

ECON 695 Final Project  
University of Wisconsin–Madison

# Gender Wage Gaps and Coworker Wages

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[Latest version and replication files](#)

**Acknowledgements.** We thank Professor Alice Wu for guidance and comments. All errors are our own.

## **AI Disclaimer**

AI tools (specifically ChatGPT) were used solely to assist with minor troubleshooting and formatting tasks, including resolving L<sup>A</sup>T<sub>E</sub>X and Python issues, and drafting descriptive tables for improved readability. All analysis, model specifications, interpretations, and the final written narrative are our own.

# Contents

AI Disclaimer . . . . .	2
Introduction . . . . .	4
Data . . . . .	4
Sample Size and Structure . . . . .	4
Variables . . . . .	5
Section 1: Overview: Female vs. Male Workers . . . . .	5
Summary Statistics . . . . .	5
Wage Distributions . . . . .	6
Section 2: Gender Wage Gaps . . . . .	7
2.1 Standard Models and Oaxaca Decomposition . . . . .	7
2.2 Gender Difference in Experience Profiles . . . . .	9
Section 3: Gender Wage Gaps Conditional on Coworker Wages . . . . .	12
Section 4: Event Study - Wage Changes around Moves . . . . .	17
Section 5 (Bonus): Shrinkage . . . . .	17
Appendix . . . . .	17
<b>References</b>	<b>18</b>

# Introduction

## Data

We use administrative data provided to us by Professor Alice Wu for the ECON 695 final project that follow men and women who are observed for several consecutive years across exactly two jobs. The dataset (projectdata.csv) contains one record per individual, with each record summarizing the worker’s demographic characteristics, education, potential labor market experience, and a sequence of annual wage observations surrounding a job transition. In total, the dataset includes 16,969 individuals—10,575 men and 6,394 women—who satisfy the sampling requirement of having at least three years of observations in their first job and three years in their second job. The timing convention indexes the first year on the second job as period 0, with years  $-3$ ,  $-2$ , and  $-1$  representing the three years prior to the move, and years 1 and 2 representing subsequent years on the second job.

A distinctive feature of the dataset is the inclusion of coworker wage measures: for each job spell, we observe a summary measure of the mean log wage of all other workers employed at the same firm. These coworker wage variables are recorded separately for the first job, where *owage1* is defined as the average coworker wage across periods  $-1$  and  $-2$ , and for the second job, where *owage2* is defined as the average coworker wage across periods 0, 1, and 2. This structure enables us to investigate how the wage distribution among a worker’s peers may influence their own wage outcomes. This richness makes the dataset particularly suitable for studying gender differences in wage determination and the role of workplace environments.

## Sample Size and Structure

The dataset contains a total of 16,969 individuals, of whom 10,575 are men and 6,394 are women. Thus, approximately 38% of the sample consists of women. The sample is further restricted to workers who move between jobs where there are at least four coworkers at each job, so that coworker wage measures are well defined. Each individual record includes demographic characteristics, education, experience, and a sequence of wage observations around a job transition.

The timing convention follows the project instructions: period 0 is the first year on the second job, periods 1 and 2 are the subsequent years, and periods  $-1$  through  $-3$  correspond to the final three years on the first job. For each job spell, the dataset also includes a measure of the mean log wage of coworkers, which is central to our later analysis of coworker wage effects.

## Variables

The dataset includes key demographic and human capital measures—age, years of education (taking values 6, 9, 12, or 16), gender (a binary indicator `female`), and potential experience constructed from age and schooling. Wage information is recorded as log hourly wages across multiple periods relative to a job transition:  $y$  denotes the wage in period 0 (the first year on the second job),  $yp1$  and  $yp2$  correspond to years 1 and 2 on the second job, and  $yl1$ ,  $yl2$ , and  $yl3$  capture wages in the final three years on the first job (periods  $-1$  through  $-3$ ). These coworker wage variables are summarized as  $owage1$  (averaged over periods  $-1$  and  $-2$  for the first job) and  $owage2$  (averaged over periods 0, 1, and 2 for the second job). Together, these variables allow us to link individual wage dynamics with characteristics of the worker’s surrounding wage environment.

