Essays on Gender, Family and Labour Markets

Madison Kerr

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University of York

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Abstract

This thesis investigates the importance of gender and the family on attitudes and labour market outcomes of individuals. Chapters 1 and 2 provide evidence of the significant influence parents have in the formation of attitudes and aspirations of children. Chapters 2 and 3 seek to understand whether adolescents and recent graduates with the same amount of experience and education aspire to and attain different occupations.

Chapter 1 estimates the intergenerational transmission of gender-role attitudes between a mother and her children. Using the National Longitudinal Survey of Youth 1979 (NLSY79) and the NLSY79 Children and Young Adults (NLSY79CYA), this paper finds evidence of measurement error when using a short-run estimate of a mother's gender-role attitudes. Two-stage least squares estimation corrects for this and provides evidence that the mother's attitudes have a larger association with her children's attitudes than previously found.

Using the NLSY79 and the Occupational Information Network (O*NET) database, Chapter 2 shows evidence that female (male) adolescents follow gender norms and aspire to occupations associated with feminine (masculine) traits. This chapter also finds that parents, especially when they are the adolescent's role model, significantly influence the aspirations of children. With a gender earnings gap in aspirations of 19%, this chapter demonstrates that policies to decrease occupational segregation should target the aspirations of adolescents.

Chapter 3 analyses if male and female college graduates with the same major sort into occupations with different traits at the beginnings of their careers. Using the American Community Survey (ACS) and the O*NET database, this paper finds that occupational segregation by gender within major contributes to the gender wage gap of college graduates with gender differences in inflexibility having the largest impact on the gender wage gap. Policies should attempt to create more flexible occupations to decrease the gender wage gap of college graduates.

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Declaration

I declare that this thesis is a presentation of original work and I am the sole author of the three self-contained chapters. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as references.

An earlier version of Chapter 1 was presented at the 2017 Workshop on Labour and Family Economics in York; 2017 Applied MicroEconometrics Seminar Series in York; the 2018 Royal Economic Society Junior Symposium in Brighton and the 2018 European Association of Labour Economists in Lyon.

An earlier version of Chapter 2 was presented at the 2018 Workshop on Labour and Family Economics in York: the 2018 Applied MicroEconometrics Seminar Series in York; and the 2019 European Society of Population Economics in Bath.

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Introduction

Over the past century, women's status around the world has changed dramatically as more women gained the rights to: vote, own property, open bank accounts, etc. which coincided with increases in women's participation in the labour market (Hyland et al., 2020; Gonzales et al., 2015; Fernández, 2014). Duflo (2005) and Goldin (1994) argue that gender equality and economic development influence one another simultaneously. As women began participating more in the labour force, their relative status within their household and in society increased while their labour force participation increased economic output (Goldin, 1994). Furthermore, increases in economic development are associated with increases in educational investment in children, enabling greater labour force participation of women. Gender inequality in labour market outcomes can lead to inequalities in educational investments. Therefore, it is imperative to study gender differences in economic outcomes to enable creation of policies which decrease inequalities and increase investment in young girls resulting in greater economic outputs for the next generation (Duflo, 2005).

Focusing on women in the United States, Goldin (2006) provides a clear story about how American women's labour market experiences have evolved over the past century due to structural and technological shifts in the economy which coincided with changes in gender norms and gender-role attitudes.[1] Women began their entry into the workforce at the beginning of the 20th century with the employment of young, unmarried women. Owing to an increase in demand for clerical workers during the 1930s and 1950s, society became more accepting of working women as office-based occupations were viewed as more fitting for women compared to factory-based occupations. Furthermore, these positions provided more flexibility as they were well-suited for part-time work which enabled greater female labour force participation. As gender-role attitudes became more progressive, the 1950s to 1970s saw increases in the labour force participation of married women. During this period, women were mostly found

[1] Gender norms are societal views about appropriate behaviours of men and women which encapsulate beliefs about appropriate work, clothing, personality traits, skills, etc. (Bertrand, 2011). Gender-role attitudes are one's beliefs regarding the specific gender norm of women being homemakers and men being breadwinners.

in occupations which required little on-the-job training such as: "secretaries, teachers, nurses, social workers and librarians" (Goldin, 2006). Mincer and Polachek (1974) explain that because women were more likely to leave the work force intermittently or entirely after the birth of a child, occupations which required on the job training were less attractive to women as there were large negative wage implications for missing work.

The end of the 1970s brought in what Goldin coined as the "Quiet Revolution" where female labour force participation accelerated along with large changes in the types of education and occupations women sought. Owing to the wide distribution of birth control, women were able to put off marriage until after they finished their education and created a foundation to a career (Goldin and Katz, 2002). This enabled women to plan for careers rather than jobs which resulted in more women seeking college degrees.

For decades, economists have researched gender in the labour market with a large set of literature focused on the trends and determinants of gender differences in wages (see Blau and Kahn (2017) for an extensive review). Since the 1970s, the gender wage gap has decreased due to gender differences in work experience and education shrinking as women became more educated and held stronger ties to the labour market. Even though there has been much progress in American women's economic opportunities, there has been little change in the gender wage gap in recent decades with gender differences in occupations remaining the largest contributor to the gender wage gap (Blau and Kahn, 2017).

This stagnation of the gender wage gap has led to research attempting to find alternative explanations for gender differences in wages. There is a large set of experimental literature analysing gender differences in psychological attributes, preferences and skills (see Blau and Kahn 2017 for a review) with an increasing emphasis on the importance of gender differences in preferences for flexible work (Goldin, 2014). Interestingly, meta-analyses have argued that studies which find gender differences regarding these traits tend to have small effect sizes indicating that the within-gender variation in these traits is much larger than the between-gender variation (Rippon, 2019; Nelson, 2015; Hyde, 2014, 2005). Bertrand (2020) argues that society perceives these gender differences to be larger than they are in reality, distorting gender norms and potentially contributing to occupational segregation by gender. Recent research has found large gender differences in occupations which are associated with these gender-specific psychological attributes, preferences and skills potentially giving some credence to Bertrand's argument (Baker and Cornelson, 2018; Cortes and Pan, 2018; Lekfuangfu and Lordan, 2018; Azmat and Petrongolo, 2014; Bertrand, 2011).

Furthermore, economists have questioned whether observed gender differences in outcomes and preferences are innate or the outcomes of socialisation and/or incentives to conform to gender norms (Bertrand, 2020; Giuliano, 2020; Blau and Kahn, 2017; Bertrand, 2011). Bisin and Verdier's model of cultural transmission argues that children learn about cultural traits (such as gender norms) from both within and outside of the family with parents, peers, teachers, the media, etc. playing large roles through socialisation (Bisin and Verdier, 2001). In addition, Akerlof and Kranton's identity model provides a framework for how individuals are incentivised to adhere to social norms that are aligned with one's social category (Akerlof and Kranton, 2000). Both of these models can help us understand why occupational segregation by gender still exists and is not necessarily due to gender differences in innate preferences.

In order to understand gender differences in labour market outcomes and wages, it is vital to understand why individuals make the labour market decisions they do in order to create effective policies which enable economic prospects to not be constrained by gender norms. This thesis contributes to our understanding about the influence of parents on attitudes and occupational preferences and provides a deeper understanding of when and where occupational segregation by gender exists by:

- More accurately estimating the intergenerational transmission of gender-role attitudes
- Analysing gender differences in, and the predictors of, occupational aspirations in adolescents
- Evaluating the roles of gender differences in college majors and occupational traits (competitiveness, social contribution and inflexibility) in explaining the gender wage gap of young graduates

Chapter 1 analyses the relationship between a mother's gender-role attitudes and those of her children using the National Longitudinal Survey of Youth 1979 (NLSY79) and the NLSY79 Children and Young Adults (NLSY79CYA) datasets. Previous research has shown that women holding more progressive gender-role attitudes is associated with stronger labour force attachment, delaying of marriage and children and higher wages in the United States (Farré and Vella 2013; Davis and Pearce 2007; Christie-Mizell 2006; Cunningham et al. 2005). In addition, men with mothers holding more progressive gender-role attitudes are associated with an increased likelihood of having a working wife (Farré and Vella 2013; Acemoglu et al. 2004). As gender-role attitudes have important implications on economic decisions, it is important to understand the determinants of these attitudes.

This chapter contributes to the previous research on the cultural transmission of norms (Bisin and Verdier, 2001), and more specifically, the intergenerational transmission of gender-role attitudes (Farré and Vella 2013; Vella 1994; Thornton et al. 1983) by providing new empirical evidence on the transmission of gender-role attitudes from mothers to children while controlling for measurement error in the mother's gender-role attitudes. By implementing a two-stage least-squares estimation strategy, this chapter shows the importance of accounting for measurement error when estimating the relationship between a mother and child's attitudes as significant attenuation bias is present in standard OLS (Ordinary Least Squares) estimations. The findings show that a one standard deviation increase in the mother's gender-role attitudes is associated with a 25.3% of a standard deviation increase in the child's gender-role attitudes. This finding is approximately four times larger than estimates in Farré and Vella (2013) when using a measure of the mother's attitudes at one point in time showing the need of correcting for measurement error to understand the significance of intergenerational transmission in the formation of gender-role attitudes.

Using the NLSY79 and Occupational Information Network (O*NET) database, Chapter 2 analyses gender differences in the traits of one's aspired occupation for adolescents aged between 15 and 17 years old. With the stagnation of the gender wage gap in recent years, it is important to understand why men and women attain different occupations in order to create effective policies to reduce the gender wage gap further. Economists have attempted to gain a better understanding of why occupational segregation by gender exists by analysing whether men and women hold occupations associated with gendered skills, non-pecuniary benefits or psychological traits (Baker and Cornelson 2018; Cortes and Pan 2018). Chapter 2 contributes to this literature by addedshowing evidence of female (male) adolescents aspiring to occupations associated with feminine (masculine) traits which may partially explain the observed segregation in the labour market.

This chapter provides evidence of adolescents abiding by gender norms in their occupational aspirations and the influence of parents and role models in the formation of these aspirations. This chapter finds that male adolescents aspire to occupations associated with higher levels of expected income, inflexibility, competitiveness, riskiness and physical skills while female adolescents aspire to occupations associated with higher levels of social contribution and interactional skills. This chapter finds that parents' occupations and education, especially if they are the adolescent's role model (i.e. someone they want to emulate), significantly influence the aspirations of children. . Furthermore, this chapter shows that occupational aspirations in adolescence significantly predicts occupational choices in adulthood. Shockingly,

the gender earnings gap in aspirations for 15-17 year olds is 19% showing that policies to decrease the gender wage gap may need to target the aspirations of adolescents.[2] In-school interventions which expose adolescents to potential role models working in gender atypical occupations have the potential to enable adolescents to not restrict their aspirations due to prevalent gender norms.

Chapter 3 focuses on the gender wage gap of young, recent college graduates. There is substantial empirical evidence of gender differences in college major contributing to the gender wage gap of college graduates (e.g. Francesconi and Parey 2018; Altonji et al. 2016a; Black et al. 2008) due to women choosing majors which lead to lower paying occupations compared to men. Chapter 3 contributes to the literature on the gender wage gap and occupational segregation by showing that the gender wage gap of college graduates can be partially explained by occupational segregation by gender within college major. Using the 2012-2017 American Community Survey (ACS) and the O*NET database, this chapter analyses gender differences in three occupational traits (competitiveness, social contribution and inflexibility) within detailed college major for college graduates between the ages of 24 and 29.

By estimating separate wage regressions by gender and major, I let returns of occupational traits to vary by college major and simulate the reduction in the gender wage gap if women held occupations with the same average occupational traits as men within major. The results find significant occupational segregation by gender within diverse-occupation majors, college majors which lead to a large set of potential heterogeneous occupations, and do not find occupational segregation by gender within specific-occupation majors, college majors which lead to a defined and limited set of occupations. On average, I find an hourly gender wage gap of 13.44% for recent college graduates which is equivalent to an annual gender wage gap of $5670.[3] Of this gap, 70.06% is due to gender differences in college major, consistent with previous research, and 16.36% is attributed to gender differences in occupations within college major. The gender wage gap due to occupational segregation by gender within college major is significant as over the course of a year, it is equivalent to nearly five months of median monthly student loan payments.[4]

More specifically, the findings indicate that of the traits analysed, gender differences in inflexibility contribute the most to within-major gender wage gaps by explaining a significant portion of the gender wage gap for graduates of 43% of the majors analysed. Furthermore,

[2]This is calculated using the median annual income of full-time, full-year workers in a given occupation.

[3]Calculated as if all individuals work full-time (35 hours a week), full-year (50 weeks) with an hourly gender wage gap of $3.24.

[4]The annualized gender wage gap due to gender differences in occupations within major is $927 and the median monthly student loan payment in 2016 the United States was approximately $200 (Frost, 2019).

I find that women choose majors which lead to more flexible occupations. Therefore, this chapter indicates that policies to decrease the gender wage gap of college graduates should not only attempt to decrease gender differences in major but also to make occupations more flexible.

The findings in this thesis are consistent across chapters. Chapters 1 and 2 show the influence parents have on the gender-role attitudes and occupational aspirations of their children indicating that gender norms, and occupational segregation potentially influenced by gender norms, may be slow to change without large shifts in attitudes about gender appropriate actions and occupations. Furthermore, Chapters 2 and 3 focused on samples of adolescents and young adults who have the same amount, and type of education, yet find the young women and men aspiring to and sorting into occupations with traits that are associated with their gender. This thesis contributes to our understanding of the ways one's gender and the expectations society places on one based on their gender, can lead to different labour market outcomes for men and women.

Chapter 1

Intergenerational Mobility in Gender-Role Attitudes in the United States: Correcting for Measurement Error

Using data from the National Longitudinal Survey of Youth 1979 Children and Young Adults, this paper analyses the effects of a mother's gender-role attitudes on her children's gender-role attitudes while correcting for measurement error. Following Solon (1992), this paper shows that the intergenerational mobility of gender-role attitudes is more accurately estimated when using a long-run estimate of the mother's gender-role attitudes. Controlling for measurement error by using Two-Stage Least Squares estimation, I find that having a mother who holds more progressive (traditional) gender-role attitudes is associated with her children developing more progressive (traditional) gender-role attitudes. Due to attenuation bias from measurement error, the mother's effect on her children's attitudes is larger than previously found revealing the important role that parents play in teaching children about gender norms and influencing their attitudes about specific norms.

1 Introduction

Since the 1960's great strides towards gender equality in the workplace have been made. There has been a historic rise in the labour force participation of women in the United States (Goldin, 2006). Gender segregation between occupations has decreased and the majority of college students are now women (Goldin, 2006). Despite this progress, women still do not see equality in the workplace or household. In 2015, the gender wage gap for full time employees in the United States was 20% and this gap has not significantly shifted since 2007 (Proctor et al., 2016). One component that created this gender wage gap is unequal distribution of childcare and household production (Waldfogel, 1997). Gender-role attitudes can impact this inequality. Gender-role attitudes are one's beliefs about the appropriate role of men and women in society. These attitudes include, among other beliefs, whether one believes women should be stay at home mothers or be active in the workforce, if being a working mother is detrimental for child outcomes and if women are expected to perform most household work. Davis and Greenstein's review of previous studies found that husbands with more progressive gender-role attitudes are associated with spending more time with their children and on household production (Davis and Greenstein, 2009). Also, women with more progressive gender-role attitudes are more likely to perceive unfairness in the distribution of household production increasing the likelihood of asking for a more equal distribution (Greenstein, 1996). If gender-role attitudes, among men and women, continue to shift so more people believe that men should help with childcare and household production, then women may have more time to commit to their careers and not receive such a large motherhood penalty. Understanding how gender-role attitudes are acquired and cultivated can help to further the progression of women in the workplace as policies can be implemented which encourage young women not to be influenced by the traditional idea of a woman's place in society and seek careers which they deem to be best suited for their abilities. As a result, women may be able to work full-time more often and increase their lifetime earnings thereby decreasing the gender wage gap.

This paper analyses the intergenerational mobility of a mother's gender-role attitudes on her children's gender-role attitudes using the National Longitudinal Survey of Youth 1979 (NLSY79) and the NLSY79 Children & Young Adult cohorts (NLSY79CYA). The main contribution with respect to previous papers who have looked at the intergenerational mobility of gender-role attitudes (Farré and Vella, 2013; Vella, 1994; Thornton et al., 1983) is that I more accurately estimate the relationship between mothers' and children's gender-role attitudes by correcting for measurement error by using Two-Stage Least Squares estimation.

Gender-role attitudes in this paper measure an individual's belief about the specific gender norm of women staying home and men being the main breadwinner. More generally, gender norms advise individuals about appropriate behaviours of men and women in a given society (Bertrand, 2011). Gender norms are not restricted to labour market participation but also include beliefs about appropriate toys, clothing, personality traits and skills based on someone's gender. The literature on cultural transmission of preferences is informative in understanding how gender norms are formed and persist.[1] Bisin and Verdier (2001) state that parents encourage their children to develop preferences similar to their own. In their model, cultural traits (which can include gender norms) are acquired via socialisation both within and outside the family where children imitate those around them.[2] Within the family, parents directly and indirectly teach gender norms by communicating their beliefs and by the degree to which they adhere to gender norms within the household (Endendijk et al., 2014; Witt, 1997; Lytton and Romney, 1991). Research has found that children begin to understand gender appropriate behaviours by the age of two (Serbin et al., 2002, 2001). Outside of the family, the media, peers and teachers advise and reinforce gender norms.[3]

Akerlof and Kranton (2000) developed a theoretical groundwork for social norms having significant impacts on one's labour market outcomes. In Akerlof and Kranton's economic model, deviating from social norms is associated with disutility. This model can be used to explain why men and women continue to make different household and labour market decisions in the 21st century as individuals are incentivised to adhere to gender norms (Bertrand, 2011). Fortin (2005) argues that countries with more traditional gender norms are associated with lower female labour force participation and greater gender wage gaps. González de San Román and De La Rica (2012) and Guiso et al. (2008) find that countries with more progressive gender norms are associated with girls performing better in maths and reading.

More specifically, previous papers have found that progressive gender-role attitudes of young women are associated with: a delay of first marriage and first birth, increased levels of desired and attained education, an increase in the likelihood of full-time labour force participation, and an increase in earnings compared to women with more traditional gender-role attitudes (Farré and Vella, 2013; Davis and Pearce, 2007; Christie-Mizell, 2006; Cunningham et al., 2005). These findings indicate that gender-role attitudes of individuals influence mul-

[1] See Bisin and Verdier (2011) for an extensive review of the cultural transmission literature.

[2] See Leaper and Friedman (2007) for a review of sociological research about the transmission of gender norms through socialisation.

[3] See Witt (2000b) for a review of research about the influence of media, Witt (2000a) for a review about influence of peers and Berenbaum et al. (2008) and Leaper and Friedman (2007) reviews about the influence of schooling and teachers.

tiple labour market and family decisions that have direct consequences on lifetime earnings for women.

The economics research about formation of gender-role attitudes has focused on the significant intergenerational relationships between mothers' and her childrens' gender-role attitudes and labour force participation. Farré and Vella (2013) found a statistically significant relationship between a mother and child's gender-role attitudes and that a son holding more progressive gender-role attitudes is positively significantly associated with their future wive's labour force participation. Viewing a mother's labour force participation as a proxy for gender-role attitudes, previous research has found that having a working mother is strongly associated with daughters participating more in the labour force and sons marrying women who are more likely to participate in the workforce (Haaland et al., 2018; Farré and Vella, 2013; Morrill and Morrill, 2013; Fernández et al., 2004; Vella, 1994). This literature shows the importance of accurately estimating the intergenerational mobility of gender-role attitudes as the attitudes of mothers have the ability to impact outcomes of her children.

Previous research has found that gender-role attitudes of individuals are not constant as they change throughout one's lifetime based on current life experiences. Acquiring more education is associated with developing less emphasis on the 'male breadwinner, female homemaker' ideology and a delay into marriage and childbearing (Cunningham et al., 2005; Ciabattari, 2001; Fan and Marini, 2000; Funk and Willits, 1987). In addition, more education increases the likelihood of participating in the labour force. Both acquiring education and participating in the labour force may expose women to new ideologies and people that are not abiding by traditional gender-role attitudes and can potentially influence one's attitudes to become more progressive (Davis, 2007; Cassidy and Warren, 1996; Davis and Robinson, 1991). Entering marriage is associated with a traditional influence on a woman's gender-role attitudes as marriage is associated with a separation of duties between husband and wife where women are encouraged to provide more household production than the husband (Davis, 2007; Fan and Marini, 2000; Gupta, 1999). In addition, having a child is associated with a movement towards traditional gender-role attitudes (Vespa, 2009; Fan and Marini, 2000). This may be due to mothers having higher household production demands and as a result spend less time outside of the household and are therefore exposed to fewer feminist ideas from outside of the home (Bolzendahl and Myers, 2004; Warner, 1991; Thornton et al., 1983).

One form of endogeneity that can bias the estimation of the intergenerational mobility of gender-role attitudes which has not been controlled for in previous research is measurement error. Applying the same methodology as Solon (1992) used to find measurement error in

studies of intergenerational income mobility in the United States, I find measurement error in the intergenerational mobility of gender-role attitudes. Using a short-run measure of the mother's gender-role attitudes, especially during a period with large transitory fluctuations due to familial and occupational decision making, as a long-run measure of the mother's gender-role attitudes causes an attenuation bias. Using the mother's gender-role attitudes measured in 1979 as an instrument for her more recent gender-role attitudes measured in 1987 corrects for measurement error as the measurement error is not correlated across time due to different transitory shocks in attitudes at different periods in one life.

To my knowledge, this is the first paper to use 2SLS estimation to analyse the intergenerational mobility of gender-role attitudes. It is important to note that the use of the lagged mother's gender-role attitudes as an instrument corrects for measurement error but does not correct for omitted variables that are related to the mother's and child's gender-role attitudes. This omitted variable bias is likely to cause an upward bias of the estimates as the mother's gender-role attitudes are also picking up the effects of these correlated omitted variables. Even though my instrument does not correct for omitted variables, I show evidence that the 2SLS estimation is not significantly affected by known omitted variables as the effect of the mother's attitudes on her child's attitudes is robust to the addition of control variables and the analysis of several subsamples. There most likely is not a perfect instrument to analyse the intergenerational mobility of gender-role attitudes in the United States; however, using a mother's previous attitudes as an instrument is incredibly robust to specification changes and consistent in its estimation while correcting for measurement error.

This paper contributes to research on intergenerational mobility of gender-role attitudes in the United States by showing evidence of measurement error and that using a long-run measurement of gender-role attitudes is less biased than using a single year measurement. By using a mother's gender-role attitudes from 1979 as an instrumental variable for her attitudes in 1987, I show that having a mother with progressive (traditional) gender-role attitudes is associated with her children having more progressive (traditional) gender-role attitudes while controlling for measurement error. Specifically, a one standard deviation increase in the mother's gender-role index is associated with a 25.3% of a standard deviation increase in the child's gender-role index. It is important to know this intergenerational link exists because understanding what causes people to have certain gender-role attitudes will enable society to formulate policies so that institutions and organisations do not negatively impact one's gender-role attitudes. Implementing policies that discourage traditional views about a

woman's place in society may have significant economic impacts that can eventually help to decrease the gender wage gap.

2 Data

2.1 Data and Sample

I will be utilizing the NLSY79 which is a longitudinal survey of 12,686 men and women who were residing in the US and aged between 15-22 in 1979 at the time of the first interview (Bureau of Labor Statistics, 2019c). These respondents were interviewed annually from 1979 to 1994 and interviewed biennially from 1994 to 2014. The NLSY79 is made up of several sub-samples. There is a nationally representative sample, an oversample of Blacks and Hispanics, an oversample of economically disadvantaged non-black, non-Hispanics and a sample of active military members. For this paper, I only use the nationally representative sample of women (3,108 women).

I will also be utilizing the NLSY79 Children and Young Adults survey (NLSY79CYA) (Bureau of Labor Statistics, 2019b). The NLSY79CYA is a survey of the children of the female respondents from the NLSY79. The children's survey began in 1986 and the current last wave is in 2014. The children begin the biennial Young Adults survey the year they turn 15 years old. The Young Adult survey consists of personal interviews that are similar to the interviews administered to the mothers at the beginning of the NLSY79 surveys.

To analyse the intergenerational mobility of gender-role attitudes, I merged the NLSY79 with the NLSY79CYA to only include mother-child pairs. I analyse this longitudinal dataset at different cross-sections in time. To be included in the sample, the mother-child pair had to answer the same set of questions regarding their gender-role attitudes. The mothers needed to answer the gender-related questions in 1979, 1982 and 1987 while the children had to answer the gender-related questions at least once while they were between the ages of 15 and 22 (1,427 mothers and 2,833 children). The sample was further restricted to children born after 1979 as I use the mother's 1979 gender-role index as an instrument (1,367 mothers and 2,521 children). The final sample size for estimation is 1,298 mothers and 2,343 children (1,206 sons and 1,137 daughters) respondents who had data available for each control variable.

2.2 Gender-Role Attitudes in NLSY

The NLSY79 and NLSY79CYA data are well suited to study intergenerational mobility regarding gender-role attitudes as both surveys ask the same set of questions about the respondents' attitudes towards the role of women in society. The NLSY respondents were asked to say how much they agreed with the following questions (Bureau of Labor Statistics, 2019c):

1. "A woman's place is in the home, not in the office or shop."
2. "A woman who carries out her full family responsibilities does not have time for outside employment."
3. "A working wife feels more useful than one who does not hold a job."
4. "The employment of wives leads to more juvenile delinquency."
5. "Employment of both parents is necessary to keep up with the high cost of living."
6. "It is better for everyone concerned if the man is the achiever outside the home and the woman takes care of the home and family."
7. "Men should share the work around the house with women, such as doing dishes, cleaning and so forth."
8. "Women are much happier if they stay at home and take care of their children."

These eight questions were asked to the mothers in 1979, 1982, 1987 and 2004 and asked to their children biennially from 1994 through 2010 (except in 2000 and 2004). The respondents answered the questions: Strongly Disagree, Disagree, Agree and Strongly Agree. Following previous research, I constructed my index so that a higher score indicates that the respondent has more progressive gender-role attitudes while a lower score indicates more traditional gender-role attitudes (Farré and Vella, 2013; Davis and Pearce, 2007).[4]

It is important to know if the eight above questions are measuring the same underlying concept, one's gender-role attitudes. To analyse this Fan and Marini (2000) and Davis (2007) used confirmatory factor analysis. If the questions are highly correlated with one another then they are assumed to be measuring the same concept. Both studies found questions (3) and (5) to not be highly correlated with the remaining questions and therefore dropped those

[4]Questions 1, 2, 4, 5, 6 and 8 were coded as follows: Strongly Agree (1), Agree (2), Disagree (3) and Strongly Disagree (4). Questions 3 and 7 were coded differently as: Strongly Disagree (1), Disagree (2), Agree (3) and Strongly Agree (4) because agreement with the statement indicated progressive attitudes while agreement with the other questions indicated traditional attitudes.

questions from analysis. Questions 1, 2, 4, 6, 7, 8 were all used in previous research to create a 24-point index of gender-role attitudes and is the index used in this paper (Farré and Vella, 2013; Davis and Pearce, 2007; Davis, 2007; Fan and Marini, 2000).

To test the validity of using these six gender questions as an index for my sample, I calculated Cronbach's Alpha for each year the gender questions were asked. Cronbach's Alpha is a measure of how much the individual questions used in an index are correlated with one another. The higher Cronbach's Alpha the more likely that the individual questions are all trying to quantify one specific idea, in this case one's gender-role attitudes.

$$\alpha = \frac{6}{6-1}\left(1 - \frac{\sum_{j=1}^{6}\sigma_{sj}^2}{\sigma_{st}^2}\right) \tag{1.1}$$

where j= $1, 2, ...6$, 6 is the number of items (questions) in the index, σ_{sj}^2 is the variance of the jth gender-role item variable, σ_{st}^2 is the variance of the total summed items (t=6). Table 1.1 shows Cronbach's Alpha for all the years of the Mother's gender-role index. These alphas show evidence of high internal consistency, providing evidence that the individual gender questions can be used as an acceptable measure for gender-role attitudes as it is above the rule of thumb cut-off point of 0.70 as found in previous literature (Bland and Altman, 1997; Nunnally, 1975). Both Farré and Vella (2013) and Judge and Livingston (2008) used Cronbach's Alpha as evidence that these six gender based questions from the NLSY79 can quantify one's gender-role attitudes in an index.[5]

Table 1.1: Descriptives of Mother Gender Indices

Year	Mean	St. Dev	Ages	Cronbach's Alpha	N
1979	17.74	3.04	15-22	0.75	2343
1982	18.30	3.04	18-25	0.80	2343
1987	18.63	3.04	23-30	0.81	2343
2004	18.63	2.97	40-47	0.80	1344

Notes: The sample size for 2004 is restricted to children with a measured gender index after 2004.

In addition to the index measuring the same concept, it is imperative that the index is measuring one's gender-role attitudes. Judge and Livingston (2008) analysed if the above gender-role index, excluding question 7, is an accurate representation of one's gender-role attitudes by comparing it to gender indices that had been used in previous research. For this analysis, they had 350 undergraduate students complete a survey that included the above NLSY gender questions and two scales that have been formerly used in published research: the

[5]I also conducted analysis using confirmatory factor analysis and my results remain unchanged; therefore I use the constructed index as it is more easily comparable to previous research.

Traditional-Progressive Sex Roles scale and the Attitudes Toward Women scale. They then analysed the correlations between the respondents' answers for the three sets of questions. They found these three scales to be highly correlated with one another. They calculated a correlation of 0.74 between the NLSY questions and the Traditional-Egalitarian Sex Roles scale and a correlation of 0.65 between the NLSY questions and the Attitudes Toward Women Scale (Judge and Livingston, 2008). This gives evidence that the NLSY gender questions are measuring one's gender-role attitudes.

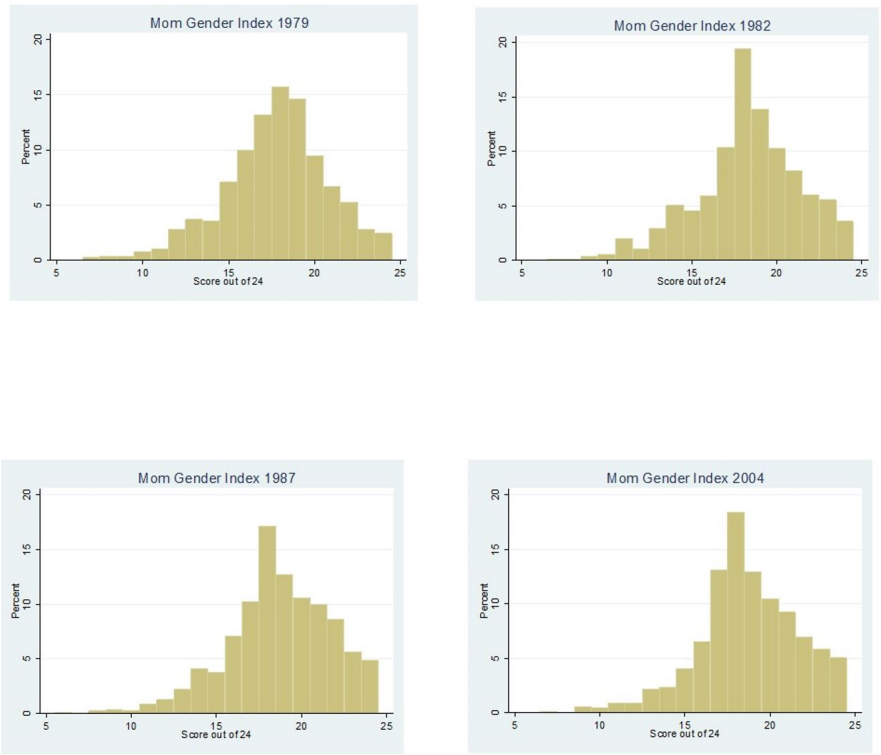
I chose to make a gender-role index of children aged between 15 and 22 years old as these respondents are at the beginning of one's academic and occupational careers. The gender-role attitudes of a 17-year-old may have large implications on whether the child decides to enrol in university or to enter the workforce. Also, most women have not married by the age of 22 making their gender-role attitudes at this age a factor into what age they enter marriage and parenthood. In this sample, only 1% of of respondents between 15 and 22 are married. This is due to the average age of respondents being 16 years old when their attitudes are measured. It is interesting to analyse the intergenerational mobility of gender-role attitudes when the child is at an age when they are making significant educational, occupational and familial decisions which have lasting impacts on their life. It would also be informative to analyse the the intergenerational mobility of attitudes earlier in the child's life as these attitudes may have had less exposure to influences outside of the family. However, measuring the attitudes of children at a younger age may not be as important in later outcomes as they change a lot through adolescence (Rippon, 2019). In addition, the NLSY79CYA only begins measuring gender-role attitudes starting at the age of 15.

