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Educational attainment, college major choice, the gender wage gap, and average starting salaries of college graduates in the United States, 1967-2011

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Educational attainment, college major choice, the gender wage gap, and average starting salaries of college graduates in the United States, 1967-2011

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NOMENCLATURE

CPS	U.S. Census Bureau, Current Population Survey
HEGIS	U.S. Department of Education, Higher Education General Information Survey
IPEDS	U.S. Department of Education, Integrated Postsecondary Education Data System
NACE	National Association of Colleges and Employers
STEM FIELDS	Disciplines in the Areas of Science, Technology, Engineering, and Mathematics

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ABSTRACT

Wage gaps between men and women have narrowed since 1970. There have been many explanations offered for this decline, but the most common have been the increased likelihood that women complete college, a narrowing of gender differences in occupational choice, and a reduction in wage discrimination. This study estimates the contributions of college entry, choice of major, and wage differentials within occupations on the overall change in gender wage gaps from 1967 to 2011 using a Tornqvist approximation to a shift-share analysis of the factors affecting relative earnings for men and women and changes in relative wages between men and women over time. College wage gaps are embedded into the overall wage gap using the labor market shares of men and women in college and other educational levels. I estimate how changes in relative educational attainment affects gender wage gaps and then, conditional on college completion, how changes in the composition of men and women within majors versus changes in the returns to majors affect the gender wage gap for college-educated individuals. Furthermore, I derive a unique institutional quality coefficient and determine some of the factors that predict the added value—either positive or negative—of attending a particular institution. I also use this quality coefficient to derive a new ranking of college quality and compare that with published rankings.

CHAPTER 1

INTRODUCTION: HOW DID WE GET HERE? A BRIEF HISTORY OF THE GENDER WAGE GAP

Women are paid less than men in the workforce, although the explanations for this vary. Occupational choice has a major role in determining an individual's earnings and is usually closely related to college major choice. Furthermore, choice of which school to attend can also have an effect on salaries, with students who attend certain schools earning a premium over other graduates. I use a three-part analysis to determine the effects of educational levels, differences in the salaries of college majors, and institutional quality on earnings and compare the results of the individual studies to data reported in the Census Bureau's Current Population Survey (CPS).

There are three main questions this paper addresses: (1) How have changes in educational attainment by men and women and changes in the relative wages for different levels of educational attainment affected the gap in relative wages between men and women overall? (2) How has the gap in relative wages between college-educated men and women been affected by changes in relative compensation between majors and changes in the proportions of men and women within majors? and (3) How does institutional quality affect the earnings of college graduates in their initial years in the labor force?

This paper adds to the existing literature by decomposing changes in the gender wage gap. More specifically, I estimate what share of the change in the gender wage gap is due to each of the following factors: changes in educational attainment, the changing distribution of men and women across college majors, and changes in the relative returns to education and college major. Furthermore, I derive a unique institutional quality coefficient. Fromm this, I

create a new ranking of colleges based on this new institutional quality coefficient and compare this ranking to published ones.

1.1 – Thesis Structure

In the remainder of this chapter I discuss some of the legislation concerning equal pay and provide an overview of changes in the gender wage gap historically. Then, I review some of the literature addressing non-educational factors which may contribute to the perpetuation of the gender wage gap.

In Chapter 2 I use a Tornqvist approximation to shift-share analysis to determine how much changes in educational attainment affect the gender wage gap. I am also able to examine changes in patterns of educational attainment within and between genders. Further analysis estimates the effects of changes in salaries for different educational levels and the financial benefit of attaining higher levels of education on the gender wage gap.

In Chapter 3 I again use a Tornqvist approximation to shift-share analysis to determine how much college major affects early-career earnings. I examine changes in the composition of men and women within and between majors to estimate the share of the gender wage gap that is attributable to college major choice. I also analyze the effects of changing relative returns to college major and the distribution of men and women across majors on the gender wage gap.

In Chapter 4 I use regression analysis to determine some of the factors that contribute to institutional quality. I derive a unique institutional quality coefficient that I define as the difference between the mean starting salary for each institution and the respective projected salary based on the composition of men and women between majors at that institution. Then, I derive a new ranking of colleges and compare this ranking to published rankings.

In Chapter 5 I summarize the results of previous chapters and embed the results from the college major analyses described in Chapter 3 into the broader, national educational attainment context presented in Chapter 2.

1.2 – Discussion of the Difference between Sex and Gender

One important distinction to make before discussing differences between men and women is the difference between the terms *sex* and *gender*. While the term *sex* refers to sexual behaviors and differences in the composition of chromosomes, hormones, biological origins, and reproductive anatomy, the term *gender* refers to social origins, maleness or femaleness, and differences in stereotypes, expectations, and socially expected roles (Muehlenhard and Peterson 2011). According to Lorber (2010), gender construction starts at birth and are based on the assignment of a particular sex to the child. She states that gender is a creation and "most people find it hard to believe that gender is constantly created and re-recreated out of human interaction, out of social life, and is the texture and order of social life. Yet gender, like culture, is a human production that depends on everyone constantly 'doing gender'" (Lorber 2010). The American Psychological Association (2010) suggests to use the term *gender* "when referring to women and men as social groups" but to use to the term *sex* "when the biological distinction is predominant" (American Psychological Association 2010). In general, I follow the recommendation presented by the American Psychological Association; however, I use the terms *sex* and *gender* interchangeably throughout this thesis.

1.3 – Equal Pay Legislation

For years, women have fought for equal rights in all aspects of their lives—from voting rights in the early 20th century to the current battle for equal pay. A number of laws

have been enacted to help equalize the wages of men and women in comparable jobs in the United States, including the Equal Pay Act of 1963, Title VII of the Civil Rights Act of 1964, and the Lilly Ledbetter Fair Pay Act of 2009. While this thesis focuses on educational decisions and the resulting effects on early-career earnings, an understanding of these laws is crucial to better understanding the struggle for equal pay between men and women, irrespective of educational decisions.

1.3.1 – The Equal Pay Act of 1963

The Equal Pay Act of 1963 prohibited employers from paying men and women different wages for equal work. The Act states that an employer is prohibited from "paying wages to employees…at a rate less than the rate at which he pays wages to employees of the opposite sex…for equal work on jobs the performance of which requires equal skill, effort, and responsibility, and which are performed under similar working conditions" (*The Equal Pay Act of 1963*). The substance of the duties being performed—rather than job title—is the factor considered when determining whether or not jobs are equal (U.S. Equal Employment Opportunity Commission). This piece of legislation, forbidding employers to discriminate purely based on a worker's sex, was one of the first stepping-stones to legally trying to close the gender wage gap between men and women.

One of the major issues with the Equal Pay Act of 1963, however, was its difficulty of enforcement. The law was only applicable to jobs that were already covered under the Fair Employment Standards Act and "made no provision for administrative enforcement…Equal pay for equal work has been, therefore, a rather weak doctrine to combat discrimination" (Goldin 1990).

Analysis of potential effects of the Equal Pay Act of 1963 conducted by Pratt, Smullen, and Kyer (1990) find that significant economic disruption would occur if there had been strict adherence to the law. More specifically, under a policy of zero-government-accommodation, full adherence to the Equal Pay Act of 1963 would have increased unemployment significantly. They speculate that this would likely result in government accommodation policies to counteract increases in inflation with wage adjustments and predict the effects of various accommodation policies on gross national product (GNP) and unemployment (Pratt, Smullen, and Kyer 1990).

1.3.2 – Title VII of the Civil Rights Act of 1964

Title VII of the Civil Rights Act of 1964 made it illegal for employers to fire or refuse to hire someone based solely on their sex, race, color, religion, or national origin. It also made it illegal for employers to "limit, segregate, or classify his employees or applicants for employment in any way which would deprive or tend to deprive any individual of employment opportunities or otherwise adversely affect his status as an employee, because of such individual's race, color, religion, sex, or national origin" (*Title VII of the Civil Rights Act of 1964*). This legislation also established the Equal Employment Opportunity Commission, designed to educate employers and employees about the legal aspects of equal employment as well as creating an enforcement agency to address discrimination issues (*Title VII of the Civil Rights Act of 1964*).

Interestingly, including sex as one of the protected factors of employment was a last-minute addition to the bill, added by Representative Howard Smith (D-VA). Critics of Smith suggest that the addition was in an attempt to prevent the bill from passing; however, Smith

claimed that the inclusion was to support the National Women's Party (U.S. National Archives and Records Administration).

In an analysis of the Congressional discourse regarding Title VII of the Civil Rights Act of 1964, Cynthia Deitch (1993) finds that there were four major groups that Representatives sorted themselves into: (1) men who supported the amendment; (2) men who opposed the amendment; (3) women who supported the amendment; and (4) the only woman who opposed the amendment. Men who supported it had a variety of reasons including the idea that women's equality was nothing more than a joke and that they were trying to protect the "weaker" sex. The second group, men opposed to the amendment, feared that it would lead to a change in traditional gender roles. Women who supported it argued that the inclusion of sex would provide equality for white and black women, not only compared to men, but also to each other. Martha Griffiths (D-MI) stated "if you do not add sex to this bill…you are going to have white men in one bracket, you are going to try and take colored men and colored women and give them equal employment rights, and down at the bottom of the list is going to be a white woman with no rights at all" (Deitch 1993). Edith Green (D-OR) was the lone female Representative who opposed the amendment. While Green did not oppose the idea of equal rights for women, she believed that black women had been more harshly discriminated against than white women. Waiting a few years for equality, she argued, would be worth it if race discrimination could be addressed first (Deitch 1993).

1.3.3 – The Lilly Ledbetter Fair Pay Act of 2009

The Lilly Ledbetter Fair Pay Act of 2009 was an amendment to the portion of Title VII of the Civil Rights Act of 1964 that gave employees 180 days to file a claim regarding wage discrimination on the basis of sex, race, color, religion, or national origin. This

legislation made it so that, with each paycheck of a discriminatory nature, the 180 day period to file a claim would be renewed, thus further empowering women to fight for equal pay (*Lilly Ledbetter Fair Pay Act of 2009*).

The Lilly Ledbetter Fair Pay Act of 2009 was created after Lilly Ledbetter, an employee at Goodyear Tire & Rubber Co. between 1979 and 1998 sued her former employer for wage discrimination on the basis of her sex. She provided evidence that, because she was female, she was not only paid less, but also that she received unfair performance reviews. The Supreme Court ruled in favor of Goodyear, arguing that Ledbetter did not file her claim within 180 days of the initial discriminatory paycheck (Ermie 2011). In a speech at Iowa State University in 2010, Ledbetter stated "I thought about letting it go, but I just couldn't. It was a matter of fairness and of my basic dignity" (Ledbetter 2010)The Supreme Court ruled that "a new violation does not occur, and a new charging period does not commence, upon the occurrence of subsequent nondiscriminatory acts that entail adverse effects resulting from the past discrimination" (*Ledbetter v. Goodyear Tire & Rubber Co., Inc.*). Justice Ruth Bader Ginsburg dissented the ruling and determined that

> under the Court's decision, the discrimination Ledbetter proved is not redressable under Title VII. Each and every pay decision she did not immediately challenge wiped the slate clean. Consideration may not be given to the cumulative effect of a series of decisions that, together, set her pay well below that of every male area manager. Knowingly carrying past pay discrimination forward [under the current Court's ruling] must be treated as lawful conduct (*Ledbetter v. Goodyear Tire & Rubber Co., Inc.*).

Justice Ginsberg concluded that "once again, the ball is in Congress' court…the Legislature may act to correct the Court's parsimonious reading of Title VII" (*Ledbetter v. Goodyear Tire & Rubber Co., Inc.*). Ultimately, her recommendations

were recognized by Congress and, on January 29, 2009, President Obama signed the Lilly Ledbetter Fair Pay Act of 2009 into law (*Lilly Ledbetter Fair Pay Act of 2009*).

1.4 – Historical Analysis of the Gender Wage Gap

Overall, the gender wage gap has decreased significantly over time. Figure 1.1 shows a comparison of the log wage ratio between men and women across all ages at all educational levels with the log wage ratio of those aged 25 to 34 across education levels using CPS data. Data used are the mean earnings of year-round, full-time workers 18 years of age and older. Tables 1.1 and 1.2 present the data accompanying Figure 1.1. As the figure shows, the overall log wage ratio across all education levels follows approximately the same pattern regardless of the age bracket in question, although, on average, the wage ratio is about 15% lower for the 25 to 34 year old group compared with those aged 18 and older.

1.5 – Non-Educational Factors Affecting the Gender Wage Gap

Not all of the factors which affect earnings are directly related to educational decisions. In this section, I present some alternative explanations of factors that may contribute to the gender wage gap including the motherhood penalty, differences in household production, women's self-valuation and negotiation habits, and the small number of women in upper-level positions.

1.5.1 – The Motherhood Penalty

For many women, the decision of how to balance work and family is a difficult one. According to Lips and Lawson (2009), "the gender pay gap most seriously affects women with children—a situation labeled the motherhood penalty" (Lips and Lawson 2009). The gender wage gap for women who have children is greater than that for women who are childless. Sigle-Rushton and Waldfogel (2007) find that the wage gap between men and

women is 7% greater for women who have one child and 12% greater for women who have two children, compared to women who are childless. Having children not only affects the gap in pay between men and women, but also between women. More specifically, women who have one child earn 11% less than childless women on average, and those who have two children earn 19% less (Sigle-Rushton and Waldfogel 2007).

The number of women working during their pregnancy has steadily increased since the period between 1961 and 1965. Education is a major factor in determining the percentage of women who work during their first pregnancy. More specifically, the percentage of women with bachelor's degrees who worked during the three months prior to their first child's birth was 92.7% and 71.8% worked within one month of their child's birth in the time period between 2006 and 2008. For those that had less than a high school level of education, however, these statistics were much lower—80.4% worked in the three months prior to their child's birth, but only 43.2% worked within one month of their child's birth in the same time period. Not only do women now work later in pregnancy, but they also return to work more quickly than they have historically. In the period between 1961 and 1965, only 16.8% of mothers returned to work within the first year of their child's birth; however, between 2005 and 2007 this percentage rose drastically to 63.8% (U.S. Department of Commerce 2011).

Some women believe that they must choose between work and family due to leave policies that are often unpaid as well as the poor availability of childcare options. These factors can cause women to either work fewer hours or seek out employment options that are part-time and have a more flexible schedule. Cumulatively, all of these factors, and many others, contribute to lower earnings for mothers, thereby increasing the gender wage gap (Lips and Lawson 2009).

1.5.2 – Differences in Household Production

Gary Becker provided many valuable contributions to understanding differences in household and market production between men and women. Much of the division in production, according to Becker, can be attributed to gains from specialization as well as intrinsic differences between the genders. Based on differences in the comparative advantages in production between men and women—men have a comparative advantage in market production and women have a comparative advantage in household production—in order to maximize household utility, men should specialize in market production and women should specialize in household production. Becker states that

> the modest increase in the hourly earnings of women relative to men during the last 35 years in the United States and many other Western countries…has been an embarrassment to the human capital interpretation of sexual earnings differentials, since this interpretation seems to imply that increased participation of married women would induce increased investment in earnings—raising market human capital" (Becker 1981).

Furthermore, Becker suggests that even if labor force participation between men and women were equal, wages would still not equalize, claiming that household responsibilities would prevent the wages of women to rise as a rate equal to that of men (Becker 1981).

Having children is a significant determinant of time spent in household and market production. In the year after having a child, women's time in household production increases significantly—50%—while changes in men's household production time are insignificant. Similarly, in the year after having a child, both men and women reduce their market production time—women's time drops by over 37% while men's time drops by approximately 9% (Kan and Gershuny 2010).

Chichilnisky and Frederiksen (2008) suggest that, although women tend to work fewer hours in the market compared with men, they work a greater number of hours in the home, resulting in a near-equal number of hours worked[1]. They claim that the gender wage gap will persist even in the absence of gender discrimination and other differences until the societal belief regarding the gender roles of men and women and the manner in which families operate equalize (Chichilnisky and Frederiksen 2008).

1.5.3 –Women's Self-Valuation and Negotiation Habits

Numerous studies have shown that women are much more likely to undervalue their economic worth and are much more hesitant to negotiate for higher pay than men. For example, Babcock and Laschever (2003) recognize that women may be satisfied and even expect to earn less because they are unsure of their true worth. They note that "many scholars believe that women are satisfied with less because they expect less: they go into the work force expecting to be paid less than men, so they're not disappointed when those expectations are met" (Babcock and Laschever 2003). Conversely, Lips and Lawson (2009) argue that the human capital model may help explain differences in expected earnings between men and women because women may take into account future decisions about having and raising children and the financial losses such decisions could incur (Lips and Lawson 2009). Orazem, Werbel, and McElroy (2003) show that there is a significant effect of differences in the reservation wages of men and women entering the workforce, which impacts actual starting pay. This is largely attributable to differences in perceived workforce opportunities

[1] Women tend to work 8.4 hours per day in the market compared to 9.3 hours worked daily by men; however, women work an average of 2.5 hours in the home daily, compared to only 1.5 hours worked by men. Then, the total number of average hours that women work daily is 10.9 hours while men work an average of 10.8 hours per day (Chichilnisky and Frederiksen 2008).

even though they find that differences in predicted workforce-attachment rates between men and women have no impact on starting salaries (Orazem, Werbel, and McElroy 2003).