## Section 1: Overview: Female vs. Male Workers

Female and male workers in our sample differ systematically in both pay and observed characteristics. Table 1 reports mean values for age, education, wages, and coworker wages for all workers and separately by gender, along with  $t$ -statistics comparing men and women at period 0 (the first year on the second job). Figure 1 then visualizes the distribution of log hourly wages by gender.

## Summary Statistics

Table 1: Summary Statistics by Gender

	All	Female	Male	$t$ -stat
Age (mean)	33.5589	33.5344	33.5737	-0.4358
Log wage $y$ (mean)	1.7879	1.6580	1.8664	-20.8163
Coworker wage $owage2$ (mean)	1.6921	1.6378	1.7249	-11.6761
Educ = 6 yrs (fraction)	0.2741	0.2487	0.2895	-5.8460
Educ = 9 yrs (fraction)	0.2274	0.1949	0.2471	-8.0450
Educ = 12 yrs (fraction)	0.2958	0.3286	0.2759	7.2054
Educ = 16 yrs (fraction)	0.2027	0.2279	0.1875	6.2317

*Notes:* Each column reports sample means for the listed variables across all workers, and separately by gender. Education is coded as categorical dummies for 6, 9, 12, and 16 years of schooling. The final column reports  $t$ -statistics from independent two-sample tests comparing male and female means. All values are measured at period 0 (first year on the second job).

Women comprise approximately 38% of the sample. As shown in Table 1, average age is nearly identical across genders, but women tend to have slightly higher educational attainment: they are more likely to have completed 12 or 16 years of schooling, whereas men are more concentrated in the 6- and 9-year categories. These differences in educational composition are large and statistically significant, with  $t$ -statistics in the range of about 6 to 8 in absolute value.

Despite women's modest advantage in formal schooling, men earn substantially higher wages at period 0. The mean log hourly wage is 1.866 for men compared to 1.658 for women, corresponding to a large and statistically significant gender gap (the  $t$ -statistic is about  $-20.8$ ). Coworker wages show a similar pattern: men are more likely to work alongside higher-paid coworkers (mean  $\text{owage}_2$  of 1.725 for men versus 1.638 for women), suggesting systematic gender differences in the types of jobs or firms where workers are employed.

## Wage Distributions

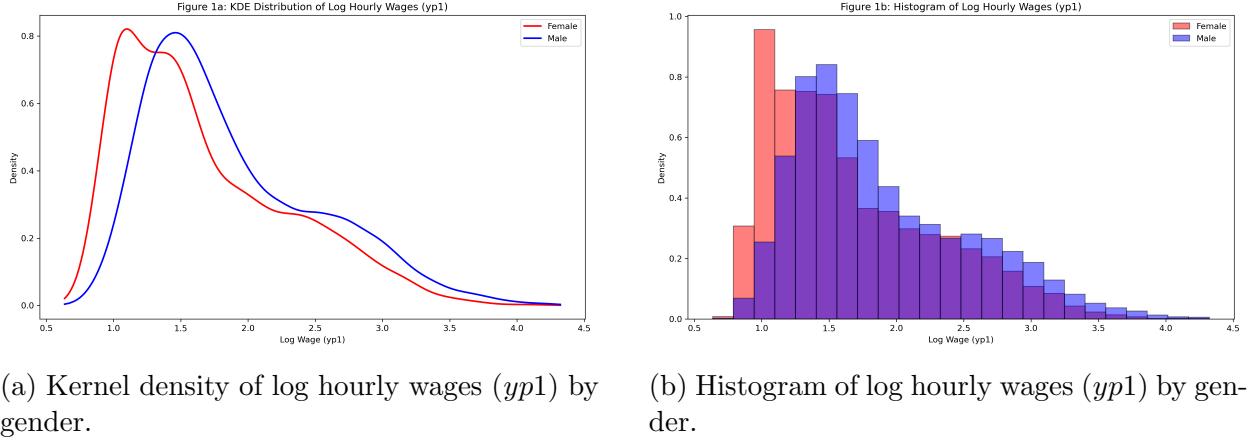


Figure 1: Distribution of log hourly wages in period 1 on the second job ( $yp1$ ) for women and men. Panels (a) and (b) show kernel densities and histograms, respectively.