2.3 Mother and Child Gender Indices

In this paper, I use the mother's gender indices from 1979, 1982 and 1987 for the main analysis as these were measured before the child's gender-role index which began in 1994. Using the 2004 index requires me to drop data for children whose gender-role index is measured before 2004 due to reverse causality as the child's gender-role index may have influence on the mother's gender-role index; therefore, it is not part of my main analysis. I only use the mother's 2004 gender-role index in robustness checks where the sample is restricted to children who answered the gender questions after 2004.

As shown in Table 1.1 and Figure 1.1, the average mother's gender-role index increased through the years from 17.74 points in 1979 to 18.63 points in 2004, signifying a movement

Figure 1.1: Mother Gender Indices by Year



Notes: Samples sizes are the same as in Table 1.1.

towards more progressive gender-role attitudes. The mother's gender-role index changed by approximately 30% of a standard deviation between 1979 and 1987 indicating a large shift in attitudes over a small period of time. This increase in gender-role attitudes has also been found in previous research (Farré and Vella, 2013; Fan and Marini, 2000).

Table 1.2 shows the proportion of the mothers who gave progressive responses to the gender questions. Progressive responses to most questions consistently increased over the years. The largest difference is a 12 percentage point increase in the proportion of women who believed that men should contribute to housework from 1979 to 1987. The questions with the smallest proportion of women providing a progressive responses were questions 6 and 8 where 28% and 27% of mother respondents in 1987 agreed or strongly agreed that it is better if the man is the achiever while the woman takes care of the family and that women are happier staying in the home. This is interesting as this shows evidence of attitudes regarding smaller role changes such as men helping out more in household work have progressed more quickly than attitudes about women leaving the household to work. Fortin (2005) states that attitudes about women as homemakers may be more persistent across time as they are formed in youth and potentially linked to religion. This implies that changes to attitudes about about

women working outside of the home may take longer to change than attitudes about smaller gender-role changes.

Table 1.2: Proportion of Egalitarian Responses to Gender Questions for Mother Gender Indices (N=2343)

	1979	1982	1987
1) A woman's place is in the home, not in the office or shop	0.84	0.87	0.88
2) A woman who carries out her full family responsibilities does not have time for outside employment	0.77	0.83	0.86
4) The employment of wives leads to more juvenile delinquency	0.78	0.81	0.82
6) It is better for everyone concerned if the man is the achiever outside the home and the woman takes care of the home and family	0.63	0.70	0.72
7) Men should share the work around the house with women, such as doing dishes, cleaning and so forth	0.82	0.91	0.94
8) Women are much happier if they stay at home and take care of their children	0.75	0.77	0.73

Notes: Table indicates proportion of women who disagreed or strongly disagreed with questions 1, 2, 4, 6 and 8 and proportion of women who agreed or strongly agreed with question 7.

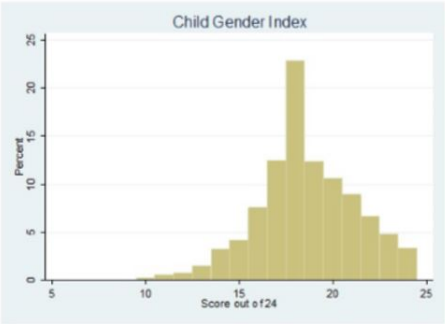
Unlike the gender-role index where I follow the same mothers over multiple years, I only analyse the child's gender-role index at one point in time when they are between the ages of 15 and 22 years old. To create the child's index, I use the child's first measured gender-role index in the years 1996, 1998, 2002, 2006, 2008 and 2010.[6] Previous research which used this dataset only analysed the child's gender-role index through 2002 (Farré and Vella, 2013). By pooling the gender indices of different children over multiple years, I have an accurate representation of the transmission of attitudes between mothers and children as I see the responses of multiple children within the same household and children who were born to younger and older mothers.

The summary statistics for the children's gender-role index are shown in Table 1.3 as well as Figures 1.2 and 1.3.[7] The overall child's gender-role index has a sample size of 2,343 respondents aged between 15 and 22 years old. The Overall Child Gender-role index has an average of 18.59 points (2.66 standard deviation). Sons are more traditional in the gender views than daughters with a mean of 17.85 (2.49) compared to 19.36 (2.62). This is consistent with findings from Farré and Vella (2013) who were only able to analyse children in the years through 2002 and from additional research on gender-role attitudes (Davis and Greenstein,

[6]Due to the sample being restricted to children born after 1979, I am not able to analyse the 1994 child gender index. In addition, the children were not asked the gender-related questions in 2000 and 2004 therefore these years are not included in the overall gender index.

[7]Not all of the children were asked the gender questions in each survey round. In 1996, only those who did not answer these questions in 1994 were respondents. In 1998, only those who did not answer these questions in 1996 were respondents. In 2002, only children aged 17 to 19 were respondents. Everyone part of the survey responded to the gender questions in 2006, which is why a largest proportion of the overall child gender index comes from 2006. In 2008, only those who did not answer in 2006 were respondents. Everyone part of the survey responded to the gender questions in 2010.

Figure 1.2: Child Gender Index



Notes: Samples size is the same as Overall in Table 1.3.

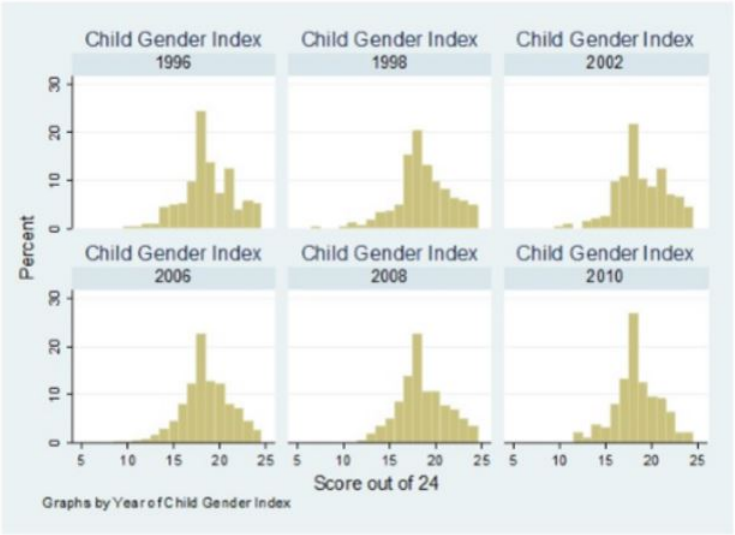
2009; Fan and Marini, 2000; Thornton et al., 1983). Referring to interested-based theory, Davis and Greenstein (2009) and Judge and Livingston (2008) argue that women hold more progressive gender-role attitudes than men as these progressive attitudes are associated with them gaining status and power. It is important for policies targeting gender-role attitudes to not only focus on young women but also on young men as previous research has shown the positive female labour market effects of men holding more progressive gender-role attitudes (Farré and Vella, 2013; Fernández et al., 2004). As division of household production requires decisions by both men and women (in heterosexual couples), it is important to focus on influencing men's gender-role attitudes which are, on average, more traditional. In addition, Cronbach's Alpha for the overall Child gender-role index is 0.76 which indicates that the Overall Child Gender-role index is a unidimensional measure that I can use as one's gender-role attitudes.

Table 1.3: Summary of Child Gender Indices

Year	N	Mean Gender Index	Index St. Dev	Mean Age	Cronbach's Alpha
1996	266	18.73	2.79	15.50	0.76
1998	304	18.58	2.95	15.47	0.82
2002	210	18.80	2.71	17.83	0.77
2006	1060	18.54	2.60	17.92	0.76
2008	274	18.59	2.61	15.84	0.79
2010	229	18.45	2.40	16.46	0.71
Overall	2343	18.59	2.66	16.93	0.76

Table 1.4 shows the responses of the children to the individual gender questions. The table shows the proportion of sons and daughters who provided progressive answers to the questions. Daughters are consistently seen to be more progressive than sons. Comparing Tables 1.4 and 1.2, a larger proportion of daughters have progressive responses compared to their mother's answers in 1979 when they were also between the ages of 15 and 22. There was a

Figure 1.3: Child Gender Indices by Year



Notes: Samples sizes are the same as individual year samples in Table 1.3.

higher proportion of sons with progressive responses compared to the mother's 1979 responses for three questions. Comparing the average mother's 1979 gender-role index (17.74) to the children's gender-role index (18.59) shows that on average the children were more progressive. This is expected since gender-role attitudes have become more progressive overtime. These findings are consistent with previous research (Farré and Vella, 2013; Mason and Lu, 1988; Thornton et al., 1983).

Table 1.4: Proportion of Egalitarian Responses to Gender Questions for Child Gender Index (N=2343)

	Sons	Daughters
1) A woman's place is in the home, not in the office or shop	0.84	0.88
2) A woman who carries out her full family responsibilities does not have time for outside employment	0.75	0.83
4) The employment of wives leads to more juvenile delinquency	0.86	0.90
6) It is better for everyone concerned if the man is the achiever outside the home and the woman takes care of the home and family	0.72	0.85
7) Men should share the work around the house with women, such as doing dishes, cleaning and so forth	0.95	0.96
8) Women are much happier if they stay at home and take care of their children	0.72	0.82

Notes: Table indicates proportion of women who disagreed or strongly disagreed with questions 1, 2, 4, 6 and 8 and proportion of women who agreed or strongly agreed with question 7. There are 1,137 daughters and 1,206 sons in the sample.

2.4 Control Variables

To capture the full effect of the mother's gender-role attitudes, I only use pre-determined control variables of the mother's characteristics that are collected in 1985 or 1986 before the mother's gender-role index is measured in 1987 as I use this gender-role index for my main estimation. For the children's background characteristics, I use information from the survey round when they were aged 15 or 16. The descriptive statistics for the control variables can be found in Table 1.5.

Table 1.5: Descriptive Statistics

VARIABLES			
Child Gender Index	18.59	Child Living in the South	0.37
	(2.66)	at 15 or 16	(0.48)
Mother's Gender Index 1987	18.63	Child Living in the West	0.14
	(3.04)	at 15 or 16	(0.47)
Mother's Gender Index 1982	18.30	Mother's Age 1987	25.59
	(3.04)		(2.15)
Mother's Gender Index 1979	17.74	Mother Non-Black,	0.77
	(3.04)	Non-Hispanic	(0.42)
Gender of Child (male=1)	0.51	Mother Black	0.15
	(0.50)		(0.36)
Child First-Born	0.43	Mother Hispanic	0.08
	(0.50)		(0.27)
Year of Child Gender Index	2,004.09	Mother Married in '79	0.12
	(4.42)		(0.33)
Age of Child Gender Index	16.94	Mother Years of Education	10.56
	(1.89)	in '79	(1.92)
Child Living in Urban Area	0.68	Mother Employed in '79	0.48
at 15 or 16	(0.46)		(0.50)
Child Living in the North-East	0.16	Mother Married in '85/'86	0.61
at 15 or 16	(0.36)		(0.49)
Child Living in the North-Central	0.33	Mother Years of Education	12.72
at 15 or 16	(0.47)	in '85/'86	(2.05)
		Mother Employed in '85/'86	0.65
			(0.48)

Notes: N=2,343. Means and standard deviations in parentheses.

It is important to look at the differences in intergenerational mobility between sons and daughters as one gender may be affected by the mother's attitudes more than the other. Previous research has found that sons typically hold more traditional gender-role attitudes than daughters (Farré and Vella, 2013; Fan and Marini, 2000). I include a dummy variable for the gender of the child where male=1 and female=0. 51% of the children are male.

The race of the mother was determined when she was originally surveyed in 1979. I created dummy variables for Non-Black & Non-Hispanic, Black and Hispanic. It is important to include race as a control as there may be differences in attitudes about gender-roles owing to race. The literature on intersectionality states that one's identity is the result of belonging to multiple social groups. Viewing gender from the intersectional approach is important as gender norms are not consistent across social groups such as race. (Vespa, 2009; Judge and Livingston, 2008; Shields, 2008; DeFour and Brown, 2006; Settles, 2006). Previous research has found that black women have higher labour force participation rates and more progressive ideas in general (Bolzendahl and Myers, 2004; Harris and Firestone, 1998; Mason and Bumpass, 1975). However, some studies have found no effect of race on gender-role attitudes (Ransford and Miller, 1983). Approximately, 77% of mothers were Non-Hispanic, Non-Black, 15% were Black and 8% were Hispanic.

The mother was asked in each survey to state their marital status as either: married and living together, not married, divorced, widowed or separated. Children seeing their mother in a relationship may affect their gender-role attitudes as entering marriage is associated with a traditional shift in a woman's gender-role attitudes (Cunningham et al., 2005). In addition, a child who lives with both a mother and father figure may be exposed to different gender-role attitudes as the parents may exhibit traditional gender-role attitudes with the wife assuming most the household production or the child may be exposed to a male figure contributing to household production. I coded the dummy variable equal to one for married and living together and zero otherwise. In 1979 only 12% of the mother were married compared to 61% of the mothers in 1985 or 1986.

The highest level of education of the mother has been shown to be important in analysing the children's gender-role attitudes. The mother was asked in each survey round to report the highest grade completed. I include the mother's years of schooling because a more educated mother may have different gender-role attitudes due to her additional education. An association between more education of the mother and higher gender-role attitudes of her children has been found in several studies (Bolzendahl and Myers, 2004; Cassidy and Warren, 1996; Mason and Lu, 1988; Plutzer, 1988; Thornton et al., 1983; Powell and Steelman, 1982). It is thought that women's gender-role attitudes become more progressive with additional education due to exposure to feminist ideas (Bolzendahl and Myers, 2004; Davis and Robinson, 1991). The average mother's years of schooling is 10.56 years in 1979 and 12.72 years in 1985 or 1986. This means that on average the mothers have a high school diploma and some

college education in 1986 but the majority of mothers had not yet graduated from high school in 1979.

A mother participating in the labour force may affect the gender-role attitudes of her children as she is deviating from the idea that women should not work. Approximately 48% of the mother were working in 1979 and 65% of the mothers were working in 1985 or 1986. It is not surprising that fewer mothers were working in 1979 as most of them were still in school. It is important to know whether the mother worked as previous studies have found that, as with acquiring more education, working women expose themselves to more feminist ideas compared to staying at home (Bolzendahl and Myers, 2004).[8] There are other channels that participating in the labour force can potentially influence the mother's and her children's gender-role attitudes such as: appreciating the freedom that comes with making one's own money and not wanting to lose out on future earnings. By working, mothers experience independence as they are not dependent on their spouse for income. This enables the woman to have greater freedom of movement regarding location and also a greater ability to leave a bad marriage. This sense of freedom and the importance of it can potentially be passed down to the children so they understand the importance of participating in the labour market. In addition, as discussed in Goldin (2006), the mother's identity may also be partially formed by her being a working mother. The influence of this on the mother's identity may then also pass down to the children who are brought up to seek this sense of identity themselves.

It is important to include what environment the child is living in, whether this is in an urban or rural area or a different region of the United States. Living in an urban versus a rural area may have significant effects on one's attitudes as residents in urban areas will interact with a more diverse group of people increasing the probability of interacting with individuals who hold different gender-role attitudes (Bolzendahl and Myers, 2004). When the children were 15-16 years old approximately 68% lived in an urban area. In addition, the NLSY constructs the region of residence based on where the child is currently living in each survey round. The regions include: Northeast, North Central, South and West. I created a set of dummy variables for each region. This variable will help control for the differences in geographic locations as different regions may be associated with different cultural values.

[8]This happens in multiples ways: first, participating in the workforce may put women in situations where they face discrimination which causes them to acknowledge inequality. Second, participating in the labour force shows women that they are capable of being in the labour force (Bolzendahl and Myers, 2004; Davis and Robinson, 1991). Third, working women encounter other working women which gives validation to their decision to work and fourth, participating in the labour force exposes women to having financial independence (Bolzendahl and Myers, 2004; Rhodebeck, 1996).

When the children were 15-16 years old, approximately 16% lived in the Northeast, 33% lived in the North Central, 37% lived in the South and 14% lived in the West.

I created a dummy variable equal to one if the child is the oldest child in the family and zero otherwise. Inclusion of this variable is important as the oldest child may be treated differently by parents and given different tasks to perform compared to younger siblings. In this sample, 43% of the surveyed children were firstborns.

I have included the year that the child's gender-role index is reported to control for whether the child was born when the mother was older and whether being born earlier or later exposed the children to different ideas about gender-role attitudes. The age of the child when their gender-role index is measured is included to see if a younger person, aged 15, is more or less progressive than an older child. The average age of children in the overall gender-role index is 16.94 years old. Gender-role attitudes that are measured at different periods in one's life may be different due to transitory fluctuations and therefore it is necessary to know the age of the child. In addition, I included the mother's age in 1987 to control for trends in the mothers' gender-role attitudes that may be present as the mother ages.

3 Methodology

The goal of this paper is to estimate the effect of the mother's gender-role attitudes as shown in the following equation:

$$ChildGI_i = \alpha + \beta MomGI_i + \boldsymbol{X_i}\boldsymbol{\gamma} + \epsilon_i \tag{1.2}$$

where i is the individual mother-child pair, $ChildGI_i$ is the child's gender-role index; $MomGI_i$ is the gender-role index of the mother; $\mathbf{X}_i$ is a vector of individual and family characteristics that affect the child's gender-role attitudes and $\boldsymbol{\gamma}$ is the corresponding vector of coefficients; α is the intercept term; β is a coefficient and ϵ_i is the homoscedastic random error term that is identically and independently distributed (i.i.d.) with a mean of zero. To simplify notation I rewrite model (1.2):

$$\widetilde{ChildGI}_i = \widetilde{\alpha} + \beta\widetilde{MomGI}_i + \widetilde{\epsilon}_i \tag{1.3}$$

where $\widetilde{ChildGI}_i$ and $\widetilde{MomGI}_i$ are the children's and mother's gender indices net of the estimated effects of control variables ($\mathbf{X}_i$) as done in previous research (Frisch and Waugh, 1933). $\widetilde{\alpha}$ is the new intercept and $\widetilde{\epsilon}_i$ is still the random error term.

3.1 Measurements of Intergenerational Mobility

There are two measurements of intergenerational mobility that can be analysed. These measures are the intergenerational coefficient (β) and intergenerational correlation (ρ). It is important to note the differences between these two measures. The intergenerational coefficient is the standard OLS beta coefficient:

$$\hat{\beta}_{OLS} = \frac{Cov(\widetilde{ChildGI}_i, \widetilde{MomGI}_i)}{\sigma^2_{\widetilde{MomGI}_i}} \tag{1.4}$$

where $\sigma^2_{\widetilde{MomGI}_i}$ is the variance of the mother's gender-role index. This is the same as the multiple linear regression coefficient β in model (1.2). It states that a one unit increase in mother's gender-role index is associated with a β increase in the child's gender-role index, ceteris paribus. The larger the β the more of an effect the mother's gender-role attitudes has on her children net of the effect of $\mathbf{X}_i$.

The intergenerational correlation ρ is the correlation of $\widetilde{ChildGI}_i$ and $\widetilde{MomGI}_i$. The intergenerational correlation is related to the intergenerational coefficient as shown below:

$$\hat{\rho} = \left(\frac{\sigma_{\widetilde{MomGI}_i}}{\sigma_{\widetilde{ChildGI}_i}} \right) \hat{\beta} \tag{1.5}$$

where $\sigma_{\widetilde{MomGI}_i}$ ($\sigma_{\widetilde{ChildGI}_i}$) is the standard deviation of the residuals of the Mother's (child's) gender-role index. The intergenerational correlation is equal to the intergenerational coefficient if the standard deviation of the residual mother's gender-role index is equivalent to the standard deviation of the residual child's gender-role index. However, if these indices have differing variances then the intergenerational correlation differs from the intergenerational coefficient. If $\rho = 0$, a child's gender-role index has no relationship to their mother's gender-role index. If $\rho = 1$, the child's gender-role index is solely determined by the mother's gender-role index. For the purpose of this paper, it is important to also estimate the intergenerational correlation because the variance of the mother's and children's gender indices are not equal due to different sentiments towards gender-role attitudes between the generations.[9]

[9]It may be possible that the gender-role attitudes of the children influence the gender-role attitudes of the mother therefore biasing the estimates of the intergenerational coefficient and correlation. Previous research has shown evidence of a bidirectional relationship between children and mother's attitudes indicating that children can be a reason for mother's gender-role attitudes changing overtime, especially as the child gets older (Marks et al., 2009; Bohannon and Blanton, 1999; Axinn and Thornton, 1993; Glass et al., 1986). In this paper, the main estimation uses the mother's gender-role attitudes measured in 1987 which is 17 years before average year (2004) that the child's gender-role attitudes are measured. However, some children were seven years old when their mother's attitudes were measured in 1987; therefore, bias of the OLS estimates owing to simultaneity is not expected to be large but may be present.

3.2 Measurement Error

Solon (1992) found measurement error when a short-run measure of income is used to analyse the intergenerational mobility of income. The measurement error comes from the short-run measures having transitory fluctuations around the person's long-run measure of income. The same classical measurement error model can be applied to the intergenerational mobility of gender-role attitudes. Previous studies have used single year measures of a mother's gender-role attitudes to measure the intergenerational mobility of gender-role attitudes (Farré and Vella, 2013). It is important to find the mother's long-run gender-role index while her child was in the household as a previous study has found that children's gender-role attitudes are affected by the gender-role attitudes of their mother beginning at one year old and continue to be affected by the mother's gender-role attitudes throughout the time they live with their mother (Cunningham, 2001; Weinraub et al., 1984). On average, the children in this sample were born in 1987, ranging from 1980 to 1995. Using one year of the mother's gender-role index in either 1979, 1982 or 1987 as the mother's long-run gender-role index for when she was raising her child is inaccurate as the mother's gender-role index likely changes between the birth of the child and when the child leaves the household.

Analysing the same NLSY79 survey, Fan and Marini (2000) found that the mother's gender-role attitudes between 1979 and 1987 statistically significantly shifted due to individual experiences during their young adult life such as: educational achievements, participation and non-participation in the labour force, marriage and having children. The transitory fluctuations around the long-run measure of the mother's gender-role index are larger during periods of significant change for the mothers; therefore, measuring the mother's gender-role index during a period of large transitory fluctuations increases the bias from measurement error.

Using a short-run measure of the mother's gender-role index as a proxy for the mother's long-run gender-role index induces an attenuation bias assuming that $MomGI_{it}$ follows a classic measurement error model:

$$\widetilde{MomGI}_{it} = \widetilde{MomGI}_{i}^{*} + v_{it} \tag{1.6}$$

where $MomGI_{it}$ is the measured mother's gender-role index in year t where t=1979, 1982, 1987 or 2004; $MomGI_i^*$ is the long-run measure of the mother's gender-role index; v_{it} is the composite error term which includes transitory fluctuations in the mother's gender-role index and random measurement error that is i.i.d. with a zero mean and homoscedastic. It is

important that after the addition of control variables that the measurement error which is leftover is uncorrelated with the mother's long-run gender-role index. The inclusion of controls such as: the mother's years of education, marital status and labour force status control for the transitory shocks that may have lasting implications on the mother's long-run index.

The same equation can be used to show the child's short-run gender-role index ($ChildGI_{it}$) is equal to the child's long-run gender-role index ($ChildGI_i^*$) plus an error term (μ_{it}):

$$\widetilde{ChildGI}_{it} = \widetilde{ChildGI}_i^* + \mu_{it} \tag{1.7}$$

where t equals the different years the child's gender-role index was measured. It is assumed that v_{it} is uncorrelated with μ_{it}. It is also assumed that v_{it} is uncorrelated with the long-run measure of the mother's gender-role index ($MomGI_i{}^*$) and μ_{it} is uncorrelated with the long-run measure of the child's gender-role index. When using a single year estimate of the mother's gender-role index Equation (1.3) is rewritten to account for this error:

$$\widetilde{ChildGI}_i^* = \widetilde{\alpha} + \beta\widetilde{MomGI}_{it} + (\widetilde{\epsilon}_i - \beta v_{it}) \tag{1.8}$$

Endogeneity is present in Equation (1.8) as $\widetilde{MomGI}_{it}$ is correlated with v_{it} in the error term. The attenuation bias owing to errors-in-variables is as follows:

$$plim\ \hat{\beta}_{OLS} - \beta = \beta_{OLS}\left(\frac{\sigma^2{}_{\widetilde{MomGI}_i{}^*}}{\sigma^2{}_{\widetilde{MomGI}_i{}^*} + \sigma^2{}_{v_{it}}}\right) - \beta\ <\ 0 \tag{1.9}$$

where $\sigma^2{}_{\widetilde{MomGI}_i{}^*}$ is the population variance of the mother's long-term gender-role index and $\sigma^2{}_{v_{it}}$ is the population variance of the error term for the mother's gender-role index. The derivation of Equation 1.9 can be found in Appendix 8.1. As stated by Solon (1992), the seriousness of the bias due to errors-in-variables is reliant upon whether the population variance of the error is large relative to the variance of the mother's long-run gender-role index. It is important to mention, measurement error in $ChildGI_i{}^*$ does not cause a bias of the estimates. This is shown in Appendix 8.2.

3.3 Estimation Methods

This paper uses two methods to solve for endogeneity due to measurement error. The first method is to take the average of the mother's gender-role index over multiple years. By measuring the mother's gender-role index over several years, the short-run gender-role index

will more closely resemble the long-run gender-role index that the child was exposed to. The below equation shows how the mother's gender-role index being averaged over time decreases measurement error. Equation (1.8) is changed to:

$$\widetilde{ChildGI}_i = \widetilde{\alpha} + \beta\overline{MomGI}_i + (\widetilde{\epsilon}_i - \beta\overline{v}_{it}) \tag{1.10}$$

where

$$\overline{MomGI}_i = \sum_{t=1}^{s} \frac{\widetilde{MomGI}_{it}}{s} \tag{1.11}$$

$$\overline{v}_i = \sum_{t=1}^{s} \frac{v_{it}}{s} \tag{1.12}$$

where $t = 1 \ldots s$ and s equals 2, 3 or 4 years depending how many years of the mother's gender-role index is included in the average. In my results section I compute individual regressions of the effect of the mother's gender-role index averaged over 2, 3 and 4 periods on the child's gender-role index showing the presence of measurement error. The averaging of the mother's short-run indices produces the following bias of the intergenerational coefficient:

$$plim\ \hat{\beta}_{OLS} - \beta = \beta_{OLS}\left(\frac{\sigma^2_{\widetilde{MomGI}_i{}^*}}{\sigma^2_{\widetilde{MomGI}_i{}^*} + \frac{\sigma^2_{v_{it}}}{s}}\right) - \beta \ < \ 0 \tag{1.13}$$

Equation (1.13) shows that the intergenerational coefficient is still susceptible to attenuation bias; however, it decreases the bias shown in Equation (1.9).

The second method I use to estimate the effect of the mother's gender-role attitudes on the child's gender-role attitudes is an instrumental variable estimation, which I implement as a Two-Stage Least Squares estimation. This estimation more accurately corrects for measurement error than averaging the mother's attitudes over multiple years. Equation (1.8) is used to show the causal model I am interested in:

$$\widetilde{ChildGI}_i = \widetilde{\alpha} + \beta\widetilde{MomGI}_{i87} + \widetilde{\omega}_i \tag{1.14}$$

where measurement error is present as shown by the composite error term $\omega_i \ = (\epsilon_i - \beta v_{i87})$. To control for this endogeneity, I use the mother's first measured gender-role index from 1979 ($MomGI_{i79}$) as an instrument for the mother's gender-role index in 1987 ($MomGI_{i87}$). The first stage is as follows:

$$\widetilde{MomGI}_{i87} = \pi_1 + \pi_2\widetilde{MomGI}_{i79} + \widetilde{\varepsilon}_i \tag{1.15}$$

where $\widetilde{MomGI}_{i79}$ is the mother's 1979 gender-role index net of control variables, π_1 is the intercept, π_2 is the coefficient and $\widetilde{\varepsilon}_i$ is the i.i.d error term with a mean of zero and homoscedastic. The second stage equation is as follows:

$$\widetilde{ChildGI}_i = \delta_0 + \delta_2 \widehat{MomGI}_{i87} + \widetilde{\epsilon}_i \tag{1.16}$$

where $\widehat{MomGI}_{i87}$ are the predicted values of $\widetilde{MomGI}_{i87}$ from the first stage in Equation (1.15). As these predicted values are uncorrelated with the measurement error from Equation (1.14), there is no correlation between $\widehat{MomGI}_{i87}$ and ϵ_i; therefore, the 2SLS estimation can be shown as the following instrumental variable intergenerational coefficient:

$$\hat{\beta}_{IV} = \frac{Cov(\widetilde{MomGI}_{i79}, \widetilde{ChildGI}_i\ )}{Cov(\widetilde{MomGI}_{i79},\ \widetilde{MomGI}_{i87})} \tag{1.17}$$

The intergenerational coefficient can then be transformed into the instrumental variable intergenerational correlation:

$$\hat{\rho} = \hat{\beta}_{IV} \frac{\sigma_{\widetilde{MomGI}_{i87}}}{\sigma_{\widetilde{ChildGI}_i}} \tag{1.18}$$

where $\sigma_{\widetilde{MomGI}_{i87}}$ is the standard deviation of the residuals from the mother's 1987 gender-role index on all other controls and $\sigma_{\widetilde{ChildGI}_i}$ is the standard deviation of the residuals from the child's gender-role index on all other controls as shown in previous research (Nicoletti and Ermisch, 2007).

In order to control for the measurement error present in Equation (1.14) there are three conditions that the mother's 1979 gender-role index must satisfy. One, the 1979 gender-role index must be significant in explaining the mother's 1987 gender-role index conditional on the remaining control variables as shown:

$$E(\widetilde{MomGI}_{i79}\ , \widetilde{MomGI}_{i87}) \neq 0 \tag{1.19}$$

Previous research has shown one's gender-role attitudes from a previous period is correlated with their attitudes in a future period as "individuals act on previously formed attitudes in seeking out new information and experiences" (Cunningham, 2001; Fan and Marini, 2000).

Two, the mother's 1979 gender-role index must only affect the child's gender-role attitudes through the mother's 1987 gender-role index:

$$E\left(\widetilde{ChildGI}_i\ ,\ \widetilde{MomGI}_{i79} \;\middle|\; \widetilde{MomGI}_{i87}\right) = 0 \tag{1.20}$$

If the child was born in or before 1979, it is possible that the mother's gender-role attitudes directly affected her interactions with her child and therefore the exclusion restriction would be violated. As stated earlier, the sample is restricted to only include children born after 1979; therefore, the child was never exposed to the mother's 1979 gender-role attitudes.[10] In addition, since having a child is associated with a change in gender-role attitudes (Vespa, 2009; Fan and Marini, 2000) the mother's gender-role attitudes before and after having a child may be significantly different and therefore the 1979 gender-role index would have even less of an impact on the child. However, a violation of the exclusion restriction may result if the child was not directly affected by the mother's 1979 gender-role index but was directly affected by decisions the mother made resulting from her 1979 gender-role attitudes. The mother may have made decisions about marriage, education or labour force participation based on these 1979 gender-role attitudes that would have lasting effects on the mother's and child's lives. To avoid this issue, I control for the mother's labour force status, marital status and education ensuring that lasting effects from career or familial decisions made due to her 1979 gender-role attitudes do not affect the estimates. This results in the mother's 1979 gender-role index only affecting the child through the mother's most recent gender-role index in 1987.

