). In the past 90 years, the workforce has been diversified in many fields, yet diversity in the pilot workforce has grown slowly. This also holds true for other aviation occupations. The Federal Aviation Administration (FAA) publishes the U.S. Civil Airmen Statistics, an annual study with statistics about airmen, both pilot and nonpilot. In 2017, 98,161 commercial pilots were registered, yet only 6,267 were female (FAA, 2018). Of the total 286,268 mechanics registered, only 6,855 were female (FAA, 2018). Only 7,264 of 36,448 air traffic controllers and airfield operations specialists registered were female (Data USA, 2018b). Of 128,406 aerospace engineers registered, only 14,817 were female (Data USA, 2018a). However, these numbers do not necessarily imply the certificate holders are currently employed in their profession and, thus the exact number of females may be lower. Accordingly, the central research question investigated in this archival study was how do females compare to males in aviation occupations in the United States across a time period of fourteen years (2005-2018), as indicated by examining other public (non-FAA) data.

Method

Data for this archival study were obtained from the American Community Survey using Public Use Microdata Sample (PUMS) from the United States Census Bureau. PUMS data are collected from a survey conducted all year, every year where randomly selected addresses in every state, the District of Columbia, and Puerto Rico are asked to complete the survey (United State Census Bureau, 2020). Anyone with an address can take the survey and respond.

The increase in the number of females and males in six aviation occupations in the private sector (civilian) in the United States was examined from 2005 to 2018. This time frame was selected because the data are readily available from the United States Census Bureau and are relatively current. A limitation of the archival research is the use of PUMS data; this database uses a smaller sample size because it is microdata and is edited using top coding to protect privacy. An assumption for the archival research is the data were collected and recorded accurately. Two key words, SEX and OCCP (Occupation), were searched and analyzed for six aviation occupations: (1) aircraft pilot and flight engineer, (2) air traffic controller and airfield operations specialist, (3) aerospace engineer, (4) avionics technician, (5) aircraft mechanic and service technician, and (6) aircraft structure, surfaces, rigging, and systems assembler. The archival study did not present any ethical issues as the data are publicly available from the United States Census Bureau and the data are gathered by mail from individuals voluntarily participating in the questionnaires administered, which were then returned and de-identified.

Results

Results will be presented separately for each of the six aviation occupations. Due to the large disparity in the number of males and females in each occupation, no inferential statistical analyses were conducted on the data. Instead, frequency counts for each year and percent change from year to year will be reported for males and females.

The results for aircraft pilots and flight engineers are shown in Table 1 and graphically illustrated in Figure 1. Frequency counts for males remained relatively stable, except for an increase between 2015 and 2016 and between 2017 and 2018. For females, the greatest increase

occurred between 2011 and 2012 and between 2015 and 2016. However, the data showed a notable decrease for females between 2012 and 2013.

Table 1

Frequency Count and Percent Change for Aircraft Pilots and Flight Engineers by Gender from 2005 to 2018

	Male		Female	
Year	Count	% Change	Count	% Change
2005	165,211	***	9,605	***
2006	165,826	0.37	8,741	-9.00
2007	172,433	3.98	8,546	-2.23
2008	171,899	-0.31	8,846	3.51
2009	169,564	-1.36	8,076	-8.70
2010	161,351	-4.84	8,230	1.91
2011	153,179	-5.06	8,652	5.13
2012	155,478	1.50	11,838	36.82
2013	154,416	-0.68	9,019	-23.81
2014	151,436	-1.93	8,401	-6.85
2015	156,705	3.48	9,790	16.53
2016	184,368	17.65	13,200	34.83
2017	173,341	-5.98	12,733	-3.54
2018	197,583	13.99	12,661	-0.57