Figure 1 provides additional detail on the distribution of wages by gender. In panel (a), the kernel density curves indicate that the female wage distribution lies to the left of the male distribution, with women clustering more heavily around log wages of roughly 1.0–1.4. Panel (b) shows a similar pattern in the histograms: women are more prevalent at lower wage levels, while men are overrepresented in the upper tail, particularly above a log wage of 2.0. The male distribution also exhibits greater spread, consistent with higher dispersion in men's wage outcomes.

Taken together, Table 1 and Figure 1 document a sizable raw gender wage gap and meaningful differences in educational attainment and coworker wage exposure, even before

controlling for other observable characteristics. These descriptive patterns motivate the regression analysis and Oaxaca decompositions in [Section 2: Gender Wage Gaps](#).

## Section 2: Gender Wage Gaps

From our descriptive analysis, it is self evident that there exists substantial raw differences in wages, education, and coworker wage environments between men and women. These gaps raise a natural question: to what extent do observable characteristics—such as education and potential experience—account for the wage differences we see, and how much remains unexplained by these factors? Here we begin to attempt to formally investigate these questions by estimating standard wage models and applying the Oaxaca decomposition to separate the portion of the gender wage gap attributable to differences in characteristics from the portion attributable to differences in returns to those characteristics.

### 2.1 Standard Models and Oaxaca Decomposition

Table 2: Wage Models and Oaxaca Decomposition of the Gender Wage Gap

	(1) Female Dummy	(2) Full Model	(3) Men	(4) Women
Intercept	1.866 (0.006)	0.557 (0.056)	0.491 (0.078)	0.327 (0.080)
Female	-0.208 (0.010)	-0.271 (0.007)		
C(educ)[T.9]		0.275 (0.009)	0.259 (0.012)	0.314 (0.015)
C(educ)[T.12]		0.680 (0.009)	0.692 (0.012)	0.667 (0.014)
C(educ)[T.16]		1.515 (0.011)	1.508 (0.014)	1.525 (0.016)
exp		0.067 (0.011)	0.072 (0.015)	0.069 (0.015)
exp2		-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
exp3		-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
R-squared	0.024	0.588	0.556	0.618
Adj. R <sup>2</sup>	0.024	0.588	0.556	0.618
N	16,969	16,969	10,575	6,394

*Notes:* Columns (1)–(2) report pooled OLS models; Columns (3)–(4) estimate the same specification separately by gender. Standard errors in parentheses. Oaxaca decomposition uses gender-specific models.

Across the pooled models, the coefficient on the female indicator is negative and statistically significant, indicating that women earn lower wages on average even before conditioning on observable characteristics. In the baseline model that includes only a constant and the female dummy, the coefficient of approximately  $-0.208$  suggests that women earn roughly 20% lower wages than men at period 0. After adding categorical controls for education and a cubic polynomial in experience, the wage gap widens to about 27%, reflecting that women in our sample tend to have slightly higher educational attainment and similar experience levels. Thus, once controlling for these favorable characteristics, the remaining wage gap attributable to gender becomes larger.

The separate regressions by gender show broadly similar returns to education and experience for men and women. Returns to schooling rise with each additional educational category, while experience exhibits diminishing marginal returns. The largest difference lies in the intercepts: men have a higher baseline log wage than women, implying that even at comparable education and zero experience, men start from a higher predicted wage level.

Yet this baseline gap is muddied between differences in the composition of the characteristics of each group (e.g., average education levels) and differences in the returns to those characteristics (e.g., how much additional education translates to wage increases). In other words, while these regressions quantify the wage gap and its relationship to observable traits, part of the wage gap may be due to differences in the average education and experience levels (composition effects), while another being due to differences each group being paid differently for the same education or experience, or actual gender discrimination, which is the object of our study.