Three, the instrument must not be correlated with the composite error term from Equation (1.14):

$$Cov\left(\widetilde{MomGI}_{i79}\ ,\ \omega_i\right) = 0 \tag{1.21}$$

This implies that the instrument must be uncorrelated with the measurement error related to $MomGI_{i87}$. This condition is satisfied if the measurement error in the mother's gender-role index is uncorrelated across time, which seems a credible assumption. Fan and Marini (2000) who studied the changes in the NLSY79 respondents gender-role attitudes overtime found that the measurement error of the gender indices were not correlated across time between any of the questions used in the index between 1979 and 1987. This makes intuitive sense as the transitory fluctuations that affect the 1979 index will most likely be due to different circumstances than the transitory fluctuations that affect the 1987 index as the women would be at different stages of their lives. For example, one's gender-role attitudes may have been affected by transitory fluctuations in 1979 due to enrolling and participating in college while in 1987 their gender-role attitudes may have been affected by transitory fluctuations due to entering marriage or parenthood. If the mother's 1979 gender-role index is correlated with

[10]Furthermore, by having this birth year restriction, instrumenting the mother's 1987 attitudes with her 1979 attitudes should control for endogeneity due to simultaneity as the children's attitudes cannot influence the mother's attitudes before they are born.

the composite error term from Equation (1.14) then this would bias the estimates:

$$plim\ \hat{\beta}_{IV} = \beta + \frac{Cov(\widetilde{MomGI}_{i79}\ ,\ \omega_i)}{Cov(\widetilde{MomGI}_{i79}\ ,\ \widetilde{MomGI}_{i87})} \tag{1.22}$$

Section 4.5 will provide evidence that the exclusion restriction is not violated.

4 Results

4.1 OLS Estimations

Table 1.6 shows basic OLS estimation results where Column 1 shows the Mother's 1987 gender-role index intergenerational coefficient of 0.151, with a correlation coefficient of 0.172, is strongly statistically significant in estimating her child's gender-role index without additional covariates. These results are interpreted as a one standard deviation increase in the mother's gender-role index is associated with a 17.2% of a standard deviation increase in the child's gender-role index. It is important to see if the mother's gender-role index remains statistically significant once additional covariates are included. Table 1.6 Column 2 shows that this is true. A one standard deviation increase in the mother's gender-role index is associated with a 14.9% of a standard deviation increase in the child's gender-role index. This shows that a mother with more progressive gender-role attitudes is associated with their child's gender-role attitudes being more progressive. It is expected that the intergenerational coefficient would be larger without additional covariates as this is expected from omitted variables bias; however, there is not a statistically significant difference between the intergenerational associations between Columns 1 and 2.

Other variables that are strongly statistically significant in describing the child's gender-role index is whether the child is male and the year the child's gender-role index was measured. The child being male is associated with a 1.49 point decrease in the child's gender-role index which is equal to 56% of a standard deviation. Farré and Vella (2013) also found that that the child being male had a traditional impact on gender-role attitudes. The child's gender-role index measured in a more recent year is associated with a traditional impact on the child's attitudes. As the year of the child's gender-role index is highly positively correlated with the age of the mother at birth of the child (correlation of 0.79) this is consistent with previous research. Farré and Vella (2013) also found that an increase in the age of the mother at birth is associated with a negative effect on the child's gender-role attitudes.

Table 1.6: OLS Estimation of the Effects of Mother's 1987 Gender Index on Child's Gender Index

VARIABLES	(1) OLS	(2) OLS with Covariates	(3) OLS with Interaction
Mother's Gender Index 1987	0.151***	0.131***	0.130***
	[0.023]	[0.024]	[0.032]
Child First-Born		-0.080	-0.080
		[0.114]	[0.114]
Gender of Child (male=1)		-1.495***	-1.540**
		[0.103]	[0.709]
Mother Married in '85/'86		-0.022	-0.022
		[0.123]	[0.123]
Mother Years of Education in '85/'86		0.033	0.033
		[0.042]	[0.042]
Mother Employed in '85/'86		0.284**	0.284**
		[0.137]	[0.138]
Mother Married in '79		-0.266	-0.266
		[0.238]	[0.238]
Mother Years of Education in '79		0.078	0.078
		[0.071]	[0.071]
Mother Employed in '79		0.130	0.130
		[0.124]	[0.125]
Year of Child Gender Index		-0.053***	-0.053***
		[0.016]	[0.016]
Age of Child Gender Index		0.091***	0.091***
		[0.030]	[0.030]
Mother's Gender Index 1987 * Male			0.002
			[0.038]
Constant	15.783***	121.283***	121.317***
	[0.446]	[32.004]	[32.031]
ρ	0.172***	0.149***	0.109***
	[0.026]	[0.027]	[0.027]
Observations	2,343	2,343	2,343
R-squared	0.030	0.130	0.130

Notes: Standard errors clustered at the mother level (1,298 clusters). *** p<0.01, ** p<0.05, * p<0.1 Additional controls are the Mother's race, the Mother's age in 1987, the region (North-East, North-Central, South or West) that the child was living in at age 15 or 16 and a dummy for if the child was living in an urban area at age 15 or 16.

As the child being male has a strong statistical and economic impact on the child's gender-role index, Column 3 includes an interaction term to see if there is a significant difference between the effects of the mother's gender-role index on the child's gender-role index if the child is male. The interaction term is found to be insignificant. Farré and Vella (2013) also did not find a significant difference between the intergenerational mobility of gender-role attitudes of sons and daughters.

4.2 Two-Stage Least Squares Estimation

To further mitigate endogeneity from measurement error, I use Two-Stage Least Squares estimation as shown in Table 1.7. The variable being instrumented is the mother's 1987 gender-role index and the instrument is the mother's 1979 gender-role index. Column 1 shows the second stage results, Column 2 shows the first stage results and Column 3 shows the OLS results. First, it is important to see if the mother's 1979 gender-role index is a strong instrument for the mother's 1987 gender-role index. The F-Statistic from the First Stage regression in Table 1.7 Column 2 is highly statistically significant with a value of 364 indicating that the mother's 1979 gender-role index is a strong instrument for the mother's 1987 gender-role index. The 2SLS estimates for the effect of the mother's gender-role index are larger than the OLS estimates indicating the presence of that attenuation bias due to measurement error. Section 4.3 goes into detail defending that the larger 2SLS estimates are due to measurement error and not violation of the exclusion restriction.

Table 1.7 Column 1 shows the Second Stage results that the mother's gender-role index has a significant progressive impact on her child's index with an intergenerational coefficient of 0.238. The intergenerational correlation in Column 1 is equal to 0.253 showing that a one standard deviation increase in the mother's gender-role index is associated with a 25.3% of a standard deviation increase in the child's gender-role index. The Second Stage results in Column 1 are found to be significantly different at the 5% level from the OLS estimates in Column 3 as I reject the Hausman Endogeneity test. Due to this rejection, the mother's 1987 gender-role index should be treated as endogenous and 2SLS estimation should be used over OLS estimation. It is expected that the mother's 1987 gender-role index is endogenous because the mothers in 1987 were experiencing large transitory shocks in their gender-role attitudes as they were between the ages of 22 and 30. 2SLS estimation should be used over OLS estimation when using a short-run measure of the mother's gender-role index that is prone to large transitory shocks.

The child being male is associated with a traditional impact with a 1.51 point decrease in the gender-role index which is 57% of a standard deviation. In addition, the year of the child's gender-role index and the age of the child when their index was measured have statistically significant effects on the child's gender-role attitudes.[11] The magnitudes and directions of the

[11]Table 1.18 in the Appendix shows results are robust to including a dummy variable for whether the child is married when their gender-role attitudes are measured. Results are also robust to dropping children respondents who are married when their gender-role attitudes are measured.

Table 1.7: 2SLS Estimation of the Effects of Mother's 1987 Gender Index on Child's Gender Index Using the 1979 Index as an Instrument

VARIABLES	(1) Second Stage	(2) First Stage	(3) OLS
Mother's Gender Index 1987	0.238***		0.131***
	[0.061]		[0.024]
Child First-Born	-0.112	0.282**	-0.080
	[0.114]	[0.112]	[0.114]
Gender of Child (male=1)	-1.507***	0.004	-1.495***
	[0.103]	[0.106]	[0.103]
Mother Married in '85/'86	-0.009	-0.035	-0.022
	[0.126]	[0.180]	[0.123]
Mother Years of Education in '85/'86	0.013	0.098*	0.033
	[0.044]	[0.056]	[0.042]
Mother Employed in '85/'86	0.145	1.222***	0.284**
	[0.149]	[0.186]	[0.137]
Mother Married in '79	-0.258	0.257	-0.266
	[0.233]	[0.308]	[0.238]
Mother Years of Education in '79	0.065	0.064	0.078
	[0.073]	[0.097]	[0.071]
Mother Employed in '79	0.109	0.015	0.130
	[0.126]	[0.183]	[0.124]
Year of Child Gender Index	-0.056***	0.020	-0.053***
	[0.016]	[0.019]	[0.016]
Age of Child Gender Index	0.098***	-0.059*	0.091***
	[0.031]	[0.032]	[0.030]
Mother's Gender Index 1979		0.366***	
		[0.030]	
Constant	124.078***	-27.178	121.283***
	[31.979]	[37.394]	[32.004]
F statistic 1st Stage		364.052	
Endogeneity Test p-value	0.041		
ρ	0.253***		0.149***
	[0.065]		[0.027]
Observations	2,343	2,343	2,343
R-squared	0.116	0.234	0.130

Notes: Standard errors clustered at the mother level (1,298 clusters). *** p<0.01, ** p<0.05, * p<0.1 Additional controls are the Mother's race, the Mother's age in 1987, the region (North-East, North-Central, South or West) that the child was living in at age 15 or 16, an indicator for if the child was living in an urban area at age 15 or 16.

covariates are similar in both 2SLS and OLS estimation, providing evidence that the 2SLS estimation is accurate in controlling for measurement error.

4.3 Evidence of Measurement Error

As the 2SLS estimates for the mother's gender-role index are larger than the OLS estimates, one of two situations may be happening: 1) attenuation bias due to measurement error is present or 2) the exclusion restriction is being violated and causing an upward bias in the

2SLS estimates. Thus, it is important to see evidence of measurement error. The Ordinary Least Squares regressions in Table 1.8 regresses the gender-role index of mothers on the gender-role index of her children with the additional covariates from Table 1.6 Column 2 partialled out.

Table 1.8: OLS Estimates of β and ρ from the Effects of Mother's Gender Indices on Child's Gender Index Supplemental Samples (N=2.343)

		Measure of Mother's Gender Index		
Year of Mother's Gender Index	Statistic	Single Year Measure	Two Year Average	Three Year Average
1979	$\beta[SE]$	0.087 [0.023]	0.144 [0.029]	0.183 [0.032]
	ρ	0.100	0.139	0.164
	SDc, SDm	2.509, 2.879	2.511, 2.430	2.511, 2.251
1982	$\beta[SE]$	0.122 [0.025]	0.171 [0.029]	
	ρ	0.138	0.167	
	SDc, SDm	2.511, 2.833	2.511, 2.446	
1987	$\beta[SE]$	0.131 [0.024]		
	ρ	0.149		
	SDc, SDm	2.511, 2.864		

Notes: Standard errors clustered at the mother level (1,298 clusters). Estimates partial out the effects of covariates in Table 1.6 Column 2. β is the intergenerational coefficient with it's corresponding cluster-robust standard error (SE). The correlation coefficient (ρ) with it's corresponding standard deviations for mother's (SDm) and child's (SDc) gender index.

Following Solon (1992), I analyse the intergenerational coefficients and correlations when averaging the mother's gender-role index over time. If measurement error is present, the coefficients and correlations should increase the more years that are averaged due to reducing bias as seen in Equation (1.13). Table 1.8 Column 1 measures the effects of a mothers' gender-role index from either 1979, 1982 or 1987 on her child's gender-role index. Column 2 measures the mothers' gender-role index as the average of her 1979 and 1982 indices and her 1982 and 1987 gender indices. Column 3 measures the mother's gender-role index as the average of her 1979, 1982 and 1987 gender indices. The mother's gender indices are strongly significant in estimating the child's gender-role index whether it is observed over multiple years or in a specific year. Table 1.8 Column 1 shows that a one standard deviation increase in the mother's 1987 gender-role index is associated with a 14.9% of a standard deviation increase in the child's gender-role index. Column 3 show that a one standard deviation increase in the mother's gender-role index is associated with a 16.4% of a standard deviation increase in the child's gender-role index the more years that are averaged. As the intergenerational coefficients consistently increase and intergenerational correlations increase overall the more years that are averaged, measurement error appears to be biasing the results. These results

show the same pattern as in Solon (1992) which concluded that measurement error was biasing the intergenerational coefficients and correlations of income.

As shown in Table 1.8, the mother's most recent gender-role index from 1987 has the largest effect on the child's gender-role index compared to gender indices measured earlier. This aids the defence of the exclusion restriction that requires that previous gender views to only affect the children through the most recent gender views. These results indicate that the mother's gender views have larger effects on her children the less time there is between the measurement of the mother's and children's attitudes.

4.4 Evidence of Transitory Fluctuations and Measurement Error

The hypothesis that the mother's gender indices from 1979, 1982 and 1987 were susceptible to measurement error due to transitory fluctuations in their gender-role attitudes can be tested by analysing if there is measurement error in the mother's 2004 gender-role index. Previous gender-role attitudes research states that individual's gender-role attitudes are susceptible to change throughout their life as people are exposed to new experiences (Davis and Greenstein, 2009; Cunningham et al., 2005; Brooks and Bolzendahl, 2004; Fan and Marini, 2000). However, individual's gender-role attitudes are highly susceptible to change during adolescence and young-adulthood due to exposure to a large number of new social situations compared to later adulthood years (Fan and Marini, 2000). As people get older, they are most likely exposed to fewer new social situations as marriage, fertility, education and labour force participation decisions have mostly been made by the age of 40. In 2004, the mothers are aged between 40 and 47. On average, by these ages women are married, have completed fertility and education. Due to not making as many decisions about these important life choices as when they were adolescents and young adults, there will be less transitory fluctuations around the mother's 2004 gender-role index compared to her 1979 and 1987 gender indices.

Table 1.9 shows the same regressions as in Table 1.8 but includes the mother's 2004 gender-role index. The sample size of 1,344 is less than the sample size of 2,343 in Table 1.8 due to restricting the sample to children whose gender-role index was measured after 2004 to decrease the potential for simultaneity bias.[12] In Table 1.8, the intergenerational coefficients and most correlations increased with each additional year that was averaged, indicating attenuation

[12]It is likely that simultaneity bias is present in the OLS intergenerational relationships using the mother's 2004 attitudes as the mother's attitudes are measured within a few years of the child's gender-role attitudes and when the child is older. Previous research has indicated that children's attitudes have larger influences on their parents attitudes as they age (Axinn and Thornton, 1993; Glass et al., 1986). While restricting the estimation to children whose attitudes are measured after 2004 may decrease the degree of simultaneity bias, it is possible that the children's attitudes have already influenced the mother's 2004 attitudes.

bias due measurement error. In Table 1.9, the intergenerational correlations that include the mother's 2004 gender-role index decrease overall with additional years averaged. In addition, the intergenerational coefficient decreases for the samples including the mother's 2004 gender index from the three year average to the four year average. This indicates that measurement error is not as large for the mother's 2004 gender-role index.

Table 1.9: OLS Estimates of β and ρ from the Effects of Mother's Gender Indices on Child's Gender Index Supplemental Samples (N=1,344)

		Measure of Mother's Gender Index			
Year of Mother's Gender Index	Statistic	Single Year Measure	Two Year Average	Three Year Average	Four Year Average
1979	β [SE]	0.071 [0.025]	0.130 [0.030]	0.180 [0.033]	0.254 [0.037]
	ρ	0.082	0.129	0.162	0.212
	SDc, SDm	2.469, 2.891	2.469, 2.446	2.469, 2.234	2.469, 2.064
1982	β [SE]	0.123 [0.027]	0.182 [0.031]	0.262 [0.036]	
	ρ	0.140	0.177	0.231	
	SDc, SDm	2.469, 2.811	2.469, 2.400	2.469, 2.179	
1987	β [SE]	0.149 [0.028]	0.242 [0.034]		
	ρ	0.166	0.234		
	SDc, SDm	2.469, 2.753	2.469, 2.391		
2004	β [SE]	0.195 [0.029]			
	ρ	0.230			
	SDc, SDm	2.469, 2.898			

Notes: Standard errors clustered at the mother level. Estimates partial out the effects of covariates in Table 1.6 Column 2. β is the intergenerational coefficient with it's corresponding cluster-robust standard error (SE). The correlation coefficient (ρ) with it's corresponding standard deviations for mother's (SDm) and child's (SDc) gender index. Sample size is restricted to children with a measured gender index after 2004.

Providing further evidence that the mother's 2004 gender-role index is not susceptible to as large of measurement error as the previous gender indices, Table 1.10 shows 2SLS estimation using the mother's 1979 gender-role index as an instrument for the average of her 1987 and 2004 gender indices. I use the average of the mother's 1987 and 2004 gender indices because for this sample, the average birth year of the child is 1989, ranging from 1984 to 1995. The children are on average are fifteen years old when the mother's 2004 gender-role index is measured which may not representative of the mother's gender-role attitudes when the child was young. As previous research has suggested that children begin learning gender-role attitudes from their parents from young ages (Cunningham, 2001; Weinraub et al., 1984) it is important to also have a measure of the mother's gender-role attitudes when the children were young. Therefore, I used the averaged of the mother's 1987 and 2004 gender indices as these two years gives an estimate of the mother's gender-role attitudes when the children were young and when they were older. By using the average, I can compare the OLS and 2SLS

results using the Hausman endogeneity test to see if there is measurement error present in the OLS estimation.

Table 1.10: 2SLS Estimation of the Effects of Mother's Average 1987 & 2004 Gender Indices on Child's Gender Index Using the 1979 Index as an Instrument

VARIABLES	(1) Second Stage	(2) First Stage	(3) OLS
Mother's Average Gender Index '87/'04	0.250***		0.242***
	[0.083]		[0.034]
Mother's 1979 Gender Index		0.282***	
		[0.029]	
F statistic 1st Stage		176.466	
Endogeneity Test p-value	0.918		
ρ	0.234***		0.234***
	[0.078]		[0.033]
Observations	1,344	1,344	1,344
R-squared	0.055	0.116	0.055

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2.

Table 1.10 provides evidence that measurement error is not a large issue when the mother's gender indices are not during periods of large transitory fluctuations as the 2SLS intergenerational correlation of 0.234 is not significantly different from the OLS correlation of 0.234 and the intergenerational coefficients are not significantly different either. If measurement error still had a large bias, I would expect the 2SLS estimates to be significantly larger than the OLS estimates. I fail to reject the Hausman endogeneity test concluding that there is not sufficient evidence that the average of the mother's 1987 and 2004 gender indices is endogenous; therefore, OLS estimation should be used over 2SLS estimation due to the decrease in measurement error.

Table 1.11 2SLS estimation, instruments the mother's 2004 gender-role index with the mother's 1979 gender-role index. The intergenerational correlation of the effect of the mother's 2004 gender-role index on the child's gender index is larger than the intergenerational correlations of the mother's 1987 gender-role index as there is less time between the measurement of the 2004 index and the measurement of the child's gender-role index compared to the mother's 1987 gender-role index. Table 1.11 Column 1 shows the Second Stage results that a one standard deviation increase in the mother's 2004 gender-role index is associated with a 38.2% of a standard deviation increase in the child's gender-role index.

When instrumenting the mother's 2004 gender-role index, I fail to reject the null hypothesis of the Hausman endogeneity test and conclude that there is not sufficient evidence that the

Table 1.11: 2SLS Estimation of the Effects of Mother's 2004 Gender Index on Child's Gender Index Using the 1979 Index as an Instrument

VARIABLES	(1) Second Stage	(2) First Stage	(3) OLS
Mother's 2004 Gender Index	0.328***		0.195***
	[0.114]		[0.028]
Mother's 1979 Gender Index		0.215***	
		[0.039]	
F statistic 1st Stage		64.528	
Endogeneity Test p-value	0.217		
ρ	0.382***		0.229***
	[0.132]		[0.033]
Observations	1,344	1,344	1,344
R-squared	0.028	0.046	0.052

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2.

mother's 2004 gender-role index should be treated as endogenous and therefore OLS estimation should be used. This defends my hypothesis that the presence of larger transitory shocks in the mother's gender indices in 1979, 1982 and 1987 creates measurement error. However, having 2SLS estimates larger than OLS estimates shows that using a single year for the mother's gender-role index, even if it is during a period of smaller transitory fluctuations, still has measurement error due to it not measuring the long-run mother's gender-role index for while her children were still living with her. Whereas in Table 1.10, using the average of the mother's 1987 and 2004 gender indices, there is no evidence of measurement error as the IV estimates are very close to the OLS estimates.

4.5 Validity of Instrument

An issue arises if the child is directly affected by the mother's 1979 gender-role index. As violation of the exclusion restriction in 2SLS estimation results in biased estimates, it is important to do additional checks to provide evidence that the children are not being directly affected by the mother's 1979 gender-role index after controlling for additional covariates. Table 1.12 shows the second stage 2SLS estimation results when restricting the sample to children born after 1979, 1983 and 1986. In the original sample shown in Table 1.12 Column 1, the average birth year of the child was 1987, varying between 1980 and 1995. If the mother's 1979 gender-role index has a direct effect on the child's gender-role index, I would expect to see the intergenerational correlations for the mother's gender-role index to change as the birth years of the children become further from 1979. This table shows that the estimation for the

effect of the mother's gender-role index does not significantly change when restricting the sample to children born later. This provides evidence that the mother's 1979 gender-role index is not directly affecting the child's gender-role index, conditional on the mother's 1987 gender-role index and additional covariates. The instrument remains strong even with each additional year restriction with a first-stage F-statistic of 216 when the births of the children are after 1986 as shown in Table 1.12 Column 3.

Table 1.12: 2SLS Estimation of the Effects of Mother's 1987 Gender Index on Child's Gender Index when Restricting Year of Birth of Child

	(1)	(2)	(3)
	Second Stage	Second Stage	Second Stage
VARIABLES	Born after 1979	Born after 1983	Born after 1986
Mother's 1987 Gender Index	0.238***	0.254***	0.263***
	[0.061]	[0.066]	[0.071]
F statistic 1st Stage	366.715	254.954	216.708
Endogeneity Test p-value	0.041	0.035	0.049
ρ	0.253***	0.270***	0.276***
	[0.065]	[0.070]	[0.074]
Observations	2,343	1,768	1,281

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2.

4.6 Omitted Variable Bias

Using the mother's 1979 gender-role index as an instrument for her 1987 gender-role index corrects for endogeneity owing to measurement error due to different transitory fluctuations at different periods in one life but it is difficult to theoretically defend that the use of the mother's previous attitudes as an instrument corrects for omitted variable bias. If the mother's 1979 and 1987 gender indices are both correlated with the same omitted variables then this would bias the estimation. In this section I provide empirical evidence that omitted variables does not seem to be driving the results. For an omitted variable to bias the estimation, it must significantly explain variation in both the mother's gender-role index and child's gender-role index; therefore, I only focus on variables which would reasonably fit this criterion.

In Bisin and Verdier's (2001) theory of cultural transmission, values are formed and influenced both within and outside the family. In the above analysis, I have accounted for the attitudes and some characteristics of the mother but have not controlled for the influences of the father. The father's gender-role attitudes may be associated with the mother's gender-role attitudes as Farré and Vella (2013) and Fernández et al. (2004) found that men with more

progressive gender-role attitudes were more likely to have working wives. Unfortunately, the NLSY79CYA only follows the children of female NLSY79 respondents. This means that I do not have information about the gender-role attitudes of the father and poor data collection about characteristics of the father (such as employment status and education levels) makes analysing the influence of fathers on children's attitudes difficult. Other omitted variables potentially include the types and duration of parental investments may be important in the formation of children's gender-role attitudes. Research on parental investments shows evidence of the types, and timings, of interactions parents have with their children can have significant effects on non-cognitive skill formation (Cunha et al., 2010; Cunha and Heckman, 2008, 2007) with fathers (and step-fathers) playing a significant role (Amato and Rivera, 1999; Amato, 1994).

It is common in the literature about formation of gender-role attitudes to not have as much information about fathers as mothers. Dhar et al. (2019) and Antill et al. (2003) are exceptions as they analyse the intergenerational mobility of gender-role attitudes in India and Australia with gender-role attitudes of both parents. They both find that mother's gender-role attitudes are more influential than father's but find evidence of fathers characteristics influencing the attitudes of their children. In a review of literature on the formation of gender-role attitudes, Davis and Greenstein (2009) state that fathers are most likely not as influential as mothers in influencing the gender-role attitudes of their children since women provide more childcare than men in households. Davis and Greenstein (2009) also state that a father's influence on children's attitudes are likely independent from the mother's influence which is consistent with the results of Dhar et al. (2019) and Antill et al. (2003). Some evidence suggests that fathers with more education are associated with children with more progressive gender-role attitudes (Farré and Vella, 2013; Fan and Marini, 2000) while others have not found this relationship (Johnston et al., 2014). Cunningham (2001) finds that fathers doing larger shares of housework is associated with their child having more progressive gender-role attitudes about the division of household labour. Leaper and Friedman (2007) shows evidence of fathers interacting differently with children than their mothers by encouraging for gender-typical behaviours.

In addition to fathers, other family members such as siblings and grandparents can also potentially influence the gender-role attitudes of children (Brenøe, 2018). Outside of the family, Bisin and Verdier (2001) argue that parents can limit their child's interactions with others holding different values by living in neighbourhoods and attending schools that are made up of peers with similar values. Psychological and sociological research about transmission of

gender norms finds that peers, teachers and geographic location can influence the attitudes of children.[13]

Table 1.13 shows 2SLS and OLS estimation with and without covariates providing evidence that omitted variables may not have a large effect on the mother's and child's gender-role index. Columns 1 and 2 show that the addition of covariates does not significantly change the estimation of the mother's gender-role index on the child's gender-role index with coefficients of 0.312 and 0.310. Additional covariates that are added to the estimation are the covariates used in the previous analysis with the addition of: the grandmother's highest level of education, age at birth, whether she worked when the mother was 14 years old and if the child regularly goes to friends' houses after school. I control for whether the child goes to a friend's house after school as these children may be more susceptible to omitted variables bias as the mother's attitudes may be more likely to be correlated with the friends' attitudes if they routinely allow their child over at the others house after school. Inclusion of this variable has no influence on the effect mother's gender-role attitudes providing evidence that omitting the attitudes of the child's friends is not driving the results. In addition, it seems a reasonable assumption that the attitudes of the child and their friends may be significantly correlated while the friends' attitudes are not significantly correlated with the mother's gender role attitudes once I control for the region of residence, whether the child lives in an urban or rural area and whether the child goes to a private school.

[13]See Leaper and Friedman (2007) for an extensive review.

Table 1.13: Omitted Variables Bias of Effect of Mother's 1987 Gender Index on Child's Gender Index

VARIABLES	(1) 2SLS Second Stage Without Covariates	(2) 2SLS Second Stage Without With Covariates	(3) 2SLS Second Stage Dropping Respondents	(4) OLS Without Covariates	(5) OLS With Covariates	(6) OLS Dropping Respondents
Mother's Gender Index 1987	0.312***	0.310***	0.358***	0.159***	0.139***	0.133***
	[0.057]	[0.064]	[0.072]	[0.028]	[0.028]	[0.029]
Observations	1,744	1,744	1,428	1,744	1,744	1,428

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2 with the addition of the grandmother's highest level of education, age at birth and whether she worked in 1978 along with whether the child regularly went to friends' houses after school. The samples in Columns 3 and 6 are restricted to children who went to public school and never lived outside the home of the mother up to the age of 14.

Columns 4 and 5 show an insignificant difference between no covariates and all covariates when using OLS estimation indicating that 2SLS is not necessarily solving the omitted variables issue as there may not be a large omitted variable bias in OLS estimation. Columns 3 and 6 show estimation with the exclusion of certain respondents who may be more susceptible to omitted variable bias. I excluded children who went to private school at some point in their life as their mother's attitudes may be more likely to be correlated with the attitudes of the school as the mother would have chosen and paid for the child to enrol in the specific school. I also excluded children who did not live with their mother at any point from birth until fourteen years old as they may have been exposed to other people's attitudes during the time they did not live with their mother. The exclusion of these respondents resulted in unchanged estimation providing further evidence that omitted variables bias is not driving my results.

The role of family members are potentially the most important social agents in the development of children means that the omission of other family members attitudes may cause a bias of the estimates (Maccoby, 1994). I analyse if omitted variable bias is present by splitting the sample into sub samples and seeing if there is a significant difference in the effect of the mother's attitudes on the child. If omitted variables bias is present, I would expect to see a significant difference. Table 1.14 shows multiple estimations with different interaction terms involving the mother's attitudes to see if there are significant differences when comparing sub samples that could be susceptible to omitted variables bias. Column 1 shows that there is not a significant difference between children who did and did not live in the same household as their father between the ages of 13 and 16 as shown by the insignificant interaction term of the mother's gender-role index and whether the child lived in the same household as their father using 2SLS estimation.[14]

[14]Additional analysis saw this result remained unchanged by extending the years the child lived in the same household of the father. Similar analysis was performed for whether the child lived in a household with their mother's spouse or partner. This enables analysis of whether the presence of an older man in the household, whether it's their biological father, step-father or cohabiting partner influences the effect on the estimation of the mother's influence. No significant difference was found indicating that omitting the father (father-figure's) attitudes is not biasing the estimates.

Table 1.14: Omitted Variable Bias in Different Subsamples on the Effect of Mother's 1987 Gender Index on Child's Gender Index

VARIABLES	(1) 2SLS Second Stage Same Household as Dad	(2) 2SLS Second Stage Only Child	(3) 2SLS Second Stage Close Grandparents
Mother's Gender Index 1987	0.249***	0.275***	0.262***
	[0.091]	[0.063]	[0.065]
Intx Mother's 1987 Gender Index & Child Lived in Same House as Dad aged 13-16	0.054		
	[0.105]		
Child Lived in Same House as Dad aged 13-16	-1.202		
	[1.953]		
Intx Mother's 1987 Gender Index & Child is an Only Child		0.018	
		[0.223]	
Child is an Only Child		-0.204	
		[4.289]	
Intx Mother's 1987 Gender Index & Child is Close to Grandparents			0.035
			[0.064]
Child is Close to Grandparents			-0.769
			[1.194]
Observations	1,984	2,069	2,069
R-squared	0.107	0.101	0.101

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2 with the addition of the grandmother's highest level of education, age at birth and whether she worked in 1978.

Column 2 shows estimation with an interaction term of whether the child was an only child and the mother's gender-role attitudes. The insignificance of this term shows that there is no difference of the effect of the mother's attitudes if the child had siblings or not. This provides evidence that omitting siblings gender-role attitudes is not causing an amplification bias of the estimates. Table 1.14 Column 3 shows that if the child had a 'close' relationship with the grandparents, this had no effect on the influence of the mother's gender-role attitudes. The child was deemed to have a close relationship with their grandparent if they ever lived in the same household of the grandparents, if they discussed personal issue with their grandparents or if the grandparents had any input on the child's friends, clothing, schooling and religious practices. Column 3 shows that the interaction term between being close to their grandparents and their mother's gender-role attitudes was insignificant; therefore, omitting the grandparents gender-role attitudes are not causing an amplification bias of the estimates. It is not surprising to find an insignificant interaction term as I am able to control for the grandmother's highest level of education, whether she worked in 1978 and age at birth of mother. These variables most likely encapsulate the attitudes of the grandparents and therefore do not cause an omitted variable bias by not including the grandparents' attitudes.[15]

Although it is not possible to conclusively state that omitted variables bias is not present, the fact that the effect of the mother's gender-role attitudes does not change with and without covariates and when interacting the mother's attitudes with sub samples of children who may be more affected by other family members provides evidence that mother's attitudes do not seem to be significantly affected by the omission of known variables. However, it is still possible that unknown unobserved variables could bias the estimates.

