Gender Wage Gap Trends

Among Information Science Workers*

(with On-line Appendix)

Forthcoming, *Social Science Quarterly*, 2019

Gabriel Courey

Department of Economics, Wittenberg University, 200 W Ward St.
Springfield, Ohio 45504 coureyg@wittenberg.edu

John S. Heywood

Department of Economics, University of Wisconsin-Milwaukee,
P.O. Box 413, Milwaukee, WI 53201 heywood@uwm.edu (414) 229-4310

OBJECTIVE: We test whether increasing gender earning differences are associated with the surprising decline in the share of women working in Information Science (IS).

METHODS: We use representative data to estimate the gender earnings differential from 1995 to 2015 for full-time, private sector IS workers in the United States. We decompose the differential within and across years. Time trends isolate the pattern of the unexplained gender differential.

RESULTS: None of our decompositions or projections reveal increased gender earnings differentials over the sample period. If anything, the unexplained differentials modestly decline.

CONCLUSION: Despite contentions that the financial treatment of women explains their departure from IS and engineering, we find no evidence of a trend toward larger earnings differentials. Thus, our data argue that the declining share of women in IS likely has its roots elsewhere.

*Direct all Correspondence to Professor John S. Heywood. This paper improved thanks to comments from Tanya Byker, Phani Wunnava and participants at the David K. Smith '42 Symposium on the Economics of Skin Tone, Gender and Ethnicity at Middlebury College in April 2016.

1. Introduction

Despite the large-scale entry of women into the labor force and the passage of civil rights and equal pay legislation in the 1960s, it was not until the 1980s that the gender wage gap in the United States showed a substantial decline (O'Neill and Polachek 1993). Scholars at the time explored the extent to which the decline simply reflected women moving into higher paying occupations and the extent to which it represented a decline of gender wage gaps within occupations. The concern was that if women increasingly moved into occupations with higher earnings, the economy wide measure could decline even as the gap in both higher and lower paying occupations remained unchanged (Johnson and Solon 1985).

Software workers provided an interesting case study as from 1975 to 1990 there was a substantial increase in female participation. Researchers speculated that this increase could reflect decreasing gender wage discrimination. Heywood and Nezlek (1993) showed, to the contrary, that over this time-period there was no decline in the unexplained gender wage gap, the gender earnings difference standardized for differences in earnings determinants and taken as a rough measure of wage discrimination. At its most dramatic, such evidence helped indicate that the earnings discrimination faced by women did not markedly change and that the decline in the economy-wide disadvantage largely represented women simply entering higher paying occupations. While such entry may have great value in itself, it obviously differs from the suggestion that wage penalties for women declined within specific labor markets improving gender equality

We return to this case study several decades later using data from 1995 to 2015. Software occupations, now broadly identified as information science (IS), remain particularly salient as female participation has dramatically reversed. While employment in IS exploded in the period we study, the share of women working in IS sharply *declined*, in contrast with both the earlier examination period and most other STEM fields. This might be considered surprisingly given that IS experienced most of its employment growth after the anti-discrimination statutes and during a period in which the NSF committed substantial resources to educating women in science. In the decades since the 1980s, the economy-wide gender wage gap continued to decline, albeit more slowly than during the 1980s (Blau and

Kahn 2016) and the Obama administration retained a strong, persistent interest in further closing the gender wage gap (Council of Economic Advisers 2015). In the face of these general trends, we ask if measured discrimination (the unexplained wage gap) increased in a way that might help illuminate the declining share of women in IS from 1995 to 2015. We show that although the raw wage gap declined since 2000 (largely due to women entering higher paying portions of the IS field), there has been essentially no change in the unexplained wage gap.

The remarkable persistence within IS in the size of unexplained gender earnings gap implies that one should likely look elsewhere for causes of the declining participation of women in IS. In our study period, participation decreased in the face of a seemingly unchanging or even modestly decreasing unexplained wage differential. While not a show of causation, this pattern remains hard to reconcile with measured gender wage discrimination being a strong determinant of employment for women in IS and continues to argue that the overall decline in the gender differential reflects changing employment composition, rather than more equal earnings within occupations.

In what follows, section 2 reviews the pattern of female education and employment in science and engineering focusing on IS. Section 3 describes our data and methodology. Section 4 presents the raw and unexplained gender differentials in each year over the two decades we examine. It also projects the unexplained differentials using the data of the first year. This documents that the unexplained gap remains unchanged for a set of characteristics held constant. Section 5 concludes, emphasizes limitations and identifies directions for future research.

2. Background and Setting

The composition of IS jobs rapidly changed with a larger share of jobs identified as "professional." The earnings of these professionals show variation by occupation. Among the nine detailed professional occupations, the median annual earnings in 2014 ranged from $50,380 for computer support specialists to $97,990 for software developers (Occupational Outlook Handbook, BLS). The overall computing workforce has grown dramatically and now totals 4 million workers. This growth slowed but was not reversed by the great recession (Csorny 2013) and BLS projects that the ten years from 2014 to 2024 will add approximately a half million additional workers representing 12 percent growth, far above the average across all US occupations.

Working as a professional in IS frequently, but not always, requires a degree in computer science. The declining female share of computer science degree recipients stands alone among the 21 STEM and related fields tracked by the NSF. The female share of first degree recipients hit a high water mark of 37.1 percent in 1984 but has since continuously declined. By 2011 the female share of first degrees stood at only 17.6 (NCES 2012). During this period of decline, the female share of other STEM degree recipients increased so that the share of females earning degrees in most other STEM fields exceeds that of computer science.[1]

The relative decline of women from this important pipeline of computer science degrees might not be crucial if compensated for by women entering IS from electrical engineering, physics and so on. Yet, this clearly has not swung the balance as we show that the share of women working in IS has fallen by at least 10 percentage points from around 40 percent of the field to 30 percent of the field. This matches other data with broader scope (with greater sample size) than the current population survey (CPS) that we use (Hayes 2010). As but a single illustration, the share of women software developers in 1973 (when BLS first started tracking them) was 25%. It rose dramatically to reach a peak of over 40 percent in 1987 but fell below its 1971 level by 2005, a decline that continues (Hayes 2010 p. 33). The early period of increasing female participation was also mimicked in the CPS (Heywood and Nezlek 1993) suggesting the contours of the results do not depend on the data source. The evidence clearly indicates that the last two decades has seen a decline in female representation in IS.

The cause for this decline likely includes several factors. We focus on changes in the unexplained gender wage differential that might make IS less desirable. Others suggest growing negative stereotypes. The image of a computer "nerd" or "hacker" may be increasingly unappealing to women. Moreover, computer science was often originally housed in the liberal arts and could be aligned with mathematics or physics. As it became more professionalized, it relocated to engineering schools losing this variety of disciplinary influences and entering a more male domain (Hayes 2010).

The decline might also be partially explained by women "leaving science," prematurely exiting STEM fields. Preston (2004 p. 22) examines both NSF data and science graduates from a large public university showing that women are twice as likely to leave a science (including engineering and IS) career for jobs unrelated to science or to exit the labor force. Moreover, women remain 1.5 times more likely to leave science specifically for jobs unrelated to science. Of those who left science, women were far more likely than men to cite as reasons that it was impossible to have a family and work in science, that the hours required were too long and that science was "unfriendly to women." This fits with survey data that isolate why women leave science including the lack of work-family balance (including laboratory and field work), the isolation of being a minority, the lack of mentoring, the risk taking environment and outright discrimination (among others see Stephan and Levin 2005, Hewlett et al. 2008 and Fouad and Singh 2011).

Yet, these studies do not attempt to make comparisons between science and other male dominated jobs to find out if science actually differs. Hunt (2016) demonstrates that the higher relative exit rates of women from science are largely driven by exit from engineering (including computer science) and that the exit gap reflects women being dissatisfied with "pay and promotion chances." Family-related issues are secondary in importance. Hunt shows that the exit rate from engineering does not differ from that of other male dominated fields such as finance. "Once the share of males in a field of study is appropriately controlled for, the relative female exit rates from science and engineering look comparable to other fields." In turn, this suggests to Hunt that future research should focus on the lack of mentoring and networks or on discrimination by managers and coworkers rather than on the unique characteristics of work in science such as labs, fieldwork and so on.