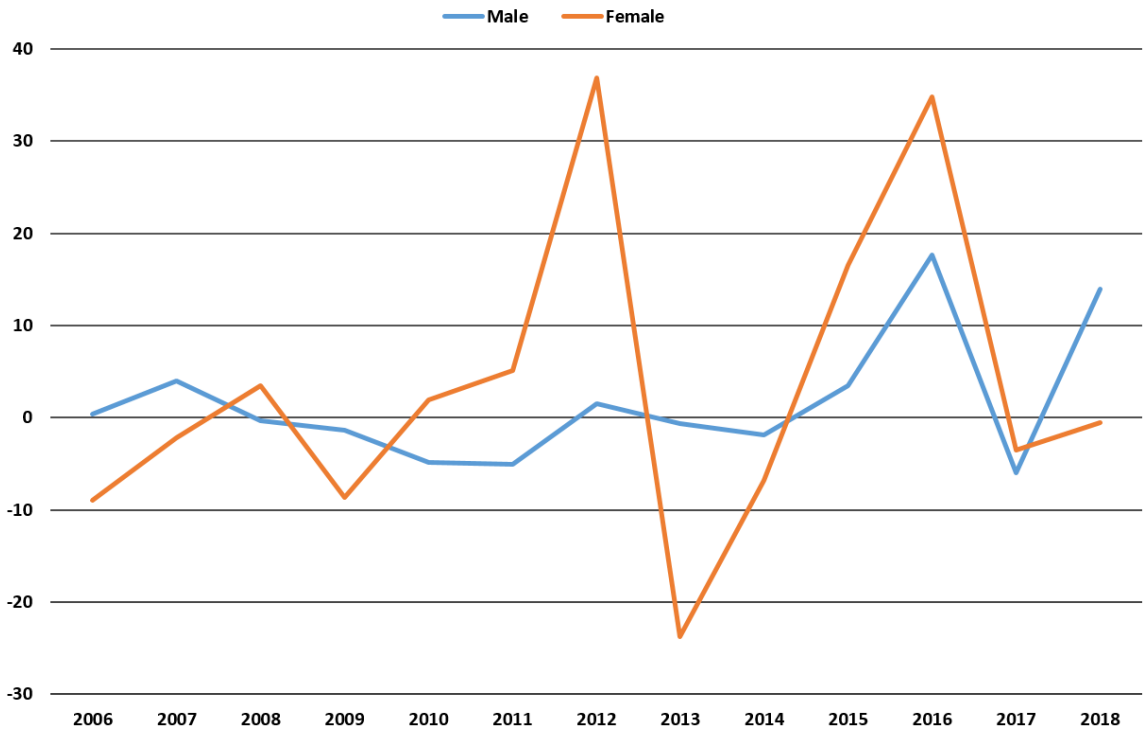

Figure 1. Percent change for aircraft pilots and flight engineers by gender from 2006 to 2018.

The results for air traffic controllers and airfield operations specialists are shown in Table 2 and graphically illustrated in Figure 2. Frequency counts for males increased between 2008 and 2009 and between 2010 and 2011, with a moderate decrease between 2009 and 2010. For females, frequency counts increased between 2005 and 2006 and between 2013 and 2014, with the largest increase (65.27%) between 2017 and 2018. However, the data showed a notable decrease for females between 2016 and 2017.

Table 2

Frequency Count and Percent Change for Air Traffic Controllers and Airfield Operations Specialists by Gender from 2005 to 2018

	Male		Female	
Year	Count	% Change	Count	% Change

2005	33,698	***	6,532	***
2006	34,665	2.87	8,910	36.41
2007	37,278	7.54	8,655	-2.86
2008	34,996	-6.12	9,354	8.08
2009	41,980	19.96	9,758	4.32
2010	35,967	-14.32	9,325	-4.44
2011	43,702	21.51	9,688	3.89
2012	40,167	-8.09	11,147	15.06
2013	37,384	-6.93	9,495	-14.82
2014	36,803	-1.55	13,238	39.42
2015	40,030	8.77	11,149	-15.78
2016	37,191	-7.09	9,446	-15.27
2017	34,408	-7.48	6,245	-33.89
2018	36,514	6.12	10,321	65.27