Part of these gender differences, according to Babcock and Laschever (2003) is that behavioral norms for men and women are different: men are expected to be assertive and dominant while women are expected to be nurturing and friendly (Babcock and Laschever 2003). Facebook Chief Operating Officer Sheryl Sandberg stated, "It makes sense that women behave as they do in the workplace. It's not irrational behavior; it's rational behavior not to own [their] success...It would be easier if the answer were to tell everyone to start negotiating more. But it's not so easy, because it's not necessarily going to work" (Brzezinski 2010). Furthermore, there is a correlation between influence and likeability for women: the more that women are liked, the more influence they have. However, women are unable to use traditional tactics—strong arguments and being assertive—to be successful in negotiation because assertiveness and likeability are negatively correlated for women (Babcock and Laschever 2003).

Kray, Thompson, and Galinsky (2001) show that information about gender stereotypes affects the approach both men and women take in negotiation. They find that while men tend to have an advantage in negotiations for salaries, it is difficult to distinguish if this is due differences in negotiating ability or stereotype effects. One study shows that, when told that a series of negotiations were most successful when negotiators were aggressive and that there were documented differences in success of men and women, women had a tendency to enter the negotiation with a much more aggressive approach. They found that this approach was instrumental in increasing women's relative success in

negotiations, counteracting previous studies that demonstrate a negative correlation between assertiveness and likeability (Kray, Thompson, and Galinsky 2001).

Barry Gerhart and Sara Rynes (1991) note that "starting salaries can have a lasting impact on career earnings. For example, salary increases are commonly awarded as percentages of base pay…In turn, base pay generally becomes the basis for other forms of compensation (e.g. pensions, profit sharing, stock options)" (Gerhart and Rynes 1991). They find that approximately 15% of women and 23% of men bargain for higher salaries; however, it is not gender that affects the probability of negotiation, but rather structural conditions surrounding initial and alternative offers (Gerhart and Rynes 1991).

1.5.4 – There are Few Women in Upper-Level Positions

The number of women who are the chief executive officers (CEOs) at Fortune 500 companies is extremely low. As of January 2014, only 4.6 percent of Fortune 500 company CEOs were female (Catalyst "CEO's" 2014). The number of women on corporate boards is relatively low as well—only 16.9% as of March 2014—with only 3.1% of board chairs being female (Catalyst "Women on Boards" 2014).

A frequently discussed issue when it comes to women in top-management positions is the concept of the 'glass ceiling[2].' According to Powell (2011), the glass ceiling makes it so that, "being competent does not ensure that a female manager will have the same amount of organizational success as her male equivalent" (Powell 2011). Conversely, Bjerk (2008) suggests that because of the time involved in becoming properly educated and the hours and effort involved in upper-level positions, "it is not unreasonable to think that females (possibly

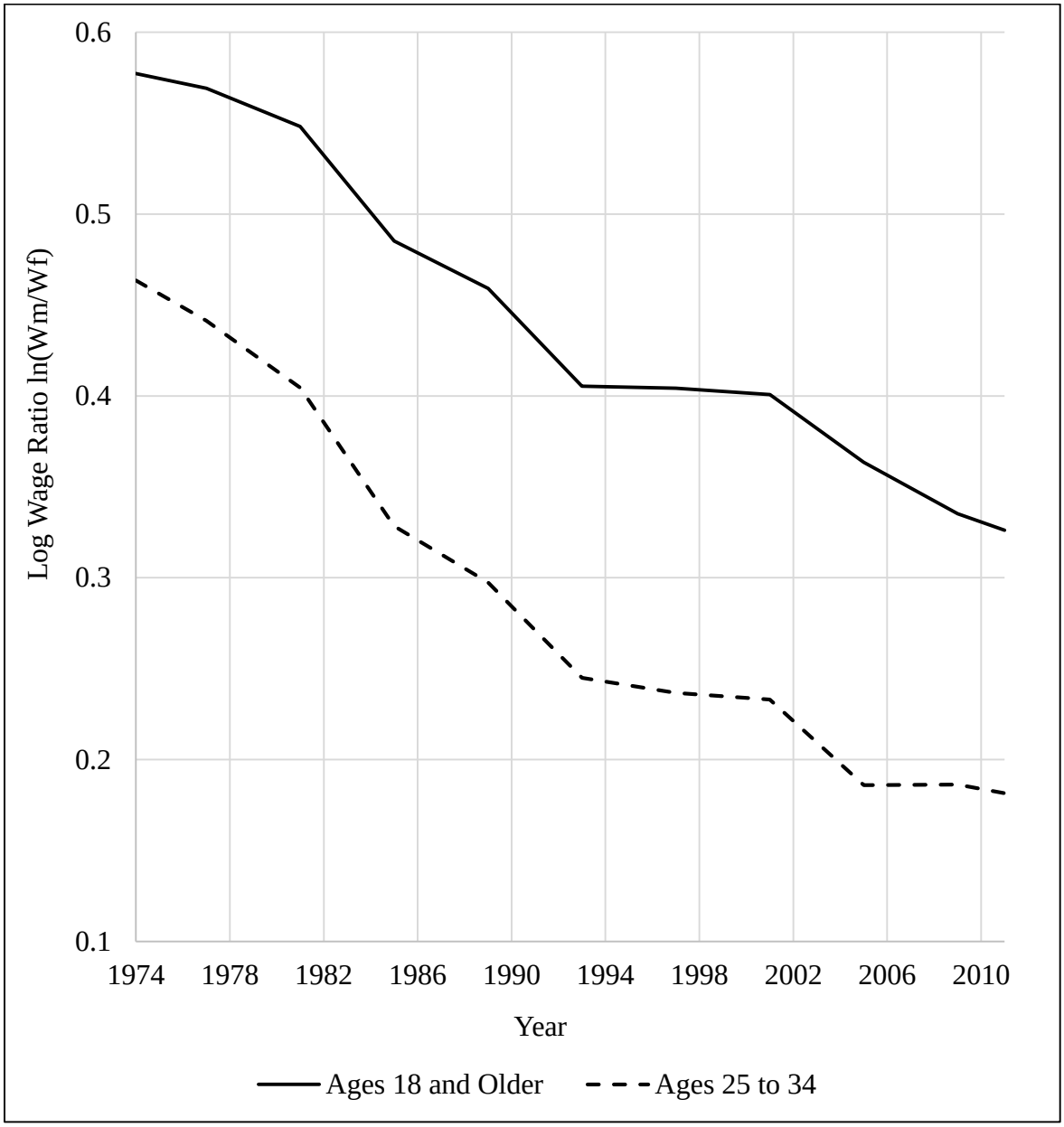
[2] The glass ceiling is the "transparent but often impermeable barrier many women still face in trying to move up to top management...[it is] the net effect of various prejudices and lack of networking opportunities women face that make it difficult for them to move into the top jobs" (Dessler 2003).

due to greater time constraints)…are on average less able or willing to make such investments than white males" (Bjerk 2008). Furthermore, Bjerk suggests that due to the differences in the gender composition of groups, underrepresented groups will inherently have a lesser chance of rising to upper-level positions (Bjerk 2008). These arguments are interesting in light of findings that firms with female CEOs tend to have higher levels of performance compared with male-led firms (Peni 2014).

APPENDIX A

CHAPTER 1 FIGURES

Figure 1.1 – Comparison of Log Wage Ratios of Full-Time, Year-Round Workers by Age, 1974-2011, 4-Year Averages



Data Source: Current Population Survey (multiple years)

APPENDIX B

CHAPTER 1 TABLES

Table 1.1 – Figure 1.1 Data: The Log Wage Ratio of Full-Time, Year-Round Workers Ages 18 and Older, 1974-2011

Year	CPI	CPI Adjustment	Mean Male Wage	Male Wage ($2011)	Mean Female Wage	Female Wage ($2011)	**Log Wage Ratio**
1974	49.3	4.5627	13,164	60,062.82	7,391	33,722.60	**0.5772**
1975	53.8	4.1810	14,047	58,730.82	7,940	33,197.32	**0.5705**
1976	56.9	3.9532	15,022	59,385.48	8,603	34,009.67	**0.5574**
1977	60.6	3.7119	16,171	60,024.56	9,133	33,900.46	**0.5713**
1978	65.2	3.4500	17,547	60,536.88	9,939	34,289.40	**0.5684**
1979	72.6	3.0983	19,100	59,178.17	10,875	33,694.38	**0.5632**
1980	82.4	2.7298	20,543	56,079.15	12,044	32,878.22	**0.5340**
1981	90.9	2.4746	22,220	54,985.09	13,117	32,459.02	**0.5271**
1982	96.5	2.3310	23,653	55,134.53	14,331	33,405.19	**0.5011**
1983	99.6	2.2584	24,608	55,575.29	15,159	34,235.44	**0.4845**
1984	103.9	2.1650	25,884	56,037.74	16,036	34,717.25	**0.4788**
1985	107.6	2.0905	27,430	57,342.72	17,033	35,607.68	**0.4765**
1986	109.6	2.0524	28,793	59,093.69	17,911	36,759.88	**0.4747**
1987	113.6	1.9801	29,936	59,276.18	18,865	37,354.53	**0.4618**
1988	118.3	1.9014	31,114	59,161.05	19,859	37,760.47	**0.4490**
1989	124	1.8140	33,028	59,913.59	21,046	38,177.95	**0.4506**
1990	130.7	1.7210	33,365	57,422.26	21,983	37,833.47	**0.4172**
1991	136.2	1.6515	34,378	56,776.45	22,956	37,912.63	**0.4038**
1992	140.3	1.6033	35,487	56,895.30	23,940	38,382.32	**0.3936**
1993	144.5	1.5567	38,039	59,214.22	25,321	39,416.47	**0.4070**
1994	148.2	1.5178	39,303	59,654.37	26,284	39,894.04	**0.4023**
1995	152.4	1.4760	40,367	59,580.79	26,547	39,182.78	**0.4191**
1996	156.9	1.4336	42,077	60,323.51	28,363	40,662.49	**0.3944**
1997	160.5	1.4015	43,709	61,257.69	29,261	41,008.97	**0.4013**
1998	163	1.3800	44,898	61,958.96	30,671	42,325.79	**0.3811**
1999	166.6	1.3502	47,450	64,065.76	31,125	42,024.17	**0.4217**
2000	172.2	1.3063	50,241	65,628.11	32,940	43,028.40	**0.4221**
2001	177.1	1.2701	51,590	65,525.71	35,348	44,896.35	**0.3781**
2002	179.9	1.2504	52,435	65,562.40	35,863	44,841.51	**0.3799**
2003	184	1.2225	53,039	64,839.89	37,197	45,473.13	**0.3548**
2004	188.9	1.1908	54,031	64,339.22	37,858	45,080.68	**0.3557**

Table 1.1 – Continued

Year	CPI	CPI Adjustment	Mean Male Wage	Male Wage ($2011)	Mean Female Wage	Female Wage ($2011)	**Log Wage Ratio**
2005	195.3	1.1518	56,187	64,714.02	39,046	44,971.68	**0.3639**
2006	201.6	1.1158	57,791	64,481.40	41,518	46,324.49	**0.3307**
2007	207.342	1.0849	58,373	63,327.08	42,219	45,802.10	**0.3240**
2008	215.303	1.0448	61,783	64,548.13	43,305	45,243.14	**0.3554**
2009	214.537	1.0485	62,445	65,472.70	44,857	47,031.93	**0.3308**
2010	218.056	1.0316	62,710	64,689.46	45,260	46,688.64	**0.3261**
2011	224.939	1.0000	64,958	64,958.00	46,882	46,882.00	**0.3261**

Data Source: Current Population Survey (Multiple Years)

Table 1.2 – Figure 1.2 Data: The Log Wage Ratio of Full-Time, Year-Round Workers Ages 25 to 34, 1974-2011

Year	CPI	CPI Adjustment	Mean Male Wage	Male Wage ($2011)	Mean Female Wage	Female Wage ($2011)	Log Wage Ratio
1974	49.3	4.5627	12,258	55,929.05	7,711	35,182.65	**0.4635**
1975	53.8	4.1810	13,071	54,650.14	8,462	35,379.81	**0.4348**
1976	56.9	3.9532	13,869	54,827.40	9,013	35,630.50	**0.4310**
1977	60.6	3.7119	14,775	54,842.80	9,555	35,466.87	**0.4359**
1978	65.2	3.4500	16,066	55,427.45	10,297	35,524.49	**0.4449**
1979	72.6	3.0983	17,526	54,301.39	11,415	35,367.48	**0.4288**
1980	82.4	2.7298	18,561	50,668.60	12,707	34,688.11	**0.3789**
1981	90.9	2.4746	19,905	49,256.44	13,812	34,178.85	**0.3654**
1982	96.5	2.3310	21,054	49,076.33	14,865	34,649.93	**0.3481**
1983	99.6	2.2584	21,609	48,802.28	15,588	35,204.31	**0.3266**
1984	103.9	2.1650	22,716	49,179.16	16,303	35,295.29	**0.3317**
1985	107.6	2.0905	24,067	50,312.33	17,701	37,004.14	**0.3072**
1986	109.6	2.0524	24,846	50,993.01	18,286	37,529.51	**0.3066**
1987	113.6	1.9801	25,546	50,583.55	18,817	37,259.48	**0.3057**
1988	118.3	1.9014	26,520	50,425.89	19,593	37,254.69	**0.3027**
1989	124	1.8140	27,350	49,613.56	20,774	37,684.54	**0.2750**
1990	130.7	1.7210	27,743	47,746.62	21,337	36,721.68	**0.2625**
1991	136.2	1.6515	28,742	47,468.40	22,429	37,042.27	**0.2480**
1992	140.3	1.6033	29,231	46,865.23	23,161	37,133.37	**0.2328**
1993	144.5	1.5567	30,224	47,048.83	23,865	37,149.96	**0.2362**
1994	148.2	1.5178	30,715	46,619.44	24,273	36,841.73	**0.2354**
1995	152.4	1.4760	32,319	47,702.12	25,145	37,113.46	**0.2510**
1996	156.9	1.4336	33,055	47,389.16	26,119	37,445.39	**0.2355**
1997	160.5	1.4015	34,807	48,781.63	27,805	38,968.40	**0.2246**
1998	163	1.3800	36,079	49,788.80	28,634	39,514.74	**0.2311**
1999	166.6	1.3502	38,607	52,126.17	29,722	40,129.87	**0.2615**
2000	172.2	1.3063	41,154	53,758.07	31,645	41,336.79	**0.2627**
2001	177.1	1.2701	40,895	51,941.73	34,273	43,530.97	**0.1766**
2002	179.9	1.2504	41,629	52,051.06	33,624	42,041.96	**0.2136**
2003	184	1.2225	41,993	51,336.21	35,845	43,820.32	**0.1583**
2004	188.9	1.1908	41,815	49,792.61	35,075	41,766.73	**0.1758**
2005	195.3	1.1518	42,913	49,425.54	35,270	40,622.62	**0.1961**
2006	201.6	1.1158	46,181	51,527.32	38,581	43,047.48	**0.1798**
2007	207.342	1.0849	46,688	50,650.38	40,204	43,616.09	**0.1495**
2008	215.303	1.0448	48,749	50,930.79	39,037	40,784.12	**0.2222**

Table 1.2 – Continued

Year	CPI	CPI Adjustment	Mean Male Wage	Male Wage ($2011)	Mean Female Wage	Female Wage ($2011)	**Log Wage Ratio**
2009	214.537	1.0485	49,105	51,485.90	40,475	42,437.46	**0.1933**
2010	218.056	1.0316	48,538	50,070.12	40,266	41,537.01	**0.1868**
2011	224.939	1.0000	49,815	49,815.00	41,768	41,768.00	**0.1762**

Data Source: Current Population Survey (Multiple Years)

CHAPTER 2

HOW MUCH DOES EDUCATION MATTER? AN ANALYSIS OF THE EFFECTS OF EDUCATIONAL ATTAINMENT

One of the factors that affects future earnings is educational attainment. There has been a great deal of discussion about the surge of women into college and how it has impacted the labor market overall. The emphasis of formal educational attainment has not always been equal for men and women. In fact, it was not until the 1970s that women began to attend college in greater numbers. Some of this aversion to college can be explained by the human capital model which suggests that women have a greater comparative advantage in household production while men have a comparative advantage in market production.

This chapter investigates the effects of educational attainment on the gender wage gap by answering the following question: *how have changes in educational attainment by men and women and changes in the relative wages for different levels of educational attainment affected the gap in relative wages between men and women overall?* I begin by presenting some background information on the changing patterns of women in higher education and the returns to education between 1974 and 2011. Then, I use a Tornqvist approximation to a shift-share analysis to determine the magnitude of the effects of changes in educational attainment and the relative wages of men and women within educational attainment levels on the gender wage gap.

2.1 – Women in Education Historically

Barbara Solomon (1985) identifies the three main generations of early female college graduates. First, female college students from the 1860s to the 1880s continued to fulfill traditional roles and focused on domestic duties rather than education. The second generation of women in college occurred between the 1890s and 1900s. Women in this generation still

conformed to traditional gender norms but became more expansive in their collegiate activities. Finally, women attending college between 1910 and 1920 fought social norms and became collegiate women, not simply women in a man's college. After World War I, participation in college increased dramatically and "women participated fully in this rush to academia…Wartime achievement of an older generation not only demonstrated the utility of women's education but served as a call to younger women to take advantage of expanded opportunities" (Solomon 1985).