We respond with our study of relative gender earnings in IS over the last twenty years. The patterns we find might reinforce the dissatisfaction that Hunt found with pay and promotion among women and support her contention that discrimination should be a focus of study. The finding of an unexplained gender wage gap in IS should be anticipated (Heywood and Nezlek 1993 and Nezlek and DeHondt 2012) and exists more generally among science and engineering occupations.[2] Yet, the gender differential in science and engineering is virtually absent upon graduation and first job (Morgan 1998 and Corbett and Hill 2012). It develops over a career and may grow worse with children. Thus, Xie and Shauman (2003) find that young children limit women scientists' migration significantly more than that of men with a resulting negative influence on their relative earnings. While the unexplained gender pay gap in IS should be expected, has it grown over time?

A growing unexplained differential would be consistent with both the pay and promotion concerns of women leaving the field and with the decline in women entering IS. This requires that women both perceive unexplained gender differentials (or closely associated factors) and respond with choices over jobs. While this is far from settled, there certainly exists supportive evidence (see Hampton and Heywood 1993). Thus, if Hunt (2016) is right and women dislike the pay in engineering and IS and that discrimination may be a cause, an increase in measured discrimination could be the cause of decreasing female representation. Yet, as we will show, there is no evidence of an increase in the unexplained gender wage gap for IS workers.

3. Data and Methods

We use the Current Population Survey (CPS) out-going rotations (ORG) for each of 21 years from 1995 to 2015. While the ORG provides a standardized relatively large sample it does so without some of the more detailed information available in particular monthly supplements. Our sample consists of workers in IS occupation codes. These codes vary over the sample period with the dramatic change being in 2000 when reclassification moved workers from outside IS into the ranks of "nonprofessionals" in IS. Those reclassified were disproportionately women. This creates some breaks in trends on employment shares by gender but does not dramatically influence the regression estimates as we routinely control for whether or not the worker is a professional. At the end of our time period there were 14 separate IS occupations, 12 professional and 2 non-professional occupations. These are listed in Table 1. Importantly, while there are only 10 detailed occupations in 2000, they can be easily cross-walked with the 14 in 2010.

We delete all observations with imputed wage measures or with wages of less the $3.00 per hour or more than $150.00 per hour in 2015 dollars. All wages are inflated to 2015 through use of the Urban CPI. When an hourly wage is given, it is used. When not given, we compute an implicit hourly wage by dividing usual earnings by usual hours. We apply the Pareto distribution to top-coded observations. While this increases the earnings of a small percentage of observations it makes virtually no difference in ultimate regressions.

The restrictions provide us between 2500 and 3500 observations in IS occupations for each of the 21 years. Key descriptive statistics are provided in Table 2 for five-year increments from 1995 to 2015. The real earnings of professionals in IS increased for both genders. The real earnings for non-professionals decreased on average (driven largely by declines for men).

By the end of the period, approximately 19 out of 20 professionals had at least some college with strong growth in the share completing a graduate degree. Interestingly, the relative prevalence of graduate degrees by gender changed over the twenty years.[3] At the beginning, graduate degrees among professionals were 17 percent more common for men than for women but by the end, graduate degrees were 5 percent more common for women than for men.[4] Finally, professionals are more likely to be married than nonprofessionals and among professionals, men are more likely to be married than women. The trends in marriage over time are muted with a very weak suggestion that the likelihood of marriage has declined for women.

Figure 1 presents the share of our IS sample comprised by women and shows the bump associated with the reclassification in the underlying occupations codes in 2000. It is clear that prior to 2000 the decline in relative IS employment for women was well underway. It then bumped up with the reclassification but continued to decline after the bump. From 2000 to 2015, the share of women in IS declined from 40 percent to 29 percent. While this is on a similarly identified set of occupations, the early drop of roughly five percentage points before the reclassification might also be added. If the original sample followed the decline of the slightly different later sample, this would represent a very substantial decline of fully 16 percentage points over the 20 years.

Figure 2 shows the share of each gender that works in professional occupations within IS. The period before the reclassification shows the female share moving toward the male share, the bump down associated with the reclassification and then a continuation of the growth toward the male share. Over the time-period, the share professional for each gender increases reflecting the fast growth in those occupations relative to nonprofessional IS occupations.

In each year we initially estimate a standard Mincerian earnings equation in which the log of the hourly wage is regressed against the available controls. In addition to the measures of education and whether or not married, these include whether or not divorced, age and age squared, residence in an urban area, controls for region of the country, controls for industry, an indicator for whether or not the worker is in a professional occupation, a government employment indicator, a part-time work indicator and a union status indicator. Over the entire period approximately 5 percent of the IS workforce was unionized and it was concentrated in the declining non-professional sector.[5]

We estimate the equations separately by gender. These estimates form the basis of a typical Oaxaca decomposition. While the weighting of the estimates can generate a variety of decompositions (see Fortin et al. 2011), we are less concerned with the one best decomposition than with focusing on the pattern over time. As a consequence, we simply provide the original two decompositions based on the two respective sets of coefficients estimated. Thus, we show the raw differential between men and women and it is decomposed into an explained and unexplained portion first assuming the coefficients from the male estimate and then the coefficients from the female coefficients.

It can easily be argued that the resulting unexplained differentials are far from adequate measures of gender discrimination. We do not have measures of ability (such as the AFQT scores available in the too small sample sizes of the NLSY). Similarly, age as a proxy for experience may not be considered reasonable when examining gender differentials (Blau and Kahn 2013). Similarly, we cannot control for soft skills or personality. We also cannot control for labor force attachment differences associated with the greater home caring responsibilities of women. On the other hand, we have standardized our sample along a number of dimensions. All workers are in IS, so for example, concern with women being crowded into helping professions seems far less relevant (Hirsch and Manzella 2015). Moreover, whether or not to include some of the missing wage determinants into a measure of wage discrimination is debatable as they may reflect an endogenous response to labor market discrimination. Yet, we recognize that being able to examine the role these omitted factors play could be constructive.

In the end, the fundamental point that interests us is the change in the estimated differentials over time so if a particular wage determinant is absent, it may bias our estimate but need not influence the direction of change or size of the trend. At issue is whether the missing variable has changed dramatically in either magnitude or influence over our time-period. For instance, while the gap in expected work years and annual work hours by gender has shrunk very dramatically since the 1960s, these have not changed much over the period we examine and seem to show remarkably little change over the last decade to fifteen years (Jacobsen et al. 2015). We claim only that we have a reasonable sample size and a straightforward but perhaps simple specification that allows a decomposition of the raw earnings difference by gender. We investigate the trends in the unexplained differential against a background of reduced relative participation by women in IS.

4. Estimation Results

Appendix Table 3 shows representative log-earnings estimation for the male and female samples. It isolates only the first and last years of those we estimate but the full set is available upon request. They appear largely as anticipated with returns to education and the usual concavity in the return to age (the proxy for experience). Unionization rarely played a role and when it did, it seemed often to simply reflect its concentration in the lower paying occupations. The return to working in a professional occupation is large and significant throughout the examination period even controlling for the large differences in education between sectors. Moreover, the return to being professional grew over the period for men but not for women. Indeed, the original return to being a professional in 1995 was larger for women but by 2015 it became larger for men.

We first show the raw wage difference between the hourly earnings of women and men over the period. We present this as the difference in average log wages per year (women minus men) and show this as the bottom series of Figure 3. It again shows the consequence of the reclassification in 2000. Yet, prior to that reclassification there seems to be a modest decrease in the raw gender wage. After the reclassification, the composition of the occupations in IS remains much more similar and the pattern in the raw wage difference seems clear as well. It decreases in magnitude, if not monotonically, over the remaining period of examination. To take a dramatic example, the absolute value of the raw wage difference in 2001 is slightly less than .4 and that 2014 is slightly less than .2. Thus, the raw wage gap fell from women earning 33 percent less than men to earning 18 percent less than men. These numbers within IS are remarkably close to the "1 percent a year" that was observed over the late 1970s and 1980s for the economy as a whole (O'Neill and Polachek 1993). While this is clearly cherry-picked, it remains the case that over the full time period since the reclassification in 2000 the log wage gap closed. Despite reasonable sample sizes, there remains nontrivial annual variation in the raw gap and so we do not hang our hat on any particular estimate but rather the more general, but clear, pattern that the gap is shrinking.