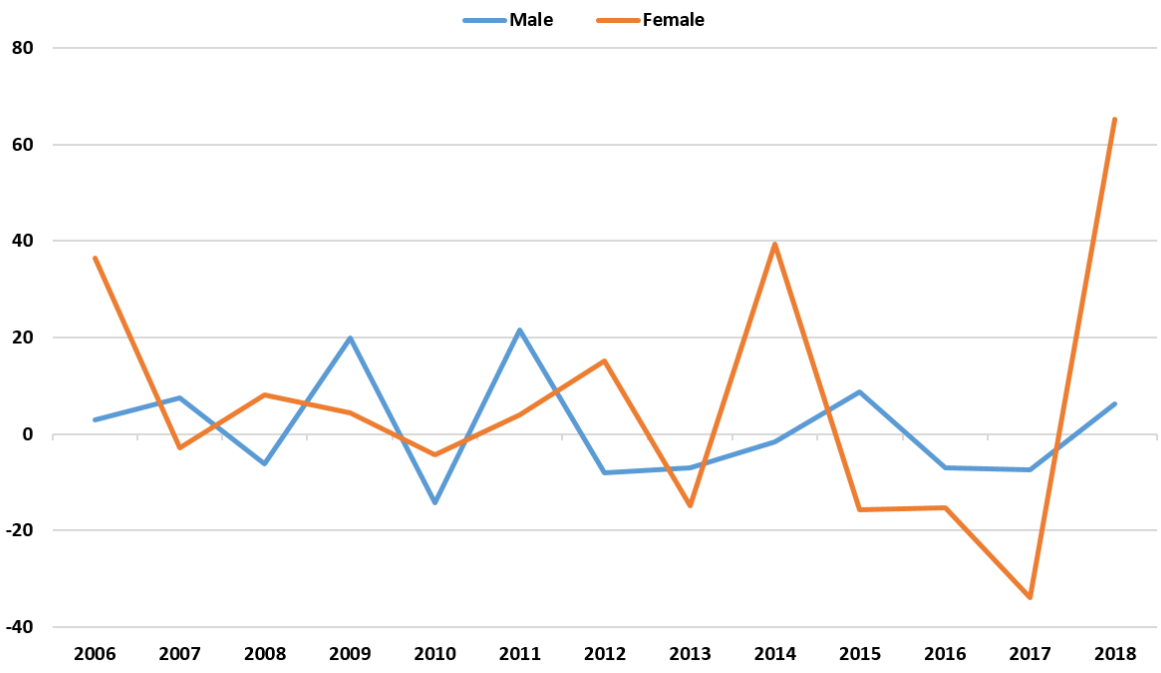

Figure 2. Percent change for air traffic controllers and airfield operations specialists by gender from 2006 to 2018.

The results for aerospace engineers are shown in Table 3 and graphically illustrated in Figure 3. Frequency counts for males remained relatively stable, though showed a moderate decrease between 2013 and 2014. For females, the greatest increase occurred between 2016 and 2017 and between 2017 and 2018. However, the data showed a notable decrease for females between 2009 and 2010 and between 2014 and 2015.

Table 3

Frequency Count and Percent Change for Aerospace Engineers by Gender from 2005 to 2018

	Male		Female	
Year	Count	% Change	Count	% Change
2005	127,891	***	14,664	***
2006	123,812	-3.19	14,585	-0.54
2007	130,991	5.80	15,347	5.22
2008	134,779	2.89	17,557	14.40
2009	134,807	0.02	20,670	17.73
2010	134,388	-0.31	17,715	-14.30
2011	131,442	-2.19	18,229	2.90
2012	134,321	2.19	18,377	0.81
2013	128,216	-4.55	18,096	-1.53
2014	116,200	-9.37	17,839	-1.42
2015	119,830	3.12	15,572	-12.71
2016	129,781	8.30	16,438	5.56
2017	138,477	6.70	19,743	20.11
2018	132,090	-4.61	23,649	19.78