5 Mechanisms

I now look at if the mother's gender-role attitudes are transmitted to their children through decisions the mothers make. Table 1.15 shows 2SLS estimation with the addition of four variables: total number of siblings of the child, whether the mother was working and the mother's years of education two years before the child's gender-role index was measured and frequency of attendance at religious services by the child at age 15 or 16. All four of these additional variables have been found to be influenced by one's gender-role attitudes so it is important to see if the mother's attitudes work through these decisions to influence their

[15]It is possible that the mother's gender-role attitudes influenced the grandmother's level of education and whether she worked in 1978 as the mothers would have been 14 years old.

child's attitudes. Table 1.15 Column 1 shows the 2SLS Second Stage results without the additional variables and Columns 2 through 5 include additional covariates.

The mother's gender-role attitudes indirectly impact the child's gender-role attitudes through their decision on how many children to have. Table 1.15 Column 2 shows that an increase in one sibling is associated with a significant traditional impact on the child's gender-role attitudes with a 0.197 point decrease in the child's gender-role index which is equal to approximately 7.4% of a standard deviation. The coefficient for the mother's gender-role index decreases by 5.6% by including the total number of siblings of the child. Column 4 shows that a mother working two years before the child's gender index is measured is associated with a 0.398 point (15% of a standard deviation) increase in the child's gender index. Column 4 also shows that the association of the mother's 1987 gender index decreases by 2.2%. Column 5 shows inclusion of all of the additional covariates. The intergenerational coefficient of the mother's gender-role index decreases to 0.212 showing a 10% reduction from Column 1; however, the mother's gender-role index remains strongly statistically significant with the inclusion of these potential mechanisms. It is important to note that the mother working and the mother's gender index are both significant predictors of the child's gender-role attitudes. This indicates that holding more progressive gender-role attitudes shapes the attitudes of the children but acting in progressive ways, such as working outside of the home, also contributes to the children's attitudes. As discussed earlier, there can be multiple channels through which a mother's labour force participation could affect the child's gender-role attitudes such as: freedom of movement, independence from earning money or believing that working is a significant part of one's identity.[16] It seems that the mother's attitudes may indirectly affect the child's attitudes through fertility and employment decisions.

[16] As previous research has found men's gender-role attitudes to be associated with labour force participation of their wives (Farré and Vella, 2013; Fernández et al., 2004), it is possible that the child's father (or step-father) could influence decisions the mother makes regarding education, work and attending religious services. Additional analysis finds that including a dummy variable for whether the mother was married two years before the child's gender-role index is measured does not change the estimates found in Table 1.15.

Table 1.15: Possible Mechanisms of Effect Mother's Gender Index on Child's Gender Index

VARIABLES	(1) 2SLS Second Stage Without Additional Covariates	(2) 2SLS Second Stage With Total Siblings	(3) 2SLS Second Stage With Mother's Recent Education	(4) 2SLS Second Stage With Mother Working	(5) 2SLS Second Stage With All Covariates
Mother's Gender Index 1987	0.234***	0.221***	0.232***	0.229***	0.212***
	[0.062]	[0.060]	[0.063]	[0.063]	[0.063]
Child Number of Siblings		-0.197***			-0.188***
		[0.059]			[0.061]
Mother Years of Education 2 Years			0.038		0.035
Before Year of Child Index			[0.059]		[0.058]
Mother Worked 2 Years Before				0.398**	0.361**
Year of Child Index				[0.182]	[0.183]
Child Frequency of Religious Attendance					-0.036
					[0.039]
Observations	2,158	2,158	2,158	2,158	2,158
R-squared	0.124	0.134	0.125	0.129	0.139

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2.

6 Effects of Mother's Gender-Role Attitudes on Child Outcomes

As it has been shown that the mother's gender-role attitudes significantly affect her child's gender-role attitudes, it is important to see if the mother's gender-role attitudes significantly affect different child outcomes. Table 1.16 shows OLS estimation of the effect of the mother's average 1987 and 2004 gender-role index on the probability of her child getting married by the age of 22.[17] I use this OLS estimation as my previous analysis found that the average of the mother's 1987 and 2004 gender indices can be treated as exogenous. In addition, I do not use IV estimation as the sample sizes are significantly smaller than in my main analysis. Table 1.16 Column 1 shows the effect of the mother's attitudes on all children with an interaction term of the mother's gender index and the gender of the child. Column 2 only shows the effect on daughters and Column 3 shows the effect on sons. Column 1 shows that there is not a statistically significant difference between sons and daughters of the effect of the mother's gender-role attitudes on the probability of the child being married by 22.[18] Column 2 shows that a one standard deviation increase in the mother's average gender-role index (2.5 points) is associated with a 2.5 percentage point less of a chance of her daughter being married by the age of 22. A mother with more progressive gender-role attitudes decreases the probability of her daughter being married by the age of 22 at the 5% level but has no effect on the son's probability of being married as shown in Column 3. This is to be expected as having different gender-role attitudes will more significantly affect the outcomes for women than men as women have more to gain from having progressive gender-role attitudes.

Women delaying entry into marriage is important as it gives them more time to acquire education and become financially independent. If a woman has more education and better work opportunities, then she may be more likely stay in the workforce after having children. As more education and participation in the labour force are associated with acquiring progressive gender-role attitudes, delaying marriage may increase one's gender-role attitudes throughout their lifetime as they are more likely to be continually exposed to progressive gender-role attitudes. In time this could decrease the gender wage gap further by having more women in the labour force for longer. Table 1.17 shows OLS estimation of the effects of the mother's average 1987 and 2004 gender indices on the probability of her child's cohabiting by the age of

[17] I am not able to analyse the effects on the age the children first marry as the average age of the children in 2014 is 27 years old which is approximately the average age of marriage; therefore, I use a binary outcome of whether the child is married by the age of 22 as most of my sample is 22 years old by 2014.

[18] Similar estimates were found when probit and logit estimation was used.

22. These results show that the mother's gender-role attitudes are not significantly associated with the probability of cohabitation by the age of 22 for both sons and daughters.

Table 1.16: OLS Estimation Effects of the Mother's Average 1987 and 2004 Gender Indices on the Probability that her Child is Married by the Age of 22

VARIABLES	(1) Child Married by 22	(2) Daughter Married by 22	(3) Son Married by 22
Mother's Average Gender Index '87/'04	-0.010**	-0.010**	-0.001
	[0.004]	[0.004]	[0.003]
Gender of Child (male=1)	-0.205**		
	[0.099]		
Intx Mother's Gender Index * Gender of Child	0.008		
	[0.005]		
Constant	-15.237***	-23.797***	-8.476*
	[4.052]	[6.684]	[4.860]
Observations	1,603	755	848
R-squared	0.063	0.079	0.041

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2.

Table 1.17: OLS Estimation Effects of the Mother's Average 1987 and 2004 Gender Indices on the Probability that her Child Cohabits by the Age of 22

VARIABLES	(1) Child Cohabiting by 22	(2) Daughters Cohabiting by 22	(3) Sons Cohabiting by 22
Mother's Average Gender Index '87/'04	0.006	0.007	0.012
	[0.009]	[0.009]	[0.011]
Gender of Child (male=1)	-0.180		
	[0.253]		
Intx Mother's Gender Index * Gender of Child	0.002		
	[0.013]		
Observations	700	358	342
R-squared	0.284	0.301	0.284

textitNotes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the mother level. Estimates partial out the effects of all covariates in Table 1.6 Column 2. Sample is restricted to children married after 2004 and who were 22 by 2014.

The insignificance, or small magnitude, of the effect of the mother's gender index on child outcomes may be due to the daughters not being old enough in the sample. The effects of the mother's gender-role attitudes may be larger for delaying marriage at older ages. In addition, the mother's gender-role attitudes were found to not affect the probability of teenage pregnancy. This may be because the mother's gender index does not affect the probability that her daughter has a teenage pregnancy but it may affect when her daughter decides to have children and the total number of children her daughter has in their lifetime. Future research should investigate the long-run impacts that a mother's gender-role attitudes has on her child's outcomes.

7 Conclusion

Using mother-child pairs from the NLSY79 and NLSY79CYA, this paper is the first to analyse the intergenerational mobility of gender-role attitudes while correcting for measurement error by using 2SLS estimation. Finding a valid instrument to analyse the intergenerational mobility of gender-role attitudes is difficult to achieve. It is possible that there is not a perfect instrument to analyse these gender-role attitudes in the United States; however, using the mother's gender-role attitudes before the birth of the child as an instrument for her later attitudes is a valid instrument to correct for measurement error.

This paper shows that using a single-year measure of the mother's attitudes, especially during a period of large transitory fluctuations around their long-run gender-role attitudes, is susceptible to measurement error as it is not representative of the mother's long-run gender-role attitudes that the child was exposed to while growing up. I find that when correcting for measurement error, the intergenerational coefficients and correlations between a mother's gender-role attitudes and her child's gender-role attitudes increase. These findings suggest that previous papers on the intergenerational mobility of gender-role attitudes may underestimate the intergenerational association in gender-role attitudes.

Using 2SLS estimation I find that having a mother who holds more progressive (traditional) gender-role attitudes is associated with her children developing more progressive (traditional) gender-role attitudes. Specifically, a one standard deviation increase in the mother's gender-role index is associated with a 25.3% of a standard deviation increase in the child's gender-role index. The gender of the child is also significant in explaining their gender-role attitudes as sons hold more traditional attitudes than daughters. The mother's gender-role attitudes affect her child directly and indirectly through fertility and employment decisions.

This research shows that the attitudes of mothers are transmitted to their children and influence their children to mould their own ideologies to be complimentary towards their mother's ideology. Understanding how gender-role attitudes are transmitted is important as having more progressive gender-role attitudes is associated with pursuing more education, participating in the labour force, entering parenthood and marriage later and being more financially independent. As gender-role attitudes are associated with unequal distribution of childcare and household production between couples, it may influence the gender wage gap. Understanding how people develop these attitudes enables society to create policies that positively affect gender-role attitudes. A recent policy to change people's gender-role attitudes has been initiated by the Advertising Standards Association (ASA) in the UK (CAP

News, 2019). ASA decided in 2017 to ban advertisements that depict gender stereotypes such as women cleaning up after the family or men failing to do basic household chores. The implementation of similar measures in the United States could be beneficial.

8 Appendix

8.1 Measurement Error in the Independent Variable

Using Equation (1.8) for the model:

$$\widetilde{ChildGI}_i^* = \widetilde{\alpha} + \beta\widetilde{MomGI}_{it} + (\widetilde{\epsilon}_i - \beta v_{it}) \tag{1.23}$$

To show that endogeneity is present, $MomGI_{it}$ must be shown to be correlated with the error term.

$$Cov\left(\widetilde{MomGI}_{it}, v_{it}\right) = E\left(\widetilde{MomGI}_{it}, v_{it}\right) \tag{1.24}$$

$$= E\left(\widetilde{MomGI}_i^* + v_{it}, v_{it}\right) \tag{1.25}$$

$$= E\left(\widetilde{MomGI}_i^*, v_{it}\right) + E({v_{it}}^2) \tag{1.26}$$

$$Cov\left(\widetilde{MomGI}_{it}, v_{it}\right) = \sigma^2_{v_{it}} \tag{1.27}$$

As the covariance between mother's short-run gender-role index and the error term is not zero, there is endogeneity. Below the amount of bias this endogeneity creates is derived:

$$plim\ \hat{\beta} = \frac{Cov(\widetilde{\alpha} + \beta\widetilde{MomGI}_{it} + \widetilde{\epsilon}_i - \beta v_{it}, \widetilde{MomGI}_{it})}{Var(\widetilde{MomGI}_{it})} \tag{1.28}$$

$$= \frac{\beta Var\left(\widetilde{MomGI}_{it}\right) - \beta Cov(\widetilde{MomGI}_{it}, v_{it})}{Var(\widetilde{MomGI}_{it})} \tag{1.29}$$

$$= \beta\left(1 - \frac{Cov(\widetilde{MomGI}_{it}, v_{it})}{Var(\widetilde{MomGI}_{it})}\right) \tag{1.30}$$

$$= \beta\left(1 - \frac{\sigma^2_{v_{it}}}{Var\left(\widetilde{MomGI}_{it}\right)}\right) \tag{1.31}$$

$$= \beta\left(1 - \frac{\sigma^2_{v_{it}}}{\sigma^2_{v_{it}} + \sigma^2_{\widetilde{MomGI}_i^*}}\right) \tag{1.32}$$

$$plim\ \hat{\beta} = \beta\left(\frac{\sigma^2_{\widetilde{MomGI}_i^*}}{\sigma^2_{v_{it}} + \sigma^2_{\widetilde{MomGI}_i^*}}\right) \tag{1.33}$$

8.2 Measurement Error in the Dependent Variable

Using Model (1.3)

$$\widetilde{ChildGI}_i = \widetilde{\alpha} + \beta\widetilde{MomGI}_i + \widetilde{\epsilon}_i \tag{1.34}$$

where we do not have the long-run measure of the child's gender-role index ($ChildGI_i$) because their index is measured in a single year and $MomGI_i$ and ϵ_i are uncorrelated. The child's gender-role index from a single year is shown in the following equation:

$$\widetilde{ChildGI}_{it} = \widetilde{ChildGI}_i^{*} + \mu_{it} \tag{1.35}$$

where $\widetilde{ChildGI}_{it}$ is the short-run measure of the child's gender-role index in year t; where t= 1994, 1996, 1998, 2002, 2006, 2008 or 2010; $\widetilde{ChildGI}_i^{*}$ the long-run measure of the child's gender-role index; ε_{it} is the is the composite error of transitory fluctuations and random measurement error. We assume that $Cov\left(\widetilde{ChildGI}_i^{*}, \varepsilon_{it}\right) = 0$ and $Cov\left(\widetilde{MomGI}_i, \varepsilon_{it}\right) = 0$.

We now have the following:

$$\widetilde{ChildGI}_{it} = \widetilde{\alpha} + \beta\widetilde{MomGI}_i + \widetilde{\epsilon}_i + \mu_{it} \tag{1.36}$$

where there are two components to the error term. It is assumed that the long-run measure of the mother's gender-role index is uncorrelated with both error terms; therefore, there is no presence of endogeneity. However, having a second error term increases the variance of the error:

$$Var\left(\widetilde{\epsilon}_i + \mu_{it}\right) = {\sigma_{\widetilde{\epsilon}_i}}^2 + {\sigma_{\mu_{it}}}^2 > {\sigma_{\widetilde{\epsilon}_i}}^2 \tag{1.37}$$

The only way to correct this is to have a long-run measure of the child's gender-role index. However, the estimates are still unbiased as is shown through the estimate of β:

$$plim\ \hat{\beta} = \frac{Cov(\widetilde{ChildGI}_{it}, \widetilde{MomGI}_i)}{Var(\widetilde{MomGI}_i)} \tag{1.38}$$

$$= \frac{Cov(\widetilde{ChildGI}_i^{*} + \mu_{it}, \widetilde{MomGI}_i)}{Var(\widetilde{MomGI}_i)} \tag{1.39}$$

$$= \frac{Cov(\widetilde{\alpha} + \beta\widetilde{MomGI}_i + \widetilde{\epsilon}_i + \mu_{it}, \widetilde{MomGI}_i)}{Var(\widetilde{MomGI}_i)} \tag{1.40}$$

$$= \frac{Cov\left(\widetilde{\alpha}, \widetilde{MomGI}_i\right) + Cov\left(\beta\widetilde{MomGI}_i, \widetilde{MomGI}_i\right) + Cov\left(\widetilde{\epsilon_i}, \widetilde{MomGI}_i\right) + Cov(\mu_{it}, \widetilde{MomGI}_i)}{Var(MomGI_i)} \tag{1.41}$$

$$= \beta \frac{Var(\widetilde{MomGI}_i)}{Var(\widetilde{MomGI}_i)} \tag{1.42}$$

$$plim\ \hat{\beta} = \beta \tag{1.43}$$

8.3 Robustness Check

Table 1.18: Robustness Check of Table 1.7 Controlling for Child Being Married

VARIABLES	(1) Second Stage	(2) First Stage	(3) OLS
Mother's Gender Index 1987	0.242***		0.132***
	[0.061]		[0.024]
Child is Married (yes=1)	-0.953*	0.854*	-0.811
	[0.536]	[0.495]	[0.537]
Child First-Born	-0.114	0.286**	-0.081
	[0.114]	[0.112]	[0.114]
Gender of Child (male=1)	-1.511***	0.009	-1.498***
	[0.103]	[0.105]	[0.103]
Mother Married in '85/'86	-0.013	-0.031	-0.026
	[0.126]	[0.180]	[0.123]
Mother Years of Education in '85/'86	0.014	0.096*	0.034
	[0.044]	[0.056]	[0.042]
Mother Employed in '85/'86	0.127	1.233***	0.272**
	[0.151]	[0.186]	[0.138]
Mother Married in '79	-0.265	0.262	-0.272
	[0.233]	[0.307]	[0.238]
Mother Years of Education in '79	0.062	0.067	0.076
	[0.073]	[0.096]	[0.071]
Mother Employed in '79	0.102	0.021	0.124
	[0.126]	[0.183]	[0.125]
Year of Child Gender Index	-0.056***	0.020	-0.053***
	[0.016]	[0.019]	[0.016]
Age of Child Gender Index	0.107***	-0.067**	0.099***
	[0.031]	[0.032]	[0.030]
Mother's Gender Index 1979		0.365***	
		[0.030]	
Constant	124.662***	-27.917	121.671***
	[32.006]	[37.348]	[32.033]
F statistic 1st Stage		361.064	
Endogeneity Test p-value	0.038		
ρ	0.257***		0.151***
	[0.065]		[0.027]
Observations	2,343	2,343	2,343
R-squared	0.117	0.235	0.131

Notes: Standard errors clustered at the mother level (1,298 clusters). *** p<0.01, ** p<0.05, * p<0.1 Additional controls are the Mother's race, the region (North-East, North-Central, South or West) that the child was living in at age 15 or 16, an indicator for if the child was living in an urban area at age 15 or 16.

Chapter 2

Gender Differences in Aspired Occupations

This paper analyses gender differences in occupational preferences by investigating whether adolescents aspire to different occupations which are associated with gendered skills, non-pecuniary benefits or psychological traits. Using the National Longitudinal Survey of Youth 1979 and the O*NET database, I find that female (male) adolescents follow gender norms by aspiring to occupations associated with feminine (masculine) traits. Furthermore, I find that parents, especially when they are the adolescent's role model, play an important role in the formation of occupational aspirations. With a gender earnings gap in aspirations of 19%, this paper indicates that policies to decrease occupational segregation and the gender wage gap may need to target the aspirations of adolescents by exposing young men and women to role models in gender atypical occupations.

1 Introduction

Occupational segregation has become the largest contributor to the gender wage gap in the United States in recent decades. It accounted for 10% of the gender wage gap in 1980 compared to 33% in 2010 as women have closed the gender gaps in education and experience (Blau and Kahn, 2017). With the stagnation of the gender wage gap in recent years, it is important to understand why men and women attain different occupations in order to create effective policies to reduce the gender wage gap further (Graf et al., 2018).

This paper helps to understand whether a source of occupational segregation occurs before entry into the labour market in the form of gender differences in occupational preferences. I use data from the National Longitudinal Survey of Youth 1979 (NLSY79) and the Occupational Information Network (O*NET) to analyse the traits of aspired occupations for adolescents aged between 15 and 17 years old. By analysing aspirations at this age, I can restrict the possible reasons for occupational segregation by gender in aspired occupations to pre-market factors such as family background characteristics.[1] First, I assess whether there are gender differences in aspired occupations associated with gender gaps such as: expected income, inflexibility, social contribution, competitiveness, riskiness, cognitive, interactional and physical skills. Then I provide analysis showing that parental characteristics (traits of their occupations and educational levels) can explain part of these gender differences in aspired occupational traits by regressing each aspired occupational trait of the child on a set of parental and background characteristics which are interacted with the gender of the adolescent.

It is important to understand when gender differences in aspirations begin to emerge. From a young age, boys and girls are influenced by their family, peers, teachers, media etc. to develop an understanding of gender norms and research finds that young girls and boys already understand society's expectations of appropriate occupations for their gender. Sherman and Zurbriggen (2014) find that girls between 4-7 already believed that boys had more occupations available for them when they are older. Bian et al. (2017) find that by the age of 6, girls, on average, believe boys to be more brilliant than girls and argue that believing such stereotypes at a young age influence girls' interests and their occupational preferences. Interestingly, they did not find a that girls believe this stereotype at the age of 5 but grew to believe it. Chambers et al. (2018) find that children at age 7 in the UK aspire to occupations that are predominately made up of their own gender and that significantly more boys aspire to STEM

[1] Previous research has found evidence that other pre-labour market factors such as teacher, peers, the media, etc. have the ability to influence the aspirations of children and adolescents through the socialisation of gender norms (i.e. Schoon and Eccles 2014; Eccles 2011; Blakemore et al. 2008; Witt 2000a,b); however, this paper focuses on the role of parent's influence the aspired occupations of adolescents.

occupations than girls. Sandberg et al. (1991) finds gender differences in aspired occupations for boys and girls aged 8-13 and that significant gender differences remained five years later. These psychological studies show that gender differences in aspired occupations emerge during childhood. This paper focuses on the aspirations of adolescents between 15 and 17 years old as aspirations at this age can potentially have large impacts on educational and occupational decisions that will occur soon.

The analysis of gender differences in aspirations is important because aspirations may be a potential reason for gender differences in labour market outcomes. A recent working paper by Azmat et al. (2020) analyses how gender differences in aspirations of new lawyers to become a partner in a law firm can explain a significant portion of gender differences in promotion rates in later years. They show that having higher aspirations is associated with exerting greater effort in the labour market. This is a nice empirical complement to the developmental economic literature which has viewed aspirations as a contributor to poverty traps around the world and states that individuals setting higher aspirations may lead to greater investment in education and less inequality (Genicot and Ray, 2017; Ray, 2006, 1998). This research also argues that people look to similar individuals in their socio-economic class to form appropriate aspirations (Ray, 2006; Appadurai, 2004). La Ferrara (2019) states that a potential policy to change aspirations, and decrease inequality, is to expose individuals to different role models, individuals whom the adolescent looks to for guidance on how to behave and wants to emulate, to enlarge the potential pool of occupations adolescents would aspire to achieve.[2]

This paper contributes to the economics literature on aspirations (Genicot and Ray, 2017; Ray, 2006, 1998) by providing empirical evidence that occupational aspirations are associated with the labour market outcomes of individuals around them as adolescent's aspired occupations are associated with their parent's occupations and educational levels. Furthermore, I provide evidence that aspirations may be influenced by role models, even within a family, as the relationship between a parent's occupation and a child's aspired occupation is greater when the parent is viewed as a role model. I also compliment the work of Azmat et al. (2020) by extending our understanding of gender differences in formation of aspirations.

In order to measure occupational segregation, this paper analyses if adolescents segregate by gender into aspired occupations which are associated with specific skills, non-pecuniary benefits or psychological traits that have been previously found to have significant gender differences (Baker and Cornelson, 2018; Cortes and Pan, 2018; Lekfuangfu and Lordan, 2018;

[2]There are economic studies which find that exposing individuals to a relateable role model may increase peoples' aspirations and investment in themselves. See Burgess (2016); Porter and Serra (2019); Bernard et al. (2014); La Ferrara (2019) for examples.

Bertrand, 2011).[3] Regarding skills, Welch (2000) states that women may segregate into occupations with higher cognitive skills and lower physical skills due to their disadvantage in physicality compared to men. In addition, Kirkland et al. (2013) and Woolley et al. (2010) show evidence that women have better interactional skills compared to men as they are better at interpreting the emotions of others. Occupations which require higher cognitive and interactional skills have been associated with higher wages while occupations which require higher physical skills have been associated with lower wages (Cortes and Pan, 2018; Borghans et al., 2014; Black and Spitz-Oener, 2010; Murnane et al., 1995). In addition, previous research has shown gender differences in preferences for non-pecuniary benefits of occupations such as the ability to work fewer hours. Women view this as a positive benefit of an occupation for which they are willing to take lower pay (Wiswall and Zafar, 2016; Flabbi and Moro, 2012). Finally, previous research about gender differences in psychological attributes found, on average, that men are more competitive than women and women are more risk averse and wanting to help others than men (Cortes and Pan, 2018; Flory et al., 2015; Azmat and Petrongolo, 2014; Bertrand, 2011; Croson and Gneezy, 2009; Fortin, 2008; Leeth and Ruser, 2006; DeLeire and Levy, 2004). A set of papers has found that occupations with competitive pay schemes and higher mortality risks are significantly associated with higher wages (Manning and Saidi, 2010; DeLeire and Levy, 2004; Hersch, 1998; Viscusi, 1993) while England et al. (2002) and Cortes and Pan (2018) found that occupations which contribute to society to be significantly negatively associated with wages. This research shows that men (women) sort into occupations associated with masculine (feminine) traits and this sorting is likely to be associated with the gender wage gap.

This paper contributes to the above growing economics literature about occupational segregation by gendered traits in the labour market by showing that adolescent men (women) decide to segregate into masculine (feminine) occupations before entry into the labour market through their aspired occupations. This is a significant contribution as it provides evidence that policies to decrease occupational segregation may need to target individuals not yet in the labour market (Baker and Cornelson, 2018; Cortes and Pan, 2018; Lekfuangfu and Lordan, 2018; Goldin, 2014; Bertrand, 2011).

In addition, this paper contributes to sociological and psychological research on what background characteristics are associated with adolescents' aspired occupations (Platt and Parsons, 2017; Polavieja and Platt, 2014; Cochran et al., 2011; Schoon and Polek, 2011; Ashby and Schoon, 2010; Jacqueline et al., 2007; Jodl et al., 2001; Andres et al., 1999; Marini and

[3]Please see Cortes and Pan (2018) for a literature review.

Fan, 1997; Marini, 1978). This paper contributes to this literature by analysing the association between a parent's occupation and a child's aspired occupation with a more detailed set of occupational traits than previously analysed. For example, to analyse whether young men and women aspire to masculine or feminine occupations, they would calculate the percentage of women in a given occupation to create a measure of femininity. I take their research a step further and analyse whether adolescents aspire to occupations associated with gendered traits (competitiveness, social contribution, riskiness, etc.). This is an important distinction between my paper and previous research as it provides more evidence on what types of occupations men and women may prefer and sort into later in life, providing policymakers a clearer picture of where to target policies. In addition, I also contribute to this literature by showing that the occupational traits of parents who are viewed as role models have a stronger association with a child's aspired occupational traits.

This paper finds that adolescent men (women) aspire to occupations which are associated with masculine (feminine) traits. I also find that there are gender differences in which background characteristics are associated with one's aspired occupations. For example, there is a stronger association between the occupational traits of fathers and sons compared to fathers and daughters for nearly every occupational trait analysed. Furthermore, this paper finds stronger associations between the expected income, social contribution, riskiness, physical and cognitive skills of a parent's occupation and an adolescent's aspired occupation if the parent is indicated to be the adolescent's role model. This provides evidence that adolescents, especially adolescent men, imitate those around them when they form occupational aspirations. Therefore, it could be beneficial to expose children to different role models holding gender atypical occupations to enlarge the pool of gender appropriate occupations for adolescents to aspire to attain as indicated in La Ferrara (2019). By enabling adolescents to not be restricted in their occupational aspirations due to their gender, we could possibly see a reduction in occupational segregation in the decades to come.

The remainder of the paper is as follows. Section 2 will discuss the four different data sets utilised in this paper and how occupational traits are measured. Section 3 will discuss the empirical methods used to analyse gender differences in traits of aspired occupations and the predictors of aspired occupations. Section 4 will provide analysis showing that there are gender differences in the traits of aspired occupations and that parental characteristics are significant predictors of an adolescent's aspired occupation. Finally Section 5 will conclude.

2 Data

This paper utilises four separate data sets that are merged using a set of census occupational codes which were developed by David and Dorn (2013) to enable estimation of a consistent set of occupational codes overtime as the Census changes their occupational codes nearly every decade.[4] I use this set of consistent occupational codes as the O*NET database and the Census of Fatality database were collected in different decades from when the aspired occupations were measured. I discuss each data set, and how I merged them, in detail below.

2.1 NLSY 1979

The National Longitudinal Survey of Youth 1979 (NLSY79), created by the Bureau of Labor Statistics, is a longitudinal nationally representative sample of men and women aged between 15 and 22 and living in the United States in 1979 when they are first interviewed. The respondents are interviewed annually from 1979 to 1994 and biennially from 1994 until 2014 (Bureau of Labor Statistics, 2019c). The NLSY79 contains detailed information about the respondents' family background and has up to date information about respondents' occupational decisions. It is comprised of a nationally representative sample and a few supplemental samples. There are 12,686 respondents for all of the samples; however, for this paper I only use the national representative sample (6,111) and drop 6,575 respondents who were part of supplemental samples. In addition, the sample is restricted to respondents who were 15 to 17 years old in 1979 and who were currently enrolled in high school, reducing the sample size to 2,277. I restrict the sample to individuals who were still enrolled in high school as their aspirations are not restricted based upon already made educational and occupational decisions.

I use the NLSY79 because in the first year of the survey, 1979, the respondents are asked what occupation they aspire to have when they will be 35 years old. Even if the adolescent states that they do not want to work at 35, they are then asked what occupation they would like to have if they had to work at 35 years old. I am then able to see what occupation they attain when they are about 35 years old. For this paper, I look at the respondent's attained occupation when they are between 30 and 40 years old to enable a large sample size as not every person was surveyed in the year that they turned 35 years old. To be a part of the sample, the respondents had to answer the aspired occupation question in 1979 (2,044) and

[4]This set of occupational codes has been used in previous research such as: Denning et al. (2019); Cortes and Pan (2018); Acemoglu and Autor (2011).

reported holding at least one occupation between the ages of 30 and 40 which reduced the sample size to 1,860.[5] I only include individuals who work 10 hours or more a week when they are 30 to 40 years old reducing the sample to 1,808.[6]

As this paper looks at whether background characteristics are associated with different traits of one's aspired occupation, I include a set of individual and family characteristics in my estimation that have the potential to be associated with the aspired occupation of the respondent. Looking at individual characteristics, I include a dummy variable that is equal to 1 if the respondent is male and 0 otherwise so I can estimate gender differences in aspired occupational traits. I also include race dummies for whether the respondent is Black or Hispanic with the omitted category of Non-Black, Non-Hispanic to control for differences in aspirations related to racial identity. In addition, it is important to control for the region the respondent lives in because growing up in different regions in the United States may influence one's occupational aspirations as there are different occupations, industries, values, etc. in different regions. Therefore, I include dummy variables for whether the respondent was living in the North-Central, the South or the West of the United States in 1979 with the Northeast dummy variable omitted. I also include a dummy variable for whether the respondent lives in an urban area in 1979 as children living in urban areas may be exposed to different types of occupations compared to children in rural areas. To control for differences in aspired occupation due to age I control for the age of the respondent in 1979.

In 1979 the respondents are asked "Who has influenced you the most on how you feel about things like school, marriage, jobs and having children?" The respondents are then able to choose from a list of fourteen possible answers including (but not limited to): Father/Step-Father, Mother/Step-Mother, Mother and Father, siblings, teachers, peers, other person and no one. I use this variable as a proxy for the adolescent's role model. I create a dummy variable equal to 1 if the father (only) or father and mother (together) are listed as their role model and zero otherwise. I do the same to create a dummy variable for whether the mother is their role model. To be in the sample, the individuals must have information for all of the above individual background characteristics reducing the sample to 1,783.

In addition to controls for background characteristics, I also include controls regarding the respondents' parents. All parental characteristics are measured in 1978, the year preceding the measurement of the respondent's aspired occupations. Previous research has found the

[5] I have this restriction as I have supplemental analysis showing the association between aspired and attained occupational traits.