We next estimate the size of the unexplained gender wage gap in each year in our observation period. Recall that this includes the set of determinants we described in the last section and first compares average male earnings to what males would receive with the female equation, the male base, and then compares average female earnings to what women would receive with the male equation, the female base. We leave the two estimates of the unexplained differential in log wage points. They are reasonably close to each other in magnitude most years with the female base typically smaller in magnitude (but not always). The first critical point is that the estimates are much smaller than the raw gap suggesting the explanatory controls matter within any given year. Second, the average absolute value over the time series is approximately .114. Finally, and perhaps most importantly, there exists no pattern over time. Despite the shrinking share of women in IS over this period, the size of the real unexplained differential neither shrinks nor expands. A trend regression results in a trivially small coefficient that is not close to significantly different from zero.[6]

We note that one consequence of the pattern in Figure 3 is that the portion of the raw gap explained by the controls shrinks over time. The two factors responsible for the vast majority of that shrinkage is the relative growth of women's education and the relative rise in the share of females in professional occupations.

We undertook a series of robustness checks. First, we estimated the unexplained gender differential separately within the group of professionals. The differential among professionals retained an average absolute value of .102 log wage points for the female base and continued to show no trend. The male base had a virtually identical average and also showed no trend.

Second, we replaced the simple professional dummy with two alternatives. The first alternative limits attention to the period from 2000 on and includes the full set of nine occupational dummy variables. This again showed the reduction in the raw differential but failed to show significant trends in the unexplained differential.[7] The second alternative replaced these dummies with a single variable that measures the female share of each occupation. We show the results in Figure 4. The declining raw differential is evident and there is a statistically significant trend in the male base of the unexplained differential. The trend takes a modest .0019 coefficient suggesting a decline in magnitude over the period of about .038 log wage points. The t-statistic is 1.83. Interestingly, the coefficient for the female base is smaller and far from statistical significance.

Third, we limited ourselves to three occupations that have retained identical definitions through the entire time of 1995 to 2015. These are "Computer Scientists and Analysts," "Computer Programmers" and "Computer operators (nonprofessional)." While a minority of the observations by 2015 (excluding for example web designers and software developers), we are interested in the pattern as it removes one source of potential variation in workers and jobs. These three occupations retain 1036 of the total 3375 observations in 2010. We show the results for this subsample in Figure 5 and note the somewhat greater annual variation likely generated by smaller sample sizes. Nonetheless, the familiar pattern of the decreasing size in the raw wage differential is evident. Indeed, the decline among these three occupations is sufficient that by the end of the time series, the earnings estimations have little explanatory power and the unexplained differential is essentially the same as the raw differential. The smaller unexplained female base differential remains .065 log points in absolute magnitude.

Most critically, there is, again, evidence of a trend as the gap using the female base shrinks at a statistically significant .0021 log wage points per year (t-statistic on the trend of 2.56). This trend indicates that the unexplained differential shrunk in absolute value by .042 over the twenty years from about .11 log points to .07 log points. The dashed line through the female differential series in Figure 5 shows the trend. There is a more modest and weaker trend for the male differential of .0015 with an associated t-statistic of 1.68. Thus, if anything, and one hesitates to make too much of this selected sample, there has been a decline in the unexplained gender gap.[8]

We next explore a slightly different methodology to examine the trend in the unexplained gender differential. We hold constant the characteristics over the twenty years and use the annual estimated earnings equations to make projections. As an illustration, we limit our sample to the females in IS in 1995. We then use their characteristics but the equations from every other year to predict the wage each female IS worker in 1995 would earn as estimated by the male equations and as estimated by the female equations. The difference in these projections moves a constant sample though time estimating what their unexplained gender differential would be in each year. Figure 6 shows the results of this exercise with the projections from 1996 to 2015. The projection from the male equation remains above that the female equation in every year. The average difference is .12 log points. The difference shows absolutely no trend. We have repeated this exercise using the female samples from five year increments with each generating a similar lack of a trend. We have also repeated this exercise using the male samples from the five year increments, again, generating no trend.[9]

Overall, our efforts have discovered nothing in the wage differentials to suggest a cause for the surprising decline in the representation of women among IS workers. Recall that this decline reflects more than just the shrinking role of the heavily female dominated nonprofessional occupations. The share female also substantially declined substantially among professional workers. We have confirmed that the raw earnings gap has been closing and so women on average have increasingly more similar overall wages to men. The full IS unexplained wage differential shows remarkable persistence with an average of about .114 wage points and no trend over time. This pattern of persistence and absence of trend is evident in the professional sample in the time-period after the major occupational reclassification in 2000 and when changing the occupational controls to identify the 10 underlying IS occupations from 2000. There is also no pattern over time if we keep the sample constant (taken from a single year and project both male and female earnings using the estimations of other years. Finally, the investigations that did reveal a trend held included share of women as a control or examined the three occupations that have kept the same title over the 20 years. Here, the raw difference shrinks dramatically. By the end of the series, the estimations have no explanatory power so the raw and unexplained are essentially the same. We find a significant trend in the unexplained differential with it shrinking noticeably over the two decades. Thus, if the raw differential shrinks and the unexplained differential is constant or even shrinking itself, IS would seem to be no less attractive to women than two decades earlier.

Further inquiry, beyond the scope of this paper and its data source, will be required to identify why female representation in IS declined. Yet, we undertake one descriptive exercise suggested by our reading of the literature. If Hunt (2016) is wrong and women do leave or fail to enter because employment and family responsibilities are incompatible (Preston 2004), than family composition might change over our time-period. As women leave for family reasons, or fail to enter anticipating family responsibilities, the share of women with children should decrease and the share without children should increase. Put differently, as the employment share of women shrinks, the women surviving in our sample should be increasingly those without children if growth in family incompatibility is the cause.

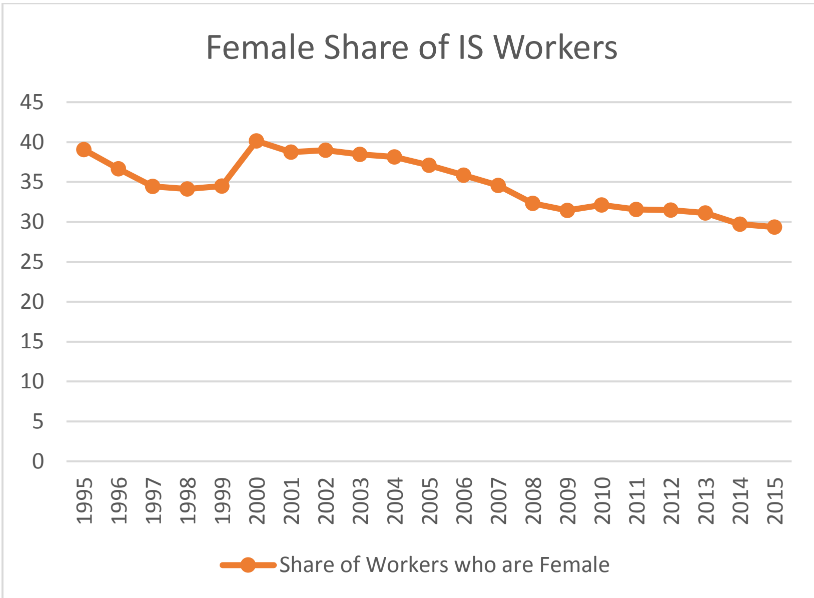
As a rough test, we limit our sample to those under 45 (approximate childbearing age) and examine the share of men and women in IS without children in their household. This data is available only since 2000 and we present the time series in Figure 7. First, note that the share of men without children is actually larger than the share of women. Second, the trend lines simply do not reflect an increasing share of childless women in IS. The only noticeable movement is a modest decline in the share of men so that it more nearly matches that of women. While an imperfect test, it fails to suggest smaller shares of professional women in IS having children. It may be difficult to reconcile a professional IS career and children but it does not seem that a smaller share of women are trying. In turn, we can present no hint that growing incompatibility explains the decline in share of women in IS. As suggested, other papers and data will be needed to fully answer why the share of women in IS has declined.