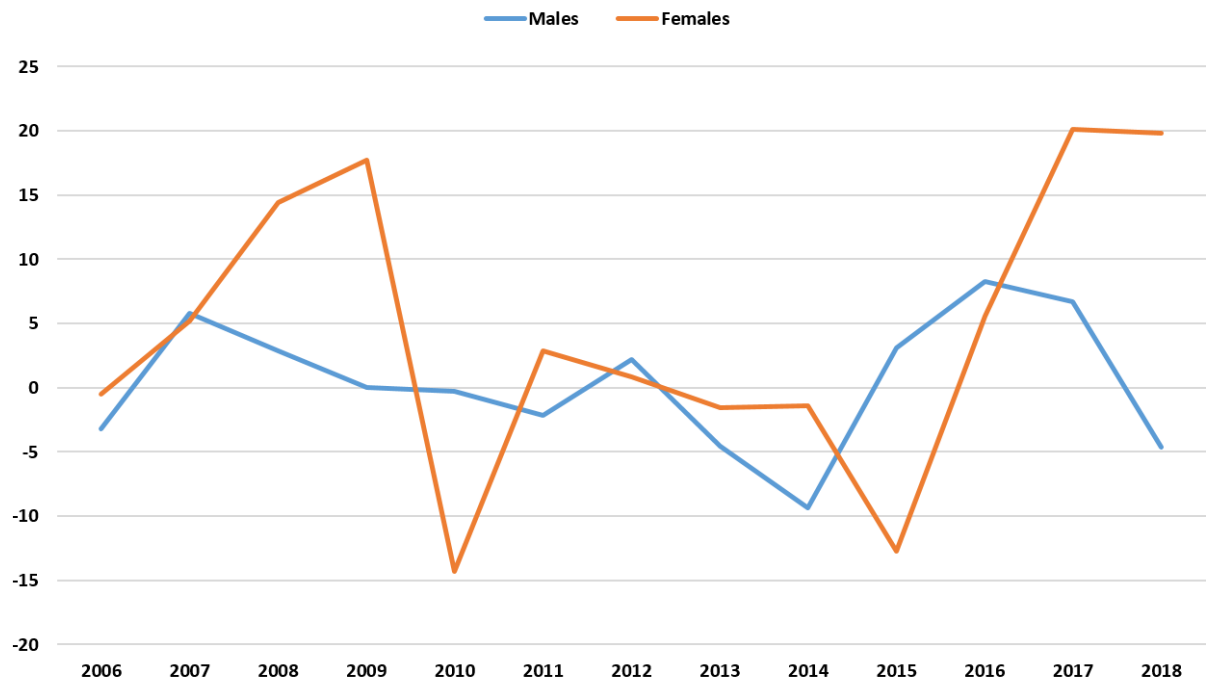

Figure 3. Percent change for aerospace engineers by gender from 2006 to 2018.

The results for avionics technicians are shown in Table 4 and graphically illustrated in Figure 4. Frequency counts for males were erratic, with notable increases between 2005 and 2006 and between 2014 and 2015 and the greatest decrease between 2013 and 2014. For females, the greatest increase occurred between 2005 and 2006 (88.75%), with notable increases between 2010 and 2011 and between 2016 and 2017. However, the data showed notable decreases for females between 2008 and 2009, between 2014 and 2015, and between 2017 and 2018.

Table 4

Frequency Count and Percent Change for Avionics Technicians by Gender from 2005 to 2018

	Male		Female	
Year	Count	% Change	Count	% Change
2005	23,068	***	1,662	***
2006	26,916	16.68	3,137	88.75

2007	25,732	-4.40	2,737	-12.75
2008	25,101	-2.45	3,295	20.39
2009	25,948	3.37	2,074	-37.06
2010	24,222	-6.65	1,727	-16.73
2011	23,549	-2.78	2,524	46.15
2012	25,945	10.17	2,669	5.74
2013	27,378	5.52	3,707	38.89
2014	21,482	-21.54	4,235	14.24
2015	27,455	27.80	2,599	-38.63
2016	24,384	-11.19	2,324	-10.58
2017	21,213	-13.00	3,438	47.93
2018	20,712	-2.36	2,293	-33.30