[6] The results about aspirations do not change if I include individuals who did not hold a part-time job when they were 30-40 years old.

socioeconomic status of a child's parents is associated with the child's labour market outcomes, therefore, it is important to know if one's socioeconomic status affects their aspired occupations (Black and Devereux, 2010). To control for one's socioeconomic status I include dummy variables equal to 1 if the father (or mother) graduated from high school and zero otherwise. I also have the Census occupational code for a father and mother's occupation in 1978. For the mother's work, I include a dummy variable equal to 1 if the mother worked in 1978 and 0 otherwise. In addition, to be included in the sample, the adolescent must have stated whether they lived in the same household as their parents as this will be included in supplemental analysis. Only respondents who provided information on their parents were included in the sample (1,312). I convert the father, mother and aspired occupational codes to David and Dorn (2013)'s set of occupational codes.

2.2 1980 United States Census

There are approximately 400 occupations from the set of 3-digit occupational codes which is the most detailed occupational code available for the 1980 Census (Ruggles et al., 2018). I use the Census to calculate the expected income and inflexibility of a given occupation similarly done in Denning et al. (2019). To estimate the expected income of one's 1979 aspired occupation, I use the 1980 Census to calculate the average log annual income for each occupation for working age (25 to 60 years old), full-year (works at least 47 weeks), full time (works at least 35 hours a week) workers. To calculate a proxy variable for inflexibility of an occupation, I use the 1980 Census to calculate the average log weekly hours of work for each occupation for working age (25 to 60 years old), full-year workers. For the inflexibility proxy I include part-time workers in the estimation of average weekly hours of an occupation as this variable captures the ability to work fewer in a given occupation. Denning et al. (2019) also use this measure as an expectation of the hours one will work in a given occupation. I then merge the expected income and inflexibility for each Census occupational code with the NLSY79 data by using David and Dorn (2013)'s occupational codes.

2.3 O*NET Database

The third data set used is the O*NET database constructed by the U.S. Department of Labor, which has replaced the Dictionary of Occupational Titles (DOT) database (National Center for O*NET Development, 2017; National Research Council, 2010). The O*NET database is updated annually and is freely available online. This database contains descriptors for over

1,000 occupations in the United States that detail the skills and characteristics of occupations. Data on individual occupations is collected by first randomly sampling businesses which have been identified as likely to hold the occupation in question and then randomly sampling individuals within those businesses who are employed in that occupation. On average, each occupation has a sample of approximately 33 individuals who are employed in the occupation or occupational experts that have recently worked in the occupation for occupations which are scarce. Therefore, the O*NET measures are not from a single respondent but the average response from a sample of respondents (National Research Council, 2010). I relied on past research and crosswalks for making the O*NET database compatible with the NLSY79 data set and more information is provided in the Data Appendix 6.1 (David and Dorn, 2013; Acemoglu and Autor, 2011).

Following Cortes and Pan (2018), I use the O*NET database to measure an occupations level of: social contribution, competitiveness, interactional, physical and cognitive skill. Each occupation is given a score from 1 to 5 about how important the given trait is for the job. For example, to measure the competitiveness of an occupation, I use the measure based on the question, "To what extent does this job require the worker to compete or to be aware of competitive pressures". Each occupation is given a score between 1 (not at all competitive), 2 (slightly competitive), 3 (moderately competitive), 4 (highly competitive) and 5 (extremely competitive). Below are the O*NET traits used in the analysis:

Social Contribution: This measure is composed of responses to the following three questions: (1) "Importance of being sensitive to others' needs and feelings and being understanding and helpful on the job", (2) "Importance of actively looking for ways to help people", (3) "Importance of providing personal assistance, medical attention, emotional support, or other personal care to others such as co-workers, customers, or patients."

Competitiveness: "To what extent does this job require the worker to compete or to be aware of competitive pressures"

Interactional Skills: This measure is composed of responses the following four questions: (1) "How much does this job require the worker to be in contact with others (face-to-face, by telephone, or otherwise) in order to perform it?", (2) "Importance of working with others in a group or team in this job?", (3) "Importance of constructing cooperative working relationships with others, and maintaining them over time?", (4) "Importance of being aware of others' reactions and understanding why they react as they do?"

Physical Skills: This measure is composed of responses to the two following statements of importance: "Using hands and arms in handling, installing, positioning and moving material and manipulating things", "Performing physical activities that require considerable use of your arms and legs and moving your whole body, such as climbing, lifting, balancing, walking, stooping and handling materials".

Cognitive Skills: This measure is composed of responses to the four following statements: "Importance of the ability to choose the right mathematical methods or formulas to solve a problem", "Importance of the ability to read and understand information and ideas presented in writing", "Importance of the ability to apply general rules to specific problems to produce answers that make sense (deductive reasoning)", "Importance of the ability to combine pieces of information to form general rules or conclusions (inductive reasoning)".

All O*NET traits are normalized to have a mean of zero and standard deviation of 1 in relation to the full set of Census occupational codes as done in previous research (Denning et al., 2019; Cortes and Pan, 2018; Baker and Cornelson, 2018; Acemoglu and Autor, 2011).[7] To be included in the sample, the respondent must have an O*NET score for their aspired occupation and both parents must have an O*NET score for their occupations in 1978, resulting in a final sample size of 1,305 respondents. It is important to include the occupational traits of the parents in the analysis as past intergenerational mobility research has shown that children choose occupations that are similar to their parents' occupations; therefore, to enable a large enough sample size, I impute a measure of 0 for the occupational trait of nonworking mothers and include a dummy variable for whether the mother worked.[8]

2.4 Census of Fatal Occupational Injuries

To calculate the riskiness of an occupation I used the Bureau of Labor Statistic's Census of Fatal Occupational Injuries 1992 data set to calculate the mortality rate for each occupation (Bureau of Labor Statistics, 2019a).[9] I calculate the mortality rate as the number of deaths per 100,000 employees in the occupation as done in (Baker and Cornelson, 2018). As the Census of Fatal Occupational Injuries occupational codes did not provide data on every Census

[7] These O*NET variables began being measured in the early 2000's but not all occupations were measured at this time and were updated with new releases of the data set. To enable a large enough sample size, I used the O*NET 15.1 release from 2010 as earlier years did not collect data on enough occupations to enable a large enough sample size for analysis. In addition, it is important to point out that the aspirations of individuals are measured in 1979. Previous research has used the O*NET database linked to data from previous decades (Baker and Cornelson, 2018; Lordan and Pischke, 2016; Acemoglu and Autor, 2011; Firpo et al., 2009).

[8] Approximately one-third of the sample has a mother would did not work in 1978.

[9] I use a 1992 data set as this was the closest data set I could get to 1979.

occupational code, when the detailed occupational code data is not available, I calculate the weighted average mortality rate for the smallest set of occupational codes. For instance, under managerial and professional occupations, there is a subcategory 'Engineer' which includes fourteen individual occupations such as: Aerospace, mining, civil engineers, etc. If the Census of Fatal Occupational Injuries do not have data on the fatalities of an aerospace engineer, I calculate the average mortality rate of the sub-category 'Engineer' weighted by the number of people who held the given detailed engineering occupations. I convert these 1990 Census occupational codes to the consistent set of occupational codes from David and Dorn (2013) to enable me to merge this data with the other data sets.

2.5 Descriptive Statistics

Tables 2.1-2.6 provide descriptive statistics of background characteristics, traits of the adolescent's aspired occupation and traits of the parents' occupations. The traits of the aspired occupations are outcome variables while the background and parental characteristics are explanatory variables. Table 2.1 shows the descriptive statistics of the control variables in the estimation. Table 2.2 shows the most frequently aspired occupations of the adolescents in the sample. It is apparent that young men (women) aspire to occupations which are typically thought of as being held by men (women). As these aspirations were measured in 1979 it informative to see whether these are indicative of aspirations of adolescents in more recent times. A recent paper shows the aspired occupations of 15-year old's in Britain from 2014 (Della Giusta et al., 2017). The girls in their sample also aspire to be: teachers, hairdressers, medical practitioners and designers which very closely resembles the aspirations of girls from this cohort as shown in Table 2.2. For boys, they also aspired to be athletes, but the other occupations were still predominately held by men such as: police officers and being in the army.

Table 2.1: Descriptive Statistics of Background Characteristics

VARIABLES	(1) Female	(2) Male	(3) Total
Gender (Male=1)			0.53
			(0.50)
Non-Black, Non-Hispanic	0.83	0.88	0.86
	(0.37)	(0.33)	(0.35)
Black	0.09	0.08	0.09
	(0.29)	(0.27)	(0.28)
Hispanic	0.08	0.04	0.06
	(0.27)	(0.20)	(0.24)
1979 Region: South	0.34	0.27	0.30
	(0.47)	(0.45)	(0.46)
1979 Region: North Central	0.32	0.38	0.35
	(0.47)	(0.49)	(0.48)
1979 Region: Northeast	0.17	0.20	0.19
	(0.38)	(0.40)	(0.39)
1979 Region: West	0.17	0.15	0.16
	(0.38)	(0.36)	(0.37)
Lives in Urban Area 1979 (yes=1)	0.73	0.75	0.74
	(0.44)	(0.44)	(0.44)
Age in 1979 (15-17)	16.06	16.09	16.08
	(0.81)	(0.81)	(0.81)
Total Number of Siblings (0-12)	3.00	2.87	2.93
	(1.98)	(1.88)	(1.93)
Mom Worked in 1978 (yes=1)	0.65	0.61	0.63
	(0.48)	(0.49)	(0.48)
Mother High School Graduate	0.69	0.77	0.73
	(0.46)	(0.42)	(0.45)
Father High School Graduate	0.69	0.72	0.71
	(0.46)	(0.45)	(0.46)
Father Role-Model (yes=1)	0.50	0.66	0.58
	(0.50)	(0.47)	(0.49)
Mother Role-Model (yes=1)	0.64	0.61	0.62
	(0.48)	(0.49)	(0.49)
Observations	617	688	1,305

Notes: Mean and standard deviations in parentheses.

Table 2.2: Most Frequently Aspired Occupations

Female	Male
Secretary	Manager
Registered Nurse	Athlete
Hairdresser	Auto Mechanic
Teacher	Carpenter
Designer	Truck Driver

Table 2.3: Descriptive Statistics of Aspired Occupations

VARIABLES	(1) Female	(2) Male	(3) Total	Diff
Expected Income of Aspired Occupation (z)	-0.06	0.64	0.31	***
	(1.10)	(0.91)	(1.06)	
Competitiveness of Aspired Occupation (z)	0.15	0.77	0.48	***
	(1.00)	(0.83)	(0.97)	
Social Contribution of Aspired Occupation (z)	0.76	0.02	0.37	***
	(0.97)	(0.83)	(0.97)	
Interactional Skills of Aspired Occupation (z)	0.66	0.20	0.41	***
	(0.58)	(0.86)	(0.78)	
Mortality Rate of Aspired Occupation (z)	-0.41	0.14	-0.12	***
	(0.34)	(1.15)	(0.91)	
Inflexibility of Aspired Occupation (z)	-0.47	0.60	0.10	***
	(1.40)	(1.24)	(1.42)	
Physicality of Aspired Occupation (z)	-0.52	-0.06	-0.27	***
	(0.77)	(0.98)	(0.91)	
Cognitive Skills of Aspired Occupation (z)	0.43	0.47	0.45	
	(0.84)	(0.91)	(0.88)	
Observations	617	688	1,305	

Notes: Mean and standard deviations in parentheses. (z) indicates standardized at the Census occupational level. Diff is the two sample t-test between male and female occupational traits. *p<.05; **p<.01; ***p<.001

Table 2.4: Descriptive Statistics of Parental Occupational Traits

VARIABLES	(1) Female	(2) Male	(3) Total
Expected Income of Father's Occ (z)	0.30	0.33	0.32
	(0.87)	(0.89)	(0.88)
Competitiveness of Father's Occ (z)	0.34	0.33	0.34
	(0.83)	(0.82)	(0.83)
Social Contribution of Father's Occ (z)	-0.17	-0.16	-0.16
	(0.62)	(0.70)	(0.66)
Interactional Skills of Father's Occ (z)	-0.06	-0.00	-0.03
	(0.83)	(0.87)	(0.85)
Mortality Rate of Dad's Occ (z)	0.17	0.14	0.15
	(0.92)	(0.93)	(0.93)
Inflexibility of Father's Occ (z)	0.57	0.66	0.62
	(0.91)	(1.06)	(0.99)
Cognitive Skills of Father's Occ (z)	-0.06	0.03	-0.02
	(0.88)	(0.88)	(0.88)
Physicality of Father's Occ (z)	0.18	0.12	0.15
	(0.99)	(1.03)	(1.01)
Expected Income of Mother's Occ (z)	-0.55	-0.52	-0.54
	(0.98)	(0.93)	(0.95)
Competitiveness of Mother's Occ (z)	-0.19	-0.22	-0.21
	(0.81)	(0.79)	(0.80)
Social Contribution of Mom's Occ (z)	0.24	0.28	0.26
	(0.72)	(0.69)	(0.71)
Interactional Skills of Mother's Occ (z)	0.07	0.10	0.09
	(0.69)	(0.62)	(0.66)
Mortality Rate of Mom's Occ (z)	-0.26	-0.22	-0.24
	(0.41)	(0.45)	(0.43)
Inflexibility of Mother's Occ (z)	-0.48	-0.44	-0.46
	(0.85)	(0.95)	(0.91)
Cognitive Skills of Mother's Occ (z)	-0.19	-0.15	-0.17
	(0.72)	(0.67)	(0.70)
Physicality of Mother's Occ (z)	-0.19	-0.16	-0.18
	(0.67)	(0.65)	(0.66)
Observations	617	688	1,305

Notes: Mean and standard deviations in parentheses. (z) indicates standardized at the Census occupational level. Parental occupational traits measured in 1978.

Table 2.5: Occupational Traits by Mother's Education Level

	(1) Mom Not High School Graduate Female	(2) Mom High School Graduate Female	(3) Diff Female	(4) Mom Not High School Graduate Male	(5) Mom High School Graduate Male	(6) Diff Male
Expected Income of Aspired Occ (z)	-0.27	0.03	***	0.44	0.71	***
	(1.13)	(1.07)		(0.79)	(0.94)	
Competitiveness of Aspired Occ (z)	0.04	0.20	*	0.70	0.79	
	(1.00)	(1.00)		(0.81)	(0.84)	
Social Contribution of Aspired Occ (z)	0.75	0.76		-0.12	0.06	***
	(0.94)	(0.98)		(0.71)	(0.86)	
Interactional Skills of Aspired Occ (z)	0.55	0.71	**	0.00	0.26	***
	(0.60)	(0.57)		(0.86)	(0.85)	
Mortality Rate of Aspired Occ (z)	-0.38	-0.42		0.21	0.12	
	(0.49)	(0.25)		(1.13)	(1.15)	
Inflexibility of Aspired Occ (z)	-0.61	-0.40	*	0.48	0.64	**
	(1.35)	(1.42)		(1.04)	(1.30)	
Physicality of Aspired Occ (z)	-0.48	-0.54		0.29	-0.16	***
	(0.80)	(0.75)		(0.94)	(0.97)	
Cognitive Skills of Aspired Occ (z)	0.37	0.46		0.15	0.57	***
	(0.90)	(0.81)		(0.87)	(0.90)	
Observations	194	423		161	527	

Notes: Mean and standard deviations in parentheses. (z) indicates standardized at the Census occupational level. Diff is the two sample t-test between male and female occupational traits. *p<.05; **p<.01; ***p<.001

Table 2.6: Occupational Traits by Father's Education Level

	(1) Dad Not High School Graduate Female	(2) Dad High School Graduate Female	(3) Diff Female	(4) Dad Not High School Graduate Male	(5) Dad High School Graduate Male	(6) Diff Male
Expected Income of Aspired Occ (z)	-0.21	0.01	*	0.40	0.74	***
	(1.10)	(1.09)		(0.78)	(0.94)	
Competitiveness of Aspired Occ (z)	0.05	0.20		0.73	0.79	
	(0.97)	(1.01)		(0.72)	(0.87)	
Social Contribution of Aspired Occ (z)	0.76	0.75		-0.16	0.09	***
	(0.94)	(0.98)		(0.71)	(0.86)	
Interactional Skills of Aspired Occ (z)	0.59	0.68		-0.05	0.29	***
	(0.64)	(0.56)		(0.85)	(0.85)	
Mortality Rate of Aspired Occ (z)	-0.38	-0.42		0.21	0.11	
	(0.49)	(0.25)		(1.08)	(1.17)	
Inflexibility of Aspired Occ (z)	-0.57	-0.42	*	0.55	0.62	
	(1.43)	(1.39)		(1.15)	(1.28)	
Physicality of Aspired Occ (z)	-0.45	-0.54		0.33	-0.21	***
	(0.79)	(0.76)		(0.94)	(0.95)	
Cognitive Skills of Aspired Occ (z)	0.35	0.47		0.17	0.60	***
	(0.85)	(0.83)		(0.86)	(0.90)	
Observations	189	428		195	493	

Notes: Mean and standard deviations in parentheses. (z) indicates standardized at the Census occupational level. Diff is the two sample t-test between male and female occupational traits. *p<.05; **p<.01; ***p<.001

Table 2.3 shows the descriptive statistics of traits of the respondent's aspired occupations which are the dependent variables in the main estimation. Table 2.3 shows that there are significant differences in the aspired occupational traits between men and women for every occupational trait measured except for cognitive skills. Adolescent men aspire to higher paying, more competitive, riskier, more physical and inflexible occupations compared to adolescent women. On the other hand, adolescent women aspire to occupations associated with higher levels of social contribution and interactional skills. Table 2.3 shows that female adolescents aspire to occupations with 6% of a standard deviation lower expected income than the average occupation while male adolescents aspire to occupations with 64% of a standard deviation higher expected incomes than the average occupation. Table 2.4 shows the occupational traits of the respondents' parents from 1978 (the year before the adolescent's aspired occupation is measured).

Tables 2.5 and 2.6 analyse heterogeneity in the adolescents' aspired occupational traits by different levels of parental education. It is important to look for heterogeneity based on socioeconomic status because the aspirations of respondents from lower socioeconomic households may be constrained compared to respondents from higher socioeconomic households. Comparing female respondents whose mothers did not graduate from high school with female respondents whose mothers did graduate from high school, Table 2.5 shows that female adolescents with more educated mothers aspire to higher paying, more competitive, interactional and inflexible occupations. Male adolescents with more educated mothers aspire to higher paying, more socially conscious, interactional, cognitive, inflexible and less physical occupations. Table 2.5 indicates that the socioeconomic status of mother's may have a larger effect on the aspirations of adolescent boys.

Table 2.6 is the same as Table 2.5 but looks at differences in aspired occupational traits by the father's education level. A female respondent having a father who graduated high school is shown to aspire to higher paying and more interactional occupations compared to female respondents whose fathers did not graduate from high school. Male respondents whose fathers graduated from high school aspire to occupations which are higher paying, more socially conscious, interactional, cognitive and less physical compared to male respondents whose fathers did not graduate from high school. As in Table 2.5, there appears to be greater heterogeneity for aspirations of male adolescents based on their parent's socioeconomic status.

3 Methodology

3.1 Gender Differences in Aspired Occupations

In order to analyse whether there are gender differences in the traits of aspired occupations, for each aspired occupational trait, I estimate associations between the adolescent being male and the aspired occupational trait while controlling for parental and background characteristics:

$$AspiredTrait_i = \alpha + \beta_1 Male_i + \mathbf{X}_i\boldsymbol{\beta}_2 + \epsilon_i \tag{2.1}$$

where i is the individual; $AspiredTrait_i$ is the aspired occupational trait (expected income, social contribution, mortality rate, competitiveness, inflexibility, interactional, physical or cognitive skills); $Male_i$ is a dummy variable equal to 1 if the respondent is male and 0 otherwise; $\mathbf{X}_i$ is a vector of individual and family characteristics (including parental occupational traits and education levels); α is an intercept term; β_1 is the coefficient capturing the differential intercept for males; $\boldsymbol{\beta}_2$ is a vector of coefficients corresponding to the vector of variables $\mathbf{X}_i$ and ϵ_i is error term.[10]

In addition to finding if there are gender differences in aspired occupations, it is important to estimate whether there are gender differences in determinants of one's aspired occupation. To see if parental and background characteristics differentially affects the aspired occupational trait by gender, I use a fully interacted model where the gender of the individual is interacted with all background characteristics as shown below:

$$AspiredTrait_i = \theta + \gamma_1 Male_i + \mathbf{X}_i\boldsymbol{\gamma}_2 + (Male_i * \mathbf{X}_i)\,\boldsymbol{\gamma}_3 + \omega_i \tag{2.2}$$

where θ is an intercept term; γ_1 is the coefficient capturing the differential intercept for males; $\boldsymbol{\gamma}_2$ is a vector of coefficients capturing the association for female adolescents for the vector of variables $\mathbf{X}_i$; $\boldsymbol{\gamma}_3$ is a vector of coefficients capturing the differential associations between male and female adolescents for the vector of variables $\mathbf{X}_i$ and ω_i is the error term. Equation (2.2) enables the analysis of whether certain background characteristics are associated with significantly different aspired occupational traits based on gender of the individual. For example, it will show whether the occupational trait of the father has a significantly stronger association with a son's aspired occupational trait compared to a daughter's aspired occupational trait.

[10] To correct for heteroskedasticity, I use robust standard errors that are clustered at the occupational level.

3.2 Role Models

As previous research has suggested exposing people to different role models to influence aspirations, it is important to analyse whether the traits of parents who are described as being a role model of the adolescent have a stronger association with the traits of the adolescent's aspired occupation as estimated below:

$$AspiredTrait_i = \pi + \lambda_1 Male_i + \lambda_2 \left(RoleModel_i^f * OccTrait_i^f \right) + \lambda_3 \left(RoleModel_i^m * OccTrait_i^m \right) + \mathbf{X}_i \boldsymbol{\lambda}_4 + \varepsilon_i \quad (2.3)$$

where the overscript f denotes father and m denotes mother; $RoleModel^{f,m}$ is a dummy variable for whether the adolescent stated their mother and/or father as their role model; $OccTrait^{f,m}$ is the father's or mother's occupational trait which corresponds to the $AspiredTrait$[11]; $\mathbf{X}_i$ is a vector of control variables including $RoleModel^{f,m}$ and $OccTrait^{f,m}$; π is an intercept term; λ_1 is the coefficient capturing the differential intercept for males; λ_2 and λ_3 are coefficients capturing the differential association for a parent's occupational trait is the parent is the adolescents role model; $\boldsymbol{\lambda}_4$ a vector of coefficients corresponding to the vector of variables $\mathbf{X}_i$ and ε_i is the error term. The coefficients of interest are λ_2 and λ_3 which show whether there is a stronger association between the father's or mother's occupational trait and the trait of the adolescents aspired occupation when the parent has been reported by the adolescent to be his or her role model.

4 Results

4.1 Predictors of Aspired Occupational Traits

Table 2.7 shows the OLS estimations of model (2.1) analysing the background characteristics associated with traits of an adolescent's aspired occupation. This table focuses on whether parental characteristics are significantly associated with the traits of the adolescent's aspired occupation while controlling for control variables from Table 2.1. In Table 2.7, the columns show the trait of the aspired occupation, which is analysed as the dependent variable. The control variables "Father's (Mother's) Occupational Trait" are the same occupational traits as the dependent variable but for the father's (mother's) 1978 occupation. For example, in Table 2.7 Column 1, the dependent variable is the expected income of the adolescent's aspired

[11] For example, if the *AspiredTrait* being measured is competitiveness then $OccTrait^{f,m}$ is the competitiveness of the father's or mother's occupation.

occupation and the "Father's (Mother's) Occupational Trait" are therefore the expected income of the Father's (Mother's) occupation. Column 1 shows that the adolescent being male is associated with a 68.9% of a standard deviation increase of the expected income of one's aspired occupation. Both parents' educational attainment is positively associated with the adolescent aspiring to a higher paying occupation. Furthermore, an increase in the expected income of both the father's and mother's occupation is associated with an increase in the expected income of one's aspired occupation. These results can be interpreted as a one standard deviation increase in the expected income of the father's occupation is associated with a 17.7% of a standard deviation increase of the expected income of one's aspired occupation. These results show that children of parents with higher incomes and more education aspire to better paying jobs.

Table 2.7: OLS Estimation of Family Background Effects on Traits of Aspired Occupation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Aspired Occupation Dependent Variable:							
VARIABLES	Expected Income	Social Contribution	Riskiness	Competitiveness	Inflexibility	Interaction	Physicality	Cognitive
Gender (Male=1)	0.689***	-0.736***	0.547***	0.615***	1.055***	-0.473***	0.475***	0.015
	[0.055]	[0.051]	[0.046]	[0.055]	[0.081]	[0.039]	[0.056]	[0.047]
Mother High School Graduate	0.128*	0.071	-0.050	0.107	0.193**	0.136***	-0.061	0.085
	[0.071]	[0.066]	[0.067]	[0.079]	[0.090]	[0.043]	[0.061]	[0.066]
Father High School Graduate	0.116**	0.103*	-0.006	0.012	0.085	0.108**	-0.173***	0.102*
	[0.048]	[0.054]	[0.053]	[0.057]	[0.070]	[0.046]	[0.060]	[0.056]
Father's Occupational Trait	0.177***	0.082**	0.102**	0.027	0.167***	0.131***	0.117***	0.186***
	[0.038]	[0.035]	[0.046]	[0.035]	[0.037]	[0.025]	[0.033]	[0.040]
Mother's Occupational Trait	0.090***	0.068*	0.020	0.027	-0.068	0.063*	0.027	0.028
	[0.030]	[0.039]	[0.070]	[0.027]	[0.065]	[0.032]	[0.041]	[0.042]
Constant	-0.205*	0.536***	-0.299***	0.100	-0.911***	0.537***	-0.398***	0.186
	[0.122]	[0.104]	[0.099]	[0.114]	[0.167]	[0.077]	[0.119]	[0.122]
Observations	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305
R-squared	0.161	0.162	0.110	0.126	0.166	0.141	0.125	0.070
Additional Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the occupational level. (z) indicates standardized values at the Census occupational level. Additional covariates are: dummy variable for whether the mother worked in 1978, race dummies, regional dummies, urban dummy, age of adolescent and the total number of siblings of the adolescent.

Table 2.7 Columns 2-8 show that there are significant gender differences in the traits of an adolescent's aspired occupations for every trait except cognitive skills. These findings show that adolescent males aspire to occupations with higher riskiness, competitiveness, inflexibility and physicality and lower levels of social contribution and interactional skills compared to female adolescents. Furthermore, parental education levels are associated with some of the traits of adolescents' aspired occupations. The mother being a high school graduate is associated with the adolescent aspiring to occupations with higher expected income, inflexibility and interactional skills while the father being a high school graduate is associated with the adolescent aspiring to occupations with higher expected income, social contribution, interactional and cognitive skills and lower levels of physical skills. Occupations associated with high levels of physicality are manual labour occupations which do not typically require being a high school graduate (Wright and Hamilton, 1979). Thus it is not surprising to see a negative relationship between the father's education level and the physicality of the adolescent's aspired occupation as it may be capturing the fact that more physical jobs require lower levels of education. Previous research has found a positive relationship between a father's education levels and the educational aspirations of adolescents (Kao and Tienda, 1998). Therefore, the adolescent with a father holding more education would be less likely to aspire to work in an occupation with high levels of physicality as they are associated with lower levels of education.

Regarding parental occupational trait's, the father's occupational traits are significantly associated with the traits of the adolescent's aspired occupation for every trait except competitiveness. This provides evidence that regardless of the occupation being associated with feminine or masculine traits, the father's occupational traits are significantly associated with the adolescent's aspired occupational traits. Other than expected income, the mother's occupational traits are only significantly associated with the adolescents' aspired traits in occupations associated with higher levels of social contribution and interactional skills which are thought to be feminine occupations. To summarize, Table 2.7 provides evidence that there are gender differences in the traits of adolescents' aspired occupations and that parental education and occupations are significant predictors of these traits.

4.2 Gender Differences in Predictors of Aspired Occupational Traits

To enable a better understanding of gender differences in aspired occupations, Tables 2.8 and 2.9 show the estimation of model (2.2), where I analyse if background characteristics are differentially associated with the aspired occupation's traits by gender. This analysis uses a fully interacted model where the gender of the adolescent is interacted with every

background characteristic. **Panel A** shows the effects of the background characteristics for female adolescents. **Panel B** shows whether there are significantly different associations with background characteristics and the trait of one's aspired occupation between male and female adolescents. **Panel C** is the summation of the interacted and non-interacted background characteristic term so one can see whether the associations for male adolescents is statistically significant. The same control variables are used as in Table 2.7 along with their interaction terms.

Table 2.8: OLS Estimation: Gender Differences Family Background Effects on Traits of Aspired Occupation

	(1)	(2)	(3)	(4)
	Dependent Variable: Aspired Occupation Trait			
VARIABLES	Expected Income	Social Contribution	Riskiness	Competitiveness
Panel A: Effects for Females				
Mother High School Graduate	0.211**	0.088	-0.034	0.155
	[0.096]	[0.095]	[0.036]	[0.116]
Father High School Graduate	0.029	0.044	-0.041	0.038
	[0.088]	[0.084]	[0.035]	[0.086]
Father's Occupational Trait	0.123**	-0.064	-0.027**	0.074
	[0.057]	[0.061]	[0.014]	[0.048]
Mother's Occupational Trait	0.158***	0.061	0.014	0.014
	[0.048]	[0.063]	[0.026]	[0.056]
Constant	-0.125	0.488**	-0.352***	0.240
	[0.209]	[0.204]	[0.063]	[0.178]
Panel B: Differential Effects for Males				
Gender (Male=1)	0.524**	-0.675**	0.612***	0.316
	[0.265]	[0.267]	[0.201]	[0.196]
Intx Male* Mother High School Graduate	-0.145	-0.027	-0.026	-0.079
	[0.127]	[0.119]	[0.127]	[0.143]
Intx Male* Father High School Graduate	0.147	0.105	0.089	-0.065
	[0.123]	[0.107]	[0.082]	[0.103]
Intx Male* Father's Occupational Trait	0.103	0.233***	0.249***	-0.091
	[0.107]	[0.070]	[0.079]	[0.073]
Intx Male* Mother's Occupation Trait	-0.142**	0.018	0.006	0.019
	[0.064]	[0.084]	[0.099]	[0.078]
Panel C: Effects for Males				
Mother High School Graduate for Males	0.066	0.061	-0.059	0.077
	[0.095]	[0.082]	[0.125]	[0.100]
Father High School Graduate for Males	0.177**	0.148**	0.048	-0.028
	[0.070]	[0.070]	[0.085]	[0.071]
Father's Occupational Trait	0.226***	0.169***	0.222***	-0.017
	[0.070]	[0.039]	[0.078]	[0.053]
Mother's Occupational Trait	0.016	0.079	0.02	0.033
	[0.040]	[0.048]	[0.100]	[0.039]
Panel D				
Observations	1,305	1,305	1,305	1,305
R-squared	0.173	0.178	0.135	0.138
Additional Covariates	Yes	Yes	Yes	Yes
Chow Test Statistic	16.569***	22.066***	9.913***	8.858***

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the occupational level. Father and Mother's Occupational Trait refers to the same trait as the aspired occupation trait that is the dependent variable. (z) indicates standardized values at the Census occupational level. Additional covariates, along with their interaction terms, are the same as in Table 2.7.

Table 2.8, Column 1 shows that there is a significantly weaker association between the expected income of the mother's occupation and the expected income of a male adolescent's aspired occupation compared to female adolescents. Looking at Panel A, a one standard deviation increase in the expected income of the mother's occupation is associated with a 15.8% increase in the expected income of a female adolescent's aspired occupation. **Panel C** shows that there is not a significant relationship between the expected income of the mother's occupation and male adolescent's occupation. These results also show that there is not a significant difference in the association between the expected income of the father's occupation and the expected income of the adolescent's aspired occupation based on the gender of the adolescent.