For many women born before 1950, college was not a place to prepare for a career—it was a way to meet a suitable husband. Beginning with women born in the late 1940s, the types of classes girls took began to more closely resemble that of their male counterparts. Their coursework began to include a larger number of college preparation classes and they began to improve their ability in math and science relative to men. This, in turn, led to a greater number of young women attending and graduating college. Another factor that has affected the rates of female college attendance historically is the increase in the age at which women first married. This increase—up to age 25 by the early 1980s—increased opportunities for women to attend and complete college (Goldin 2006).

2.2 – The Educational Attainment Gap

Educational attainment for both men and women has increased over time. In Figure 2.1, I present the ratio of men to women by their highest level of educational attainment who are full-time, year-round workers ages 18 and older for the time period covering 1974 to 2011. These data show that, among those whose highest level of education is some college or a bachelor's degree, there was a sharp decline in the ratio of men to women from 1974 until the mid-1980s when the ratio began to stagnate. These statistics indicate that, for each

woman earning a bachelor's degree, there are approximately 1.23 men who earn the same degree. The reason that these data show that men still earn more bachelor's degrees than women despite other studies indicating the contrary is because the data used here only include those that are working full-time, not the full number of degrees awarded. There is a large literature that shows that women, particularly those with children, are more likely to work part-time and thus, even if they have earned a bachelor's degree, would be excluded from the data used in this analysis (Higgins, Duxbury, and Johnson 2002; Connolly and Gregory 2008; Tijdens 2002). One of the most interesting facts these data show is that, since about 2002, the number of women earning advanced degrees has actually surpassed that of men. To summarize, overall, these data show a convergence in educational attainment by men and women, particularly above the high school level.

2.3 – Returns to Education

Before discussing specifics about the returns to education, it is important to understand that the returns for men and women are not equal in magnitude both marginally and on average. Carneiro, Heckman, and Vytlacil (2011) find that the overall returns to college can range from -31.56% to 51.02%. They recognize that an individual's comparative advantage has a direct influence on their educational attainment decisions. As is expected, then, those that believe they will have a high gross return to college are more likely to attend (Carneiro, Heckman, and Vytlacil 2011).

Following the human capital theory, individuals will invest in additional education if there is a positive return to their investment. If there is not a positive return, strictly following the human capital theory, individuals will choose not to invest in further schooling. In a within-college sample at one institution, Orazem, Werbel, and McElroy (2003) find that

human capital differences only explain about 14% of the gap in expected earnings while 37% of the gap is due to differences in expected pay and search strategies. They suggest that improving job search, pay expectation, and career planning training may be a way to help reduce the gap in pay between men and women. When combined with demographic variables, about 26% of expected differences in pay can be explained (Orazem, Werbel, and McElroy 2003).

Interestingly, DiPrete and Buchmann (2013) recognize that, while the returns to additional schooling—namely a college degree—for women *have* improved, the returns relative to males have not increased because men, too, have realized increases in the returns to schooling. In addition to the financial gains from a college education, there is frequently a positive social return as well that is realized through marriage. The authors find that there has been an increase in the probability of marriage for those with a bachelor's degree relative to those with only a high school degree (DiPrete and Buchmann 2013). Similarly, Long (2010) finds that higher levels of educational attainment are likely to delay marriage and childbearing, but that the magnitude of these effects decrease as the time since high school graduation increases. The author attributes this to educational attainment leading individuals to delay when they marry and have children rather than decreasing the overall likelihood of these events (Long 2010).

Examining some individual variables, Long (2010) finds that 7 years after high school graduation there is actually a slight negative effect of each year of education (-0.012 log points); however, 14 years after high school this effect reverses and increases to 0.062 log points, resulting in a net-positive return to additional education. More specifically, the effect of additional education for men and women is not equal—10 years after high school

completion, men experience an increase in log-annual earnings that is substantially higher than that of women. More specifically, the increase in log-annual earnings attributable to additional education is 0.058 for men compared to only 0.024 for women (Long 2010).

2.4 – Data

The data for this analysis is taken from the Census Bureau's Current Population Survey (CPS). More specifically, I use data on the full-time, year-round earnings of men and women by sex, age, and educational attainment. Because my analysis is focused on starting salaries, I limit the sample to those in the 25 to 34 year old age range.

2.5 – Methods

Equation (1) presents the traditional shift-share equation I can use to examine wage differences in pay between men and women.

(1) $(W_{Mt}) - (W_{Ft}) = \left[\sum_i M_{it}\, W_{M_{it}}\right] + \left[\sum_i F_{it} \times W_{F_{it}}\right]$

In this equation, M_{it} is the proportion of men in education level *i* and year *t* and F_{it} is the corresponding proportion of women in education level *i* in year *t.* Equation (1) can be rearranged into two components, one that reflects differences in wages due to pay differences for men and women within the same educational attainment level and the other reflecting differences in pay that are attributable to differences in educational attainment as is shown in equation (2).

(2) $(W_{Mt}) - (W_{Ft}) = \left[\sum_i M_{it}\left(W_{M_{it}} - W_{F_{it}}\right)\right] + \left[\sum_i W_{F_{it}}\,(M_{it} - F_{it})\right]$

The first term on the right-hand-side is the 'within' term and the second is the 'between' term.

There are several problems with the typical shift-share analysis. First, it can be influenced by outliers if there are unusually high or low wages in the sampled population due

to uneven numbers of men and women within education groups. For this reason, researchers often prefer to work with log wage differences rather than differences in wage levels. Second, the decomposition is not unique because it depends on the choice of weights for the within term. If the decomposition shown in equation (2) instead used weights derived from the female educational attainment distribution, the corresponding decomposition would be equation (2') below which would not yield the same decomposition.

(2') $(W_{Mt}) - (W_{Ft}) = \left[\sum_i F_{it}\left(W_{M_{it}} - W_{F_{it}}\right)\right] + \left[\sum_i W_{M_{it}}\left(M_{it} - F_{it}\right)\right]$

An alternative aimed at resolving these problems is the Tornqvist decomposition which can be viewed as an alternative measure of the 'within' component. Consider the weighted average of log wage differences $\sum_i \frac{(M_{it}+F_{it})}{2} \ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right)$ where we sum across educational attainment. This will differ from the observed aggregate log wage difference by a residual that can be interpreted as the 'between' component, shown in equation (3) below

(3) $\ln\left(\frac{W_{M_t}}{W_{F_t}}\right) = \frac{1}{2}\sum_i (M_{it} + F_{it}) \ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) + Residual$

If, for example, average wages between men and women differed but $W_{M_{it}} = W_{F_{it}}$ for all i, the entire wage differential would be attributable to differences in educational attainment between men and women and none of the difference would be attributable to wage differentials within education groups.

Education is closely related to occupational decisions, therefore one of the reasons for examining changes in the overall log wage ratio is that "a number of scholars have focused upon the existence of occupational segregation by sex as a crucial barrier to the attainment of economic equality for women" (Blau and Hendricks 1979). I extend the methods used by Orazem, Mattila, and Yu (1990) to examine the effects of educational attainment on the

gender wage gap by decomposing changes in the log wage ratio between men and women between 1974 and 2011.

Equation (4) presents the Tornqvist shift-share equation, modeled as the log approximation to equation (3). Equation (5), (6), and (7) decompose equation (4) into three parts. More specifically, equation (5) models the effect of changes in the relative wages of men and women within educational attainment levels, equation (6) models the effect of changes in the proportion of men within educational levels, and equation (7) models the effect of changes in the proportion of women within educational levels.

(4) $\Delta \ln\left(\frac{W_{M_t}}{W_{F_t}}\right) = \frac{1}{2}\sum_i \left[(M_{it} + F_{it}) \ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) - (M_{i0} + F_{i0}) \ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)\right] + Residual$

(5) $Change\ Due\ to\ Relative\ Wages = \frac{1}{2}\sum_i \left[(M_{it} + F_{it})\left(\ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) - \ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)\right)\right]$

(6) $Change\ Due\ to\ Men = \frac{1}{2}\sum_i \left[(M_{it} + F_{it})\left(\ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) - \ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)\right)\right]$

(7) $Change\ Due\ to\ Women = \frac{1}{2}\sum_i \left[(M_{it} + F_{it})\left(\ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) - \ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)\right)\right]$

Equation (5) models the effect of changes in the relative wages of men and women within educational attainment levels by using the proportion of men and women in educational level *i* in year *t* and calculating the change in the overall log wage ratio from the base year. Equations (6) and (7) model the effects of changes in the proportions of men and women within educational attainment levels, respectively, by using the relative wages of men and women at base year levels and calculating the change in the overall log wage ratio that results from the changing proportions of men and women.

Equation (8) is a decomposition of equation (6) incorporating equations (7), (8), and (9) into the overall Tornqvist equation.

$$(8)\ \Delta \ln\left(\frac{W_{M_t}}{W_{F_t}}\right) = \frac{1}{2}\sum_i \left[\ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right)(F_{it} - F_{i0})\right] + \frac{1}{2}\sum_i \left[\ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)((M_{it} - M_{i0}) + (F_{it} - F_{i0}))\right] + Residual$$

In the above equations, the index on the summation sign is the level of education (i=1…5). The educational levels are defined as follows: i=1 is less than a high school degree; i=2 is a high school diploma or equivalent; i=3 is some college but less than a four-year degree; i=4 is a bachelor's degree; and i=5 indicates an advanced degree. W_{Mt} represents the average wage of men across all education levels in year t and W_{Ft} is the average wage of women across all education levels in year t. The average wage for men and women in education level i in year t are represented by $W_{M_{it}}$ and $W_{F_{it}}$ respectively and the proportions of men and women in education level i in year t are represented by M_{it} and F_{it}. To be clear, $\sum_i M_{it} = 1 = \sum_i F_{it}$ because the sum of the proportions of men and women must equal one.

Additional analyses are conducted first by holding the proportions of men and women by educational attainment level constant at 1974 levels and allowing wages to fluctuate in accordance with true values and then by holding relative wages within educational levels constant and allowing the proportions of men and women to fluctuate in accordance with true values. Equations (9) and (10) model the log wage ratios when holding the composition of men and women and relative wages constant, respectively.

$$(9)\ Holding\ Composition\ Constant:\ \ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) = \ln\left(\frac{W_{M_{it}} \times M_{i,1974}}{W_{F_{it}} \times F_{i,1974}}\right)$$

$$(10)\ Holding\ Relative\ Wages\ Constant = \ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) = \ln\left(\frac{W_{M_{i,1974}} \times M_{it}}{W_{F_{i,1974}} \times F_{it}}\right)$$

This analysis allows me to predict what the log wage ratio would have been if the distribution of men and women between educational levels or their relative wages had been unchanged.

2.6 – Results and Discussion

As Figure 2.2 demonstrates, over time, the wage gap between college-educated men and women has narrowed significantly. The figure shows some noise, which I attribute to large standard errors in the data. In 1974, the log wage ratio of college-educated individuals between the ages of 25 and 34 was 0.40, indicating that, on average, women were earning only 60 cents for each dollar earned by men. By 2011, this ratio dropped to 0.32. As the data for college educated individuals between the ages of 25 and 34 show, the log wage ratio is significantly lower for that subset than that for college-educated individuals of all ages. Furthermore, particularly since the early 1980s, the gap between 25 and 34 year olds across all education levels compared to those who earned a bachelor's degree has narrowed.

Analysis of the data using the Tornqvist equations shows that the effect of changes in relative wages within educational attainment levels greatly overshadows the effect of changes in the proportion of men and women within educational levels. Table 2.1 provides a summary of the magnitude of the effects of changes in relative wages within educational levels and changes in the proportion of men and women within educational levels on the log wage ratio calculated using the Tornqvist equations. As these results show, between 1974 and 2011, changes in the proportion of men and women within educational levels had a cumulative effect[3] of increasing the log wage ratio by 0.038 while the effect of changes in relative wages between men and women within educational levels decreased the log wage ratio by 0.384. Together, these effects reduced the overall log wage ratio by 0.346. While the magnitude of the effect due to changes in the proportions of men and women within

[3] Changes due to men switching between educational levels decreased the ratio by 0.0043 while changes in the female shares increased the ratio by 0.0422

educational levels is small compared to the change due to changes in relative wages, the effects are still significant.

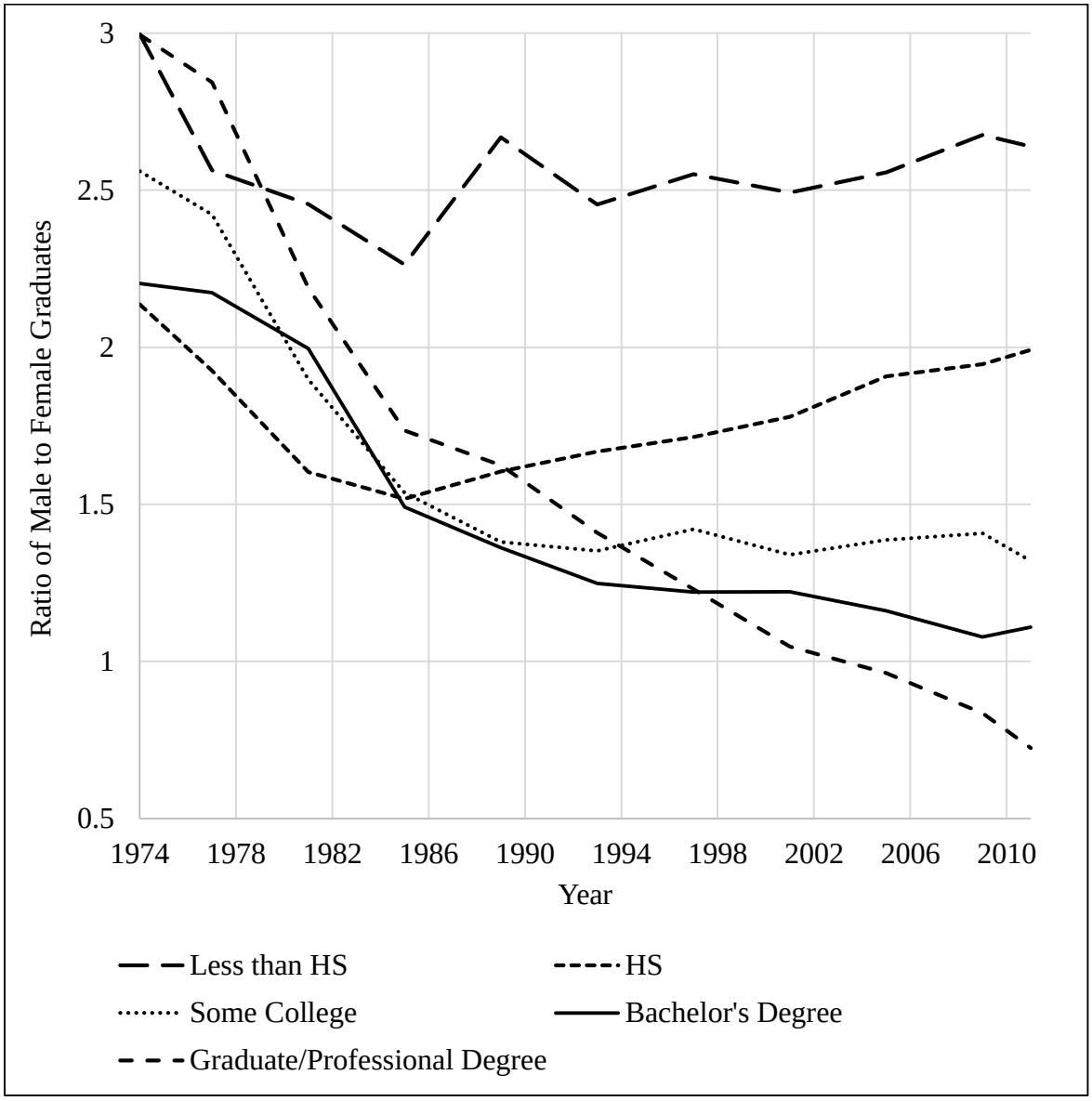
The analyses where the proportions of men and women by educational attainment level and relative wages are held constant show some interesting results. These results are described in Figure 2.3. When holding wages constant, changes in the proportion of men and women within educational levels leads to approximately a 7% decrease in the log wage ratio. When holding the proportion of men and women within educational levels constant, however, the effect on the change in the log wage ratio is much greater—there is a decrease of over 15%. This indicates that much of the change in the log wage ratio due to within educational attainment level changes are attributable to a narrowing of the relative wages of men and women within educational levels rather than changes in the proportion of men and women within educational attainment levels.

One of the most surprising results of these analyses was that changes in the proportions of men and women within educational attainment levels have a relatively small effect on the gender wage gap overall. Many people believe that increased access to education, particularly higher education for women, has helped to reduce the gender wage gap; however, as these results demonstrate, changes in the proportions of men and women within educational levels do not have nearly as significant of an impact on the wage gap between men and women as do changing relative wages within educational levels.