5. Conclusions

The relative share of women in IS occupations has fallen sharply over the last two decades. We build on recent evidence that women leave science (and may fail to enter) because of poor pay and promotions. A possible cause for this is discrimination. We present evidence on the relative earnings of men and women to explore whether increasing measured earnings discrimination correlates with the decline in the share of women. First, we find that the raw earnings gap continues to decline with women's earnings growing closer to men's because of improving education and occupation choice. Second, we find a persistent and largely unchanging double digit unexplained difference in earnings. In the set of occupations with consistent titles, the unexplained gender differential actually shrinks. Thus, from the wage data we find no descriptive evidence to indicate why the more recent generation of women should find IS occupations less desirable than did previous generations.

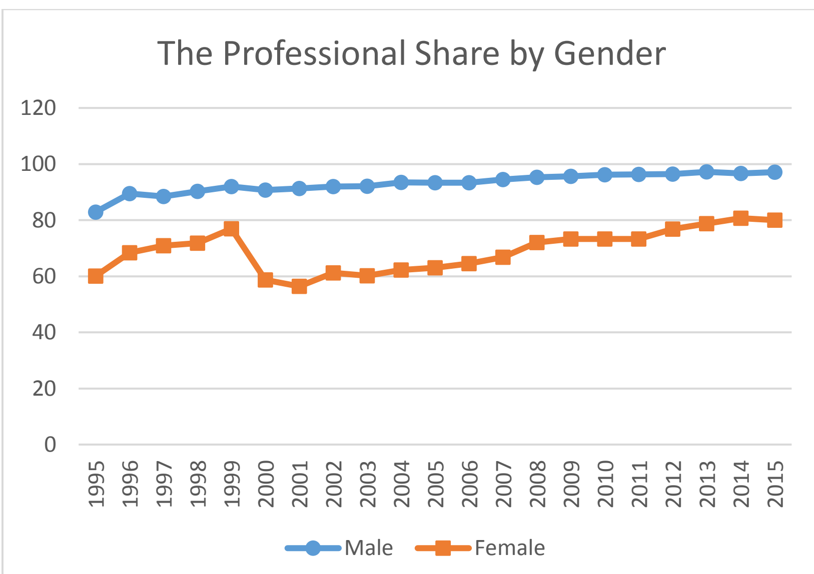
It remains possible that superior estimates could reveal a pattern of growing unexplained gender wage gaps but we doubt it. It seems more likely that the unexplained differential in IS has broadly remained the same and perhaps improved but that the gains in other fields have been greater. Thus, other fields now look more attractive to women than IS both financially and perhaps because they have done more to be welcoming to families. In this view, the declining share of women in IS might better be explored by investigating which occupations have increasing shares of women who might have otherwise been in IS.

Figure 1. The Gender Composition of IS Occupations



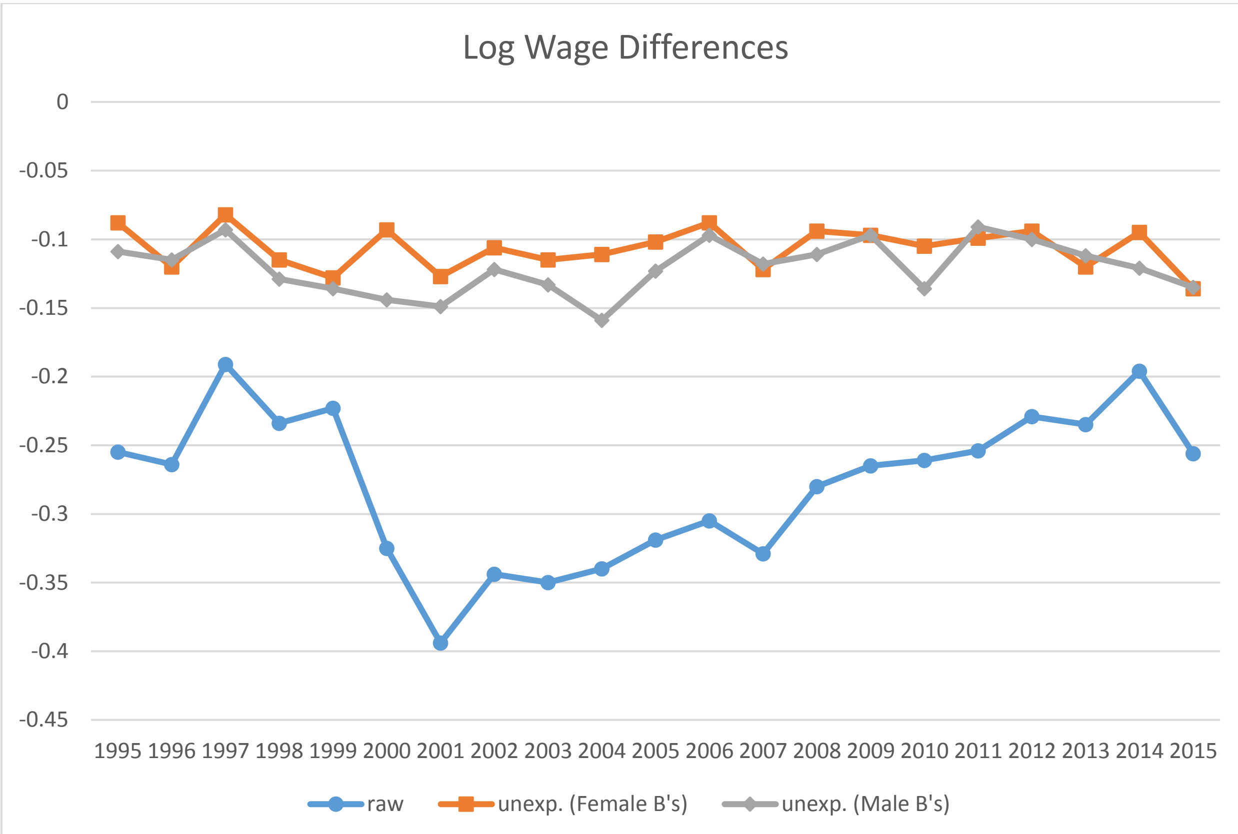
Source: CPS, MORG from 1995 to 2015.

Figure 2: The Share of Each Gender that is "Professional"



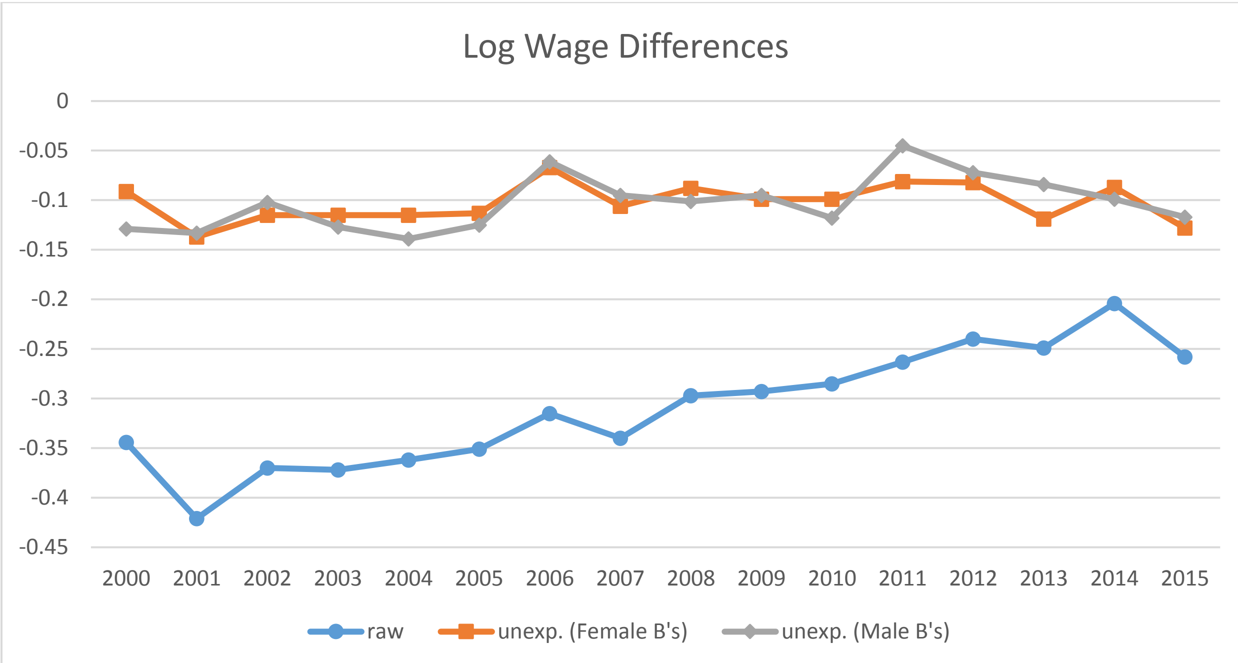
Source: CPS, MORG from 1995 to 2015.