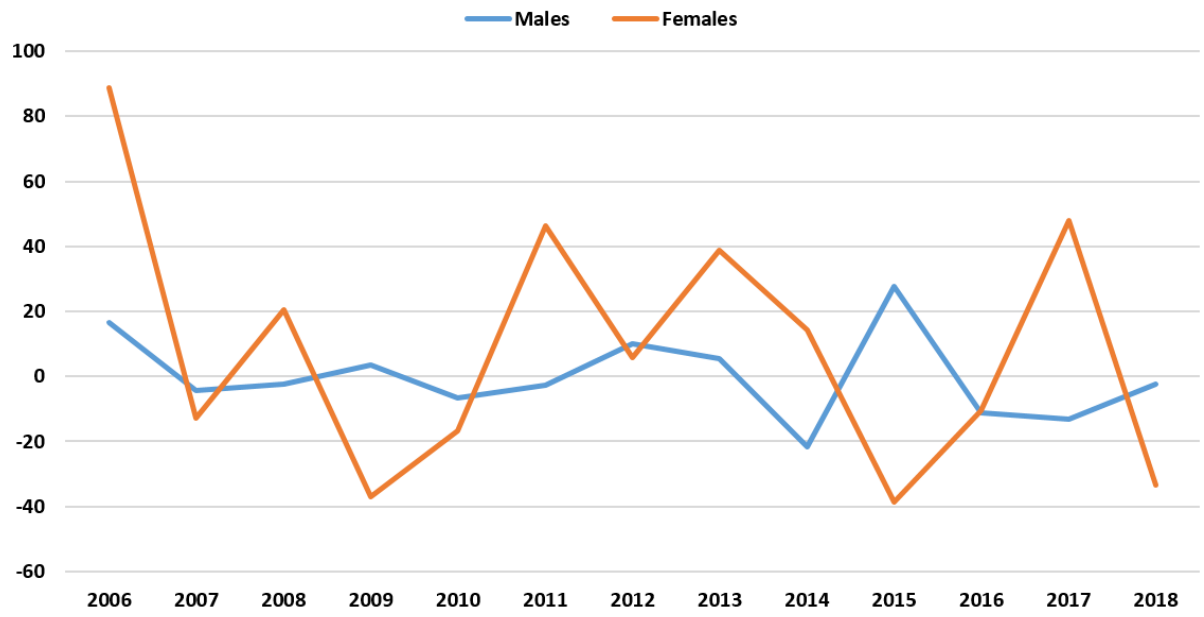

Figure 4. Percent change for avionics technicians by gender from 2006 to 2018.

The results for the aircraft mechanics and service technicians are shown in Table 5 and graphically illustrated in Figure 5. Frequency counts for males remained relatively stable, though

moderate increases occurred between 2011 and 2012 and between 2014 and 2015. For females, the greatest increase occurred between 2006 and 2007 (35.30%), with notable increases between 2013 and 2014, between 2014 and 2015, and between 2016 and 2017. However, the data showed notable decreases for females between 2005 and 2006, between 2008 and 2009, and between 2015 and 2016.

Table 5

Frequency Count and Percent Change for Aircraft Mechanics and Service Technicians by Gender from 2005 to 2018

	Male		Female	
Year	Count	% Change	Count	% Change
2005	195,847	***	12,120	***
2006	188,994	-3.50	9,633	-20.52
2007	198,185	4.86	13,033	35.30
2008	193,659	-2.28	12,629	-3.10
2009	200,394	3.48	9,940	-21.29
2010	185,888	-7.24	10,219	2.81
2011	191,429	2.98	11,158	9.19
2012	217,427	13.58	11,459	2.70
2013	196,858	-9.46	10,168	-11.27
2014	180,242	-8.44	12,622	24.13
2015	206,542	14.59	15,402	22.03
2016	198,658	-3.82	10,714	-30.44
2017	209,044	5.23	12,992	21.26
2018	197,455	-5.54	11,356	-12.59