APPENDIX C

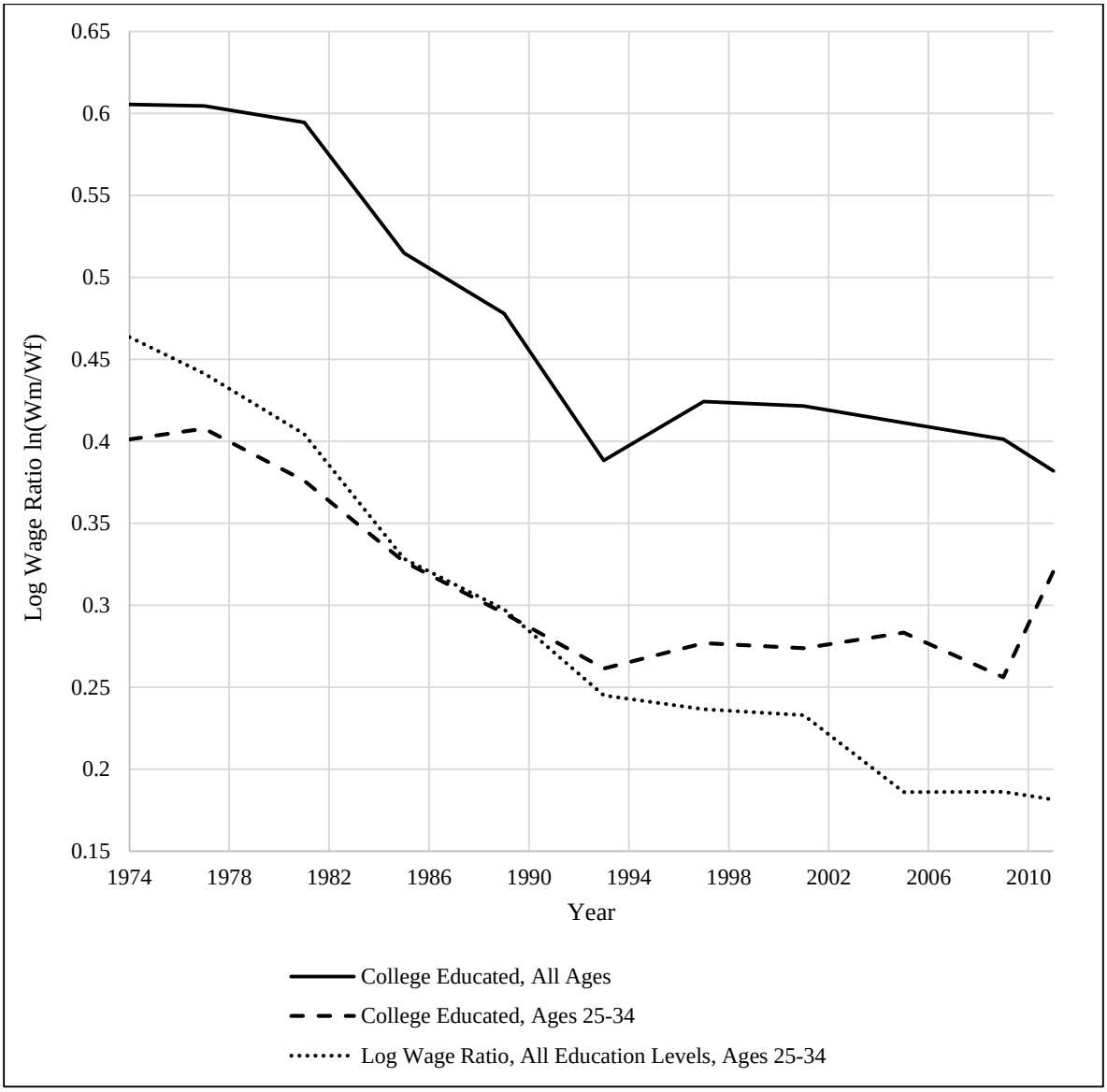
CHAPTER 2 FIGURES

Figure 2.1 – Ratio of Men to Women by Highest Level of Educational Attainment, 1974-2011, 4-Year Averages



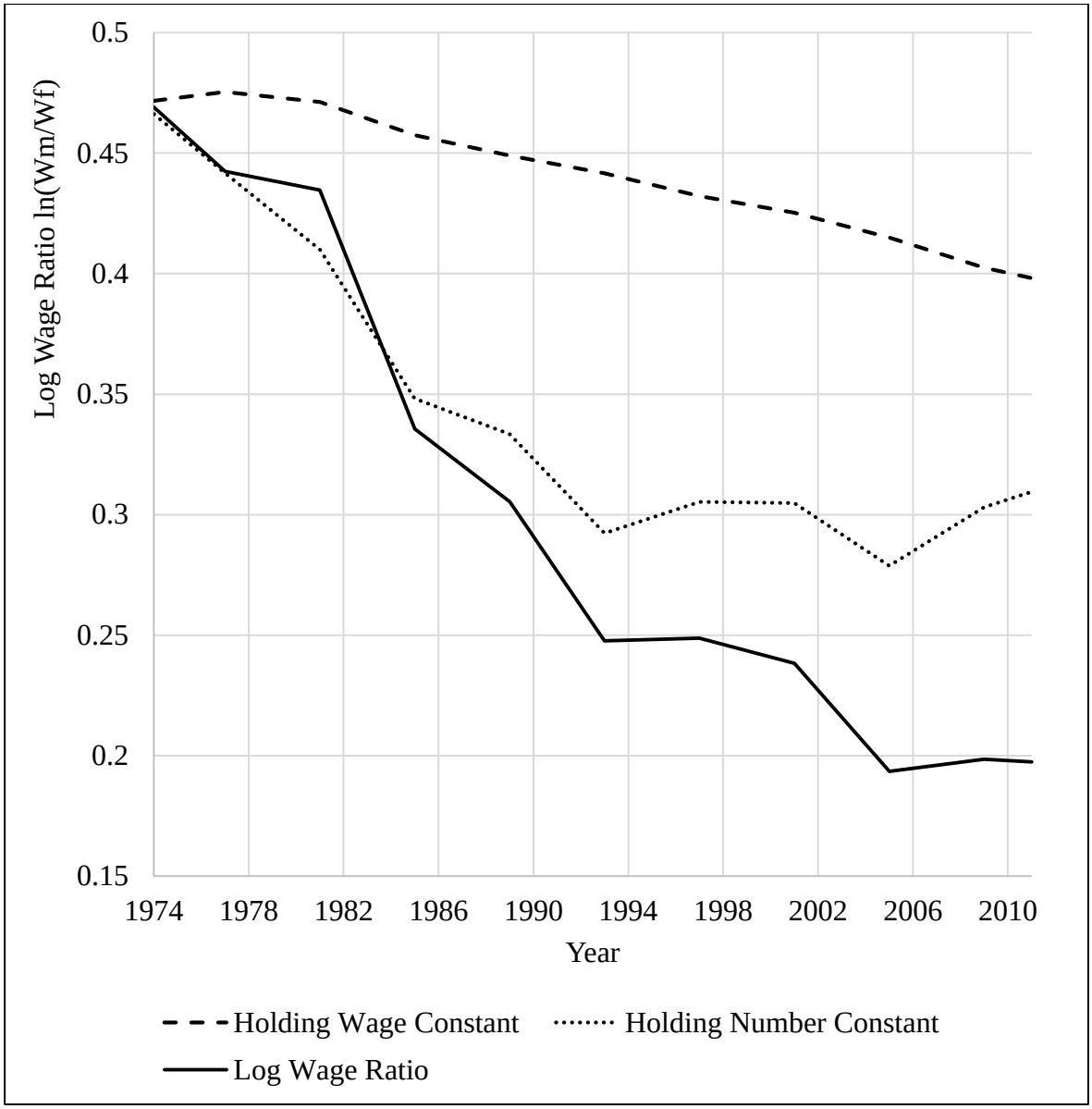
Source: Current Population Survey (multiple years)

Figure 2.2 – Comparison of Log wage Ratios for Full-Time, Year-Round, College-Educated Workers by Age and Sex with the Log Wage Ratio of Workers Aged 25 to 34 Across All Educational Levels, 1974-2011, 4-Year Averages



Data Source: Current Population Survey (multiple years)

Figure 2.3 – Changes in the Log Wage Ratio from 1974 to 2011 Holding Wages and the Proportion of Men and Women within Educational Attainment Levels Constant at 1974 Levels, 4-Year Averages



Source: Current Population Survey (multiple years)

APPENDIX D

CHAPTER 2 TABLES

Table 2.1 – Tornqvist Equation Summary Results of the Effects of Changes within Educational Attainment Levels

This table describes the aggregate change in the log wage ratio from 1974 levels that can be attributed to changes within individual educational attainment levels. I choose to show the effects of these changes at multiple stages over the course of the time period to show fluctuations in the log wage ratio, rather than simply showing the overall change during the period studied. The values within the table for each year are the total change in the log wage ratio from 1974 levels.

Year	Overall Change	Change Due to Changing Relative Wages*	Change Due to Changes in the Proportion of Men**	Change Due to Changes in the Proportion of Women***
1980	-0.1063	-0.1050	-0.0038	0.0025
1985	-0.1697	-0.1674	-0.0038	0.0015
1990	-0.1829	-0.1799	-0.0035	0.0004
1995	-0.1303	-0.1737	-0.0027	0.0461
2000	-0.1835	-0.2255	-0.0025	0.044
2005	-0.2229	-0.2613	-0.0044	0.0428
2011	-0.3458	-0.3837	-0.0043	0.0422

* This is derived from the results of equation (5):

$$\frac{1}{2}\sum_i \left[(M_{it} + F_{it})\left(\ln\left(\frac{W_{M_{it}}}{W_{F_{it}}}\right) - \ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)\right)\right]$$

** This is derived from the results of equation (6):

$$\frac{1}{2}\sum_i \left[\ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)(M_{it} - M_{i0})\right]$$

*** This is derived from the results of equation (7):

$$\frac{1}{2}\sum_i \left[\ln\left(\frac{W_{M_{i0}}}{W_{F_{i0}}}\right)(F_{it} - F_{i0})\right]$$

CHAPTER 3

HOW MUCH DOES COLLEGE MAJOR MATTER? AN ANALYSIS OF THE EFFECTS OF UNDERGRADUATE MAJOR

Understanding the returns to different college majors can help explain the portion of the gender wage gap that is attributable to students' decisions about which field to major in. There is a clear correlation between choice of college major and career. For the purposes of this analysis, I assume that students enter careers in the fields that they majored in. It is well known that the returns to majors differ between fields, however the magnitude of these differences is not always as clear. Therefore, it is important to examine the impact of undergraduate major choice and the associated returns when analyzing the overall gender wage gap.

This chapter investigates the effects of college major choice on the gender wage gap by answering the following question: *how has the gap in relative wages between college-educated men and women been affected by changes in relative compensation between majors and changes in the proportions of men and women within majors?* I begin by presenting some background information on the returns to various college majors and differences in college major choices between men and women. Then, I use a Tornqvist approximation to a shift-share analysis to estimate the magnitude of the effects that changes in college major choice and the relative wages of men and women within these majors have on the gender wage gap. It is important to recognize that the log wage ratio estimated using the Tornqvist equation may not be identical to that of the log wage ratio derived from CPS data. This is because the Tornqvist equation estimates the changes in the log wage ratio as a result of changes within majors—taking into account both wages and the proportions of men and women within majors—while the overall log wage ratio derived from CPS data incorporates

changes within majors as well as other market factors. For example, I assume that graduates will earn the mean starting salary for the field they majored in. I am unable to control for the occupational choice of students after graduation; therefore, although students may earn degrees in the same fields, they may take different career paths, and therefore may have very different salaries. Because the NACE data is reported by college major there is some correction for this; however, unobserved factors lead to the difference in the log wage ratio estimated using the Tornqvist equation and the log wage ratio derived from CPS data. Then, the difference between the log wage ratio estimated using the Tornqvist equation and the log wage ratio derived from CPS data estimates the effect of market factors. These differences are summarized in Table 3.1.

3.1 – Returns to College Major

The distribution of students between majors is not equal—women tend to be more concentrated in fields such as education, health, and psychology, while men are more prevalent in fields such as engineering, mathematics, and physical sciences. As is expected, the more technical fields have greater financial returns than less technical fields (U.S. Department of Education 2000). Brown and Corcoran (1997) find that the financial return for completing a traditionally-male field is greater for men compared to women (Brown and Corcoran 1997). Thomas and Zhang (2005) address college major choice as a significant factor affecting future earnings. They note that students who majored in fields such as business, mathematics, natural sciences, and social sciences have greater returns on their educational investments relative to students who majored in fields such as education and history; however, they recognize that there are outside factors that can influence choice of major including academic preparation (Thomas and Zhang 2005).

Goldin, Katz, and Kuziemko (2006) find that better mathematics preparation has had a positive effect on reducing the gender wage gap. Along with an increased presence of women in college beginning in the early 1970s, between 1972 and 1992 the gap in academic achievement between men and women in mathematics, science, and reading narrowed. They also find that the educational choices women are making have become much more career-oriented, potentially leading to a smaller differential in earnings (Goldin, Katz, and Kuziemko 2006).

Examining different cohorts of women attending college, Goldin (2006), finds that not only are women switching from traditionally female occupations between cohorts but also *within* cohorts which has helped narrow the gender wage gap. She attributes these changes, at least in part, to the effects of antidiscrimination legislation (Goldin 2006). Similarly, Eide (1994) finds that the gender wage gap declines as the choice of college major becomes more similar between men and women. Notably, however, he acknowledges that, even with equal proportions of men and women within majors, the gender wage gap will not disappear until there is equality in the wages of men and women within a major. He estimates that 27% of the wage gap between college graduates can be attributed to differences in choice of college major. If the wages between men and women within a major are equalized but distributions are consistent with the data, he estimates that the wage differential could decrease by as much as 40%, but a gap would remain nonetheless. His findings support the assertion that both returns to major and the distribution of men and women between majors are substantial elements of the gender wage gap (Eide 1994).

Morgan (2008) finds that weekly earnings for women across all majors are 0.051 log points lower than earnings for men. When controlling for occupation, this effect is nearly

halved, with weekly earnings for women being 0.028 log points lower than men. Furthermore, she finds that the effects of college major choice become larger for more advanced degrees. For those whose highest degree is a bachelor's degree, she estimates that 40% of the wage gap can be attributed to college major choice; however, she estimates that up to 70% of the gender wage gap can be attributed to college major choice for those with advanced degrees (Morgan 2008).

An interesting approach to understanding returns to college major is presented by Roksa and Levey (2010). They find that the level of occupational specificity associated with a major—which refers to how closely a major is tied to labor force opportunities—has lasting impacts on future earnings. They define majors to have one of three levels of occupational specificity: (1) high—e.g., fields such as education and health; (2) moderate—e.g., fields such as business, engineering, and computer science; and (3) low—e.g., fields such as the humanities, biological and physical sciences, and the social sciences. They find that the relationship between occupational specificity, career growth, and earnings over time is significant. In fields with high occupational specificity, graduates experience higher levels of both starting earnings and a higher proportion of individuals with some college education, but experience the lowest growth in those areas. Conversely, graduates in fields with low occupational specificity begin their careers with lower proportions of individuals with at least some college education and lower earnings levels, but experience the fastest growth (Roksa and Levey 2010).

3.2 – Gender Distributions by Major

The concept of "traditionally male" and "traditionally female" fields as determined by gender stereotypes has led to a dramatic difference in the distribution of men and women

between majors. Bobbit-Zeher (2007) finds that although distribution of men and women within majors has gotten more equal, since the mid-1980s this progress has stalled and integration stagnated. She notes that women with bachelor's degrees who are working full-time after graduation earn an average of 17% less than their similarly-educated male colleagues. 39% of this gap can be attributed to the percentage of women within a major, another 10% to cognitive differences measured by standardized test scores, and 4% to school selectivity. When controlling for factors such as major, cognitive ability, and educational institution attended, the overall gender wage gap is only reduced by 36%, resulting in women continuing to earn less than comparable men (Bobbit-Zeher 2007).

The index of dissimilarity determines the percentage of individuals—men or women—who would need to change majors in order to equalize the distribution of men and women across majors. Equation (11) below shows how the segregation index is computed.

(11) $Segregation\ Index = \frac{1}{2} \sum_i |M_i - F_i|$

In the above equation, M_i and F_i are the proportions of men and women within major i, respectively. In Figure 3.1, I present changes in the index of dissimilarity between 1967 and 2011. There are two elements of this graph. The first is the index of dissimilarity using a disaggregated set of college majors. Second, I recalculate the index of dissimilarity using the classification of majors that had NACE data available in 1967. This controls for the effect that adding more majors has on the index, which can be clearly seen by the difference in the two lines in Figure 3.1. The full taxonomy of how I categorized majors added after 1967 into the original set is described in Table 3.2. As the figure shows, there was a significant downward trend in the segregation index from 1967 to 1986. The level then rose until about 1991 when it began to stagnate. Since then, it has fluctuated around an average level of 30.5.

This indicates that 30.5% of men (or women) would need to switch majors in order for there to be an equal distribution of men and women across majors. These conclusions are in comparison to the trend that the aggregated index of dissimilarity shows of a consistent decline until 2000, when it began to stagnate around 18.5—a full 12 points lower than the disaggregated index. This is an expected finding due to the functional form of the index of dissimilarity. Because the index is calculated over *i* categories (in this case, college majors) the larger the index, the higher the index of dissimilarity is expected to be. As more detail is added to the index, the differences between men and women will rise unless men and women are equally distributed across the categories.