Table 2.8, Column 2 shows that there is a significantly stronger association between the social contribution of the father's occupation and male adolescent's aspired occupation compared to female adolescents. A one standard deviation increase in the social contribution of the father's occupation is associated with a 16.9% of a standard deviation increase in the social contribution of the male adolescent's aspired occupation. Column 3 also shows a stronger relationship between the aspired occupational trait of adolescent males and fathers. A one standard deviation increase in the riskiness of the father's occupation is associated with a 22.2% of a standard deviation increase in the riskiness of the male adolescent's aspired occupation. Interestingly, there is a slightly significant negative relationship between the riskiness of a father's occupation and daughter's aspired occupation. In addition to Table 2.7, Table 2.8 Column 4 shows that there are not significant gender differences in predictors of the competitiveness of the adolescent's aspired occupation.

Table 2.9 Column 1 shows that there are significant gender differences in the association of the inflexibility of both parents' occupations. For adolescent males, a one standard deviation increase in the inflexibility of the father's occupation is associated with a 27.3% of a standard deviation increase in the inflexibility of their aspired occupation while there is no relationship between the inflexibility of fathers' and daughters' occupations. Furthermore, for female adolescents, a one standard deviation increase in the inflexibility of the mother's occupation is associated with a 33.7% of a standard deviation *decrease* in the inflexibility of their aspired occupation while there is no relationship between mothers' and sons' occupations.

This result may be due to daughters seeing their mothers who work in more inflexible occupations having a difficult time balancing family and work responsibilities. Research shows that women in the US still provide the majority of household production and child care duties even though their labour force participation rates have increased (Blau and Winkler, 2017;

Blau and Kahn, 2017; Sayer et al., 2004; Hochschild and Machung, 1989). In addition, Fleche et al. (2020) find women provide more household production than their male partners even if they work longer hours. This coincides with Akerlof and Kranton's (2000) identity model that even if women work, they are still expected to produce the majority of household production due to prevalent gender norms. Stevenson and Wolfers (2009) find that during the increase in female labour force participation in the United States over the past few decades, their well-being has simultaneously decreased. Bertrand (2011) discusses the possibility that women's well-being is negatively correlated with the female labour force participation rate since the identity of a modern woman is one who works outside of the house while maintaining the household. Research shows that having competing demands for work and family can have negative psychological effects on mothers (see Judge and Livingston (2008) for a review). If the mother is working in an occupation with long hours, this will make being able to combine work and family more difficult. Daughters may notice this difficulty and recognise that they too will have to juggle family and work someday while sons don't have to dwell about this. Therefore, having mothers working in more inflexible occupations may deter daughters from doing the same.

Table 2.9 Column 2 shows that there is a stronger association between a father's educational level and the interactional skills of a male adolescent's aspired occupation compared to female adolescents. These results indicate that the father being a high school graduate is associated with a 18.5% of a standard deviation increase in the interactional skills of a male adolescent while no relationship is found between fathers and daughters. In addition, again I find that the interactional skills of the father's occupation has a significantly stronger association with the interactional skills of a male adolescent's aspired occupation compared to female adolescents. Table 2.9 Column 3 shows a significantly stronger negative relationship between a father's educational level and the physical skills of male adolescents' aspired occupations compared to female adolescents. Furthermore it shows a statistically (in)significant negative relationship between the father's education level and the physicality of the (daughter's) son's aspired occupation. These results are consistent with results in Table 2.7 Column 7. In addition, there is also a stronger relationship between the physicality of a father's occupation and male adolescent's aspired occupation. Last, Table 2.9 Column 4 shows a significantly stronger relationship between the cognitive skills of a father's occupation and male adolescent's aspired occupation compared to female adolescents.

To summarise, Tables 2.8 and 2.9 show that for every occupational trait, except expected income and competitiveness, there is a significantly stronger association between a father's

Table 2.9: OLS Estimation: Gender Differences Family Background Effects on Traits of Aspired Occupation

	(1)	(2)	(3)	(4)
	Dependent Variable: Aspired Occupation Trait			
VARIABLES	Inflexibility	Interaction	Physicality	Cognitive
Panel A: Effects for Females				
Mother High School Graduate	0.126	0.168***	0.007	-0.004
	[0.134]	[0.051]	[0.071]	[0.082]
Father High School Graduate	0.021	0.011	-0.051	0.040
	[0.108]	[0.051]	[0.078]	[0.081]
Father's Occupational Trait	-0.025	0.034	0.034	0.110**
	[0.056]	[0.026]	[0.041]	[0.055]
Mother's Occupational Trait	-0.337**	0.078**	0.019	0.037
	[0.142]	[0.036]	[0.047]	[0.059]
Constant	-0.567**	0.618***	-0.504***	0.301**
	[0.257]	[0.123]	[0.131]	[0.145]
Panel B: Differential Effects for Males				
Gender (Male=1)	0.433	-0.650***	0.720***	-0.235
	[0.320]	[0.209]	[0.201]	[0.236]
Intx Male* Mother High School Graduate	0.113	-0.055	-0.150	0.184
	[0.174]	[0.091]	[0.142]	[0.117]
Intx Male* Father High School Graduate	0.079	0.174*	-0.224**	0.096
	[0.142]	[0.093]	[0.107]	[0.109]
Intx Male* Father's Occupational Trait	0.298***	0.176***	0.143***	0.139*
	[0.053]	[0.053]	[0.053]	[0.074]
Intx Male* Mother's Occupation Trait	0.355**	-0.030	0.014	-0.025
	[0.146]	[0.065]	[0.070]	[0.080]
Panel C: Effects for Males				
Mother High School Graduate for Males	0.239**	0.113	-0.143	0.181*
	[0.116]	[0.074]	[0.114]	[0.093]
Father High School Graduate for Males	0.100	0.185**	-0.275***	0.136*
	[0.089]	[0.072]	[0.080]	[0.076]
Father's Occupational Trait for Males	0.273***	0.209***	0.177***	0.249***
	[0.028]	[0.042]	[0.043]	[0.055]
Mother's Occupation Trait for Males	0.017	0.048	0.033	0.011
	[0.043]	[0.051]	[0.058]	[0.057]
Panel D				
Observations	1,305	1,305	1,305	1,305
R-squared	0.202	0.162	0.151	0.090
Additional Covariates	Yes	Yes	Yes	Yes
Chow Test Statistic	46.004***	16.494***	10.560***	5.064***

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the occupational level. Father and Mother's Occupational Trait refers to the same trait as the aspired occupation trait that is the dependent variable. (z) indicates standardized values at the Census occupational level. Additional covariates, along with their interaction terms, are the same as in Table 2.7.

occupation and male adolescent's aspired occupation compared to female adolescents. This is indicative of findings in previous intergenerational research which finds stronger father to son relationships (Black and Devereux, 2010). The mother's occupational trait had a significantly stronger association with female adolescent's aspired occupation for expected income (positive association) and inflexibility (negative association) compared to male adolescents. In addition, the father's education levels has a significantly stronger relationship with the interactional and physical skills of male adolescent's aspired occupations.

4.3 Role Model Estimation

Table 2.10 shows the estimation of model (2.3) where I analyse whether the occupational trait of a parent, who is stated to be the adolescent's role model, has a stronger association with the traits of the adolescent's aspired occupation. Just as in Tables 2.8 and 2.9, the variables of interest are the interaction terms. **Panel A** shows the estimation for adolescents whose father and/or mother were not listed as their role models. **Panel B** shows the estimation for parents who are the adolescent's role model. **Panel C** shows the estimation for parent who are the adolescent's role model as this section displays the linear combination of the non-interacted and interacted occupational trait variables.

Table 2.10 shows that there is a significantly stronger association between the expected income, riskiness, physicality and cognitive skills of a father's occupation and adolescent's aspired occupation if the father is the adolescent's role model. For example, a one standard deviation increase in the expected income of the father's occupation is associated with a 24.5% of a standard deviation increase in the expected income of the adolescent's aspired occupation if the father is their role model. If the father is not the adolescent's role model, the association is significantly less as a one standard deviation increase in the expected income of the father's occupation is associated with a 7.7% of a standard deviation increase in the expected income of the adolescent's aspired occupation.

Furthermore, I find that a stronger relationship between the social contribution and physicality of a mother's occupation and adolescent's aspired occupation if the mother is one's role model. For both of these occupational traits, there is not a significant association between the mother's occupational trait and adolescent's aspired occupational trait if the mother is not their role model while there is a significant relationship if the mother is the adolescent's role model. These results provides empirical evidence that adolescents may look to role models for what types of occupations they should aspire to achieve.

As the results in Table 2.10 indicate that a parent who is a role model can have a larger influence on one's aspired occupation, it is important to attempt to understand what makes a parent more likely to be an adolescent's role model. Tables 2.11 and 2.12 show differences in descriptive statistics based on whether the father or mother is the adolescent's role model. Table 2.11 shows that adolescents who said their father is their role model are significantly more male, who live in the same household as their father and have fewer siblings. In addition, fathers who are listed as role models have more education and have occupations with higher

levels of expected income, competitiveness, interactional skills, inflexibility and cognitive skills and lower levels of physicality.

Table 2.10: OLS Estimation: Interactions Between Parental Role Model and Family Background Effects in Explaining Traits of Aspired Occupations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable: Aspired Occupation Trait							
	Expected Income	Social Contribution	Riskiness	Competitiveness	Inflexibility	Interaction	Physicality	Cognitive
Panel A: Effects for Parents Not Role Models								
Father's Occupational Trait	0.077*	0.093	-0.022	0.023	0.153***	0.120***	0.073*	0.115**
	[0.041]	[0.064]	[0.040]	[0.050]	[0.046]	[0.030]	[0.037]	[0.047]
Mother's Occupational Trait	0.079	-0.012	0.151	0.009	-0.139	0.004	-0.042	-0.014
	[0.049]	[0.058]	[0.123]	[0.049]	[0.086]	[0.048]	[0.062]	[0.054]
Panel B: Differential Effects for Parents Role Models								
Father Role-Model (yes=1)	-0.003	-0.030	-0.058	-0.039	0.021	-0.026	-0.082	0.041
	[0.062]	[0.059]	[0.052]	[0.061]	[0.108]	[0.041]	[0.052]	[0.048]
Mother Role-Model (yes=1)	0.057	0.021	0.073	0.050	0.183	0.075*	0.025	0.049
	[0.081]	[0.052]	[0.064]	[0.052]	[0.115]	[0.044]	[0.058]	[0.060]
Intx Father Role* Father's Occ Trait	0.168***	-0.021	0.188***	0.007	0.013	0.019	0.072*	0.121***
	[0.058]	[0.084]	[0.068]	[0.071]	[0.052]	[0.045]	[0.040]	[0.042]
Intx Mother Role* Mother's Occ Trait	0.015	0.131*	-0.200	0.029	0.097	0.093	0.112*	0.063
	[0.064]	[0.076]	[0.121]	[0.065]	[0.077]	[0.061]	[0.060]	[0.066]
Panel C: Effects for Parents Role Models								
Father's Occupational Trait	0.245***	0.072	0.166***	0.030	0.166***	0.138***	0.145***	0.236***
	[0.049]	[0.046]	[0.061]	[0.049]	[0.063]	[0.041]	[0.038]	[0.052]
Mother's Occupational Trait	0.094**	0.119**	-0.049	0.038	-0.042	0.097**	0.070*	0.049
	[0.039]	[0.051]	[0.088]	[0.036]	[0.044]	[0.035]	[0.040]	[0.044]
Panel D								
Observations	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305
R-squared	0.167	0.165	0.123	0.127	0.170	0.144	0.130	0.076
Additional Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the occupational level. Father and Mother's Occupational Trait refers to the same trait as the aspired occupation trait that is the dependent variable. (z) indicates standardized values at the Census occupational level. Additional covariates are the same as in Table 2.7.

Table 2.11: Occupational Traits by Father Being a Role Model

	(1) Father Role Model No	(2) Father Role Model Yes	(3) Diff
Gender (Male=1)	0.43	0.60	***
	(0.49)	(0.49)	
Father Lives in Same Household	0.87	0.95	***
	(0.33)	(0.22)	
Father High School Graduate	0.67	0.73	**
	(0.47)	(0.44)	
Total Number of Siblings	3.07	2.83	**
	(1.98)	(1.89)	
Expected Income of Father's Occ (z)	0.21	0.33	**
	(0.80)	(0.85)	
Competitiveness of Father's Occ (z)	0.27	0.38	**
	(0.81)	(0.84)	
Social Contribution of Father's Occ (z)	-0.17	-0.16	
	(0.66)	(0.66)	
Interactional Skills of Father's Occ (z)	-0.08	0.01	*
	(0.84)	(0.86)	
Mortality Rate of Dad's Occ (z)	0.13	0.17	
	(0.84)	(0.98)	
Inflexibility of Father's Occ (z)	0.55	0.67	*
	(1.16)	(1.26)	
Cognitive Skills of Father's Occ (z)	-0.09	0.03	**
	(0.86)	(0.89)	
Physicality of Father's Occ (z)	0.23	0.09	**
	(0.98)	(1.02)	
Observations	542	763	

Notes: *** p<0.01, ** p<0.05, * p<0.1 N=1,305. Mean and standard deviations in parentheses. (z) indicates standardized at the Census Occupational level. Diff is the two-sample t-test between male and female occupational traits.

Looking at Table 2.12, there is not much heterogeneity in descriptive statistics based on whether the mother is the adolescent's role model. Adolescents who state that their mother is their role model live in the same household of their mother and also have fewer siblings. Interestingly, there is no heterogeneity in the education level or occupational traits of the mother's occupation based on if she is the adolescent's role model.

Furthermore, Table 2.13 shows the estimation results for a Linear Probability Model for a dummy variable that takes value 1 if the father (mother) is a role model for the child and 0 otherwise while controlling for parental and background characteristics. Column 1's (2's) dependent variable is the dummy variable for whether the father (mother) is listed as the adolescent's role model. The explanatory variables about a parent refer to the father in Column 1 and the mother in Column 2. Table 2.13 Column 1 shows that the adolescent being a male is associated with a 0.159 increase in the probability of the father being one's role model. In addition, the father living in the same household of the adolescent is associated

Table 2.12: Occupational Traits by Mother Being a Role Model

	(1) Mother Role Model No	(2) Mother Role Model Yes	(3) Diff
Gender (Male=1)	0.55	0.52	
	(0.50)	(0.50)	
Mother Lives in Same Household	0.95	0.98	***
	(0.21)	(0.13)	
Mother High School Graduate	0.72	0.73	
	(0.45)	(0.44)	
Total Number of Siblings	3.08	2.84	**
	(2.09)	(1.82)	
Expected Income of Mother's Occ (z)	-0.47	-0.47	
	(0.73)	(0.71)	
Competitiveness of Mother's Occ (z)	-0.18	-0.22	
	(0.77)	(0.82)	
Social Contribution of Mom's Occ (z)	0.24	0.28	
	(0.71)	(0.70)	
Interactional Skills of Mother's Occ (z)	0.08	0.09	
	(0.65)	(0.66)	
Mortality Rate of Mom's Occ (z)	-0.24	-0.23	
	(0.36)	(0.48)	
Inflexibility of Mother's Occ (z)	-0.40	-0.39	
	(0.77)	(0.88)	
Cognitive Skills of Mother's Occ (z)	-0.18	-0.16	
	(0.70)	(0.69)	
Physicality of Mother's Occ (z)	-0.14	-0.20	
	(0.66)	(0.66)	
Observations	496	809	

Notes: *** p<0.01, ** p<0.05, * p<0.1 N=1,305. Mean and standard deviations in parentheses. (z) indicates standardized at the Census Occupational level. Diff is the two-sample t-test between male and female occupational traits.

with a 0.227 increase in the probability of the being the adolescent's role model which is quite substantial. Looking at the father's occupational traits, there is some evidence that an increase in the physicality of the father's occupation is associated with a father being less likely to be the adolescent's role model while an increase in the riskiness of the father's occupation is associated with an increase in the probability of being the adolescent's role model. However, these results are only significant at the 10% level and are small in magnitude.

Table 2.13 Column 2 shows that unlike fathers, the gender of the adolescent does not have a significant association with the probability of the mother being the adolescent's role model. It is also found that the mother living in the same household as the adolescent is associated with an increase in the probability of the mother being the adolescent's role model. In addition, I also find similar to fathers that an increase in the physicality of the mother's occupation decreases the likelihood of the mother being viewed as a role model. These results show that the most important predictor of a adolescent choosing a parent as a role model is if

Table 2.13: Predictors of Parent Being a Role Model

VARIABLES	(1) Father Role-Model (yes=1)	(2) Mother Role-Model (yes=1)
Gender (Male=1)	0.159***	-0.033
	[0.026]	[0.027]
Parent Lives in Same Household	0.227***	0.255***
	[0.050]	[0.077]
Total Number of Siblings	-0.011	-0.014*
	[0.007]	[0.008]
Expected Income of Parent's Occ	0.019	0.022
	[0.020]	[0.029]
Interactional Skills of Parent's Occ	-0.029	-0.031
	[0.033]	[0.042]
Physicality of Parent's Occ	-0.040*	-0.054**
	[0.022]	[0.024]
Mortality Rate of Parent's Occ	0.032**	0.037
	[0.016]	[0.034]
Inflexibility of Parent's Occ	0.012	0.021
	[0.013]	[0.025]
Social Contribution of Parent's Occ	-0.004	0.048
	[0.033]	[0.039]
Competitiveness of Parent's Occ	0.023	-0.032
	[0.017]	[0.021]
Cognitive Skills of Parent's Occ	-0.006	-0.036
	[0.023]	[0.035]
Constant	0.229***	0.393***
	[0.070]	[0.096]
Observations	1,305	1,305
R-squared	0.063	0.027
Additional Covariates	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the occupational level. Additional covariates are: regional, urban, race, age in 1979 and whether mother worked in 1978 dummy. (z) indicates standardized values at the Census occupational level. Column 1 (2) shows the dependent variable for the father (mother) being indicated as a role model.

the parent lives in the same household of the child and that male adolescents are significantly more likely to choose their father as a role model.

4.4 Attained Occupations

The previous results have shown that there are significant gender differences in the types of aspired occupations of adolescents; however, it is important to know whether the traits of aspired occupations are associated with the traits of attained occupations. As the aspired occupation is measured before entry into the labour market, it is not expected for there to be a perfect correlation between an adolescent's aspired and attained occupation owing to the influence of additional schooling, labour market and family experiences between the two mea-

surements. Other factors that can influence the correlation between the aspired and attained occupations of individuals include the specific capital, whether human or physical, which is required for the given occupation and whether the individual has this capital. There is a literature which finds that parents transfer occupation specific human and/or physical capital (including property) to their child thereby reducing the barrier to entry in certain occupations (Aina and Nicoletti, 2018; Lindquist et al., 2015; Fairlie and Robb, 2007; Dunn and Holtz-Eakin, 2000; Laband and Lentz, 1983).[12] In addition, there could be gender differences in the strength of the relationship between one's aspired and attained occupation due to gender differences in labour market experience (discrimination) and the impact of having a family on one's occupational trajectory.

Table 2.14 analyses the associations between one's aspired occupational trait and their attained occupational trait measured when the individual is approximately 35 years old. Background characteristics, including parental occupational traits and number of siblings are also included in the estimation but are not shown for conciseness. The second column in each occupational trait section includes an interaction term between the respondent being male and the aspired occupational trait to see if the aspired occupational trait is differentially associated with the attained occupational trait by gender. Table 2.14 shows that all of the aspired occupational traits are significantly associated with the attained occupational trait. For example, a one standard deviation increase in the expected income of the aspired occupation is associated with an 13.9% of a standard deviation increase in the expected income of the attained occupation. The interaction term of being male and the aspired occupational trait is found to be significant with regard to riskiness, physicality, cognitive, interactional skills and expected income of the occupations. The reason for men having a stronger correlation between their aspired and attained occupations may be due to facing less discrimination in the labour market and their careers not being as impacted by family decisions compared to women in the sample.

Overall these results show that individuals segregate not only in their aspired occupation but also in their attained occupations along gender lines. Men attain occupations with significantly higher levels of competitiveness, riskiness, inflexibility, physicality and expected income while women attained occupations with significantly higher levels of interactional skills, social

[12]Furthermore, inheritance of the family business could also reduce the barrier to entry for specific occupations (Aina and Nicoletti, 2018; Lindquist et al., 2015; Nordin et al., 2010; Laband and Lentz, 1983). In this scenario, having siblings could diminish one's ability to enter into specific occupations if only one sibling inherits the family business, for example. Lindquist et al. (2015) finds that the occupational transmission of being an entrepreneur between parents and children decreases with the addition of more siblings. Nordin et al. (2010) find that not having siblings increases the probability of becoming a farmer if one's parents are farmers. See Wang (2010) for a review about how daughters inherit family businesses less often.

Table 2.14: OLS Estimation of Aspired Occupational Trait Influencing Attained Occupational Trait

	Dependent Variables: Attained Occupational Traits			
	Competitiveness		**Interactional**	
Gender (Male=1)	0.362***	0.366***	-0.338***	-0.400***
	[0.052]	[0.060]	[0.049]	[0.050]
Aspired Occupation Trait	0.075***	0.078**	0.154***	0.070
	[0.027]	[0.035]	[0.040]	[0.045]
Intx Male*Aspired Trait		-0.007		0.120*
		[0.048]		[0.072]
	Riskiness		**Social Contribution**	
Gender (Male=1)	0.344***	0.397***	-0.510***	-0.526***
	[0.041]	[0.042]	[0.043]	[0.041]
Aspired Occupation Trait	0.079***	-0.056	0.123***	0.103**
	[0.026]	[0.038]	[0.030]	[0.040]
Intx Male*Aspired Trait		0.147***		0.046
		[0.047]		[0.059]
	Inflexibility		**Physicality**	
Gender (Male=1)	0.580***	0.579***	0.411***	0.507***
	[0.058]	[0.058]	[0.058]	[0.054]
Aspired Occupation Trait	0.149***	0.144***	0.275***	0.098***
	[0.022]	[0.032]	[0.030]	[0.038]
Intx Male*Aspired Trait		0.010		0.278***
		[0.042]		[0.053]
	Cognitive Skills		**Expected Income**	
Gender (Male=1)	-0.177***	-0.237***	0.458***	0.422***
	[0.054]	[0.053]	[0.068]	[0.061]
Aspired Occupation Trait	0.182***	0.107***	0.139***	0.092**
	[0.030]	[0.038]	[0.026]	[0.043]
Intx Male*Aspired Trait		0.135**		0.108*
		[0.056]		[0.057]

Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at the occupational level. N=1,305. Background covariates from Table 2.7 also included. Occupational traits are standardized at the Census occupational level.

contribution and cognitive skills. It is interesting that there were no gender differences in cognitive skills of one's aspired occupation but significantly more women attained occupations with higher cognitive skills compared to men. As the aspired occupational trait is significantly associated with the attained occupational trait, changing one's aspirations has the potential to influence their actual labour market outcomes.

5 Conclusion

Occupational segregation remains the largest contributor to the gender wage gap; therefore, research analysing why individuals segregate into different types of occupations is imperative for developing policies that can help to decrease occupational segregation. This paper furthers

our understanding of occupational segregation by examining whether a potential reason for occupational segregation by gender occurs prior to labour market entry in the form of gender differences in aspired occupations. This analysis finds that adolescent men aspire to occupations which are associated with higher levels of expected income, competitiveness, riskiness, physicality and inflexibility while adolescent women aspire to occupations associated with higher levels of social contribution and interactional skills.

Furthermore, this paper finds that there are gender differences in potential predictors of aspired occupational traits as there are significantly stronger associations between the occupational traits of fathers and adolescent men compared to adolescent women for every occupational trait other than expected income and competitiveness. In addition, I find that the expected income, social contribution, riskiness, physicality and cognitive skills of parents occupations who are indicated as role models have significantly stronger relationships with the traits of the adolescent's aspired occupation compared to parents who are not the adolescent's role model.

These results indicate that adolescents look to those around them when forming preferences of the occupations they want to have later in life. If individuals aspire to occupations because of societal pressures of what is appropriate work for men and women, it could be beneficial to have programs in school that expose young men and women to individuals working in gender atypical occupations to break the stigma that that one should be in an occupation associated with their gender. A great example of an organisation breaking gender barriers about occupations is L'Oreal's "For Girls and Science" which has female scientists visit high schools in France to discuss careers in science. Recent research by Breda et al. (2020) finds this program has a significant impact on the number of girls entering science programs in college and university after a one-time intervention of female scientists delivering presentations about science occupations in schools in Paris. Furthermore, they find that this intervention decreased the gender stereotyped beliefs that science is a male domain of both boys and girls. More broadly, Speakers for Schools is an organisation which sends famous and successful individuals to speak with students at school. Having inspirational speakers visit schools can potentially have positive effects on students. Burgess (2016) shows evidence that Michelle Obama visiting a girl's school in London significantly increased their GCSE scores. Another recommendation is the utilisation and creation of organisations which develop the skills of adolescents in specific fields. Girls Who Code and Kode with Klossy give free coding courses to high school girls. These programs show young girls that women work in computer science and there is some

evidence of impact as graduates of the programs go on to major in Computer Science related fields at high rates.

6 Appendix

6.1 O*NET Data Appendix

In order to convert the O*NET data into the occupational codes of David and Dorn (2013), I followed previous research and crosswalks as described below:

1. Convert O*NET-SOC 2010 codes to SOC 2010 codes

   The 15.1 release of the O*NET database collects occupational information based on their own occupational structure which is built off the SOC codes from the Bureau of Labor Statistics; however, it deviates from the SOC codes by breaking some of the SOC codes into different industries. Using a crosswalk provided by the O*NET database, I convert the 8 digit 2010 O*NET-SOC codes into 6 digit 2010 SOC codes. There is a one-to-one crosswalk between the majority of occupations; however, in the instance where there are multiple O*NET-Soc codes for one Soc code, the score for the SOC 2010 code is equal to the average of the O*NET occupations. For example, in the O*NET-SOC 2010 code they have separate codes for Auditors and Accountants while this is combined into one code 'Auditors and Accountants' in the SOC 2010 codes. The O*NET value for the SOC 2010 code is then the average O*NET value for the separate Auditors and Accountants O*NET-SOC codes.

2. Convert SOC 2010 codes to SOC 2000 codes

   Once I have the Soc 2010 codes I must convert these into 2000 codes as I ultimately need to have the occupational O*NET values associated with the occupational codes provided by David and Dorn (2013). To do this I use a crosswalk from the Bureau of Labor Statistics.[13] Most of the occupational codes match one-to-one but in the cases where there are multiple Soc 2010 codes for one Soc 2000 code, I calculate the average of the O*NET variable from the multiple Soc 2010 codes to be the O*NET value for the SOC 2000 codes. For example, in the SOC 2010 codes they have separate codes for 'Funeral Service Managers' and 'Mortician, Undertakers and Funeral Directors' while these only refer to one SOC 2000 code 'Funeral Directors'. The O*NET value for the SOC 2000 code is the average of 'Funeral Service Managers' and 'Mortician, Undertakers and Funeral Directors' from the SOC 2010 codes.

3. Convert SOC 2000 codes to Census 2000 codes

[13] https://www.bls.gov/soc/soccrosswalks.htm

Once I have the O*NET values in the SOC 2000 codes, I then convert these into 2000 Census occupational codes. To do this I use a crosswalk developed by Acemoglu and Autor (2011). For most of the occupations, there are multiple SOC 2000 codes for one 2000 Census code, I follow Acemoglu and Autor's crosswalk which utilises the Occupational Employment Statistics (OES). The OES provides the total number of individuals working in each SOC 2000 code. To calculate the O*NET value for each Census 2000 codes, following Acemoglu and Autor (2011), I calculate the weighted average of the O*NET value based on the number of employees in a given SOC 2000 code to get the O*NET value for the relevant Census 2000 occupation.

4. Convert Census 2000 codes to David and Dorn (2013) codes

   Once I have the Census 2000 occupational codes, the last step is to convert these to the consistent set of Census codes developed by David and Dorn (2013) using a crosswalk developed by them. For the occupational codes which do not match one-to-one, there may be multiple Census 2000 codes that correspond with one Census code, in this instance I use weights provided in the David and Dorn crosswalk to calculate weighted average O*NET variables for a given 2000 Census occupational code. As done in Cortes and Pan (2018), I standardise the O*NET values to have a mean of 0 and standard deviation of 1 for the full set of Census occupational codes.

6.2 Tables

Table 2.15: Five Highest Ranked Occupations for Each Occupational Trait

Expected Income	**Inflexibility**
Physician	Sailor
Actuary	Physician
Electrical Engineer	Firefighter
Aerospace Engineer	Veterinarian
Mathematical Scientist	Petroleum Engineer
Social Contribution	**Interactional Skills**
Physician	Psychologist
Social Worker	Social Worker
Nurse Practitioner	Education Administrator
Clergy	Physician
Registered Nurse	Counsellors
Riskiness	**Physicality**
Sailor	Brick Mason
Timber Cutting	Plumber
Taxicab Driver	Firefighter
Airline Pilot	Electrician
Surfacing Equipment Operator	Surfacing Equipment Operator
Competitiveness	**Cognitive Skills**
Financial Services Sales	Physicist and Astronomer
Dancer	Mathematical Scientist
Athlete	Biological Scientist
Actor / Director	Physician
Real Estate Agent	Aerospace Engineer

Table 2.16: Descriptive Statistics of Attained Occupations

	(1)	(2)	(3)	
VARIABLES	Female	Male	Total	Diff
Expected Income of Attained Occ (z)	-0.23	0.27	0.03	***
	(1.01)	(0.85)	(0.96)	
Competitiveness of Attained Occ (z)	-0.16	0.27	0.07	***
	(1.04)	(0.87)	(0.98)	
Social Contribution of Attained Occ (z)	0.46	-0.13	0.15	***
	(0.85)	(0.69)	(0.83)	
Interactional Skills of Attained Occ (z)	0.43	0.03	0.22	***
	(0.69)	(0.79)	(0.77)	
Riskiness of Attained Occ (z)	-0.36	0.02	-0.16	***
	(0.44)	(0.76)	(0.66)	
Inflexibility of Attained Occ (z)	-0.33	0.33	0.02	***
	(1.10)	(0.82)	(1.02)	
Physicality of Attained Occ (z)	-0.52	-0.01	-0.25	***
	(0.82)	(1.04)	(0.98)	
Cognitive Skills of Attained Occ (z)	0.18	0.03	0.10	***
	(0.83)	(0.89)	(0.86)	
Observations	617	688	1,305	

Notes: *** p<0.01, ** p<0.05, * p<0.1 Mean and standard deviations in parentheses. (z) indicates standardized at the Census Occupational level. Diff is the two sample t-test between male and female occupational traits.

Chapter 3

Occupational Segregation by Gender of Recent College Graduates

This paper seeks to understand whether similarly experienced and educated men and women follow gender norms by sorting into occupations associated with gendered traits (competitiveness, social contribution and inflexibility). Using the American Community Survey (ACS) and the Occupational Information Network (O*NET), this paper finds occupational segregation by gender within college major contributes to the gender wage gap of college graduates at the beginnings of their careers. More specifically, gender differences in inflexibility of an occupation explain a significant portion of the gender wage gaps within 43% of the majors analysed. Findings indicate that to decrease the gender wage gap of college graduates, policies should focus on making occupations more flexible to decrease gender differences in occupational choices within major and potentially enable more women into majors which feed into inflexible occupations.

1 Introduction

Gender differences in college major have been shown in previous research to significantly contribute to the gender wage gap of college educated men and women; however, even after controlling for these majors, previous studies find a substantial gender wage gap still exists (Francesconi and Parey 2018; Altonji et al. 2016a; Black et al. 2008; Goldin and Katz 2008; McDonald and Thornton 2007; Machin and Puhani 2003; Weinberger 1999, 1998; Brown and Corcoran 1997; Gerhart 1990; Daymont and Andrisani 1984).

Female and male graduates seem to sort into different occupations and women tend to end up in occupations that are less well paid. There is already ample evidence on such occupational segregation of women (e.g. Baker and Cornelson 2018. Altonji et al. 2016a and Altonji et al. 2012), but studies on segregation within majors are just starting to be considered. Sloane et al. (2019) is the first empirical paper evaluating gender differences in the mapping between majors and occupational sorting, and, to my knowledge, there are no studies that evaluate how these gender differences in occupational sorting within major impact the gender wage gap. As emphasized by Altonji et al. (2016a), there are previous papers that allow the gender wage gap to be explained by majors and occupational choices; but they do not allow for interaction effects between majors and occupations therefore they impose that the same type of occupation be paid equally across all types of majors.