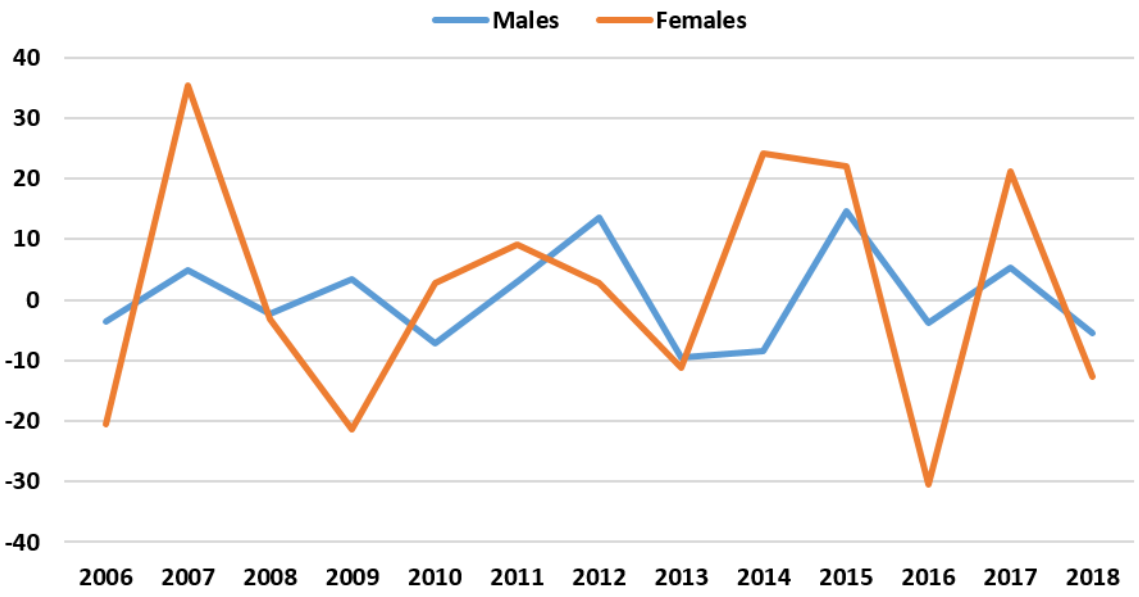

Figure 5. Percent change for aircraft mechanics and service technicians by gender from 2006 to 2018.

The results for aircraft structure, surfaces, rigging, and systems assemblers are shown in Table 6 and graphically illustrated in Figure 6. Frequency counts for males were erratic, with notable decreases between 2009 and 2010, between 2011 and 2012, and between 2012 and 2013. The greatest increase occurred between 2014 and 2015 (40.20%). For females, frequency counts were also erratic. The greatest increase occurred between 2006 and 2007 (61.69%), with notable increases between 2009 and 2010 and between 2016 and 2017. However, the data showed notable decreases for females between 2008 and 2009, between 2010 and 2011, between 2012 and 2013, and between 2015 and 2016.

Table 6

Frequency Count and Percent Change for Aircraft Structure, Surfaces, Rigging, and Systems Assemblers by Gender from 2005 to 2017

	Male		Female	
Year	Count	% Change	Count	% Change
2005	8,423	***	3,317	***
2006	7,755	-7.93	3,203	-3.44
2007	8,872	14.40	5,179	61.69
2008	9,978	12.47	5,514	6.47
2009	10,819	8.43	3,979	-27.84
2010	8,087	-25.25	5,427	36.39
2011	8,582	6.12	3,238	-40.34
2012	6,554	-23.63	3,708	14.52
2013	4,330	-33.93	1,975	-46.74
2014	4,634	7.02	2,257	14.28
2015	6,497	40.20	2,398	6.25
2016	6,362	-2.08	1,535	-35.99
2017	6,584	3.49	2,191	42.74

Note: No data reported for 2018.