One of the interesting aspects of the distribution of men and women between majors is that factors other than financial gains affect preferences. Non-financial aspects such as parental approval and the ability to balance work and family obligations explain about 85% of college major choices for women but only 55% for men. This is not to suggest that financial returns to college major are unimportant. In fact, the explanatory power of financial returns are four times as large as non-financial aspects for men, while these two aspects are of equal value for women. Additionally, the importance of expectations and preferences varies between majors. For example, the distribution of men and women in fields such as literature, fine arts, and economics is primarily impacted by beliefs about enjoyment of a subject, the potential for successfully balancing work and family obligations, and ability in a field. Fields such as English and social sciences, however, are more heavily influenced by expectations of post-graduation outcomes such as income (Zafar 2012).

Differences in academic ability is a common explanation for differences in the distribution of men and women. Zafar (2012) finds that differences in perception of ability

are insignificant factors in affecting differences in choice of college major and that equalizing the expectations of men and women would have a relatively small effect on the distribution (Zafar 2012). Similarly, Turner and Bowen (1999) estimate that less than 50% of the difference in choice of major between fields can be explained by differences in SAT scores. This is an important finding, demonstrating that the effect of SAT scores is not the primary factor in determining college major choice; rather, other factors such as preferences and expectations about labor market conditions and future labor force participation are more important factors (Turner and Bowen 1999). Conversely, Polachek (1978) finds that sorting into different college majors is a function of ability independent of sex. Specifically, he concludes that quantitative ability is a predictor of college major: those with greater ability are more likely to enter the math, science, or engineering fields (Polachek 1978).

Lewis and Oh (2009) find that there is little effect of men and women switching majors on the overall gender wage gap. They estimate that approximately 25% of the gender wage gap can be explained by college major choice, a fraction that remained relatively constant from 1983 to 2003. Even though the dissimilarity index has decreased, there has been a minimal effect on the gender wage gap overall for which the authors offer two explanations. First, they suggest that although proportions of men and women are becoming more similar in some fields, they are not doing so in majors that will ultimately affect the overall gender wage gap. Alternatively, they suggest that relative pay between men and women in certain fields has dropped due to women entering those fields. In analyses where they hold wages by major constant and then hold the distribution of men and women within majors constant, they find that the net effect of changes in relative wages and men and

women switching majors affects overall changes in pay but not the gender wage gap overall (Lewis and Oh 2009).

3.3 – Data

The data used in this chapter come from a number of different sources. First, all data on the starting salaries for men and women is from the National Association of Colleges and Employers (NACE). Data on completions come from the United States Department of Education, with data acquired through both the Integrated Postsecondary Education Data System (IPEDS) and the Higher Education General Information Survey (HEGIS).

There are two years—1970 and 1983—for which data from the Department of Education is not available. Therefore, I omit these years from my analysis. Furthermore, the coding of completions by major by the Department of Education is changed multiple times throughout the period studied. To address this issue, I created a system for coding Department of Education completion data to match the majors for which NACE wage data is available in a given year. This alleviates issues with missing wage data for individual majors in some years because I only code the completions data into the majors for which I have wage data. In years where there is only wage information for one gender in a particular major, I discard that major from the set and code the completions data into another major. For example, if in a particular year there is only data on wages for male agricultural engineering degrees, I would code all agricultural engineering degrees—male and female—under the more general engineering category. This method prevents me from having to drop any observations due to missing data. Additionally, for the years between 1967 and 1973, NACE wage data for women are reported by position rather than college major. To account

for this, I created a taxonomy between positions and college major which is described in detail in Table 3.3.

I do not differentiate between first and second majors, so there are some schools that have greater numbers of degrees awarded than individuals graduating. I do this because it is difficult to know what field students who earn two degrees enter.

3.4– Methods

Similar, I use a Tornqvist shift-share equation to estimate the effect of changes in the relative wages of men and women within majors and changes in the proportions of men and women within majors on the overall log wage ratio. Equation (12) presents the Tornqvist shift share equation and equations (13), (14), and (15) decompose equation (12) into three parts.

$$(12)\ \Delta \ln\left(\frac{W_{M_{ct}}}{W_{F_{ct}}}\right) = \frac{1}{2}\sum_j \left[\left(M_{cjt} + F_{cjt}\right)\ln\left(\frac{W_{M_{cjt}}}{W_{F_{cjt}}}\right) - \left(M_{cj0} + F_{cj0}\right)\ln\left(\frac{W_{M_{cj0}}}{W_{F_{cj0}}}\right)\right] + Residual$$

$$(13)\ Change\ Due\ to\ Relative\ Wages = \frac{1}{2}\sum_j \left[\left(M_{cjt} + F_{cjt}\right)\left(\ln\left(\frac{W_{M_{cjt}}}{W_{F_{cjt}}}\right) - \ln\left(\frac{W_{M_{cj0}}}{W_{F_{cj0}}}\right)\right)\right]$$

$$(14)\ Change\ Due\ to\ Men = \frac{1}{2}\sum_j \left[\ln\left(\frac{W_{M_{cj0}}}{W_{F_{cj0}}}\right)\left(M_{cjt} - M_{cj0}\right)\right]$$

$$(15)\ Change\ Due\ to\ Women = \frac{1}{2}\sum_j \left[\ln\left(\frac{W_{M_{cj0}}}{W_{F_{cj0}}}\right)\left(F_{cjt} - F_{cj0}\right)\right]$$

Equation (13) models the effect of changes in the relative wages of men and women within a major by using the proportion of men and women in major *j* in year *t* and calculating the change in the overall log wage ratio from the base year. Equations (14) and (15) model the effects of changes in the proportions of men and women within majors, respectively, by

using the relative wages of men and women at base year levels and calculating the change in the overall log wage ratio that results from the changing proportions of men and women. Then, equation (16) is a decomposition of equation (12) incorporating equations (13), (14), and (15).

$$(16)\ \Delta \ln\left(\frac{W_{M_{ct}}}{W_{F_{ct}}}\right) = \frac{1}{2}\sum_j \left[\ln\left(\frac{W_{M_{cj0}}}{W_{F_{cj0}}}\right)\left(F_{cjt} - F_{cj0}\right)\right] + \frac{1}{2}\sum_j \left[\ln\left(\frac{W_{M_{cj0}}}{W_{F_{cj0}}}\right)\left(\left(M_{cjt} - M_{cj0}\right) + \left(F_{cjt} - F_{cj0}\right)\right)\right]$$

In the above equations, the index on the summation sign is the college major (j=1…M). Each major is considered to be a "level" in itself, so depending the year of data used, M ranges in size. $W_{M_{ct}}$ represents the average wage of college-educated men across all colleges in year t and $W_{F_{ct}}$ is the average wage of college-educated women across all colleges in year t. The average wage for college-educated men and women in major j in year t are represented by $W_{M_{cjt}}$ and $W_{F_{cjt}}$ respectively. The proportions of men and women in major j in year t are represented by M_{cjt} and F_{cjt}. Similar to the previous chapter, the following equality holds $\sum_j W_{M_{cjt}} = 1 = \sum_j W_{F_{cjt}}$.

I also conduct analyses first by holding the proportions of men and women within majors constant at 1967 levels and allowing wages to fluctuate in accordance with true values and then by holding relative wages within majors constant and allowing the proportions of men and women to fluctuate.

3.5– Results and Discussion

Using the Tornqvist equation I am able to estimate the effect of changes in relative wages within majors and changes in the proportions of men and women within majors on the overall log wage ratio. I find that the effect of changes in relative wages of men and women

within majors is much greater than the change due to men and women changing majors. Figure 3.2 shows what the overall log wage ratio would have been if all graduates in the same were to earn the mean wages for their major and compares it to the log wage ratio for college-educated individuals between the ages of 25 and 34. As the figure shows, the log wage ratio derived from the NACE data remained relatively stagnant around 14% beginning in 1976 after a significant decline, while the CPS data show a greater amount of fluctuation and remain consistently higher than the NACE log wage ratio.

Table 3.3 provides a summary of the magnitude of the effects of changes in the proportion of men and women within college majors and changes in the relative returns to majors on the overall log wage ratio between men and women. As the results show, since 1967, the overall log wage ratio has decreased by 0.076. What is notable about this decrease, however, is that, in 1995, the log wage ratio had decreased by 0.166 from its 1967 level, but increased significantly in the following years. Another interesting finding is that, although the net effect of changes in the log wage ratio due to changes in the proportions of men and women within majors contributed an increase of only 0.004 to the log wage ratio, the effect of changes in the proportion of women within majors accounted for less than an a 0.001 decrease in the log wage ratio, but the effect of men switching majors actually increased the log wage ratio. Similar to the results found in Chapter 2, the majority of the change in the log wage ratio between men and women is attributable to changes in the relative wages between men and women within majors rather than changes in the proportions of men and women.

Results of the analyses where wages and the proportions of men and women within majors were held constant are presented in Figure 3.3. As the figure shows, the effect of changing proportions of men and women within majors leads to a decrease in the log wage

ratio of approximately 7% while the effect of changing relative wages decreases the log wage ratio by approximately 10% despite an initial decrease in the log wage ratio of approximately 20% between 1967 and 1988.

Figure 3.4 presents the data on the distribution of men and women by field in 1967 and 2011. This figure demonstrates the distribution of men and women across fields over time to better understand changes in the choice of college major by men and women. In general, between 1967 and 2011, there was not a significant change in the distribution of men across fields. Conversely, the distribution of women, especially in business and science, increased dramatically. These results indicate that, while men did not significantly change the fields they chose to major in, the changes in choice of major by women were dramatic. Additionally, Figure 3.5 shows the percentage of men and women within fields. The fields in which the percentage of women has increased most significantly are engineering and business. Finally, it is important to make a distinction between the results presented in Figures 3.4 and 3.5. While Figure 3.4 shows the distribution of men and women across majors, Figure 3.5 shows the relative number of men and women within individual fields.

The results of these analyses are surprising given the attention devoted to increasing the number of women in the STEM fields. One would expect that with more women entering non-traditional fields, there would be a substantial decrease in the gender wage gap; however, this is not what the data show. One possible explanation for the small change in the overall gender wage gap despite changes in choice of major by both men and women is that, for each woman who moves to a field with a higher expected starting salary, there must be a movement of more than one man to a traditionally-female major. For example, if one woman graduating in 2011 switched from elementary education to mechanical engineering, there

would be a $27,424 increase in the total earnings of women[4]. In order to equalize this financial gain, 1.41 men would need to switch from mechanical engineering to elementary education[5]. Figure 3.6 shows changes in the log wage ratio of mean starting salary by field between 1967 and 2011. The humanities and social science, business, and science fields all follow similar trends during this time period. These fields experience a decrease in the log wage ratio until the mid-1980s when the log wage ratio began to stagnate around a 5% premium in wages for men compared to women. Interestingly, from about 1970 to 2007, women had higher predicted mean starting salaries within engineering, but that trend has since reversed.

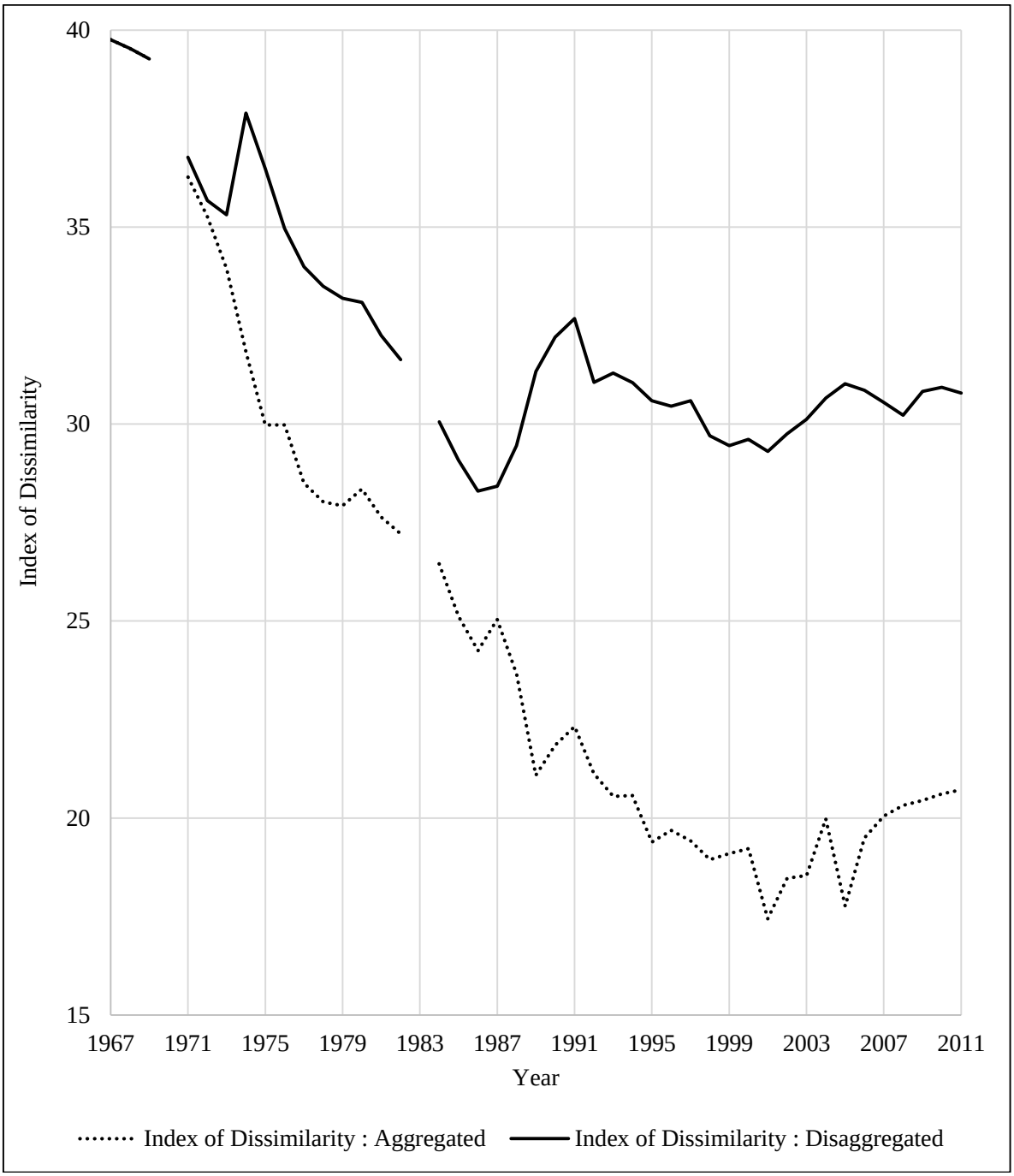
In conclusion, much of the change in the log wage ratio that is attributable to college major choice is due to changes in the relative wage of men and women within majors rather than changes in the proportions of men and women within majors despite the fact that the data show significant changes in choice of major, particularly for women.

[4] This increase is calculated by taking the average starting salary for women in mechanical engineering and subtracting the average salary for women in elementary education.
[5] This is calculated by dividing the difference in average earnings for men between education and mechanical engineering and dividing that by the increase in earnings realized by woman from one woman switching from elementary education to mechanical engineering.