Figure 3: Differences in Log Wages by Gender



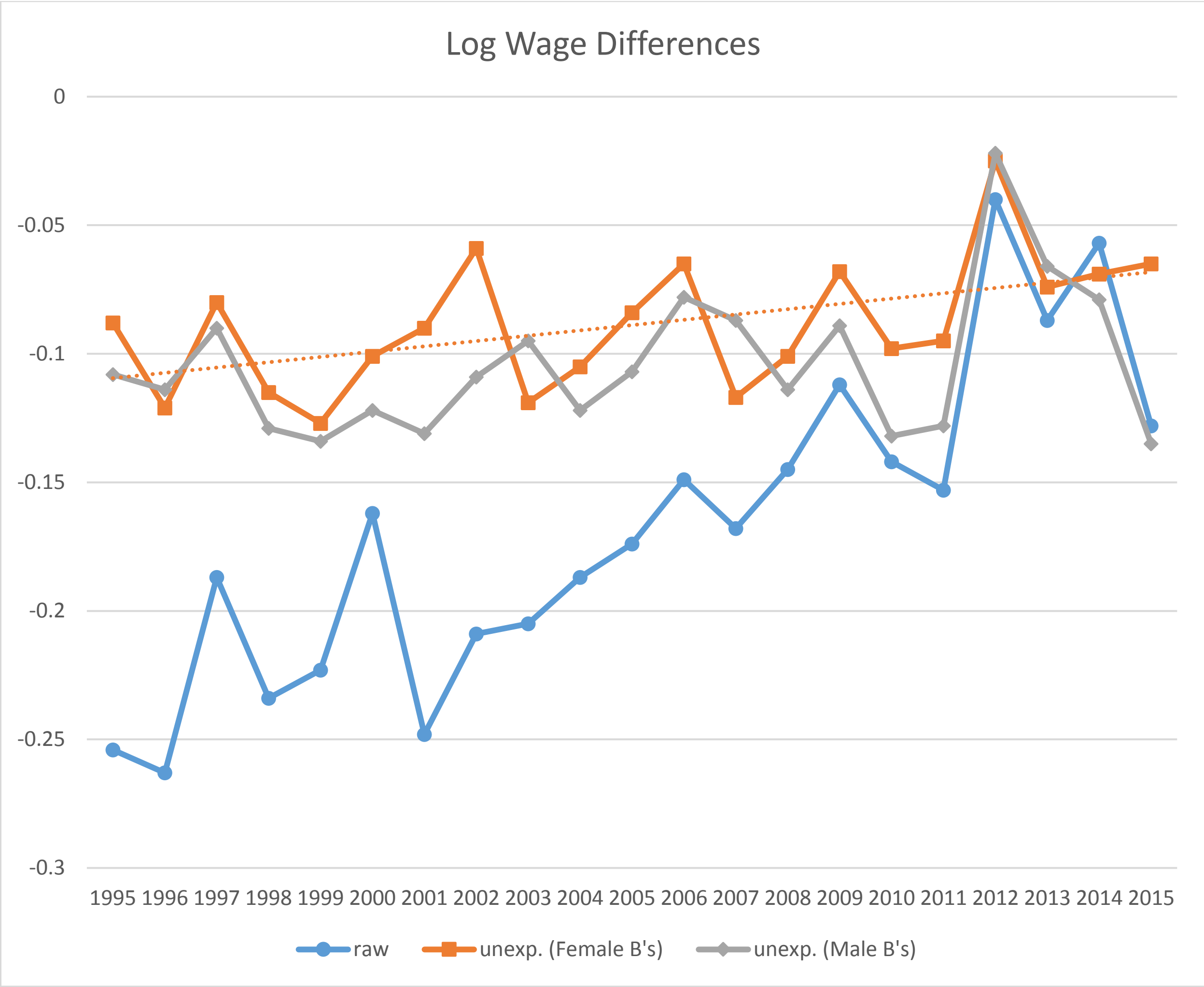
Source: CPS estimations and computations by the authors using all IS occupations.

Figure 4: The Wage Differential from 2000 to 2015



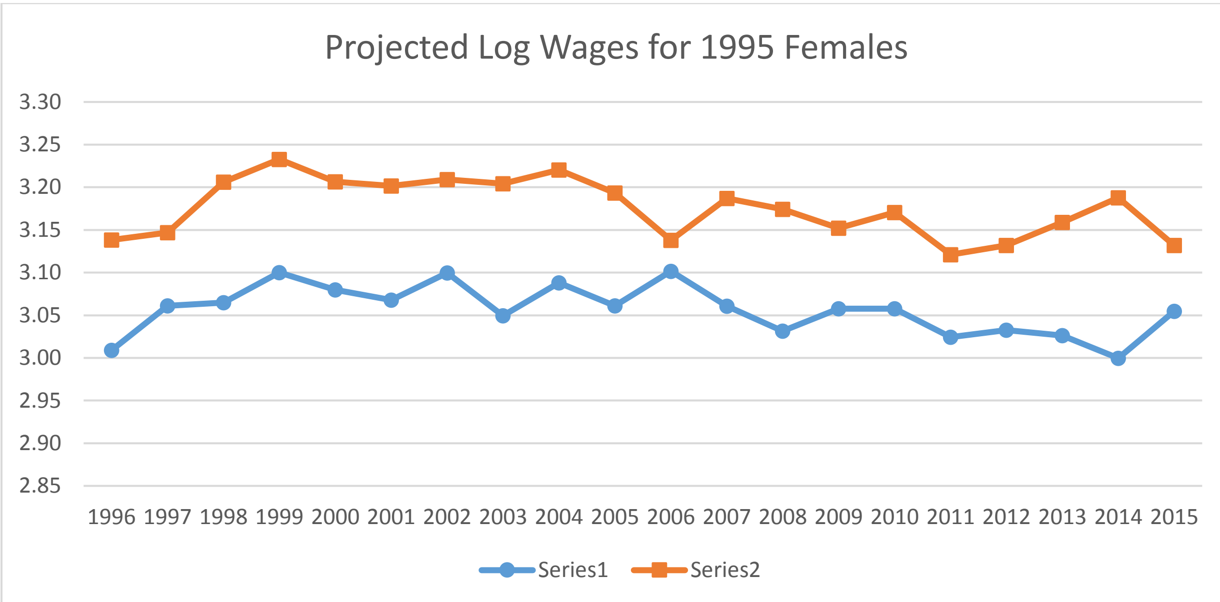
Source: CPS estimations and projections by the authors using all IS occupations, including the percent female for each detailed occupation and limiting the sample from 2000 to 2015.

Figure 5: Differences in Log Wages by Gender for Unchanged Occupation Titles



Source: CPS estimations and computations by the authors using the IS occupations that retain the same title over the time series "Computer Scientists and Analysts," "Computer Programmers" and "Computer Operators (nonprofessional)."

Figure 6: Estimated Earnings for 1995 Females for 1996 - 2015



Source: CPS estimations and projections using all IS occupations. Series 1 are the projections using the female equations and Series 2 are the projections using the male equations.