To separate the portion of the wage gap arising from differences in average characteristics from the portion arising from differences in how those characteristics are rewarded in the labor market, we apply the Oaxaca decomposition of [Oaxaca \(1973\)](#) using the gender-specific regressions in Columns (3) and (4). Let  $y_{gi}$  denote log hourly wages for individual  $i$  in group  $g \in \{m, f\}$  and let  $X_{gi}$  be the vector of observable characteristics (education dummies and a cubic polynomial in potential experience).<sup>1</sup> We model wages as

$$y_{gi} = \alpha_g + X'_{gi}\beta_g + \varepsilon_{gi}, \quad g \in \{m, f\}. \quad (1)$$

Taking sample means yields

$$\bar{y}_g = \hat{\alpha}_g + \bar{X}'_g \hat{\beta}_g.$$

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<sup>1</sup>The intercept is excluded from  $X_{gi}$  and treated separately.

The raw gender wage gap is defined as

$$\Delta \equiv \bar{y}_m - \bar{y}_f.$$

Using women as the reference group, the Oaxaca decomposition expresses  $\Delta$  as

$$\Delta = (\bar{X}_m - \bar{X}_f)' \hat{\beta}_f + \bar{X}'_m (\hat{\beta}_m - \hat{\beta}_f). \quad (2)$$

The first term,

$$(\bar{X}_m - \bar{X}_f)' \hat{\beta}_f,$$

is the *explained* or *between-group* component: it reflects how differences in average education and experience across men and women would translate into a wage gap if both groups received the same returns estimated for women.

The second term,

$$\bar{X}'_m (\hat{\beta}_m - \hat{\beta}_f),$$

is the *unexplained* or *within-group* component: it captures differences in the returns to these characteristics, evaluated at men's mean characteristics.

Applying equation (2) to our estimates, we obtain an explained component of approximately  $-0.0623$ , indicating that women's observable characteristics would predict *higher* wages than men if both groups were rewarded according to the female returns. The unexplained component is about  $0.1071$ , showing that men receive higher returns to education and experience than women. This unexplained component dominates, yielding a total wage gap of roughly  $0.0448$  log points, or about  $4.5\%$ , in favor of men.

## 2.2 Gender Difference in Experience Profiles

Of course, the existence of a wage gap we identified in [2.1 Standard Models and Oaxaca Decomposition](#) is not monotone—behaviors, attitudes, lawsuits, macro-trends, and many other of the world's moving parts can influence changes in any such gap we have identified and maybe too effects people differently. As such, it become necessary to ask how it evolves over the life cycle. Here, we explore gender differences in the relationship between log wages and potential experience, focusing first on workers with 12 years of education and then extending the comparison across the full education distribution.

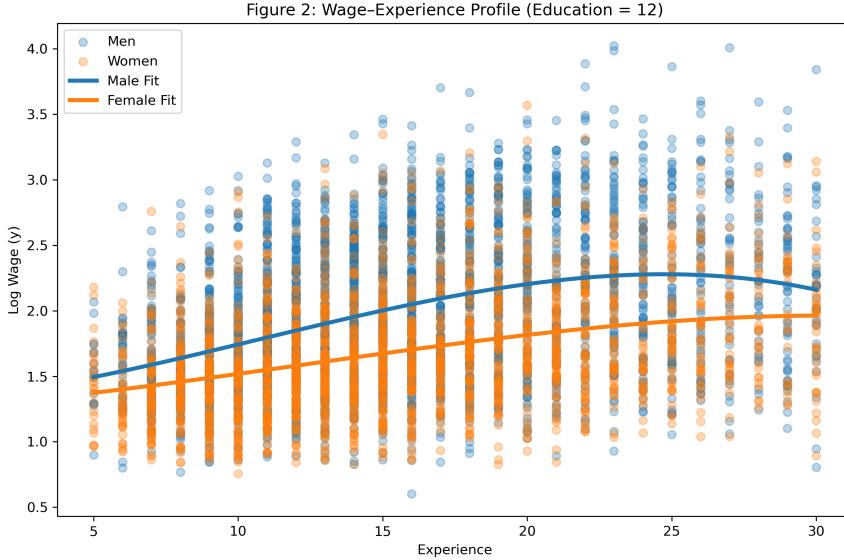


Figure 2: Experience–wage profiles by gender for workers with 12 years of education. Notes: Figure plots log hourly wages against potential experience (5–30 years) and overlays the fitted values from a cubic polynomial in experience, estimated separately for men and women.