The main contribution of this paper is to assess for the first time how the gender wage gap of college graduates can be explained by occupational segregation within majors. I do this by letting characteristics of the occupation have returns that change across major, therefore allowing the compensating wage differential for undesirable job characteristics and the reward for specific occupational characteristics to differ across major. More precisely, I consider three occupational traits that have been found to differ substantially across gender and to be important to explain graduate wages, which are inflexibility, competitiveness and social contribution (see Cortes and Pan 2018, Baker and Cornelson 2018, Goldin 2014 and Bertrand 2011). Occupations that are inflexible, competitive and with high levels of social contribution are occupations that require, respectively, longer work hours, to work in a competitive environment and social skills such as being sensitive and taking care of people.

Using the American Community Survey (ACS) and the Occupational Information Network (O*NET) database, I analyse the gender wage gap for a sample of young, recent college graduates. Analysis of the gender wage gap of highly skilled individuals is important as previous research has shown larger gender wage gaps at the top of the income distribution (Blau

and Kahn, 2017; Chzhen and Mumford, 2011). My empirical results show that the sorting of female graduates into occupations characterized by more flexibility, less competitiveness and more social contribution explain more than 50% (30%) of the within-major gender wage gap in 15 (18) out of the 30 most common majors in US. Furthermore, I show that the returns to inflexibility, competitiveness and social contribution depend on the chosen major.[1] Interestingly, the 18 majors for which a large part of the within-major wage gap is explained by inflexibility, competitiveness and social contribution provide access to numerous types of occupations and for this reason I call them diverse-occupation majors; while the remaining 12 majors, which I call specific-occupation majors, tend to feed into a smaller number of occupations therefore limiting the scope for occupational segregation by gender. Remarkably for the 12 specific-occupation majors the average gender wage gap within majors is only 1.46% while I find an average gender gap of 5.94% within diverse-occupation majors.[2] Notice that a 5.94% wage difference within major is quite large given that I minimize the effect on the gender wage gap of work hours choices, career patterns, and fertility decisions, by focusing on young graduates aged between 24 and 29, working full time and with no children.

Given the importance of major choices and occupational segregation in explaining the gender wage gap of graduates, I simulate the effect of different theoretical scenarios that could represent the ideal result of policy interventions or of a gender convergence in the future. I simulate what the gender wage gap would be if (i) men and women had the same probability to choose each of the specific majors, (ii) the occupational traits were on average identical between men and women within all majors, (iii) both major choices and occupational traits were on average identical across gender.[3]

[1]These results are related to the research which finds that technological advances have decreased the need for workers to perform routine tasks and increased the need for workers to perform non-routine tasks that cannot be automated (see Acemoglu and Autor (2011) and Autor et al. (2003)). This automation changed the skills composition, and returns to skills, of occupations which had routine tasks that were able to be automated by computers (Deming, 2017; Borghans et al., 2014; Acemoglu and Autor, 2011; Autor et al., 2003; Juhn et al., 1993). Deming (2017), Borghans et al. (2014) and Black and Spitz-Oener (2010) argue that technological changes have made social skills more important in the workplace as routine tasks have been automated. If substitutability of workers in occupations is associated with routine tasks and/or social and interactive skills, this automation may be associated with changes in, and the returns to, flexibility between and within occupations over time.

[2]Similar type of evidence can be drawn from previous papers that focus on different types of majors. Bertrand et al. (2010) study graduates with Master's degree in Business Administration that gives access to several different type occupations and find a statistically significant gender wage gap even at the start of the career. On the contrary, Goldin and Katz (2016) focus on Pharmacists, who typically need a Doctor of Pharmacy degree, i.e. a specific-occupation major, and find small gender wage gap, which can be explained by the little heterogeneity in the Pharmacist occupation and, as the authors suggest, a lower penalty for part-time work with respect of other occupations.

[3]While there are papers who have simulated the effect of equalizing major choices between men and women (e.g. Eide 1994; McDonald and Thornton 2007) or of equalizing occupational choices between men and women (e.g. McDonald and Thornton 2007), no paper has looked at the effect of equalizing occupational choices within majors or at the effect of equalizing both major and occupational choices within majors.

The three simulations are based on the estimation results of the regression of hourly wage on occupational traits separately by major and by gender,[4] which allows the return of occupational traits to vary across majors. These simulated scenarios are quite utopian and difficult to implement in real life. For this reason I also simulate the effect of more targeted policies such as interventions aimed at equalizing the number of women and men within STEM (science, technology, engineering and mathematics) majors. STEM majors do usually give access to a small number of occupations, i.e. they are in most cases specific-occupation majors, and tend to be among the most well-paid majors. I also simulate the effect of equalizing the distribution of occupational traits only within majors with access to a variety of occupational choices, diverse-occupation majors, where the scope for segregation is higher. The results suggest that equalizing the distribution of women and men within well-paid specific-occupation majors such as the STEM majors leads to a reduction of the gender gap of 66.05%, which is almost identical to equalizing the distribution of women and men within all majors, 70.06%. Furthermore, equalizing the occupational traits only within diverse-occupation majors leads to a reduction of the gap by 16.05%, which again is almost identical to equalizing the distribution of occupational traits across gender for all majors, 16.36%. After equalizing the distribution of male and female graduates across majors and the gender difference in occupational traits within majors gender, the gender wage gap reduces from 13.44% to 1.61%.[5]

Given these results, I suggest that eliminating the gender wage gap would require the combination of two different strategies.[6] The first strategy is the one that has been suggested by numerous previous papers and consists in equalizing the presence of men and women in different majors in order to reduce the number of women who segregate into badly paid rather than well paid majors. Given my empirical findings, such equalization could cancel

[4]In these regressions I consider also demographic characteristics to control for race, work experience, region and year dummy effects; but in the simulations these characteristics are not equalized between gender.

[5]My simulations are based on the estimated effect of subject choices on wages which do not take account of the sorting of graduates based on differential abilities by majors (see Altonji et al. 2016a and Belasco et al. 2014). This implies that the estimated contribution of subject choices in explaining the gender wage gap is probably overestimated. Because male and female graduates in the same major have much smaller differences in their observed and unobserved occupational skills, based on which they sort into occupations, I think that the corresponding selection bias for the estimation of the effects of occupational traits is much smaller. Therefore the estimated contribution of occupational choices in explaining the gender wage gap might be underestimated with respect to the simulated contribution of major choices.

[6]This paper complements the vast literature on the extent and determinations of the gender wage gap (see Blau and Kahn (2017) and Altonji and Blank (1999) for reviews). It is important to keep in mind other possible contributors to the gender wage gap that are not investigated here such as: within-occupation gender wage gaps (Blau and Kahn 2017; Goldin 2014; Noonan et al. 2005), women sorting into lower paying firms and workplaces (Jewell et al. 2020; Barth et al. 2017; Goldin et al. 2017; Drolet and Mumford 2012; Bayard et al. 2003; Blau 1977) and the potential role of discrimination keeping women out of specific occupations and firms or inhibiting their progression up the ladder within occupations and firms (Blau and Kahn 2017; Altonji and Blank 1999).

out completely the wage gap for graduates in specific-occupation majors. However, such a strategy is unlikely to eliminate the gender gap for diverse-occupation majors for which I find statistically significant within-major gender wage gaps. The second complementary strategy suggests providing opportunities for women to choose the same type of occupations as men within diverse-occupation majors. How to implement these two strategies in practice is a challenging question. Before providing some concrete suggestions, I need to consider my empirical results on gender differences in occupational traits and how these differences contribute to the explanation of the gender wage gap within majors.

I measure inflexibility in an occupation considering the average hours worked by people in the occupation.[7] Because inflexibility of an occupation does not reflect any worker skill, I could expect that its effect on hourly wage should be zero. Nevertheless, I find that only majors in Nursing, Graphic Design, Liberal Arts, and Parks and Recreation have little or zero wage compensation for inflexibility, while the remaining majors tend to reward more for occupations with potential longer hours. This differential effect of inflexibility on wages across majors can be explained by the fact that in some occupations the cost of flexibility is high because of time demands and lack of substitutability between workers and this creates incentives that disproportionately reward long hours (see Goldin 2014). This high cost of flexibility in some occupations can ultimately raise the entry barrier to these occupations as well as to majors that feed in these occupations for women.

Occupations characterized by competitiveness could be more attractive for men who seem to prefer competitive environments more than women.[8] There is some evidence that competitiveness explains part of the gender difference in wage (Flory et al. 2015; McGee et al. 2015; Manning and Saidi 2010; Kleinjans 2009; Niederle and Vesterlund 2007) and even for highly educated individuals (see Reuben et al. 2017 and Reuben et al. 2015). In my empirical findings I find that competitiveness explains the gender wage gap within some majors and has an effect on wages that vary across majors.[9]

[7]Several previous papers have found that women have preferences for workplace flexibility and are willing to take a job with lower pay to accommodate such preference (Sloane et al. 2019, Cortes and Pan 2018, Cortes and Pan 2016, Wiswall and Zafar 2016, Wasserman 2015, Flabbi and Moro 2012, Goldin and Katz 2011), which leads to a gender wage gap (Goldin 2014, Gicheva 2013) especially for occupations which require highly educated workers.

[8]See e.g. the empirical evidence provided using experimental studies reviewed by Azmat and Petrongolo (2014) and Gneezy et al. (2003).

[9]Similarly to competitiveness, there are also other occupational characteristics associated with psychological traits and preferences such as ambition, leadership, self-esteem, overconfidence and attitudes towards bargaining (see Bertrand et al. 2010); but there is evidence the gender wage gap in some of these traits are converging, e.g. ambition and leadership (Fortin, 2008), and that these other psychological traits explain a very small portion of the gender gap (Manning and Swaffield, 2008). Furthermore, these traits capture dimensions that are highly overlapping with competitiveness and inflexibility, which I already include in my analysis (Goldin, 2014).

Occupations with higher levels of social contribution, such as being understanding of feelings and helping or taking care of people, may be more attractive for women who may have stronger social preferences (see Kerr 2019, Baker and Cornelson 2018, Cortes and Pan 2018, Bertrand 2011, Fortin 2008, England et al. 2002). The sorting of women in occupations characterized by social contribution has been found to be a potential explanation for the gender wage gap (see Folbre 2017, Grove et al. 2011, Fortin 2008 and England et al. 2002). As in previous papers I find evidence that women are more likely to choose occupations characterised by higher levels of social contribution; but I also find that the return to social contribution depends on the major. The return is positive for Nursing, negative for Computer Science, Graphic Design and different branches of Engineering and not statistically different or close to zero for the remaining majors. This differential return to social contribution could be explained by the fact that occupations which require social contribution are not well matched with some of the college majors.[10]

Among the three occupational traits, inflexibility explains the largest portion of the within-major gender wage gaps. This result reinforces the argument made by Goldin (2014) that changes in the labour market to reduce the large compensating wage differential for inflexibility observed in some occupations could be one the major levers to reduce the gender wage gap. This reduction in the compensation for inflexibility could decrease the gender wage gap for college graduates in multiple ways. For diverse-occupation majors, the within-major wage gaps would reduce because all occupations would have a similar small reward for inflexibility. In addition, for specific-occupation majors that feed to occupations with higher inflexibility, a smaller differential wage compensation for flexibility would reduce the entry cost into these majors for women who have preference for flexibility.

The paper is outlined as follows. Section 2 describes the two datasets used in the analysis and Section 3 the empirical strategy for the simulations. Section 4 discusses the results of the different simulations and decompositions of the gender wage gap of college graduates and Section 5 concludes.

[10]Besides social contribution, there are also other occupational traits related to skills (human capital) required by an occupation, such as physical, mathematical, language, motor, sensory and spatial skills (see Baker and Cornelson 2018). Since my focus is on the gender wage gap within majors for graduates early in their career and there is no evidence of substantial gender differences in these occupational traits within majors, I do not include these traits in my empirical analysis. Nevertheless, to take account that there could be a premium for people who work in occupations who are well matched with their major skills (e.g. Kinsler and Pavan 2015, Lemieux 2014 and Robst 2007) and that men might select into occupations that better match their major, the results are robust to including a measure of how much the skills acquired in the major match with the occupation.

2 Data

2.1 American Community Survey

The first dataset used in this paper is the American Community Survey (ACS) 2012-2017 retrieved from IPUMS USA (Ruggles et al., 2018). This dataset is ideal for analysing labour market outcomes of college graduates as it not only has information on respondents' college major, occupation and wages but it has large enough sample sizes to enable within major analysis. The ACS is a nationally representative dataset which surveys at least two million individuals each year. Furthermore, it has collected information on people's college major from 2009 onwards. If a respondent stated that they have obtained at least a bachelor's degree, they are asked to state their major. These responses are coded in detailed codes (171 categories) which are used in this analysis.

In addition to having information about individuals' college majors, the ACS also collects detailed information on an individuals occupation using 4-digit occupational codes. These codes offer information on more than 400 detailed occupations of respondents. This enables analysis of gender differences in occupations for individuals who have the same college major. The ACS collects information about the weeks and hours worked for the previous year. I then calculate the hourly wage of an individual by their annual earnings divided by the product of the number of weeks they worked and their usual hours they worked per week. To create a measure of inflexibility of an occupation, I follow Denning et al. (2019) and Sloane et al. (2019) and calculate the average log weekly hours worked in a given occupation of full-year employed individuals. Occupations with lower average weekly hours are likely to enable part-time work while than occupations with long weekly hours may not. Denning et al. (2019) found that women sorting into occupations with fewer weekly hours contributes to the gender wage gap.

2.2 O*NET Database

The second dataset used is the O*NET (Occupational Information Network) database constructed by the U.S. Department of Labor, which has replaced the Dictionary of Occupational Titles (DOT) database (National Center for O*NET Development, 2017; National Research Council, 2010). The O*NET database collects information on the skills and characteristics of occupations in the United States by randomly sampling businesses with a high likelihood of holding a given occupation. The U.S. Department of Labor then randomly samples workers holding that occupation within the business. For each occupation in the O*NET database,

they survey an average of 33 individuals working in that occupation or occupational experts who worked in that occupation previously in the case of rare occupations. This results in the O*NET measures being the average response of the approximately 33 surveyed individuals (National Research Council, 2010).

The main categories that the O*NET database collects information on individual occupations are: abilities, background, education and training, work activities, knowledge, skills, work context and work styles. The variables of interest are: competitiveness and social contribution of a given occupation which were both used in Cortes and Pan (2018) and Baker and Cornelson (2018). Each occupation is given a score from 1 to 5 measuring how important the given trait is for the job. For example, to measure the competitiveness of an occupation, I use the measure based on the question, "To what extent does this job require the worker to compete or to be aware of competitive pressures". Each occupation is given a score between 1 (not at all competitive), 2 (slightly competitive), 3 (moderately competitive), 4 (highly competitive) and 5 (extremely competitive). Below are the O*NET measures used in the analysis:

Competitiveness: "To what extent does this job require the worker to compete or to be aware of competitive pressures"

Social Contribution: This measure is composed of responses to the following three questions: (1) "Importance of being sensitive to others' needs and feelings and being understanding and helpful on the job", (2) "Importance of actively looking for ways to help people", (3) "Importance of providing personal assistance, medical attention, emotional support, or other personal care to others such as co-workers, customers, or patients".

The O*NET occupational data is linked with individual occupations from the ACS so the occupation in the ACS has a measure for competitiveness and social contribution. Both O*NET measures are standardized to have a mean of zero and standard deviation of 1 for the sample of all college graduates in the United States.

2.3 Sample Selection

To be included in the sample respondents of the ACS surveys from 2012-2017 must have been between the ages of 24 and 29 with at least a bachelor's degree. I apply this age restriction to analyse whether there are labour market differences between men and women with the same major at the beginning of their careers.[11] In addition, graduates must have worked full-

[11] I follow Altonji et al. (2012) and restrict the age to greater than 23 as the majority of students graduate when they are 22.

time (35+ hours a week) (dropped 71,481 observations) for the full year (40 weeks) (21,976 observations) in the past year. I also restrict the sample to graduates without children (33,653 observations). I do this as previous research has shown that men's and women's labour market experiences diverge once they have children as women take time out of the labour force and if they do return, may work fewer hours or different occupations (Blau and Kahn, 2017). The sample is also restricted to individuals with only a bachelor's degree (48,409 observations) as I do not have information on the subject of their graduate degree. Furthermore, I only include graduates without a double major (21,117 observations). I also restrict the sample to individuals who are not enrolled in school or college (16,113 observations) as enrolled individuals may only have the job temporarily (Joy, 2006). Following Denning et al. (2019) and Altonji et al. (2016b), I further restrict the sample to graduates who earned at least half of the annual salary of a full-time minimum wage earner (586 observations) and earned less than $400,000 annually (168 observations) to reduce the effect of outliers. I also dropped graduates holding the few occupations which are not covered by crosswalks between the ACS and O*NET databases (1,669 observations). Finally I restrict the sample to individuals who majored in one of the 30 most common majors (36,006 observations). I apply this restriction so as to have large enough sample sizes for each college major. This restriction coincides with each major have at least 1000 graduates (where at least 100 of these graduates are males or females). The 30 most common majors (out of 171 majors) covers approximately 70% of recent college graduates. This results in a final sample size of 79,017 individuals.

2.4 Descriptive Statistics

Table 3.1 shows descriptive statistics for my sample by gender. The fourth column 'Diff' displays the stars for the level of statistical significance of the difference in means between males and females. *, ** and *** indicate significance at 10, 5 and 1% level respectively.

Table 3.1 shows that graduates in my sample are 52% female and 48% male. In addition, female graduates have significantly lower hourly wages than male graduates and are in occupations with lower levels of competitiveness and inflexibility and higher levels of social contribution. To explain the interpretation of the occupational traits I will focus on inflexibility. In the sample, female (male) graduates have occupations that are 21% (24%) of a standard deviation less (more) inflexible than the average occupation for college graduates. Therefore, men in the sample are employed in occupations that are 45% of a standard deviation more inflexible than female graduates.

Table 3.1: Overall Descriptive Statistics

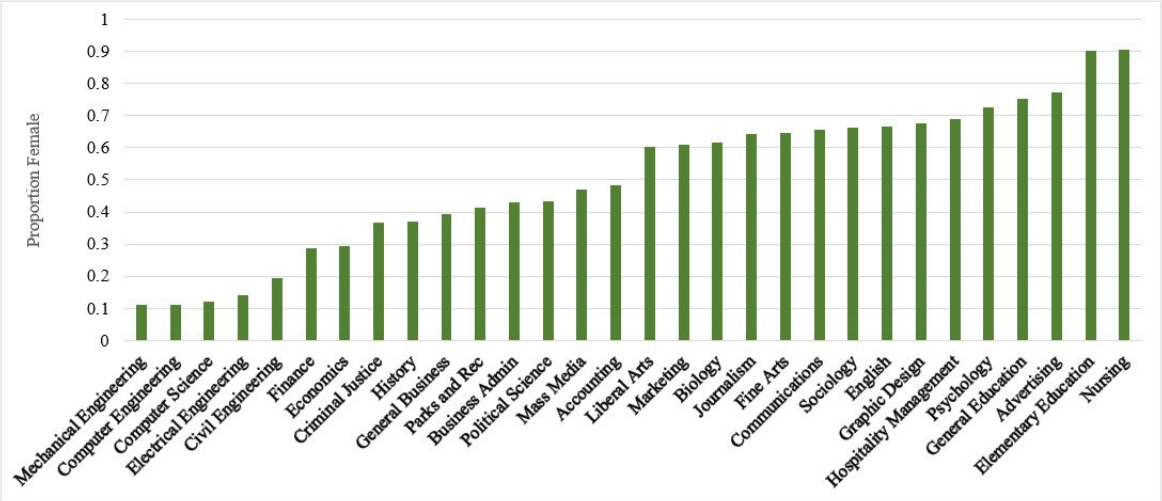
VARIABLES	1 Female	2 Male	3 Total	4 Diff
Hourly Wage (2017 US $'s)	20.86	24.10	22.40	***
	(9.66)	(12.48)	(11.20)	
Female			0.52	
			(0.50)	
Competitiveness of occ (z)	-0.13	0.27	0.06	***
	(1.00)	(0.95)	(1.00)	
Social Contribution of occ (z)	0.31	-0.30	0.02	***
	(1.04)	(0.88)	(1.02)	
Inflexibility of occ (z)	-0.21	0.24	0.00	***
	(1.01)	(0.89)	(0.98)	
Non-white	0.17	0.18	0.18	**
	(0.38)	(0.38)	(0.38)	
Potential Experience	4.39	4.59	4.48	***
	(1.67)	(1.66)	(1.67)	
New England	0.06	0.07	0.06	***
	(0.24)	(0.25)	(0.25)	
Mid-Atlantic	0.16	0.17	0.17	***
	(0.37)	(0.38)	(0.37)	
East North Central	0.15	0.15	0.15	
	(0.36)	(0.36)	(0.36)	
West North Central	0.06	0.06	0.06	**
	(0.25)	(0.24)	(0.24)	
South Atlantic	0.20	0.18	0.19	***
	(0.40)	(0.38)	(0.39)	
East South Central	0.05	0.04	0.04	***
	(0.21)	(0.20)	(0.20)	
West South Central	0.10	0.10	0.10	
	(0.31)	(0.30)	(0.30)	
Mountain	0.06	0.06	0.06	
	(0.23)	(0.23)	(0.23)	
Pacific	0.16	0.16	0.16	
	(0.37)	(0.37)	(0.37)	
2012 Survey	0.15	0.15	0.15	
	(0.35)	(0.35)	(0.35)	
2013 Survey	0.16	0.16	0.16	**
	(0.37)	(0.36)	(0.37)	
2014 Survey	0.16	0.16	0.16	
	(0.36)	(0.37)	(0.37)	
2015 Survey	0.17	0.17	0.17	
	(0.38)	(0.38)	(0.38)	
2016 Survey	0.18	0.18	0.18	
	(0.38)	(0.38)	(0.38)	
2017 Survey	0.18	0.19	0.19	
	(0.39)	(0.39)	(0.39)	
Observations	41,473	37,544	79,017	

Notes: Mean and standard deviations in parentheses. Occupational traits are standardized to (0,1) for the entire college graduate sample. Diff column indicates whether t-test difference in means was significant. Potential Experience is age minus 22. The sample is restricted to individuals aged 24-29 who are employed full-time, full year who have no children, only one college major, no degree above a bachelor's degree, not currently enrolled in school and have a bachelor's degree from a Top 30 major. Wages are restricted to individuals who made between $7,000 and $400,000 annually as done in previous research.

The gender differences in wages and occupational traits from Table 3.1 may originate from men and women having different college majors which lead to different types of occupations.[12]

[12]In the tables and figures for this paper, I order the college majors from the ones with lowest proportion of female graduates to the ones with the highest proportion of female graduates as shown in Figure 3.1.

Figure 3.1: Proportion Female by College Major



Notes: Data from ACS. Refer to Table 3.1 for sample restrictions.

Therefore, it is important to analyse gender differences within major which are shown in Table 3.2 and Figures 3.2, 3.3 and 3.4. Table 3.2 shows the average hourly wage for men and women of a given college major and whether these wages are significantly different. There are significant gender wage gaps for young, recent college graduates in 16 of the 30 majors. In 14 majors, male graduates have significantly higher wages than female graduates. In contrast, female mechanical and civil engineering graduates have significantly higher wages than male graduates. This may be due to self-selection with the highest achieving women sorting into engineering majors. It is striking that the highest paying majors (Engineering and Computer Science) are also the most male dominated majors.

Figures 3.2, 3.3 and 3.4 show the mean occupational trait by gender for graduates of a given college major.[13] A pattern emerges by sorting the majors from lowest to the highest proportion of female graduates. Figures 3.2, 3.3 and 3.4 show that more male dominated majors lead to occupations that are more competitive, inflexible and have less social contribution while the opposite is true for female dominated majors. This provides evidence that different majors lead to different types of occupations which are correlated with masculine and feminine occupational traits. These figures also show that the occupational segregation by gendered occupational traits found in Table 3.1 is also found within college major. It is striking that in nearly every major, men sort into more competitive and inflexible occupations while women sort into occupations with higher levels of social contribution. Table 3.16 in the appendix shows that male graduates hold occupations which are significantly more

[13]Table 3.16 shows the same descriptive statistics along with difference in means tests.

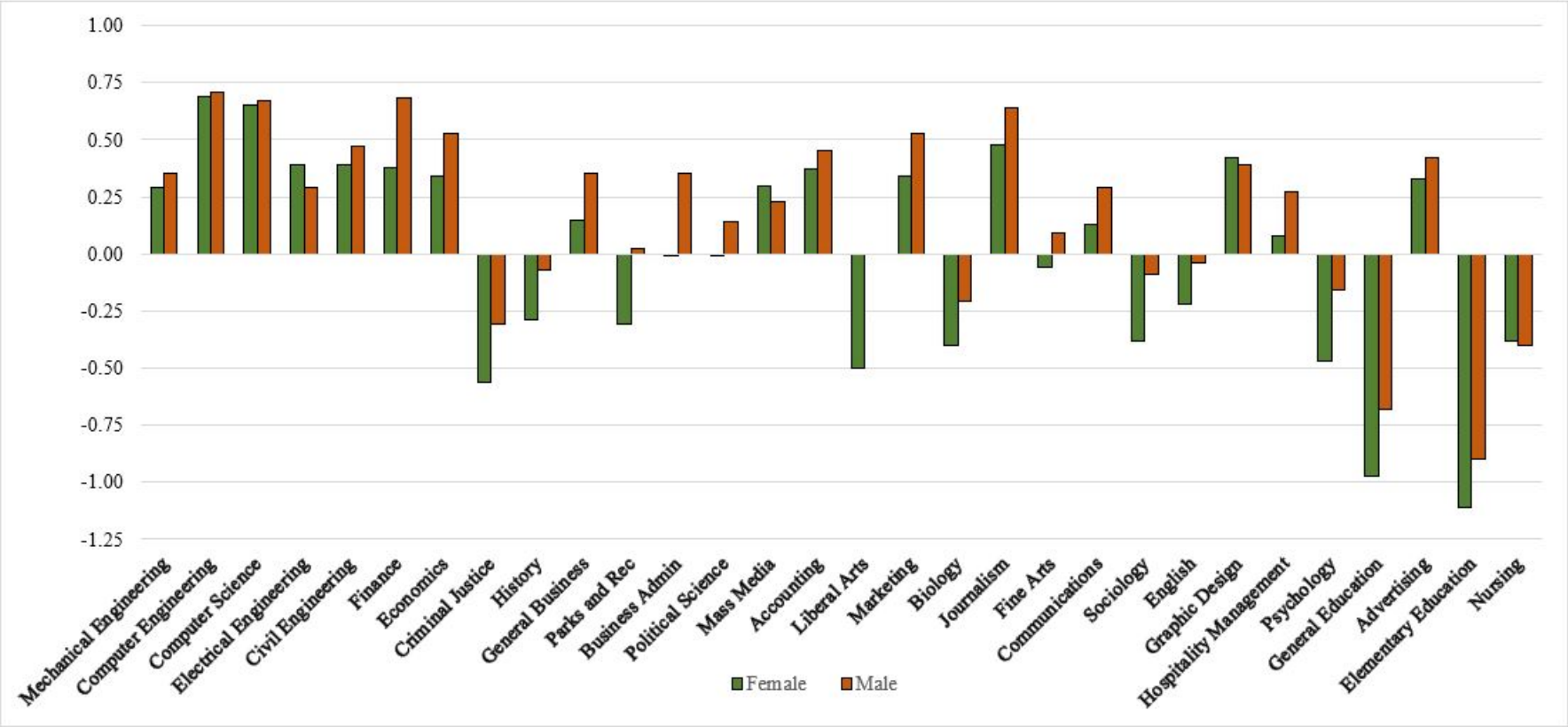
competitive (inflexible) within 24 (22) majors while; female graduates hold occupations with significantly higher levels of social contribution within 24 majors.

Table 3.2: Descriptive Statistics of Wages by College Major

Major	Female Mean Wage	Male Mean Wage	Difference	Gender Gap	N
Mechanical Engineering	31.96	30.47	-1.49**	-4.89%	2684
Computer Engineering	34.85	35.78	0.93	2.60%	1023
Computer Science	33.25	34.24	0.99	2.89%	2706
Electrical Engineering	33.04	32.59	-0.45	-1.38%	1378
Civil Engineering	27.98	26.76	-1.18**	-4.41%	1359
Finance	26.35	27.55	1.20**	4.36%	3292
Economics	26.97	27.27	0.30	1.10%	2301
Criminal Justice	17.71	20.21	2.50***	12.37%	3258
History	18.37	19.02	0.65	3.42%	1929
General Business	21.88	23.50	1.62***	6.89%	3764
Parks and Rec	16.51	18.05	1.54***	7.69%	2098
Business Admin	20.96	22.77	1.80***	7.95%	7209
Political Science	21.01	21.93	0.92**	7.50%	2254
Mass Media	18.80	18.69	-0.11	-0.59%	1075
Accounting	23.71	23.84	0.13	0.55%	3285
Liberal Arts	16.92	19.33	2.41***	12.47%	1119
Marketing	21.67	23.29	1.63***	7.00%	4581
Biology	17.93	18.90	0.97***	5.13%	2595
Journalism	19.71	19.14	-0.57	-2.98%	1469
Fine Arts	16.63	17.70	1.07	6.05%	1236
Communications	20.45	21.00	0.55	2.62%	4391
Sociology	18.11	19.49	1.38**	7.08%	1707
English	18.08	18.18	0.10	0.55%	2766
Graphic Design	19.43	20.41	0.98**	4.80%	2628
Hospitality Management	17.78	18.28	0.50	2.74%	1224
Psychology	17.43	18.99	1.56***	8.21%	4658
General Education	16.94	18.09	1.15*	6.36%	1733
Advertising	21.32	22.58	1.26	5.58%	1172
Elementary Education	15.84	16.35	0.51	3.12%	2853
Nursing	28.13	29.41	1.28***	4.35%	5270

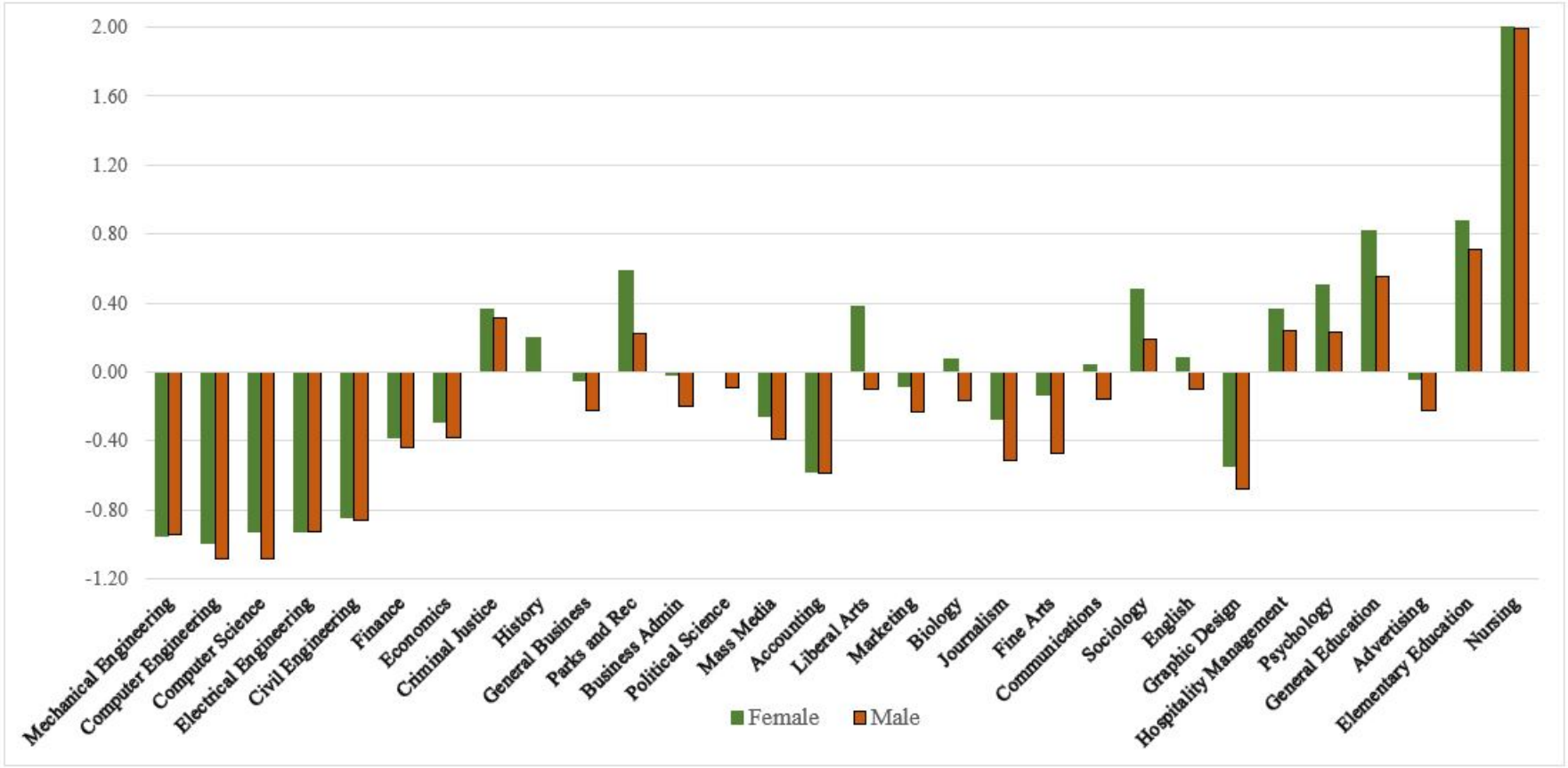
Notes: *** p<0.01, ** p<0.05, * p<0.10. Data from ACS. Hourly wage calculated in 2017 US dollars. Majors are ordered from the lowest proportion female graduates to the highest proportion female graduates. Difference indicates whether t-test difference in means was significant. Gender Gap is calculated as the Difference divided by the Male Mean Wage. Refer to Table 3.1 for sample restrictions.