APPENDIX E

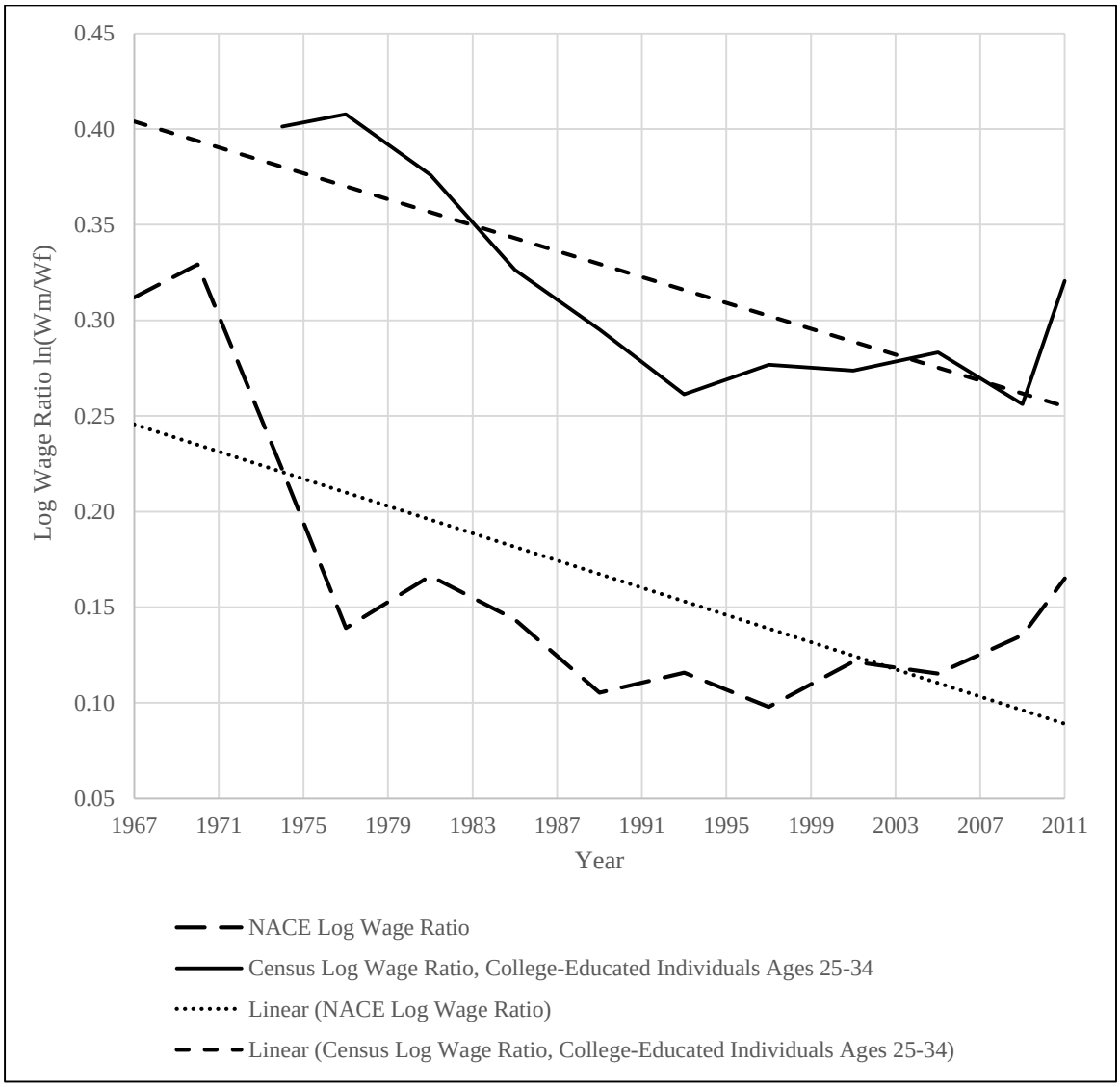
CHAPTER 3 FIGURES

Figure 3.1 –Index of Dissimilarity for College Majors, 1967-2011



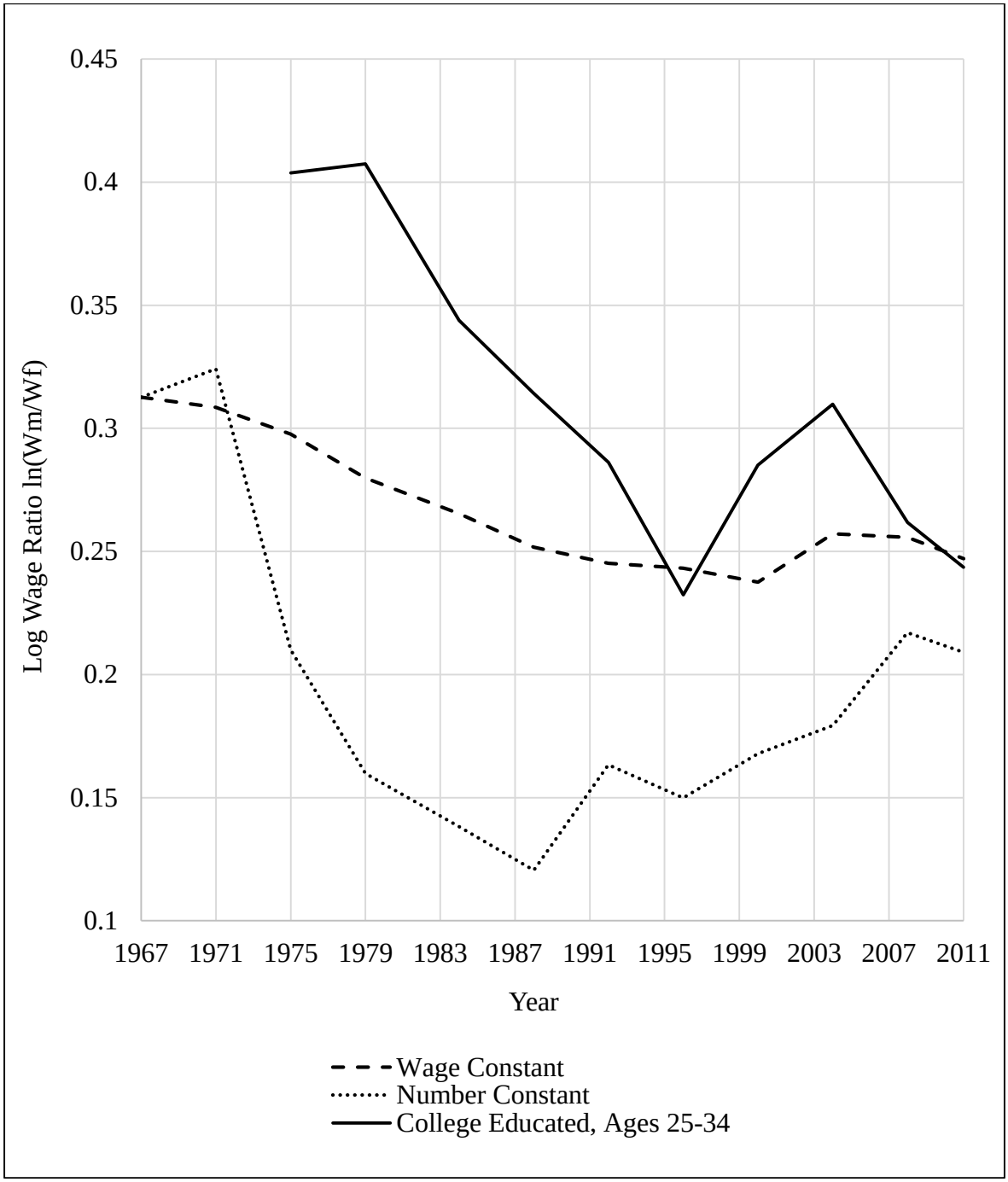
Source: U.S. Department of Education (HEGIS and IPEDS)

Figure 3.2 – Comparison of the Log Wage Ratio Using NACE Wage Data with CPS Data, 1967-2011, 4-Year Averages



Data Sources: U.S. Department of Education (HEGIS and IPEDS); NACE

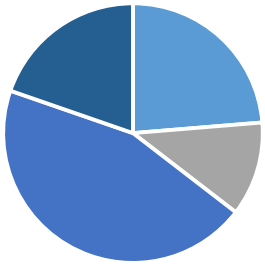
Figure 3.3 – Changes in the Log Wage Ratio from 1967 to 2011 Holding Wages and the Proportion of Men and Women within Majors Constant at 1974 Levels, 4-Year Averages



Sources: U.S. Department of Education (HEGIS and IPEDS); NACE

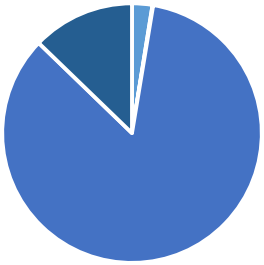
Figure 3.4 – Comparison of the Distributions of Men and Women by Field in 1967 and 2011

Distribution of Men, 1967



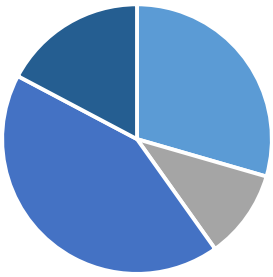
- Business (23.69%)
- Engineering (11.75%)
- Humanities and Social Sciences (44.85%)
- Sciences (19.70%)

Distribution of Women, 1967



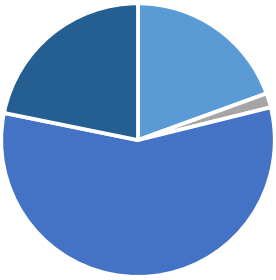
- Business (2.53%)
- Engineering (0.08%)
- Humanities and Social Sciences (84.61%)
- Sciences (12.77%)

Distribution of Men, 2011



- Business (29.47%)
- Engineering (10.69%)
- Humanities and Social Sciences (42.58%)
- Sciences (17.26%)

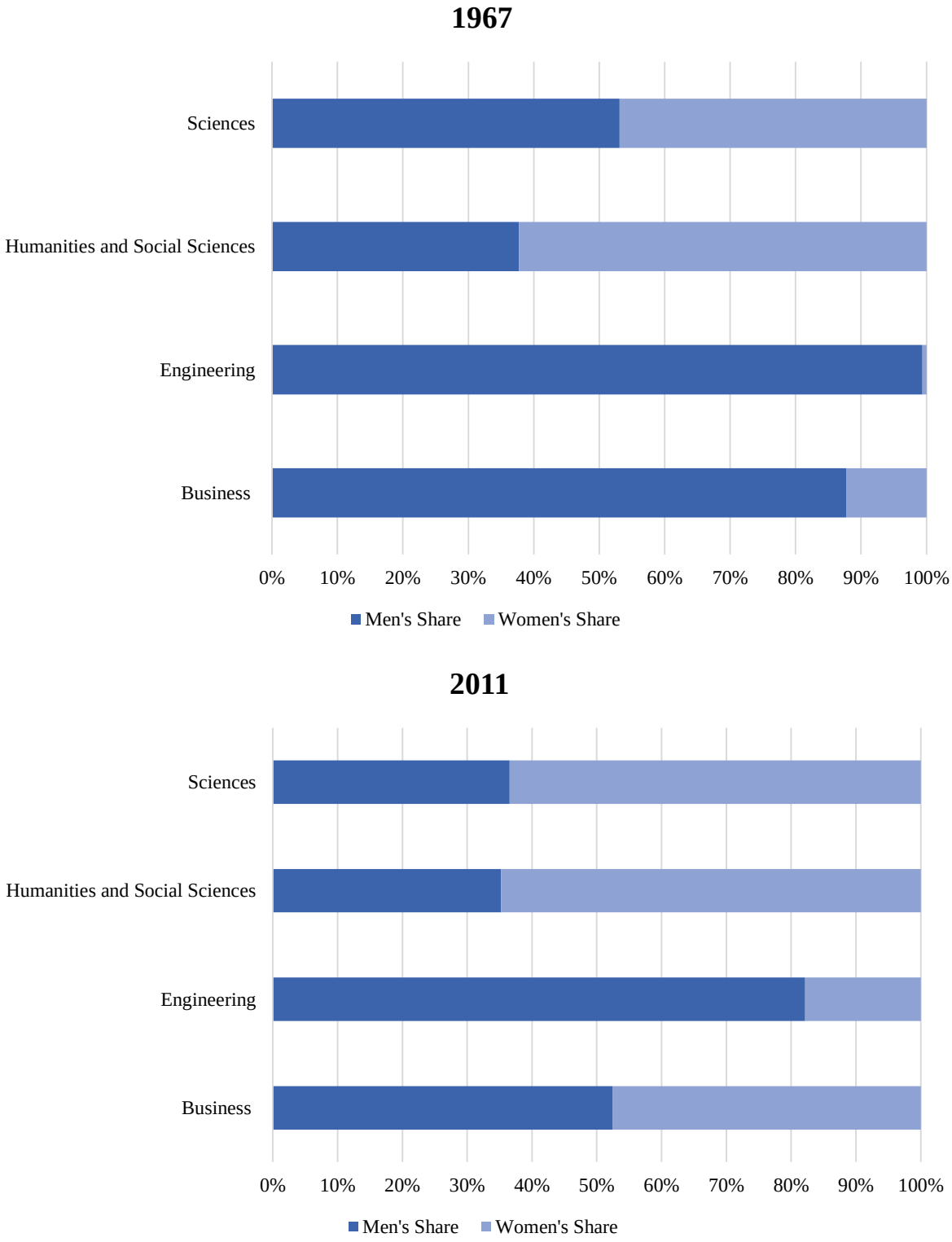
Distribution of Women, 2011



- Business (19.46%)
- Engineering (1.69%)
- Humanities and Social Sciences (57.04%)
- Sciences (21.81%)

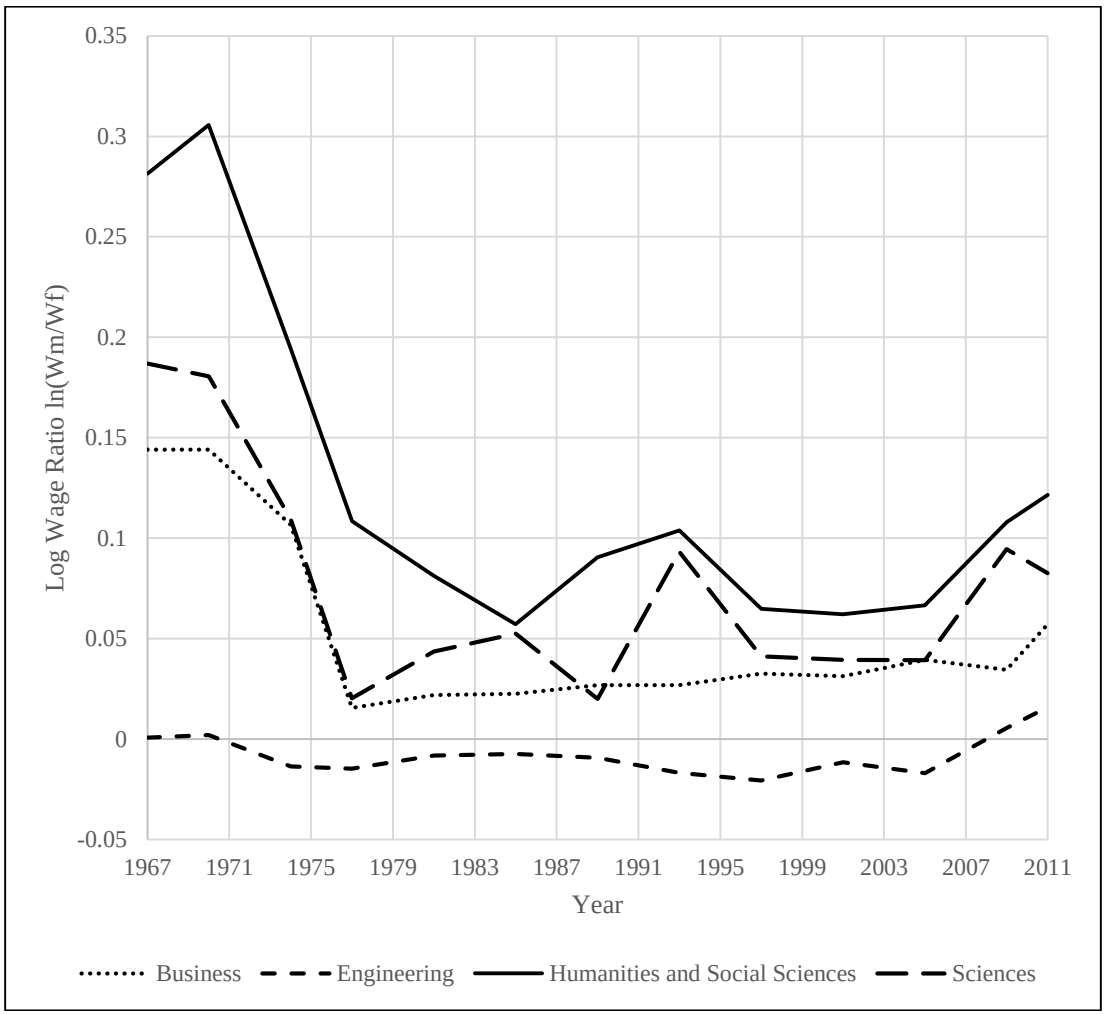
Data Source: U.S. Department of Education (HEGIS and IPEDS)

Figure 3.5 – Comparison of the Percentage of Men and Women within Fields in 1967 and 2011



Data Source: U.S. Department of Education (HEGIS and IPEDS)

Figure 3.6 – Changes in the Log Wage Ratio by Field, 1967-2011, 4-Year Averages



Data Source: NACE

APPENDIX F

CHAPTER 4 TABLES

Table 3.1 – Differences in the Log Wage Ratio between Sources

This table describes the difference between the log wage ratio derived from the CPS data and the log wage ratio estimated by the Tornqvist equation.

Year	Log Wage Ratio, College Educated Individuals, Ages 25-34 (CPS)	Log Wage Ratio (Tornqvist)	Difference
1974	0.4691	0.1418	0.3273
1975	0.4290	0.1436	0.2854
1976	0.4255	0.1373	0.2881
1977	0.4460	0.1334	0.3125
1978	0.4501	0.1650	0.2851
1979	0.5320	0.1549	0.3771
1980	0.3867	0.1680	0.2187
1981	0.3701	0.1772	0.1930
1982	0.3572	0.1415	0.2158
1983	0.3324	--	--
1984	0.3386	0.1489	0.1897
1985	0.3142	0.1401	0.1741
1986	0.3159	0.1379	0.1780
1987	0.3106	0.0860	0.2246
1988	0.3121	0.0824	0.2297
1989	0.2826	0.1149	0.1677
1990	0.2684	0.1164	0.1520
1991	0.2473	0.1223	0.1249
1992	0.2406	0.1236	0.1170
1993	0.2343	0.1007	0.1336
1994	0.2368	0.0990	0.1378
1995	0.2781	0.0747	0.2034
1996	0.2489	0.0965	0.1523
1997	0.2313	0.1215	0.1098
1998	0.2251	0.1142	0.1109
1999	0.2742	0.1162	0.1580
2000	0.2716	0.1213	0.1503
2001	0.1826	0.1343	0.0483
2002	0.2097	0.1125	0.0972
2003	0.1687	0.1072	0.0615
2004	0.1831	0.1231	0.0600

Table 3.1—Continued

Year	Log Wage Ratio, College Educated Individuals, Ages 25-34 (CPS)	Log Wage Ratio (Tornqvist)	Difference
2005	0.2125	0.1184	0.0942
2006	0.2268	0.1213	0.1055
2007	0.1704	0.1326	0.0379
2008	0.2194	0.1455	0.0739
2009	0.1776	0.1422	0.0354
2010	0.2031	0.1635	0.0396
2011	0.1916	0.1664	0.0252

Data Source: Current Population Survey (Multiple Years)

Table 3.2 – Taxonomy of Aggregating Majors

For each of the groupings of majors, 1967 major is bolded and other majors that were included in the NACE data in subsequent years are listed below the original major. For the purposes of my analysis, when using aggregated data on majors, I use the bolded categories which include any majors added after 1967.