Figure 2 shows that among workers with 12 years of education, men’s predicted wages start above women’s even at low experience levels, and the gap widens as experience accumulates. The male profile rises more steeply early in the career and peaks at a higher level of log wages, while the female profile is flatter and turns over earlier. For both genders, returns to experience are largest in the early years and then level off, consistent with the diminishing marginal effects of experience estimated in Table 2. Taken together, these patterns are consistent with the Oaxaca result that differences in returns, rather than differences in observed characteristics, play an important role in sustaining the wage gap.

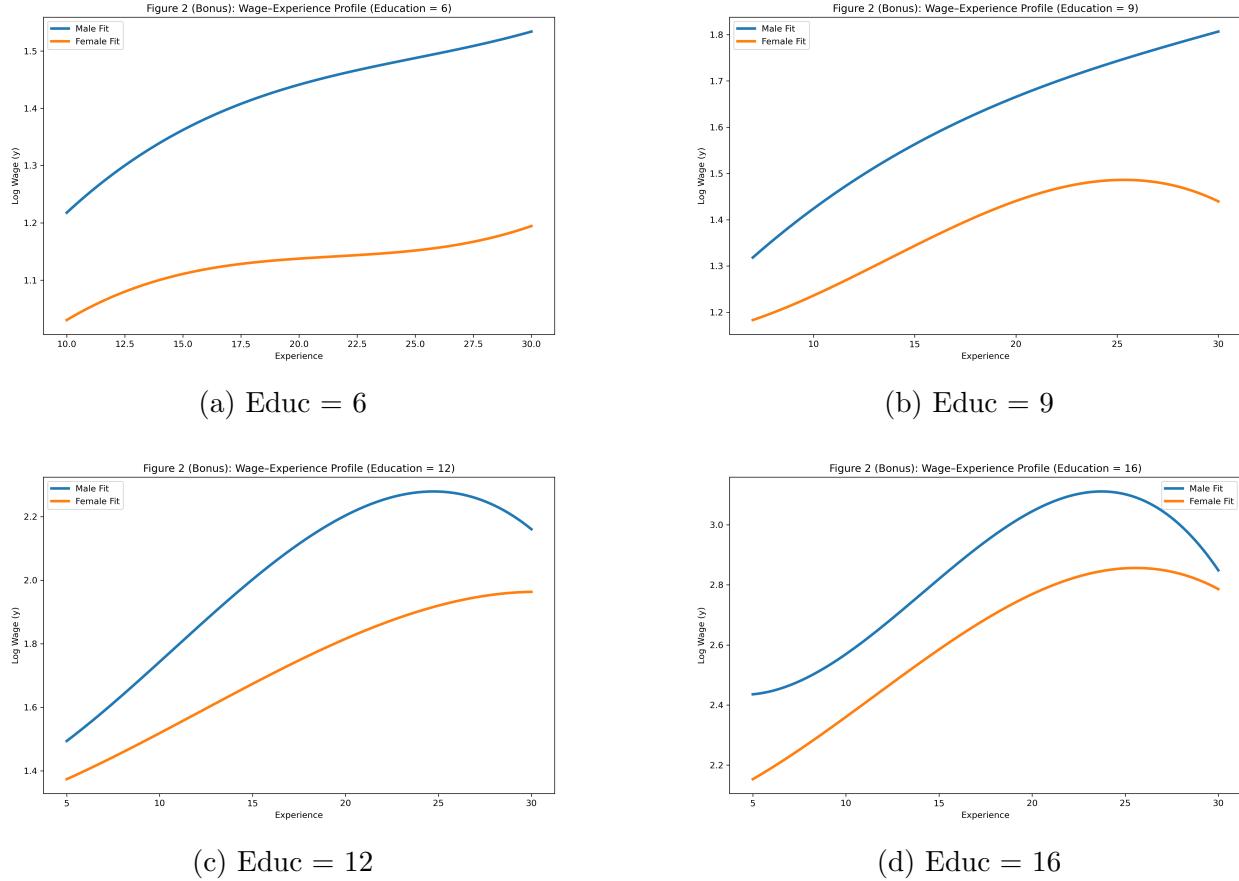


Figure 3: Experience-wage profiles by gender and education level. Notes: Each panel plots log hourly wages against potential experience for the indicated education category and overlays gender-specific cubic fits in experience.