Figure 7: Share of Professional Workers under 45 Without Children Under 18

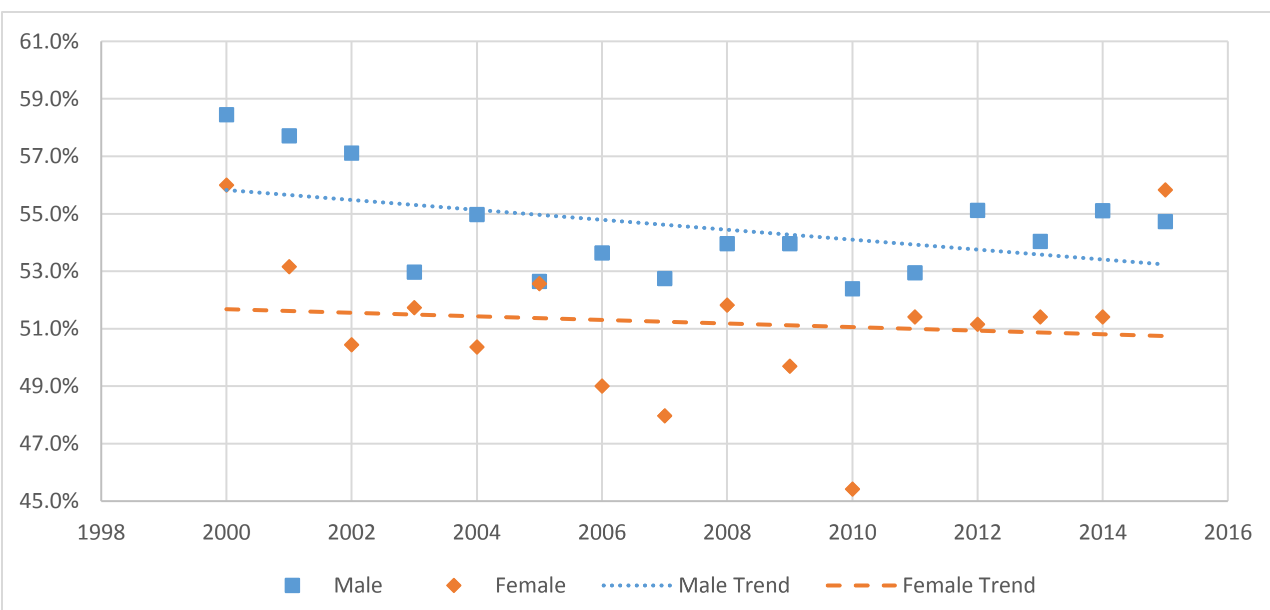


Table 1: Detailed Occupations in IS as of 2010

Occupation Code	Occupation Title
	Professional
0110	Computer and Information Systems Managers
1005	Computer and Information Research Scientists
1006	Computer Systems Analysts
1007	Computer Occupations, All Other
1010	Computer Programmers
1020	Software Developers
1050	Computer Support Specialists
1060	Database Administrators
1105	Network and Computer Systems Administrators
1007	Information Security Analysts
1030	Web Developers
1106	Computer Network Architects
	Non-Professional
5800	Computer Operators
5810	Data Entry Keyers

Table 2: Descriptive Statistics by Gender

	PROFESSIONAL							NONPROFESSIONAL						
	MALES													
	Log Wage	Age	Some College	BA	Grad	Married		Log Wage	Age	Some College	BA	Grad	Married	
1995	3.42	36.30	27.9%	48.0%	18.3%	68.6%		2.96	37.66	42.8%	21.1%	4.1%	61.3%	
2000	3.50	36.78	28.5%	46.0%	16.6%	65.0%		2.96	35.84	49.3%	18.7%	3.0%	39.6%	
2005	3.54	38.63	26.2%	48.6%	18.3%	69.0%		2.90	36.24	43.3%	23.1%	2.9%	42.3%	
2010	3.58	39.57	23.7%	50.0%	19.5%	67.3%		3.00	40.88	42.1%	31.6%	3.5%	47.4%	
2015	3.58	40.69	22.7%	49.8%	22.0%	68.1%		2.79	35.59	45.5%	31.8%	0.0%	31.8%	
	FEMALES													
1995	3.32	36.19	23.8%	52.4%	15.6%	58.4%		2.73	37.66	42.5%	10.7%	0.4%	58.3%	
2000	3.41	37.59	26.2%	50.6%	13.7%	51.6%		2.68	37.65	38.6%	8.3%	0.6%	49.4%	
2005	3.44	39.17	26.0%	46.8%	17.9%	60.1%		2.74	40.60	43.0%	12.6%	1.4%	48.8%	
2010	3.47	42.18	23.6%	43.7%	23.9%	61.8%		2.77	42.62	42.4%	19.4%	0.0%	55.2%	
2015	3.44	43.09	21.5%	48.5%	23.1%	55.4%		2.80	42.53	45.9%	17.3%	3.1%	48.0%	

Source: Authors calculations from the CPS ORG files after data exclusions identified in the text.

TABLE 3: Log-Earnings equations for Males and Females in 1995 and 2015

VARIABLES	(1) Female, 1995	(2) Male, 1995	(3) Female, 2015	(4) Male, 2015
Black	-0.0847**	-0.0272	-0.104**	-0.0805**
	(0.0397)	(0.0439)	(0.0457)	(0.0353)
Public	-0.109**	-0.208***	-0.0392	-0.151***
	(0.0498)	(0.0433)	(0.0374)	(0.0283)
Part_Time	-0.151***	-0.307***	-0.350***	-0.317***
	(0.0393)	(0.0508)	(0.0442)	(0.0533)
Some_College	0.0496	-0.0364	0.0430	0.0349
	(0.0321)	(0.0340)	(0.0462)	(0.0396)
BA	0.252***	0.130***	0.284***	0.231***
	(0.0366)	(0.0346)	(0.0462)	(0.0382)
Grad	0.375***	0.186***	0.357***	0.377***
	(0.0499)	(0.0396)	(0.0521)	(0.0412)
age	0.0671***	0.0774***	0.0494***	0.0467***
	(0.00778)	(0.00738)	(0.00770)	(0.00517)
age_squared	-0.0721***	-0.0812***	-0.0457***	-0.0407***
	(0.00954)	(0.00909)	(0.00855)	(0.00577)
Professional	0.415***	0.366***	0.415***	0.473***
	(0.0284)	(0.0274)	(0.0367)	(0.0521)
Union	0.0205	0.0440	-0.0131	-0.0572
	(0.0500)	(0.0459)	(0.0702)	(0.0464)
Currently_Married	0.0612**	0.0759***	0.0237	0.135***
	(0.0297)	(0.0250)	(0.0355)	(0.0224)
Past_Married	0.0530	0.0480	-0.0390	0.0768*
	(0.0397)	(0.0414)	(0.0445)	(0.0401)
Metro	0.0623***	0.0273	0.0875*	0.170***
	(0.0238)	(0.0195)	(0.0485)	(0.0343)
Constant	1.351***	1.349***	1.452***	1.481***
	(0.163)	(0.153)	(0.171)	(0.123)
Observations	989	1,543	991	2,384
R-squared	0.538	0.431	0.447	0.358

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Controls for region (New England, Mid Atlantic, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific) and industry (Agriculture, Construction, Manufacturing, Transport, Wholesale, and Services) are also included in the regressions.

Online Appendix

TABLE OA1: Proportion Female in Specific Occupations

Year	Professional									Non-Professional	
	1	2	3	4	5	6	7	8		1	2
2000	0.35	0.35	0.28	0.25	0.36	0.42	0.27	0.27		0.58	0.81
2001	0.28	0.33	0.28	0.21	0.34	0.49	0.22	0.22		0.6	0.84
2002	0.32	0.35	0.27	0.25	0.38	0.43	0.23	0.23		0.55	0.85
2003	0.29	0.31	0.29	0.24	0.37	0.44	0.29	0.29		0.55	0.82
2004	0.27	0.35	0.31	0.26	0.34	0.42	0.19	0.19		0.62	0.83
2005	0.3	0.36	0.26	0.24	0.31	0.39	0.2	0.2		0.57	0.83
2006	0.3	0.35	0.24	0.26	0.3	0.34	0.2	0.2		0.54	0.82
2007	0.3	0.31	0.28	0.22	0.3	0.43	0.17	0.17		0.55	0.82
2008	0.3	0.3	0.21	0.23	0.34	0.3	0.2	0.2		0.54	0.79
2009	0.29	0.3	0.2	0.22	0.29	0.36	0.22	0.22		0.46	0.81
2010	0.32	0.32	0.23	0.22	0.27	0.41	0.16	0.16		0.51	0.84
2011	0.27	0.3	0.23	0.22	0.3	0.34	0.24	0.25		0.53	0.85
2012	0.27	0.32	0.26	0.22	0.28	0.46	0.25	0.24		0.58	0.79
2013	0.32	0.32	0.26	0.2	0.31	0.33	0.21	0.23		0.56	0.83
2014	0.3	0.31	0.2	0.23	0.26	0.32	0.2	0.26		0.5	0.76
2015	0.31	0.32	0.21	0.19	0.26	0.38	0.17	0.25		0.56	0.77