Business
Human Resources
International Business
Distribution Management
Management Info. Systems
Marketing
Real Estate
Institutional Management
Accounting and Computer Science

Accounting
Economics
Finance
Agribusiness

Business Admin

Engineering
Agricultural Engineering
Architectural Engineering
Biomedical and Bioengineering
Computer Engineering
Engineering Technology
Industrial Technology
Materials Engineering
Nuclear Engineering (incl. Engrg. Physics)
Ocean Engineering
Petroleum Engineering
Software Engineering
Systems Engineering
Textile Engineering
Mining
Construction Science

Aerospace and Aeronautical and Astronautical Engineering

Chemical Engineering
Civil Engineering (incl. Construction, Sanitary, & Transportation Engrg.)

Electrical Engineering

Environmental Engineering

Industrial Engineering

Mechanical Engineering

Metallurgical Engineering (incl. Metallurgy & Ceramic Engrg.)

Humanities and Social Sciences
Communications
Advertising
Broadcast Journalism
Communications
Journalism
Public Relations
Telecommunications
Education
Elementary Education
Physical Education
Pre-Elementary Education
Secondary Education
Special Education
Specific Academic/Vocational Teacher Education
Textiles & Clothing
Home Economics
Criminal Justice
Foreign Languages
History
Liberal Arts & Sciences/General Studies

Table 3.2—Continued

Humanities and Social Sciences (continued)

Liberal Arts & Sciences/General Studies
Humanities
Other Social Sciences
Political Science/Government
Psychology
Social Work
Sociology
Visual & Performing Arts
Letters (incl. English, Lit.)
Parks/Recreation, Leisure/Fitness Studies & Related Programs

Sciences

Computer Sciences
Computer Programming
Computer Science
Systems Analysis
Information Sciences & Systems
Health Sciences

Health Sciences
Nursing
Architectural and Environmental Design
Biological Sciences
Geological
Agricultural Sciences
Mathematics and Computer Science
Natural Resources
Plant Sciences
Animal Sciences
Agriculture and Natural Resources

Chemistry

Mathematics

Actuarial Science

Other Physical & Earth Sciences

Environmental Sciences
Physics

Table 3.3 – Taxonomy of Positions to College Major for Women, 1967-1973

Position	1967 Major Classification
Accountant/Auditor	Accounting
Air Stewardess/Reservationist	Humanities and Social Sciences
Artist/Designer	Humanities and Social Sciences
Business (General) Trainee	Business--General (incl. mgmt.)
Communications	Business
Community/Service Organization Worker	Humanities and Social Sciences
EDP Program/Systems Analyzer	Sciences
Educational Administrator	Humanities and Social Sciences
Engineer	Engineering
Home Economist/Dietician/Home Service Representative	Humanities and Social Sciences
Language Specialist	Humanities and Social Sciences
Library Intern	Humanities and Social Sciences
Mathematician/Statistician	Mathematics
Medical Worker	Sciences
Merchandise/Sales Promotion Trainee	Business
Research Assistant--Non-Scientific	Humanities and Social Sciences
Research/Lab Assistant--Scientific	Sciences
Secretary/Receptionist	Humanities and Social Sciences
Writer/Editor/Public Relations	Humanities and Social Sciences

Table 3.4 – Tornqvist Equation Summary Results of the Effects of Changes within College Majors

The values within the table are the total changes in the log wage ratio from 1967 levels that are attributable to changes within majors.

Year	Overall Change	Change Due to Wages	Changes in the Proportion of Men	Changes in the Proportion of Women
1970	0.0333	0.0327	0.0008	-0.0001
1975	-0.1024	-0.1030	0.0020	-0.0013
1980	-0.0930	-0.0841	-0.0023	-0.006
1985	-0.1367	-0.1222	-0.0047	-0.0098
1990	-0.1499	-0.1395	-0.0020	-0.0083
1995	-0.1657	-0.1606	0.0005	-0.0056
2000	-0.1643	-0.1594	0.0008	-0.0056
2005	-0.1501	-0.1507	0.0010	-0.0004
2011	-0.07629	-0.0806	0.0045	-0.0001

Data Sources: U.S. Department of Education (HEGIS and IPEDS); NACE

CHAPTER 4

HOW MUCH DOES CHOICE OF COLLEGE MATTER? AN ANALYSIS OF THE EFFECTS OF INSTITUTIONAL QUALITY

There are numerous factors students consider when deciding which college or university to attend: Is a school public or private? Where is it located? What are the academic credentials of the incoming class? What services does the school have to help students? All of these factors—and many more—are taken into consideration when deciding which school to attend and, ultimately, the decision of which school to attend can have long-term impacts on future earnings.

In this chapter I develop a unique college quality coefficient based on graduates' earnings relative to the market norm wage for a school's educational offerings and address the following question: *how does institutional quality affect the earnings of college graduates in their initial years in the labor force?* I begin by presenting some background information on the effects of college quality on earnings as well and discuss school selectivity. Then, I derive an institutional quality coefficient, create a new ranking of colleges and universities, and compare my findings to published rankings.

4.1 – College Selectivity and Institutional Quality

One factor that influences future earnings of students is the selectivity of the college or university they attend. Thomas and Zhang (2005) state that "graduates from more prestigious, more selective, and higher academic quality colleges enjoy small but significant wage premiums relative to peers graduating from less academically distinctive institutions" (Thomas and Zhang 2005). Furthermore, the effect of college quality on earnings is delayed—that is, immediately upon graduation and in the early stages of a person's career, college quality has a minimal impact; however, later in one's career stronger effects can

emerge (Thomas and Zhang 2005). Similarly, Long (2010) finds that attending a higher-quality institution has a positive effect on log-annual earnings ten years after high school for men, but that the effect is insignificant for women (Long 2010).

When controlling for background characteristics, going to a school one standard deviation above the mean can have significant impacts on earnings for both men and women, although these results are not equal in magnitude. For men, a one-standard-deviation increase in institutional quality as measured by annual earnings can result in an 8.1% increase in annual earnings; however, for women, this increase is even larger at 17.4%. Interestingly, the institutional characteristics that impact the returns to an education at particular institutions are different for men and women. For men, selectivity of the school has a positive effect on annual earnings as does attending large, private, research-oriented institutions. For women, selective institutions, schools located in the mid-Atlantic or New England regions, and large schools have higher annual earnings among graduates (U.S. Department of Education 2000).

James et al. (1989) also find an effect of institutional choice on future earnings. While the selectivity of a school is not statistically significant, some of the factors that contribute to how selective a school is are significant. For example, graduates from schools with higher average SAT scores are expected to have higher earnings than graduates from schools with lower average scores. Long (2008) finds that a one-standard-deviation increase in median SAT scores at an institution are insignificant in affecting log-hourly earnings, but that moving from the bottom quartile to the top quartile of scores increases earnings for men but this result is insignificant for women (Long 2008).

Examining other factors affecting institutional quality, Long (2008) finds that the effect of the student-faculty-ratio is insignificant for both men and women, suggesting that

the availability of faculty members is not a factor in predicting future earnings. He finds that the overall quality of a school has a positive impact on log-hourly earnings for men, but that the effect is insignificant for women (Long 2008). Black and Smith (2004) estimate that individuals realize between a 12% and 17% increase in earnings as a result of switching from a college in the bottom quartile of the quality distribution to one in the top quartile. The authors recognize, however, that some of the financial returns for attending a higher-quality institution may partially be an effect of more higher-ability students sorting into higher quality institutions (Black and Smith 2004).

4.2 – Data

Again, the data used in this chapter come from a variety of sources. First, all data on institutional characteristics come from the United States Department of Education Integrated Postsecondary Education Data System (IPEDS). Data on school-specific starting salaries come from PayScale, a company that provides data and reports about school-specific, major-specific, and career-specific salaries.

The gender-specific starting salaries for individual schools come from a special-access data set that was provided by PayScale. The original data set included the 500 largest undergraduate institutions by the number of enrolled undergraduate students during the 2011-2012 academic year. From that data set, 77 institutions were dropped as a result of not having data on gender-specific starting salaries.

4.3 – Methods

College wages for each institution *k* are some function of the quality of the institution and the composition of students within majors at that institution. Equation (17) demonstrates this.

(17) $College\ Wage = f(institutional\ quality, composition\ of\ majors)$

The wages for each institution change yearly, something I attribute to changes in wages for individual majors and changes in the composition of students between majors, rather than changes in institutional quality. To begin, I estimate a predicted wage for graduates in college *k* in year *t*, assuming that graduates earn the mean pay for their major. I call this wage the college's "norm" wage. The derivation of the norm wage is described in equations (18), (19), and (20).

(18) $W_{mkt}^{N} = \frac{M_{kit} \times W_{mi}}{M_{kt}}$

(19) $W_{fkt}^{N} = \frac{F_{kit} \times W_{fi}}{F_{kt}}$

(20) $W_{kt}^{N} = \ln\left[\frac{(M_{kt} \times W_{mkt}^{N}) + (F_{kt} \times W_{fkt}^{N})}{(M_{kt} + F_{kt})}\right]$

In the above equations, W_{mkt}^{N} is the norm wage for men at college *k* at time *t*. Similarly, W_{fkt}^{N} is the norm wage for women at college *k* at time *t*. The number of male and female graduates from college *k* in major *i* at time *t* are represented by M_{kit} and F_{kit} respectively, while M_{kt} and F_{kt} are the number of male and female graduates from college *k* at time *t*. Finally, W_{mit} and W_{fit} represent the mean wages for male and female students in major *i* at time *t* across all colleges.

The observed average log wage for a college reported by PayScale, W_{kt}, may be higher or lower than the market norm wage depending on college quality. Equation (21) shows how the observed average log wage for college *k* is calculated and equation (22) describes how the institutional quality coefficient for college *k* is calculated.

(21) $W_{kt} = q_k W_{kt}^{N} = q_k \ln\left[\frac{(M_{kt} \times W_{mkt}^{N}) + (F_{kt} \times W_{fkt}^{N})}{(M_{kt} + F_{kt})}\right]$

(22) $q_k = W_{kt} - W_{kt}^{N}$

4.3.1 – The Model

The following model is used to estimate the effect of various school characteristics on the institutional quality coefficient:

(23) $q_k = \delta_0 + \delta_1 \boldsymbol{X}_k + \delta_2 \boldsymbol{S}_k + \delta_3 \boldsymbol{F}_k + \delta_4 \boldsymbol{L}_k + \varepsilon_k$

In equation (23) $\boldsymbol{X}_k$ is a vector of institutional and admissions characteristics, $\boldsymbol{S}_k$ is a vector of student characteristics, $\boldsymbol{F}_k$ is a vector of faculty characteristics, $\boldsymbol{L}_k$ is a vector of dummy variables indicating geographic region, and ε_i is the error term.

Equation (23) is estimated for two different cohorts. The first cohort is comprised of 985 schools for which the average wage is reported by PayScale. The second cohort is smaller, comprised of 443 schools for which I have the male and female specific data from PayScale. By estimating the coefficients of the model described in equation (23) for men and women separately I am able to determine if there are differences in the determinants institutional quality between men and women at the same school.

4.3.2 – Creating a New Raking System

Another important part of this analysis was to create a new ranking of colleges using the derived institutional quality coefficient, q_k, described above and then to compare that ranking to published ones by Forbes and U.S. News and World Report. I choose to present these rankings as percentages, where a value of 1 is the highest ranking attainable—i.e. the best school—and a ranking of 0 is the worst. I present the results this way because the number of schools included in the rankings varies by source and using percentages allows me to more easily compare rankings across sources.

4.4 – Results and Discussion

4.4.1 – Regression Results and Discussion

To determine the factors contributing to institutional quality, I conducted regression analyses using the derived institutional quality coefficient as the dependent variable. The results of the regression using average wages for men and women combined are presented in Table 4.1. Male and female specific regression results are presented in Tables 4.2 and 4.3, respectively. Additionally, Table 4.4 presents a comparison of the regression coefficients for men and women which are estimated using a female interaction term to determine if the effects of the independent variables are different from each other with statistical significance.

The coefficients can be interpreted as the effect that each independent variable has on the difference between actual and predicted starting salaries for students from each institution. A positive coefficient indicates that starting salaries for graduates from a school are greater than that of the predicted salary for the school (the norm wage)—indicating a premium for attending a particular school. Conversely, a negative coefficient indicates that the norm wage is greater than that of the average salary that earned by graduates from that school—in other words, there is effectively a financial penalty for attending that school

As Table 4.1 shows, 30.8% of institutional quality can be explained by the independent variables. In the full model, a greater percentage of students who are non-white (except for an increased number of Black or African-American students) has a positive effect on the institutional quality coefficient. A higher student-faculty ratio negatively impacts the institutional quality coefficient. This may be partially attributable to the effect of faculty availability on student outcomes: having greater access to faculty members may improve academic performance, potentially impacting post-graduation outcomes. Attending a private

for-profit institution has a negative impact on institutional quality, yet the effect of attending a private non-profit institution is insignificant. As is discussed in the literature (e.g. Chung 2012), this may be attributable to the composition and academic ability of students at private for-profit institutions rather than a reflection of other characteristics of those institutions. Finally, it is interesting to examine the effects of location on institutional quality. The results show that there is a negative effect of attending institutions in regions other than the Northeast, but not all effects are statistically significant. It is difficult to determine the cause of these differences in institutional quality by region but two possible explanations include different concentration of high-quality institutions in different parts of the country and regional price differences.

Tables 4.2 and 4.3 show that 26.6% and 34.2% of institutional quality is explained by the independent variables for men and women respectively. The most notable difference between the male- and female-specific regressions compared to one using average wages overall, is that region becomes insignificant for men and only a few regions are significant for women. It is important to recognize that, although the independent variables that are significant for men and women are different between the regressions; however, hypothesis testing determined that there is only marginal statistical significance at the 10%-level that the effects of the regressors are different for men and women. In Table 4.4 I compare the magnitude of the coefficients for men and women. As the table shows, in many cases the coefficients of the independent variables are smaller for women compared to men; however, the magnitude of the coefficients are relatively similar, thus I conclude that the variables affecting institutional quality are the same for all students regardless of sex.

4.4.2 – Rankings Results

Overall, there was a moderate correlation between the new college rankings created in this study and published rankings. Appendix H includes details of the methodology used to derive the public rankings. The correlation between my rankings and published rankings was 0.502 with the Forbes rankings, 0.611 with the U.S. News and World Report rankings of national universities, and 0.503 with the U.S. News and World Report rankings of liberal arts colleges and universities. It is interesting to see that differences in the rankings between my derived rankings and published ones is not consistently higher or lower across institutions. The schools with the largest absolute differences between my ranking and published ones are described in Table 4.5. These differences, it is important to note, are not unique to my rankings compared to the Forbes or U.S. News and World Report rankings, they are present between the published sources as well, likely due to differing methodologies.