The bonus panels in Figure 3 show that this pattern is remarkably stable across education groups. At 6, 9, 12, and 16 years of education, men's predicted wages exceed women's at nearly every experience level, and male profiles tend to be steeper in the early career years and peak at higher wage levels. Higher education shifts both curves up, but the gender gap persists and often grows with experience within each education category. These figures complement Table 2 and the Oaxaca decomposition by illustrating, in a more visual way, that women do not only start from a lower baseline but also appear to receive weaker returns to experience over the life cycle, even when we hold education fixed.

## Section 3: Gender Wage Gaps Conditional on Coworker Wages

So far, we've seen that differences in education and experience explain only part of the gender wage gap. In particular, up until this point, we know that a substantial portion of the gender wage gap reflects differences in the *returns* to education and experience rather than differences in characteristics themselves. However, wages aren't determined in isolation — they're shaped by the environments people work in. In particular, does the wage level of the people you work with affect your own wage — and does this differ by gender?

Specifically, we ask whether working alongside higher-paid coworkers boosts individual wages, and whether this effect differs by gender. The idea is simple: if men tend to work in higher-paying environments, and if those environments raise wages, then part of the gender gap may reflect where people work, not just who they are.

To attempt to address this question, it becomes necessary to examine the average wage of a worker's coworker (`owage2`) by including it into our regression models to then be able to examine how it interacts with gender. This way, it becomes possible to test whether men and women benefit equally from high-wage peer groups — and whether differences in coworker exposure help explain the residual wage gap. In other words, we examine whether men and women sort into systematically different workplace environments and how much these differences contribute to the wage gap.

We extend our baseline wage models by incorporating coworker wages directly into the regression framework. By comparing pooled and gender-specific specifications, we evaluate both *how strongly coworker wages predict individual wages* and *whether the returns to working with higher-paid coworkers differ by gender*. These estimates then feed into a new decomposition that asks: to what extent do gender differences in coworker wage exposure explain the remaining wage gap after controlling for education and experience?

We begin by estimating a set of pooled and gender-specific regressions that progressively incorporate `owage2` and its interaction with gender as shown below in Table 3.

Table 3: Wage Models with Coworker Wages and Gender Interactions

	(1) Pooled: female + owage2	(2) Pooled: full + owage2	(3) Pooled: + female×owage2	(4) Men	(5) Women
Intercept	0.131 (0.013)	-0.199 (0.047)	-0.244 (0.047)	-0.297 (0.064)	-0.284 (0.066)
female	-0.121 (0.007)	-0.189 (0.005)	-0.071 (0.020)		
owage2	1.006 (0.007)	0.634 (0.007)	0.662 (0.008)	0.660 (0.009)	0.598 (0.010)
C(educ)[T.9]		0.153 (0.008)	0.154 (0.008)	0.150 (0.010)	0.165 (0.013)
C(educ)[T.12]		0.377 (0.008)	0.377 (0.008)	0.394 (0.011)	0.349 (0.013)
C(educ)[T.16]		1.011 (0.010)	1.013 (0.010)	1.030 (0.013)	0.978 (0.016)
exp		0.056 (0.009)	0.055 (0.009)	0.056 (0.012)	0.062 (0.013)
exp2		-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)
exp3		-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
female:owage2			-0.070 (0.011)		
R-squared	0.549	0.727	0.727	0.707	0.748
Adj. R <sup>2</sup>	0.548	0.727	0.727	0.707	0.748
N	16,969	16,969	16,969	10,575	6,394

*Notes:* Columns (1)–(3) report pooled OLS models of log wage  $y$  that include coworker wages (owage2). Column (1) includes only a female dummy and coworker wage. Column (2) adds categorical education and a cubic polynomial in experience. Column (3) further interacts coworker wages with the female dummy. Columns (4)–(5) estimate the same specification as Column (2) separately for men and women. Standard errors are in parentheses. Oaxaca decompositions based on these gender-specific models are reported and discussed in the text rather than in the table.