Key:

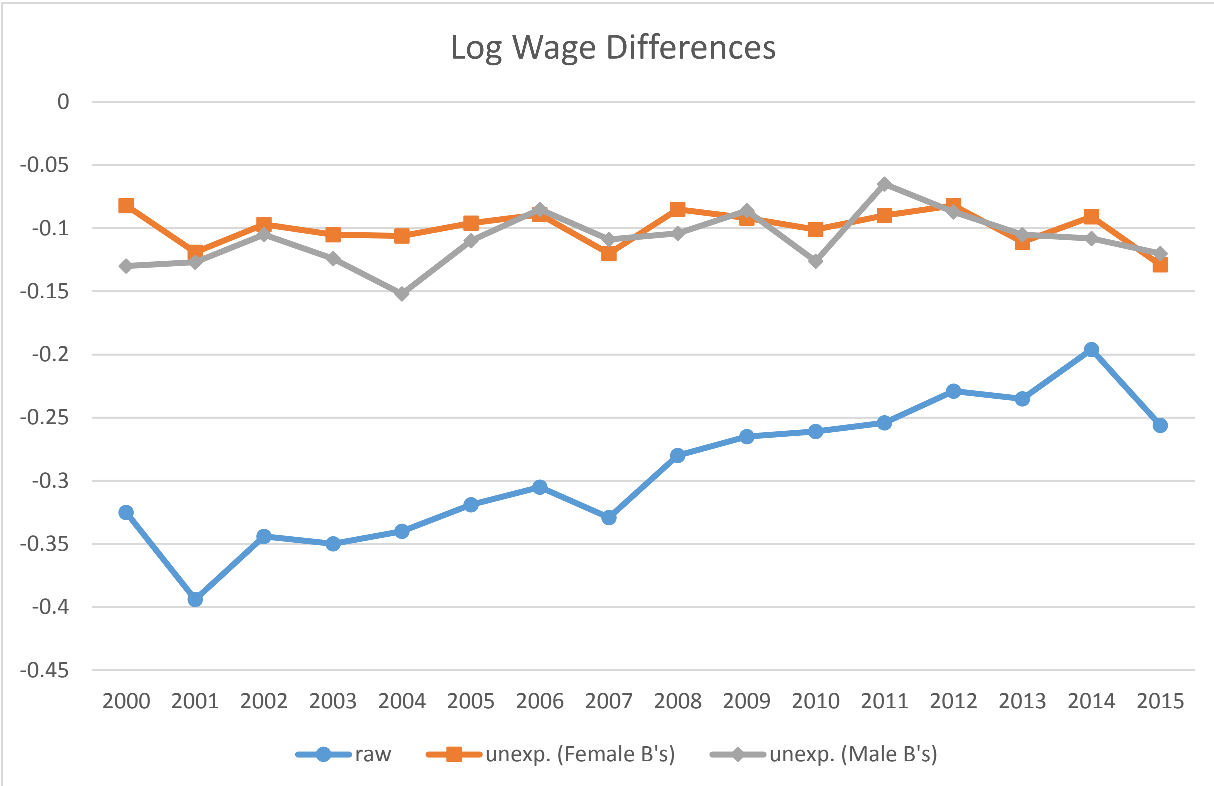
Professional

1 Computer and Information Systems Managers
2 Computer Scientists and Systems Analysts
3 Computer Programmers
4 Computer Software Engineers
5 Computer Support Specialists
6 Database Administrators
7 Network and Computer Systems Administrators
8 Network Systems and Data Communications Analysts

Nonprofessional

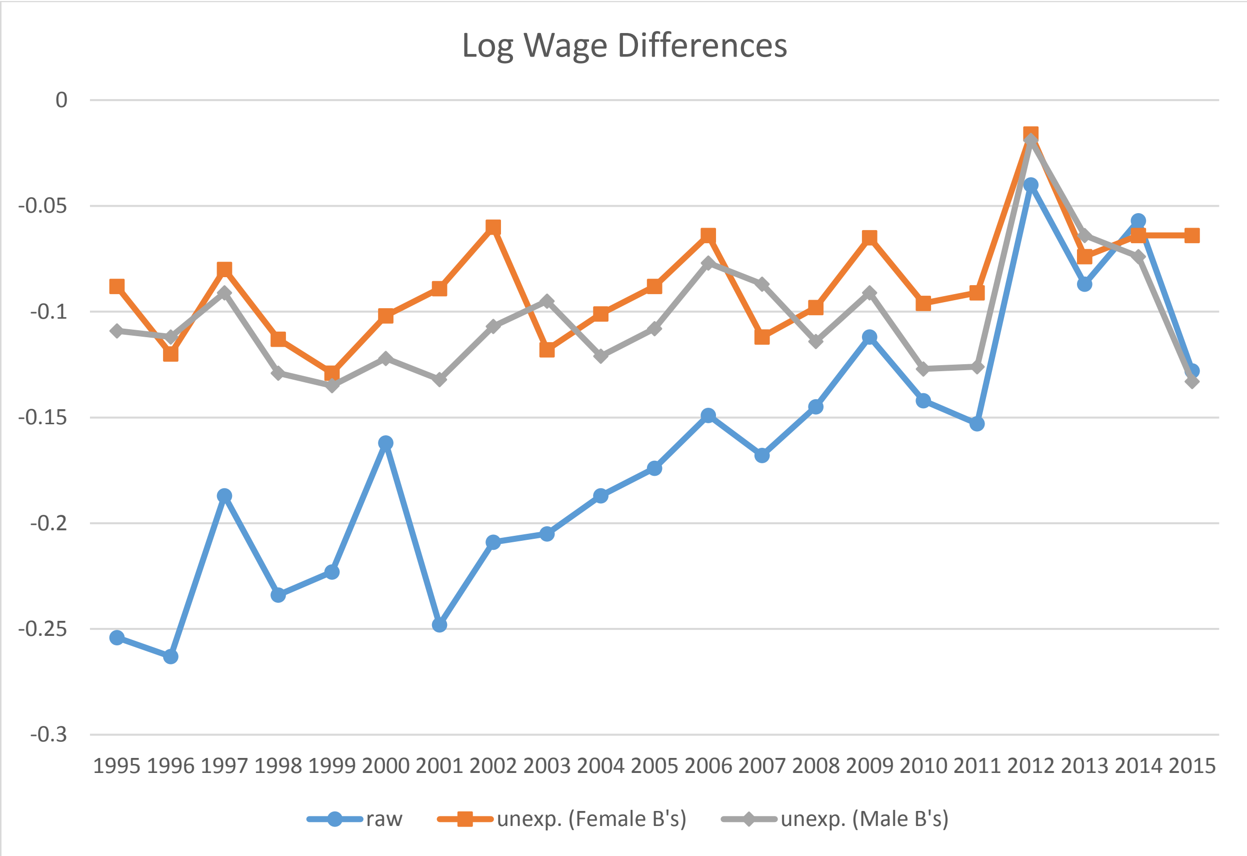
1 Computer Operators
2 Data Entry Keyers

Figure OA1: The Wage Differential from 2000 to 2015



Source: CPS estimations and projections by the authors using all IS occupations, including a dummy variable for each detailed occupation and limiting the sample from 2000 to 2015.

Figure OA2: Differences in Log Wages for Unchanged Occupation Titles



Source: CPS estimations and computations by the authors using the IS occupations that retain the same title over the time series "Computer Scientists and Analysts," "Computer Programmers" and "Computer Operators (nonprofessional)," including dummy variables for each of the three occupations.

References

Bender, Keith A. and John S. Heywood. 2009. "Educational Mismatch among Ph.D.s: Determinants and Consequences," 229– 55 in *Science and Engineering Careers in the Unites States: An Analysis of Markets and Employment*, eds.. R. B. Freeman and D. L. Goroff, University of Chicago Press.