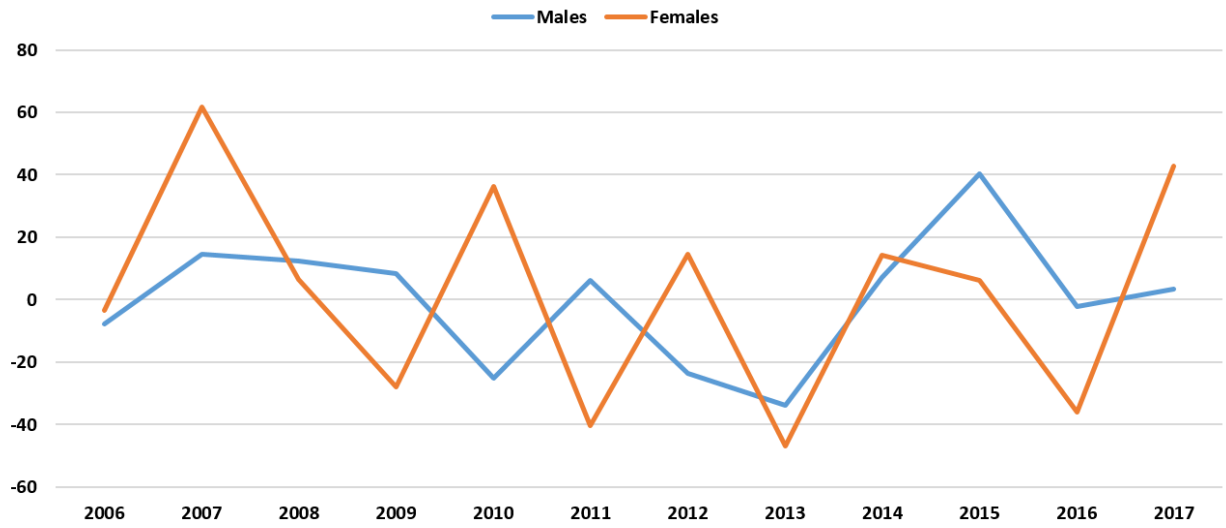

Figure 6. Percent change for aircraft structure, surfaces, rigging, and systems assemblers by gender from 2006 to 2017. No data reported for 2018.

Discussion

Although females have continued to grow in the aviation domain over the past century, results of this archival study revealed females still comprise a very small percentage of the total workforce across aviation occupations. These findings are consistent with the workforce report on women in aviation by Lutte (2019). The two aviation occupations with the most females in 2018 were aerospace engineers at 23,649 (compared to males at 132,090) and aircraft pilots and flight engineers at 12,661 (compared to males at 197,583). The two aviation occupations with the least females were avionics technicians at 2,293 (compared to males at 20,712) in 2018 and aircraft structure, surfaces, rigging, and systems assemblers at 2,191 (compared to males at 6,584) in 2017. Change across the years was shown to be more erratic for females, compared to males, with the most erratic changes occurring for avionics technicians and for aircraft structure, surfaces, rigging, and systems assemblers.

The low number of women in aviation has been well established across a variety of data sources (e.g., FAA U.S. Civil Airmen Statistics, Bureau of Labor Statistics). What remains to be fully explored is the underlying causes for the erratic trends in the female aviation workforce. Is the cause economic (e.g., layoffs due to downturns in the market) or social (e.g., leaving or forced to leave the workforce due to the workplace environment or family issues)? With regard to the latter, a study by Lutte (2020) revealed the top three factors negatively influencing women's decision to remain in aviation were the existence of a 'good ole boy' network, cost of required training and education, and family life impact. Cost can be addressed through scholarships and access to more affordable technical training. Family life impacts can be addressed with more flexible schedules and by tailoring contracts and negotiations to address the special needs of this population (e.g., paid family leave, employer-sponsored childcare). However, the pervasive male dominated culture will require a concerted effort to increase awareness of the negative consequences of implicit bias and harassment disproportionately affecting women in aviation as well as restructuring organizational and operational systems in the aviation industry to create a safe and inclusive work environments open to all individuals.

From a practical perspective, the pilot shortage is a crisis for the aviation community. Boeing estimates North America will need 117,000 new pilots in the next 20 years (Ostrower, 2017, para 3). The high number stems from the current pilot groups being forced to retire at the age of 65, "more than 42% of active U.S. airline pilots at the biggest carriers will retire over the next 10 years, about 22,000, according to a recent report by Cowen & Company" (Ostrower, 2017, para 2). With the number of pilots declining, airlines, private aviation firms, and cargo carriers will be forced to decrease the number of routes and number of planes flown, or look for

a way to recruit new pilots. The data from this study illustrate how attracting more females to consider careers in aviation could help solve the severe labor shortage affecting the entire aviation industry.

In conclusion, women are a vast workforce resource overlooked for far too long (Hansen & Oster, 1997). Future research is warranted to identify and implement viable strategies aimed at helping break down the barriers to recruitment and retention of women in aviation. Another area for future research is to explore gender from a more modern lens. For the purpose of this study, the focus was on the traditional definition of gender, as biologically determined (male or female). However, over the past few decades, gender has become a broad term encompassing biological gender, gender identity, gender fluidity, transgender, and so forth. Accordingly, how these distinct groups are represented in the aviation industry warrants further investigation.

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