Table 3 shows that coworker wages are strongly correlated with individual wages. In all pooled specifications, the coefficient on `owage2` is large and precisely estimated, and the  $R^2$  rises sharply relative to the models in Table 2. The interaction specification in Column (3) suggests that women benefit somewhat less from high-wage coworkers than men do: the estimated coefficient on `female×owage2` is about  $-0.07$ , indicating a smaller marginal return to coworker wages for women. Columns (4) and (5) then estimate the full model separately by gender and confirm that both groups receive sizable returns to `owage2`, but the male coefficient is modestly larger.

While these patterns show that coworker wages matter, they do not, by themselves, tell us how much of the gender wage gap is explained by men and women sorting into different coworker environments versus differences in how those environments are rewarded. To parallel the analysis in 2.1 Standard Models and Oaxaca Decomposition, we therefore extend the Oaxaca decomposition to the richer specification that includes coworker wages.

For each group  $g \in \{m, f\}$ , let  $y_{gi}$  denote log hourly wages in period 0 and let  $X_{gi}$  collect the observable characteristics. Relative to the earlier decomposition,  $X_{gi}$  now includes

education dummies, a cubic polynomial in potential experience, *and* coworker wages `owage2` (the intercept is again treated separately). The group-specific wage equations estimated in Columns (4) and (5) of Table 3 can be written as

$$y_{gi} = \alpha_g + X'_{gi}\beta_g + \varepsilon_{gi}, \quad g \in \{m, f\},$$

with corresponding sample means

$$\bar{y}_g = \hat{\alpha}_g + \bar{X}'_g \hat{\beta}_g.$$

The raw gender wage gap is  $\Delta \equiv \bar{y}_m - \bar{y}_f$ , and, using women as the reference group, the Oaxaca decomposition becomes

$$\Delta = (\bar{X}_m - \bar{X}_f)' \hat{\beta}_f + \bar{X}'_m (\hat{\beta}_m - \hat{\beta}_f). \quad (3)$$

As before, the first term  $(\bar{X}_m - \bar{X}_f)' \hat{\beta}_f$  is the *explained* or *between-group* component, now capturing differences in average education, experience, and coworker wages evaluated at the female returns  $\hat{\beta}_f$ . The second term  $\bar{X}'_m (\hat{\beta}_m - \hat{\beta}_f)$  is the *unexplained* or *within-group* component, reflecting differences in how these characteristics—including coworker wages—are rewarded for men and women.

Applying equation (3) to the gender-specific estimates in Columns (4) and (5) of Table 3, we obtain an explained component of about 0.0168 log points and an unexplained component of about 0.2043 log points, yielding a total gap of  $\Delta \approx 0.2211$ . In other words, once we account for education, experience, and coworker wages, differences in observable characteristics—including the fact that men tend to work with somewhat higher-paid coworkers—explain only a small fraction of the gender wage gap, while the bulk of the gap is still attributed to differences in returns.

**Interpreting the Role of Coworker Wages** The introduction of coworker wages into the wage models opens a new window into how workplace environments shape wage inequality. What stands out immediately from Table 3 is the sheer magnitude of the `owage2` coefficient: workers who are surrounded by higher-paid peers earn markedly higher wages themselves. This relationship is not subtle—it is large, precisely estimated, and remarkably stable across pooled and gender-specific specifications. Yet the gender pattern layered on top is equally striking: in every relevant model, women receive *smaller* marginal returns to high-wage coworker environments than men. Even after conditioning on education and experience, the wage benefits associated with working alongside highly paid coworkers appear systematically

muted for women.

This naturally raises a deeper question: *why* does working with higher-paid coworkers raise wages, and why does this return differ by gender? The answer is not obvious, and in fact, the mechanism behind coworker spillovers is the source of genuine interpretive uncertainty. To discipline the narrative, it is helpful to think through the two economic hypotheses laid out in the assignment, each of which implies a different reading of what our decomposition captures.