Blau, Francine D. and Lawrence M. Kahn. (2016). "The Gender Wage Gap: Extent, Trends, and Explanations," *NBER Working Paper No. 21913*, Issued in January 2016

Blau, Francine D. and Lawrence M. Kahn. (2013). "The Feasibility and Importance of Adding Measures of Actual Experience to Data Collection," *Journal of Labor Economics*, 31(2): S17 - S58.

Broyles, Philip. (2009). "The Gender Pay Gap of STEM Professionals in the United States," *International Journal of Sociology and Social Policy* 29(5/6): 214 – 26.

Corbett, Christianne and Catherine Hill. (2012) *Graduating to a Pay Gap: The Earnings of Women and Men One Year after College Graduation*, American Association of University Women, http://www.aauw.org/files/2013/02/graduating-to-a-pay-gap-the-earnings-of-women-and-men-one-year-after-college-graduation.pdf

Council of Economic Advisers, (2015). *Gender Pay Gap: Recent Trends and Explanations, Issue Brief*, April, Executive Office of the President, Washington D.C.

Csorny, Lauren. (2013). "Beyond the Numbers: Careers in the Growing Field of Information Technology Services," *Employment and Unemployment* April: 2(9), Bureau of Labor Statistics, http://www.bls.gov/ooh/computer-and-information-technology/home.htm

Fortin, Nicole, Thomas Lemieux and Sergio Firpo. (2011). "Decomposition Methods in Economics," pp. 1 - 102 in *Labor Economics: Handbooks in Economics*, Vol. 4A, eds. Orley Ashenfelter and David Card, Amsterdam: North Holland.

Fouad, Nadvay A. and Romila Singh (2011). "Stemming the Tide: Why Women Leave Engineering," NSF, http://energy.gov/sites/prod/files/NSF_Stemming%20the%20Tide%20Why%20 Women%20Leave%20Engineering.pdf .

Heywood, John S. and Mary B. Hampton. 1993. "Do Workers Accurately Perceive Gender Wage Discrimination?" *Industrial and Labor Relations Review*, 47(1): 36 - 49.

Hayes, Caroline. (2010) "Computer Science: The Incredible Shrinking Woman," pp. 25 – 50 in *Gender Codes: Why Women are Leaving Computing*, ed. T.J. Misa, Hoboken, NJ: Wiley and Sons, Inc.

Heywood, John S. and George Nezlek. (1993). "The Gender Wage Gap among Software Workers: Trends over the Last Two Decades," *Social Science Quarterly* 74(3): 603 – 13.

Hewlett, Sylvia Ann, Carolyn Buck Luce, Lisa J. Servon, Laura Sherbin, Peggy Shiller, Eytan Sosnovich and Karen Sumberg. (2008). *The Athena Factor: Reversing the Brain Drain in Science, Engineering and Technology*. Cambridge, MA: Harvard Business Publishing.

Hirsch, Barry T. and Julia Manzella. (2015). "Who Cares and Does it Matter? Measuring Wage Penalties for Caring Work," in *Gender Convergence in the Labor Market (Research in Labor Economics Vol. 41)*, pp. 213 – 76, eds. S. W. Polachek, K. Tatsiramos and K. F. Zimmermann, Bingley UK: Emerald House Publishing.

Hunt, Jennifer. (2016) "Why do Women Leave Science and Engineering?" *Industrial and Labor Relations Review* 69(1): 199 - 2016.

Jacobsen, Joyce, Melanie Khamis and Mutlu Yuksel. "Convergences in Men and Women's Work Life Patterns: Lifetime Work, Lifetime Earnings and Human Capital Investment," in *Gender Convergence in the Labor Market (Research in Labor Economics Vol. 41)*, pp. 1 – 34, eds. S. W. Polachek, K. Tatsiramos and K. F. Zimmermann, Bingley UK: Emerald House Publishing.

Jagsi, Reshma, Kent A. Griffith, Abigail Stewart, Dana Sambuco, Rochelle DeCastro, Peter A. Ubel. (2012). "Gender Differences in the Salaries of Physician Researchers," *Journal of the American Medical Association* 307(22): 2410 – 17.

Johnson, George and Gary Solon. (1985). Estimates of the Direct Effects of Comparable Worth Policy," *American Economic Review* 76: 1117 – 1265.

Lal, Bhavya, Sam Yoon and Ken Carlson. (1999). "Low Large is the Gap in Salaries of Male and Female Engineers," *Issue Brief NSF 99 -352*, Division of Science Resources Studies, National Science Foundation, Washington DC.

Morgan, Laurie A. (1998). "Glass-Ceiling Effect or Cohort Effect? A Longitudinal Study of the Gender Earnings Gap for Engineers, 1982 to 1989," *American Sociological Review* 63(4): 479 – 93.

National Center for Educational Statistics, "Degrees in computer and information sciences conferred by degree-granting institutions, by level of degree and sex of student: 1970-71 through 2010-11," 2012, https://nces.ed.gov/programs/digest/d12/tables/dt12_349.asp

Nezlek, George and Gerald DeHondt. 2012. "Gender Wage Differentials in Information Systems, 1991 – 2008: A Quantitative Analysis," pp. 31 – 47 in *Integrations of Technology Utilization and Social Dynamics in Organizations*, ed. Dawn Medlin, Hershey PA: Information Science Reference.

Occupational Outlook Handbook, Computer and Information Technology Occupations, Bureau of Labor Statistics, 2015, http://www.bls.gov/ooh/computer-and-information-technology/home.htm

O'Neill, June and Solomon Polachek. (1993). Why the Gender Gap in Wages Fell in the 1980s," *Journal of Labor Economics* 11(1): 205 – 28.

Preston, Anne E. (2004). *Leaving Science: Occupational Exit from Scientific Careers*. New York: Russel Sage Foundation.

Sonnert, Gerhard, Mary Frank Fox and Kristen Adkins. (2006). "Undergraduate Women in Science and Engineering: Effects of Faculty, Fields and Institutions Over Time," *Social Science Quarterly* 88: 1333 – 56.

Stephan, Paula E. and Sharon G. Levin. (2005). "Leaving Careers in IT: Gender Differences in Retention," *Journal of Technology Transfer* 30: 383 – 96.

West, Martha S. and John W. Curtis, 2006, "AAUP Faculty Gender Equity Indicators 2006," American Society of University Professors, Washington, D.C

Xie, Yu and Kimberlee A. Shauman (2003). *Women in Science: Career Processes and Outcomes*. Cambridge MA: Harvard University Press.

Endnotes

[1] The decline in female computer science degrees does not reflect a decline in female professors. While such role models can be crucial in STEM (Sonnert et al. 2007), the share of female professors in computer science grew from 1995 to 2005 even as the female share of students declined (West and Curtis 2006).

[2] Substantial differentials exist among chemists (Broyles 2009), pharmacists (Carvajal et al. 2012) and medical researchers (Jagsi 2012). Yet, when holding constant very detailed measures of experience and specialty (among other factors), Lal et al. (1999) found a statistically significant but small gender gap in engineering in the US – only 2 or 3 percentage points.

[3] Among all scientists and engineers with doctoral degrees, men with degrees in computer science have broadly similar job satisfaction. Yet, women with a degree in computer science report *greater* job satisfaction than women holding degrees in other fields of science and engineering after standardizing for other typical determinants (see Bender and Heywood 2006).

[4] These figures are computed by taking the absolute difference in the percent of each gender with graduate degrees and dividing it by the gender that has the lower percent of graduate degrees.

[5] We have also limited our estimations to only full-time, private sector workers without substantial differences in the flavor or implications of the results.

[6] In 1995 the male share of IS workers foreign born was 12.7% and the female share was 9.8%. This grew proportionately such that by 2015 the male share was 20.3% and the female share was 16.3%. Thus, the growth in foreign-born workers does not generate the relative decline in women. Moreover, when added to the estimation, foreign born is rarely a significant determinant of earnings.

[7] We compare the 2000 on estimates with a full set of occupational dummies to that with a simple professional dummy. They prove virtually identical and are both presented in the on-line appendix.

[8] This pattern remains whether one simply controls for professional or controls for each occupation. See the on-line appendix.

[9] These are available from the authors upon request.