APPENDIX G

CHAPTER 4 TABLES

Table 4.1 – Institutional Quality Regression Results Using Average Wages

Standard errors in parentheses * p<0.05 ; ** p<0.01 ; *** p<0.001

	(1)	(2)	(3)	(4)	(5)	(6)
Other Races	0.199***					0.152***
	(0.0337)					(0.0365)
Black&African American	-0.129***					-0.0703
	(0.0207)					(0.0364)
Hispanic	0.130***					0.119**
	(0.0382)					(0.0405)
Tenure Percent		0.0434***				0.0127
		(0.0127)				(0.0139)
Student-Faculty Ratio		-0.00434***				-0.00322***
		(0.000688)				(0.000801)
Percent Women Enrolled			-0.218***			-0.202***
			(0.0305)			(0.0277)
75th Percentile SAT			-0.0000136			0.0000117
			(0.0000273)			(0.0000234)
No-SAT			-0.00719			0.0217
			(0.0342)			(0.0293)
Distance Learning				-0.0273**		0.000965
				(0.00834)		(0.00780)
Placement Services				0.0105		-0.0142
				(0.0117)		(0.0105)
HBCU				-0.0736***		0.0274
				(0.0195)		(0.0315)
Hospital				0.0943***		0.0669***
				(0.0167)		(0.0150)
Land Grant				0.0737***		0.0593***
				(0.0146)		(0.0131)
Private, Non-Profit				0.0166*		-0.00000719
				(0.00766)		(0.00831)
Private, For-Profit				-0.0820***		-0.0771***
				(0.0172)		(0.0196)
Mid-East					-0.0352**	-0.0163
					(0.0128)	(0.0119)
Great Lakes					-0.0878***	-0.0579***
					(0.0134)	(0.0127)
Plains					-0.125***	-0.0927***
					(0.0146)	(0.0138)
Southeast					-0.121***	-0.0787***
					(0.0128)	(0.0127)
Southwest					-0.0544***	-0.0359*
					(0.0161)	(0.0160)
Rocky Mountains					-0.0565**	-0.0414*
					(0.0203)	(0.0189)
Constant	0.643***	0.704***	0.804***	0.666***	0.734***	0.839***
	(0.00699)	(0.0155)	(0.0374)	(0.0139)	(0.0107)	(0.0414)
N	985	985	985	985	985	985
adj. R-sq	0.100	0.057	0.047	0.105	0.157	0.308
F	37.44	30.53	17.33	17.49	27.28	20.93

Table 4.2 – Institutional Quality Regression Results Using Male Wages

Standard errors in parentheses * p<0.05 ; ** p<0.01 ; *** p<0.001

	(1)	(2)	(3)	(4)	(5)	(6)
Other Races	0.391***					0.180**
	(0.0528)					(0.0619)
Black&African American	-0.000513					0.0690
	(0.0327)					(0.0675)
Hispanic	0.0819*					0.0356
	(0.0412)					(0.0472)
Tenure Percent		0.0324				0.0869**
		(0.0256)				(0.0289)
Student-Faculty Ratio		-0.00747***				-0.00353**
		(0.00104)				(0.00125)
Percent Women Enrolled			-0.294***			-0.166**
			(0.0638)			(0.0631)
75th Percentile SAT			-0.00000598			0.0000397
			(0.0000363)			(0.0000321)
No-SAT			-0.000336			0.0551
			(0.0455)			(0.0404)
Distance Learning				-0.0621***		-0.0309
				(0.0168)		(0.0167)
Placement Services				0.0351		0.00586
				(0.0199)		(0.0199)
HBCU				-0.0153		-0.0422
				(0.0272)		(0.0544)
Hospital				0.0459**		0.0280
				(0.0158)		(0.0157)
Land Grant				0.0623***		0.0500***
				(0.0135)		(0.0136)
Private, Non-Profit				0.0791***		0.0572***
				(0.0113)		(0.0148)
Mid-East					-0.000171	0.00962
					(0.0205)	(0.0185)
Great Lakes					-0.0537*	-0.0105
					(0.0214)	(0.0199)
Plains					-0.0698**	-0.0261
					(0.0235)	(0.0216)
Southeast					-0.0506*	-0.00577
					(0.0200)	(0.0194)
Southwest					-0.0173	0.0313
					(0.0236)	(0.0230)
Rocky Mountains					-0.0251	0.0142
					(0.0277)	(0.0255)
Far West					0.0123	0.0371
					(0.0224)	(0.0216)
Constant	0.185***	0.354***	0.414***	0.241***	0.273***	0.251**
	(0.0108)	(0.0262)	(0.0581)	(0.0261)	(0.0176)	(0.0763)
N	443	443	443	443	443	443
adj. R-sq	0.118	0.103	0.040	0.181	0.062	0.266
F	20.63	26.40	7.123	17.28	5.158	8.632

Table 4.3 – Institutional Quality Regression Results Using Female Wages

Standard errors in parentheses * p<0.05 ; ** p<0.01 ; *** p<0.001

	(1)	(2)	(3)	(4)	(5)	(6)
Other Races	0.320***					-0.00852
	(0.0577)					(0.0640)
Black&African American	-0.0732*					-0.126
	(0.0357)					(0.0698)
Hispanic	0.185***					0.153**
	(0.0450)					(0.0488)
Tenure Percent		0.0580*				0.0684*
		(0.0275)				(0.0299)
Student-Faculty Ratio		-0.00888***				-0.00562***
		(0.00112)				(0.00130)
Percent Women Enrolled			-0.240***			-0.105
			(0.0702)			(0.0652)
75th Percentile SAT			-0.0000468			-0.00000195
			(0.0000399)			(0.0000332)
No-SAT			-0.0666			-0.0138
			(0.0502)			(0.0418)
Distance Learning				-0.0654***		-0.0188
				(0.0183)		(0.0173)
Placement Services				0.0289		-0.0178
				(0.0217)		(0.0206)
HBCU				-0.0332		0.0887
				(0.0296)		(0.0563)
Hospital				0.0684***		0.0512**
				(0.0172)		(0.0162)
Land Grant				0.0592***		0.0446**
				(0.0147)		(0.0141)
Private, Non-Profit				0.0850***		0.0586***
				(0.0123)		(0.0153)
Mid-East					-0.00927	-0.00332
					(0.0213)	(0.0191)
Great Lakes					-0.0849***	-0.0458*
					(0.0222)	(0.0206)
Plains					-0.104***	-0.0612**
					(0.0244)	(0.0223)
Southeast					-0.0969***	-0.0486*
					(0.0208)	(0.0201)
Southwest					-0.0518*	-0.0208
					(0.0245)	(0.0238)
Rocky Mountains					-0.0380	-0.0155
					(0.0288)	(0.0264)
Far West					0.0176	0.0330
					(0.0232)	(0.0223)
Constant	0.179***	0.346***	0.421***	0.234***	0.282***	0.376***
	(0.0118)	(0.0283)	(0.0639)	(0.0284)	(0.0183)	(0.0788)
N	443	443	443	443	443	443
adj. R-sq	0.116	0.127	0.023	0.184	0.152	0.342
F	20.32	33.06	4.456	17.62	12.28	11.92

Table 4.4 – Comparison of Regressions Using a Female Interaction Term

Standard errors in parentheses * p<0.05 ; ** p<0.01 ; *** p<0.001

	Male Quality	Female Quality	Change in Sign ?	Direction of Change (Male to Female) ?
Other Races	0.163** (0.0611)	-0.154 (0.0836)	**Yes**	**Negative**
Black&African American	0.0643 (0.0685)	-0.186 (0.0967)	**Yes**	**Negative**
Hispanic	0.0379 (0.0480)	0.113 (0.0678)	**No**	**Negative**
Tenure Percent	0.0756** (0.0277)	0.00406 (0.0366)	**No**	**Negative**
Student-Faculty Ratio	-0.00391** (0.00123)	-0.00133 (0.00168)	**No**	**Positive**
Percent Women Enrolled	-0.195** (0.0591)	0.119 (0.0756)	**Yes**	**Positive**
75th Percentile SAT	0.0000247 (0.0000299)	-0.0000116 (0.0000380)	**Yes**	**Negative**
No-SAT	0.0372 (0.0380)	-0.0331 (0.0489)	**Yes**	**Negative**
Distance Learning	-0.0333* (0.0168)	0.0170 (0.0236)	**Yes**	**Positive**
Placement Services	0.00106 (0.0198)	-0.0140 (0.0273)	**Yes**	**Negative**
HBCU	-0.0380 (0.0553)	0.122 (0.0780)	**Yes**	**Positive**
Hospital	0.0264 (0.0159)	0.0265 (0.0224)	**No**	**Positive**
Land Grant	0.0480*** (0.0137)	-0.00135 (0.0192)	**Yes**	**Negative**
Private, Non-Profit	0.0532*** (0.0146)	0.00942 (0.0201)	**No**	**Negative**
Mid-East	0.00669 (0.0187)	-0.00709 (0.0261)	**Yes**	**Negative**
Great Lakes	-0.0144 (0.0200)	-0.0274 (0.0278)	**No**	**Negative**
Plains	-0.0293 (0.0218)	-0.0287 (0.0306)	**No**	**Positive**
Southeast	-0.00911 (0.0195)	-0.0362 (0.0273)	**No**	**Negative**
Southwest	0.0279 (0.0232)	-0.0452 (0.0326)	**Yes**	**Negative**
Rocky Mountains	0.0105 (0.0257)	-0.0223 (0.0361)	**Yes**	**Negative**
Far West	0.0355 (0.0219)	-0.000852 (0.0309)	**Yes**	**Negative**
Constant	0.163** (0.0611)	-0.154 (0.0836)	**Yes**	**Negative**

Table 4.5 – Schools with the Largest Differences between Derived Ranking and Published Rankings

Note: In the table below, I provide all of the data for the difference between the ranking I derive and the ranking published in Forbes. There are some missing data for the US News differences because of matching issues between the two data sets. Furthermore, in each column, the five schools in which the difference between the derived and published ranking.

Name	Forbes Difference	US News Difference (National University)	US News Difference (Liberal Arts College)
Adelphi University	0.5939	**0.6974**	--
Albright College	0.3914	--	**0.6098**
Haverford College	**-0.8227**	--	**-0.8429**
Kalamazoo College	**-0.7459**	--	**-0.5956**
Lamar University	**0.8045**	--	--
Louisiana Tech University	0.5982	**0.8154**	--
Macalester College	-0.5322	--	**-0.5457**
Minnesota State University-Mankato	**0.6895**	--	--
New Mexico State University-Main Campus	0.3211	**0.6845**	--
Pace University-New York	0.4937	**0.7217**	--
Tennessee State University	**0.8177**	--	--
University of Houston	0.3744	**0.7870**	--
William Jewell College	0.2831	--	**0.5578**

A positive score difference indicates that I give a school a higher ranking that the published ranking being considered. Conversely, a negative difference indicates that I attribute a lower ranking to a school than the published rankings.

APPENDIX H

METHODOLOGIES USED IN PUBLISHED RANKINGS

FORBES (CCAP) RANKING METHODOLOGY

School Selection:

The 650 institutions of higher education included in this list award undergraduate degrees or certificates requiring "4 or more years" of study, according to the U.S. Department of Education and are classified by The Carnegie Foundation as Doctorate-granting Universities, Master's Colleges and Universities, or Baccalaureate Colleges. We have accounted for any changes in the names of institutions that have occurred over the past year.

Ranking Factors and Weights:

FACTOR	WEIGHT (%)
Student Satisfaction	**25%**
Student Evaluations from *RateMyProfessor.com*	15%
Actual Freshman-to-Sophomore Retention Rates	5%
Predicted vs. Actual Freshman-to-Sophomore Retention Rates	5%
Post-Graduate Success	**35%**
Salary of Alumni from *Payscale.com*	15%
American Leaders List	20%
Student Debt	**17.50%**
Average Federal Student Load Debt Load	10%
Student Loan Default Rates	5%
Predicted vs. Actual Percent of Students Taking Federal Loans	2.5%
Four-Year Graduation Rate	**11.25%**
Actual Four-Year Graduation Rate	8.75%
Predicted vs. Actual Four-Year Graduation Rate	2.5%
Academic Success	**11.25%**
Student Nationally Competitive Awards	7.5%
Alumni Receiving PhDs	3.75%

US NEWS AND WORLD REPORT RANKING METHODOLOGY

School Selection:
First, schools are categorized by their mission, which is derived from the breakdown of types of higher education institutions as refined by the Carnegie Foundation for the Advancement of Teaching in 2010. The Carnegie classification has been the basis of the Best Colleges ranking category system since our first rankings were published in 1983, given that it is used extensively as the accepted standard by higher education researchers. In total, U.S. News has collected data on nearly 1,800 colleges and all their data is on usnews.com, but only 1,376 are included in the actual numerical rankings described in this methodology.

The U.S. Department of Education and many higher education associations use the system to organize their data and to determine colleges' eligibility for grant money, for example. The category names we use are our own – National Universities, National Liberal Arts Colleges, Regional Universities and Regional Colleges – but their definitions rely on the Carnegie principles.

National Universities offer a full range of undergraduate majors, plus master's and Ph.D. programs, and emphasize faculty research. National Liberal Arts Colleges focus almost exclusively on undergraduate education. They award at least 50 percent of their degrees in the arts and sciences.

Ranking Factors and Weights:

FACTOR	WEIGHT (%)
Undergraduate Academic Reputation	**22.5%**
Academic Peer Assessment	15%
College Counselor Assessment	7.5%
Retention	**22.5%**
Six-Year Graduation Rate	18%
Freshman Retention Rate	4.5%
Faculty Resources	**20%**
Proportion of Classes with Fewer than 20 Students	6%
Proportion of Classes with More than 50 Students	2%
Faculty Salary (including benefits)	7%
Proportion of Professors with Highest Degree in Their Fields	3%
Student-Faculty Ratio	1%
Proportion of Faculty Who are Full Time	1%
Student Selectivity	**12.5%**
Critical Reading and Math SAT Score, ACT Composite Score	8.125%
Proportion of Enrolled Freshman Who Graduated in Top 10% of High School Class	3.125%
Acceptance Rate (Ratio of Students Admitted to Applicants)	1.3%
Financial Resources	**10%**
Graduation Rate Performance	**8%**
Alumni Giving Rate	**5%**

CHAPTER 5

SUMMARY AND CONCLUSIONS

There is a large literature devoted to examining increases in the number of women graduating from college and the components of school quality. Furthermore, with the attention that has been given to the gender wage gap and the increased participation of women in traditionally male fields, the role of college major in determining future earnings is an important factor to examine.

It is important to recognize that there *has* been progress in decreasing the gender wage gap since the late 1960s. Of course, there are numerous reasons for this trend. Notably, there has been an increase in the number of women attaining higher levels of education and women are switching from the more traditional female-majors to non-traditional fields. As a result, understanding the underlying causes of changes in the gender wage gap are key to a better understanding of the role of educational decisions on future earnings and the perpetuation of the gender wage gap.

Using a variety of techniques, this paper addresses the following questions: (1) How have changes in educational attainment by men and women and changes in the relative mean wages for different levels of educational attainment affected the gap in relative wages between men and women? (2) How has the gap in relative wages between college-educated men and women been affected by changes in relative compensation between majors and changes in the shares of men and women within majors? and (3) How does institutional quality affect the earnings of college graduates in their initial years in the labor force?

In the first chapter I described some of the legislation that has been passed to encourage equal pay and treatment for men and women in the workforce. I also presented an

overview of some of the changes in the gender wage gap over time and discussed some of the non-educational factors that may contribute to the perpetuation of pay disparities for men and women over time.

In Chapter 2, I discussed some historical trends in the education of women and the returns to education. I then utilized a Tornqvist approximation to a shift-share analysis to show the effects of changes in educational attainment on the wage gap over time. Analysis of the CPS data using the Tornqvist equation showed that the effect of wages greatly overshadows the effect of changes in educational attainment. Overall, there was a small, yet significant change in the log wage ratio as a result of changes in the proportions of men and women within educational attainment levels. I estimate that the overall change in the log wage ratio would have decreased by about 7% between 1967 and 2011as a result of changes in the proportion of men and women by educational attainment.

Similarly, in Chapter 3, I used a Tornqvist approximation to a shift-share analysis to determine the effects of college major choices on the gender wage gap. I also discussed differing returns to college majors and trends in how men and women sort into different fields. When examining the effect of changes in college major, the effect of changes in the proportions of men and women within majors would have led to a decrease in the log wage ratio of about 9%. These results are interesting because, since the overall log wage ratio has dropped over 20%, there is an indication that narrowing wage gaps—not changes in the proportion of men and women within educational levels or college majors—are the key forces behind the narrowing wage gap between men and women.

In Chapter 4 I used regression analysis to determine some of the factors that predict institutional quality using a unique institutional quality coefficient derived from projected

and actual wages for graduates for individual institutions. I also created a unique ranking of schools based on their quality and compared that with published rankings.

One of the important parts of this thesis was to determine how well the NACE data fit with that of the CPS. The comparison of the log wage ratios between college-educated individuals aged 25 to 34 with the derived log wage ratio from the NACE data are presented in Figure 3.2. As the figure shows, there has been a narrowing of the log wage ratios between the two sources. Part of the persistent differential is due to the fact that the NACE log wage ratio is derived using starting salaries while the CPS data incorporates those ages 25 to 34, therefore including those who are just staring their careers (and therefore, in general, have lower pay than more experienced workers) and those that have been in the workforce for a period of time. This differential is also attributable to the effect of market forces and individual decisions beyond college major choice such as occupational choice. Furthermore, the trendlines for the two data series have almost identical slopes, further suggesting that the changes in the log wage ratio, regardless of source, has been consistent and is therefore the trend is likely an accurate representation of trends.

Regression results showed that 30.8% of institutional quality can be explained by the regressors used in my analysis. Using male and female specific data I am able to show that 26.6% and 34.2% of institutional quality is explained by the independent variables for men and women, respectively. Some of the key variables affecting institutional quality include the control of the school, the percentage of female students, the number of tenured and tenure-track faculty members, and the location of the school. Interestingly, I did not find that SAT scores were statistically significant in any of the models, and hypothesis testing found that

there is little evidence to suggest that the effects of each of the independent variables are different for men and women.

In conclusion, while there is little doubt that the gender wage gap has been shrinking over time, understanding the underlying causes is key to a better understanding of the role of education on future earnings and the perpetuation of the gender wage gap. This thesis has demonstrated that changes in the gender wage gap are complex and multifaceted. There is no single factor that can be identified at the sole cause of changes in the gender wage gap, rather there is a combination of factors including educational attainment, college major choice, and school selectivity—as well as a number of unobserved variables—that affect the overall gender wage gap for college-educated individuals in the United States.

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