**Model 1: Coworker wages reflect luck, networks, or access to better jobs.** Under this view, sorting into high-wage coworker environments is not mainly about productivity but about opportunity. Workers may reach these jobs through referrals, informal hiring networks, or sheer good fortune. If men have stronger networks, or search more aggressively, they may disproportionately end up in higher-wage peer groups. In this interpretation, the explained component of the decomposition—about 0.0168 log points, or roughly 8% of the total 0.2211 gap—captures an inequality in job *access*. Men are more likely to land in workplaces with higher-paid coworkers, and those environments boost wages, so men benefit twice: first from better job sorting, and second from stronger returns to those environments.

Model 1 treats the large unexplained component ( $\approx 92\%$ ) cautiously. If job access is partly random or network-driven, then the structural gap in returns to coworker wages—men receiving larger wage boosts from similar environments—may signal discriminatory pay-setting or organizational norms that reward men more for the same workplace exposure.

**Model 2: Coworker wages proxy for unobserved productivity or ambition.** A very different interpretation emerges if coworker wages simply reflect who ends up working with whom. High-ability workers may seek out (or be recruited into) high-skill, high-paying teams. In this case, `owage2` acts as a measurable proxy for something we cannot otherwise observe: cognitive skills, ambition, or complementary abilities. If men and women differ in these unobserved traits—or if women face barriers that suppress the labor market rewards to those traits—the decomposition shifts meaningfully.

Under Model 2, the explained portion of the gap still reflects differences in coworker wage exposure, but now this exposure is interpreted as an indirect measure of latent productivity. The fact that only 8% of the gap is explained would then suggest that men and women with similar observed characteristics differ substantially in unobserved characteristics, or that employers reward unobserved male traits disproportionately. Meanwhile, the unexplained component captures both these latent differences and potential structural forces (bias, norms, bargaining disparities) that influence how unobserved skills are monetized.

**How the decomposition informs these competing interpretations.** The decomposition result reinforces that coworker wage exposure is relevant but cannot, on its own, account for the bulk of the gender wage gap. Even after controlling for education, experience, and coworkers' wages, sorting differences explain only a small slice of wage inequality. Most of the gap arises from differences in returns, not from systematic differences in observed characteristics or environments.

The direction of the results also matters. The explained component is *positive*: men sort into higher-wage coworker groups than women, and this sorting pushes their wages upward relative to women. But because the explained share is small, the narrative is dominated by the unexplained component. This feature is consistent with both models, but its implications differ:

- Under Model 1, the large unexplained component suggests that unequal returns to workplace exposure—potentially driven by discrimination or gendered organizational dynamics—are a major driver of the gap.
- Under Model 2, the unexplained component would reflect gender differences in unobserved productivity, or differences in how the labor market rewards those traits.

**Where does this leave us?** Both mechanisms remain plausible, and the decomposition alone cannot adjudicate between them. However, two empirical facts stand out: (i) men benefit more from high-wage peers than women do, and (ii) men sort into those environments more frequently. Taken together, these patterns underscore that workplace environments are not gender-neutral, and that the processes determining sorting and wage-setting differ meaningfully by gender.

It remains to be seen which of these stories best captures the role of coworker wages in practice. If coworker wage exposure truly reflects unobserved ability (Model 2), then we would expect workers with strong underlying skills or ambition to remain in, or quickly return to, high-wage peer groups even as their careers evolve. If instead coworker wages primarily reflect access, luck, or networks (Model 1), then movements across jobs could generate sharp changes in coworkers' wage profiles that are only loosely tied to individual productivity. Observing how workers move between different coworker environments over time thus becomes a natural way to probe whether coworker wages are acting as structural inputs to wage determination or simply as signals of deeper, unobserved differences across workers.

**Section 4: Event Study - Wage Changes around Moves**

**Section 5 (Bonus): Shrinkage**

**Conclusion**

**Appendix**

# References

Oaxaca, R. (1973). Male-Female Wage Differentials in Urban Labor Markets. *International Economic Review* 14(3), 693–709.