Figure 3.2: Mean Competitiveness by College Major



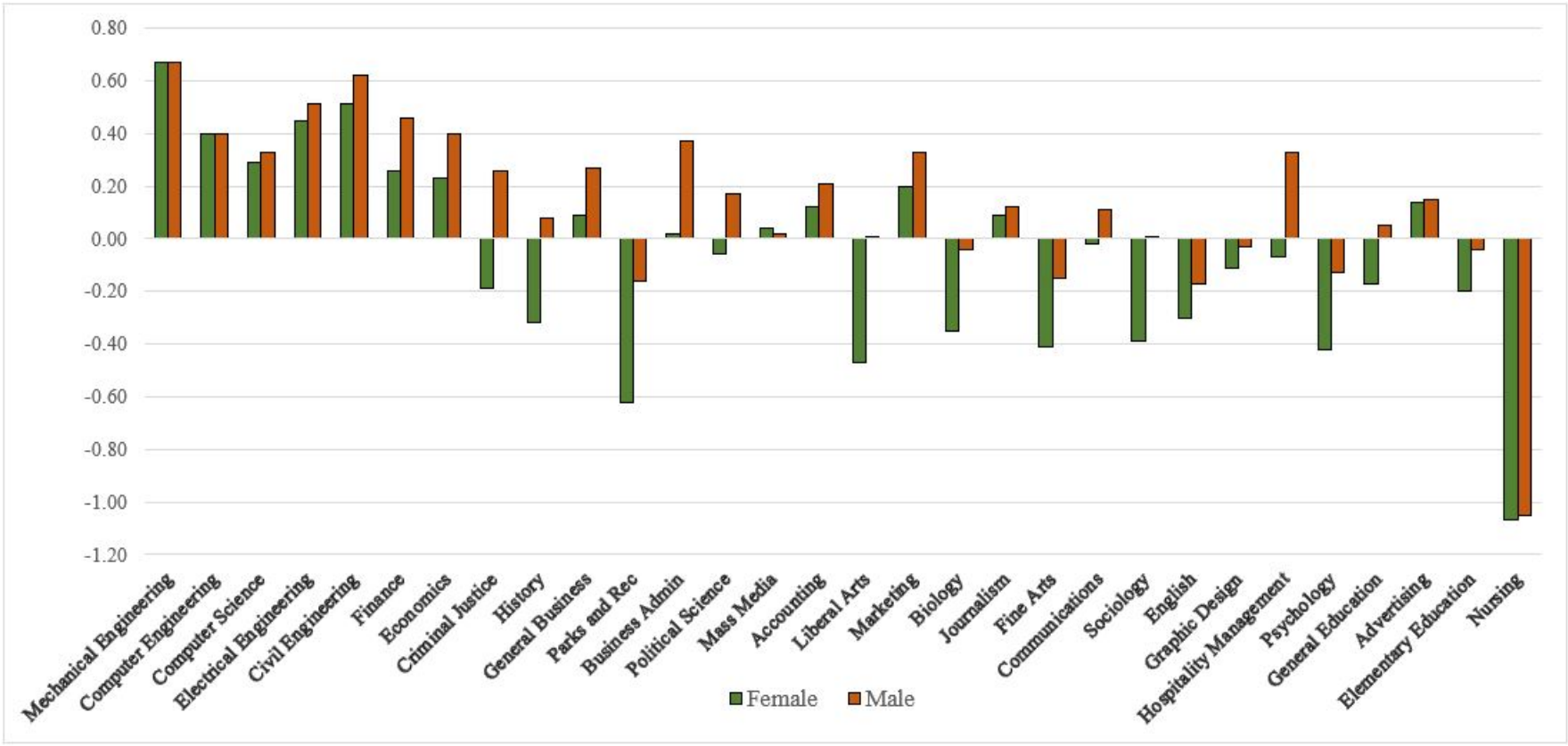
Notes: Data from ACS and O*NET. Competitiveness is standardized to (0,1) for the sample of all college graduates. Sample sizes are the same as in Table 3.2.

Figure 3.3: Mean Social Contribution by College Major



Notes: Data from ACS and O*NET. Social contribution is standardized to (0,1) for the sample of all college graduates. Sample sizes are the same as in Table 3.2

Figure 3.4: Mean Inflexibility by College Major



Notes: Data from ACS and O*NET. Inflexibility is standardized to (0,1) for the sample of all college graduates. Sample sizes are the same as in Table 3.2

3 Methodology

3.1 Observed Gender Wage Gap

To assess the effect on wages of occupational segregation within college major, I conduct several simulations to show the change in the average gender wage gap when equalizing occupational traits within college major. To do this, I first analyse the wages of men and women separately for each college major:

$$Wage_c^s = \beta_{c,0}^s + \mathbf{Occ}_c^s \boldsymbol{\beta}_{c,occ}^s + \mathbf{X}_c^s \boldsymbol{\beta}_{c,x}^s + \epsilon_c^s \tag{3.1}$$

where $Wage_c^s$ is the hourly wage of individual for males (s=m) and females (s=f); the subscript c denotes the college major and goes from 1 to 30 (see Table 3.2 for the list of college majors); $\beta_{c,0}^s$ is the intercept; $\mathbf{Occ}_c^s$ is a vector of occupational traits (competitiveness, social contribution and inflexibility); $\mathbf{X}_c$ is a vector of demographic variables (race, potential experience, region of residence and survey year); $\boldsymbol{\beta}_{c,occ}^s$ and $\boldsymbol{\beta}_{c,x}^s$ are vectors of coefficients and ϵ_c^s is the homoscedastic, zero mean error term.

I then analyse the wages of men and women separately at their mean outcomes (denoted by overbars) for each college major:

$$\overline{Wage}_c^m = \hat{\beta}_{c,0}^m + \overline{\mathbf{Occ}}_c^m \hat{\boldsymbol{\beta}}_{c,occ}^m + \overline{\mathbf{X}}_c^m \hat{\boldsymbol{\beta}}_{c,x}^m \tag{3.2}$$

$$\overline{Wage}_c^f = \hat{\beta}_{c,0}^f + \overline{\mathbf{Occ}}_c^f \hat{\boldsymbol{\beta}}_{c,occ}^f + \overline{\mathbf{X}}_c^f \hat{\boldsymbol{\beta}}_{c,x}^f \tag{3.3}$$

where $\hat{\beta}_{c,0}^s$ is the estimated intercept and $\hat{\boldsymbol{\beta}}_{c,occ}^s$ and $\hat{\boldsymbol{\beta}}_{c,x}^s$ are vectors of estimated coefficients. The average wage for a graduate of gender s in college major c is identical to the average predicted wage for a graduate of sex s in college major c. The average gender wage gap for college graduates is calculated with the following equation:[14]

$$\overline{Wage}^m - \overline{Wage}^f = \sum_{c=1}^{30} \left(\frac{n_c^m}{N^m} \overline{Wage}_c^m \right) - \sum_{c=1}^{30} \left(\frac{n_c^f}{N^f} \overline{Wage}_c^f \right) \tag{3.4}$$

where n_c^s is the number of graduates of sex s with college major c and N^s is the total number of graduates of sex s.

[14] The simulations are done using level wages for ease of interpretation but results are robust to log transformation of wages.

3.2 Simulations

3.2.1 Equalizing Gender Representation Within Major

I first simulate the case where men and women are equally represented in every major. This simulation is used to show whether eliminating gender differences in college major closes the gap entirely or whether there is still a portion of the gap remaining. The simulated gender wage gap is calculated with the following equation:

$$\breve{Wage}^{m} - \breve{Wage}^{f} = \sum_{c=1}^{30} \left(\frac{(n_c^m + n_c^f)(P^m)}{N^m} \overline{Wage}_c^m \right) - \sum_{c=1}^{30} \left(\frac{(n_c^m + n_c^f)(P^f)}{N^f} \overline{Wage}_c^f \right) \quad (3.5)$$

where P^m and P^f are equal to the proportion of all college graduates who are male or female:

$$P^m = \frac{\sum_{c=1}^{30} n_c^m}{N^m + N^f} = \frac{N^m}{N^m + N^f} \quad (3.6)$$

$$P^f = \frac{\sum_{c=1}^{30} n_c^f}{N^m + N^f} = \frac{N^f}{N^m + N^f} \quad (3.7)$$

This simulation imposes that for each college major c, women make up P^f of the graduates and men make up P^m graduates. In my sample P^f=0.52 and P^m=0.48.[15] This simulation enables me to keep the same distribution of college majors as the total graduates from a given major c remains the same and the total number of female (N^f) and male (N^m) graduates remains the same while the proportion of men and women in a given major c is allowed to change.

3.2.2 Equalizing Occupational Traits Within Major

For the second simulation, I replace

$$\overline{Wage}_c^f$$

with

$$\widetilde{Wage}_c^f$$

where $\widetilde{Wage}_c^f$ is the predicted average hourly wage for female graduates for a given major when they have the same average occupational traits as men in that major. I want to do this to see what the gender wage gap for all college graduates would be if women had the same average occupational traits within a major as men. To calculate $\widetilde{Wage}_c^f$ I use the following

[15] I do this instead of an equal 50/50 split of graduates for each college major to keep the total number of male and female graduates the same.

equation:

$$\widetilde{Wage_c}^f = \beta_{0_c}^f + \overline{\mathbf{Occ}_c}^m \boldsymbol{\beta}_{c,occ}^f + \overline{\mathbf{X}}_c^f \boldsymbol{\beta}_{c,x}^f \tag{3.8}$$

where I replaced $\overline{\mathbf{Occ}_c}^f$ from Equation 3.3 with $\overline{\mathbf{Occ}_c}^m$ from Equation 3.2. By replacing $\overline{Wage_c}^f$ from Equation 3.4 with $\widetilde{Wage_c}^f$ I simulate the gender wage gap that would occur if women had the same average occupational traits within a major as men but are compensated as women. The gender wage gap is then calculated as:

$$\overline{Wage}^m - \widetilde{Wage}^f = \sum_{c=1}^{30} \left(\frac{n_c^m}{N^m} \overline{Wage_c}^m \right) - \sum_{c=1}^{30} \left(\frac{n_c^f}{N^f} \widetilde{Wage_c}^f \right) \tag{3.9}$$

3.2.3 Equalizing Occupational Traits and Gender Representation Within Major

Finally I combine the two above simulations to simulate a scenario where men and women are equally represented in each college major and have the same average occupational traits within each major. Analytically this is done by using the following equation:

$$\breve{Wage}^m - \grave{Wage}^f = \sum_{c=1}^{30} \left(\frac{(n_c^m + n_c^f)(P^m)}{N^m} \overline{Wage_c}^m \right) - \sum_{c=1}^{30} \left(\frac{(n_c^m + n_c^f)(P^f)}{N^f} \widetilde{Wage_c}^f \right) \tag{3.10}$$

3.2.4 Equal Representation in STEM Majors

In addition, as there are currently policies in the United States to increase the proportion of women in STEM majors in hopes to decrease the gender wage gap, I also conduct simulations to show the change in the gender wage gap if women are equally represented in STEM majors as men.[16] The simulated gender wage gap is calculated with the following equation:

$$\begin{aligned} Wage_{stem}^m - Wage_{stem}^f = \\ \left[\sum_{c=1}^{7} \left(\frac{(n_c^m + n_c^f)(P^m)}{N^m} \overline{Wage_c}^m \right) + \sum_{c=8}^{30} \left(\frac{(n_{c,non}^{m,new})}{N^m} \overline{Wage_c}^m \right) \right] - \\ \left[\sum_{c=1}^{7} \left(\frac{(n_c^m + n_c^f)(P^f)}{N^f} \overline{Wage_c}^f \right) + \sum_{c=8}^{30} \left(\frac{(n_{c,non}^{f,new})}{N^f} \overline{Wage_c}^f \right) \right] \end{aligned} \tag{3.11}$$

where majors are ordered so that STEM majors are associated with c=1...7 and non-STEM majors with c=8...30 and $n_{c,non}^{m,new}$ and $n_{c,non}^{f,new}$ are defined below. This simulates the gender

[16] To classify college majors in the data as STEM majors, the "STEM Designated Degree Program List" is utilized from the US Department of Homeland Security (DHS). The DHS classifies STEM majors as international students who gain a degree in a STEM field have the ability to extend their student visas after graduation. I link these STEM majors from the DHS approved list to the majors in the ACS. In this sample there are seven STEM majors: Computer Science, Computer Engineering, Mechanical Engineering, Civil Engineering, Electrical Engineering, Biology and Psychology.

wage gap if there is equal representation of men and women in each STEM major. Each STEM major will be made up of 52% women and 48% men (which are the percentage of women and men in the sample) with the total number of male and female STEM majors being defined by the following two expressions:

$$\sum_{c=1}^{7}(n_c^m + n_c^f)(P^m) = N_{STEM}^{m,new}, \tag{3.12}$$

$$\sum_{c=1}^{7}(n_c^m + n_c^f)(P^f) = N_{STEM}^{f,new}. \tag{3.13}$$

The original male and female STEM graduate totals were

$$\sum_{c=1}^{7} n_c^m = N_{STEM}^m, \tag{3.14}$$

$$\sum_{c=1}^{7} n_c^f = N_{STEM}^f. \tag{3.15}$$

In the sample, when imposing the equal representation of genders within each STEM major, the total number of male and female STEM graduates will be different from the observed male and female STEM graduates. The difference in the total number of male and female STEM graduates are

$$Excess_{STEM}^m = N_{STEM}^m - N_{STEM}^{m,new}, \tag{3.16}$$

$$Excess_{STEM}^f = N_{STEM}^f - N_{STEM}^{f,new}. \tag{3.17}$$

As males made up more than 48% of STEM graduates in the sample, $Excess_{STEM}^m$ will be positive for men and $Excess_{STEM}^f$ will be negative for women. This means that $Excess_{STEM}^m$ of men will need to be placed in non-STEM majors and $|Excess_{STEM}^f|$ of women will need to be taken away from non-STEM majors to be placed into STEM majors. To do this, I calculate the proportion of male (and female) graduates from each non-STEM major out of the total of non-STEM male (female) majors and place the excess males and females into each non-STEM major, c, at this proportion:

$$Excess_{c,non}^m = (Excess_{STEM}^m)\left(\frac{n_{c,non}^m}{N_{non}^m}\right), \tag{3.18}$$

$$Excess_{c,non}^f = \left(Excess_{STEM}^f\right)\left(\frac{n_{c,non}^f}{N_{non}^f}\right). \tag{3.19}$$

for each non-STEM major c where:

$$\sum_{c=8}^{30} n_{c,non}^{m} = N_{non}^{m}, \tag{3.20}$$

$$\sum_{c=8}^{30} n_{c,non}^{f} = N_{non}^{f}. \tag{3.21}$$

I then add the additional number of graduates to each non-STEM major:

$$n_{c,non}^{m,new} = n_{c,non}^{m} + Excess_{c,non}^{m}, \tag{3.22}$$

$$n_{c,non}^{f,new} = n_{c,non}^{f} + Excess_{c,non}^{f}. \tag{3.23}$$

for each non-STEM major c. As $Excess_{c,non}^{f}$ is negative, this means that I takeaway female graduates from each non-STEM major while I am adding male graduates to each non-STEM major. Finally, the new total number of male and female non-STEM graduates are:

$$\sum_{c=8}^{30} n_{c,non}^{m,new} = N_{non}^{m,new}, \tag{3.24}$$

$$\sum_{c=8}^{30} n_{c,non}^{f,new} = N_{non}^{f,new}. \tag{3.25}$$

With this simulation, I am able to keep the total number of STEM and non-STEM graduates the same as:

$$N_{non}^{m,new} + N_{non}^{f,new} = N_{non}, \tag{3.26}$$

and

$$N_{STEM}^{m,new} + N_{STEM}^{f,new} = N_{STEM}. \tag{3.27}$$

while also keeping the total number of female and male graduates the same:

$$N_{STEM}^{m,new} + N_{non}^{m,new} = N^{m}, \tag{3.28}$$

and

$$N_{STEM}^{f,new} + N_{non}^{f,new} = N^{f}. \tag{3.29}$$

3.2.5 Equal Representation in STEM Majors and Equalizing Occupational Traits

This last simulation calculates the gender wage gap if there is equal representation of gender within each STEM major and female STEM graduates have the same average occupational traits as male STEM graduates:

$$Wage^m_{stem} - \widetilde{Wage}^f_{stem} = \left[\sum_{c=1}^{7}\left(\frac{(n^m_c + n^f_c)(P^m)}{N^m}\overline{Wage}^m_c\right) + \sum_{c=8}^{30}\left(\frac{(n^{m,new}_{c,non})}{N^m}\overline{Wage}^m_c\right)\right] - \left[\sum_{c=1}^{7}\left(\frac{(n^m_c + n^f_c)(P^f)}{N^f}\widetilde{Wage}^f_c\right) + \sum_{c=8}^{30}\left(\frac{(n^{f,new}_{c,non})}{N^f}\overline{Wage}^f_c\right)\right] \quad (3.30)$$

This will show whether it is important in a policy which increases the representation of women in STEM majors to also try to decrease occupational segregation within STEM majors.

4 Results

4.1 OLS Estimations

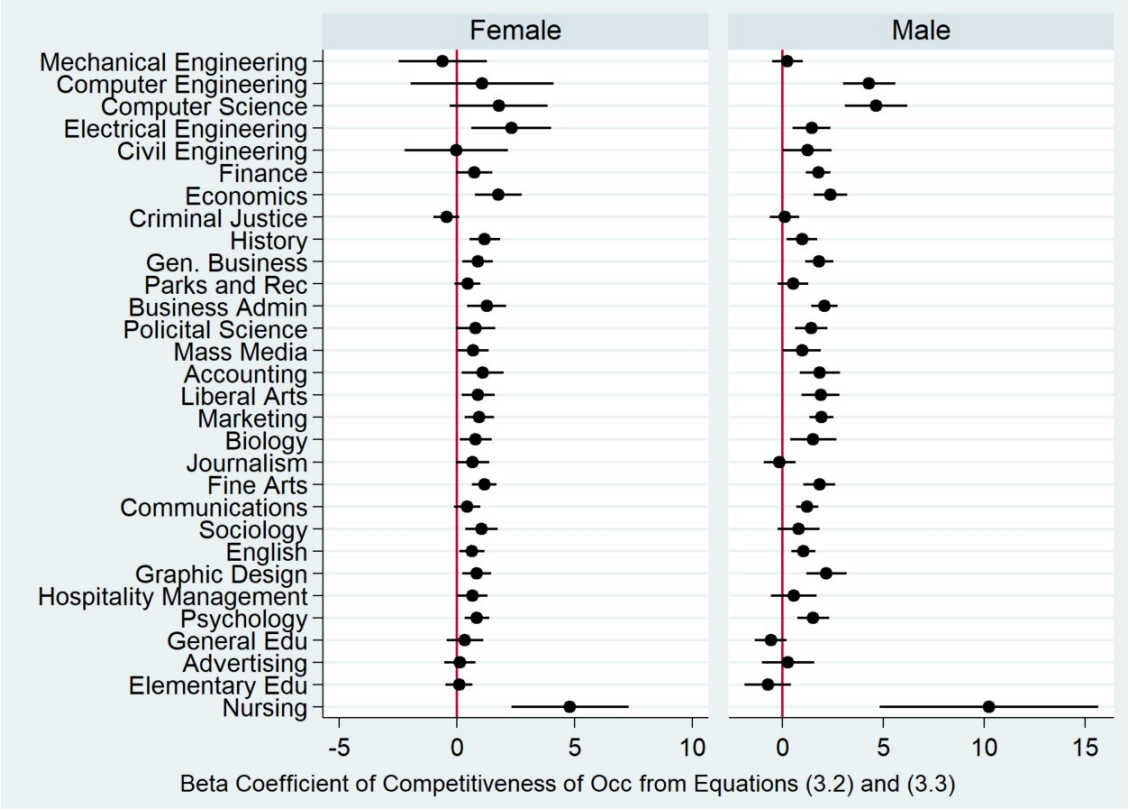
In this section I discuss the ordinary least squares estimation results for the wage equation (3.1) estimated separately by major and gender. Figures 3.5, 3.6 and 3.7 show the estimated effects of the three occupational traits on female and male wages for the 30 main majors and the corresponding 90% confidence intervals.[17] The estimated effect of competitiveness of an occupation captures the increase in hourly wage for one standard deviation increase in the competitiveness and holding all other covariates constant,[18] e.g., for Economics graduates, one standard deviation increase in competitiveness leads to approximately a $2.4 increase in hourly wage for male graduates (see Figure 3.5).

Figure 3.5 shows that being in an occupation with higher levels of competitiveness is associated with higher wages in almost all majors and the return to competitiveness differs somewhat across majors. Strangely Nursing is be the major with highest estimated reward for competitiveness, but this seems to be driven by higher wages received by nursing graduates who end up work as hospital managers positions. Figure 3.6 shows that the return to social contribution also change across major and it is positive for Nursing, negative for Computer Science, Graphic Design and different branches of Engineering and not statistically different

[17] Confidence intervals are computed using standard errors clustered at the occupational level.

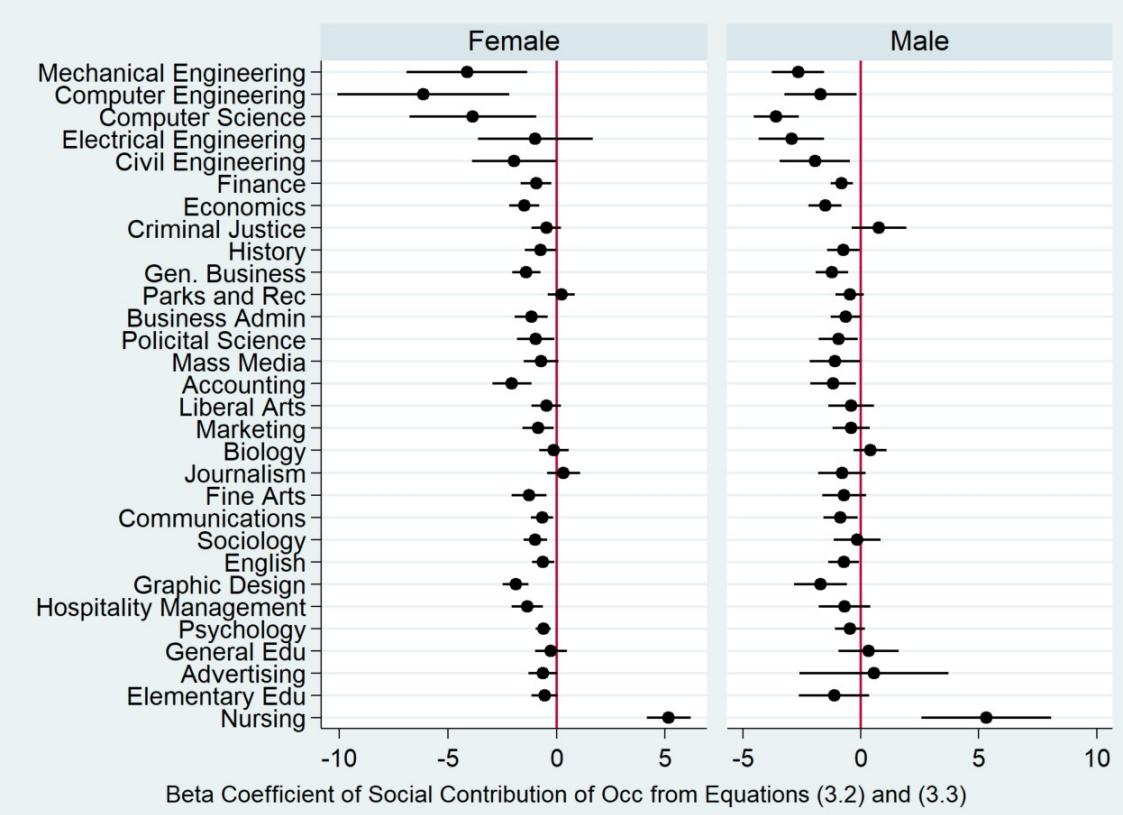
[18] The remaining control variables are potential work experience, and dummies for race, region and year.

Figure 3.5: Association of Competitiveness of Occupation on Hourly Wage



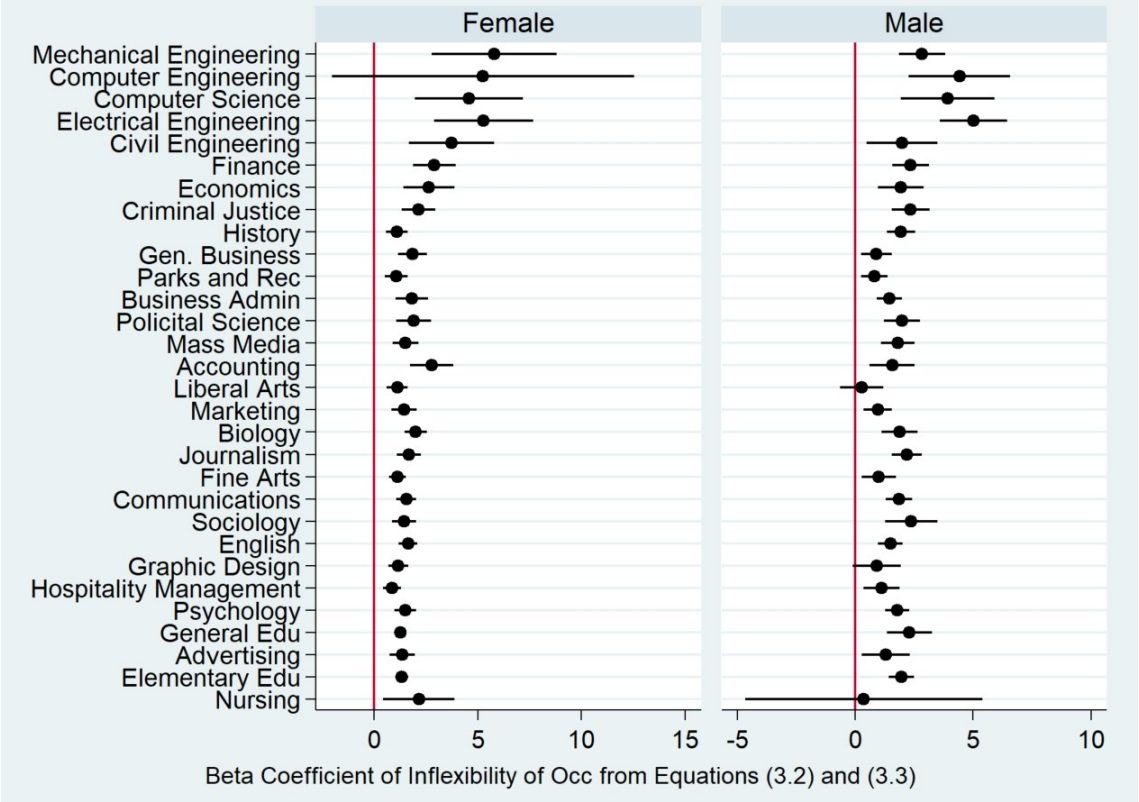
Notes: Data from ACS and O*NET. This figure shows the beta coefficients from Equations (3.2) and (3.2) for the association of the competitiveness of an occupation on the hourly wage of the individual holding all other covariates constant (potential experience, and race, regional and survey year dummies). The coefficients are plotted to show if they are significantly different from 0 at the 10% significance level. Sample sizes are the same as in Table 3.2.

Figure 3.6: Association of Social Contribution of Occupation on Hourly Wage



Notes: Data from ACS and O*NET. This figure shows the beta coefficients from Equations (3.2) and (3.2) for the association of the social contribution of an occupation on the hourly wage of the individual holding all other covariates constant (potential experience, and race, regional and survey year dummies). The coefficients are plotted to show if they are significantly different from 0 at the 10% significance level. Sample sizes are the same as in Table 3.2.

Figure 3.7: Association of Inflexibility of Occupation on Hourly Wage



Notes: Data from ACS and O*NET. This figure shows the beta coefficients from Equations (3.2) and (3.2) for the association of the inflexibility of an occupation on the hourly wage of the individual holding all other covariates constant (potential experience, and race, regional and survey year dummies). The coefficients are plotted to show if they are significantly different from 0 at the 10% significance level. Sample sizes are the same as in Table 3.2.

or close to zero for the remaining majors. This seems to suggest that occupations which require social skills are not well matched with some of the college majors. Finally, Figure 3.7 shows that there is a differential wage compensation for inflexibility, except for Nursing, Graphic Design and Liberal Arts. This difference in the reward for inflexibility across major is probably related to time demands and lack of substitutability between workers in some occupations with respect to others (see Goldin 2014).

The majors in Figures 3.5, 3.6 and 3.7 as in all other figures and tables, are ordered from the most male dominated to most female dominated major and reveal some patterns. For both female and male graduates, the returns to inflexibility and competitiveness seem to be more positively associated with wages in more male dominated majors.[19] On the contrary, the returns to social contribution are more negatively associated with wages in more male dominated majors. These results combined with Figures 3.2, 3.3 and 3.4 show that male dominated majors lead to occupations associated with higher levels of and larger rewards for inflexibility and competitiveness and with lower levels of and lower rewards for social contribution.

4.2 Simulations

4.2.1 Overall Simulations

To create effective policies to decrease the gender wage gap, it is important to understand whether the gender wage gap of recent college graduates comes from gender differences in majors and/or occupational choices within major. Table 3.3 shows the observed gender wage gap and the simulated gender wag gap under three different hypothetical scenarios: (i) equal probability to choose each of the specific majors by gender (Equal Major Choices Across Gender), (ii) no gender differences within majors in the average of three occupational traits, competitiveness, social contribution and inflexibility (Equalize Traits), (iii) no gender difference in majors choices and occupational traits within majors (Equalize Traits and Majors). The first column, Actual, shows the observed average male and female wage and the resulting average wage gap (as shown in Equation 3.4). The wage gap expressed in percentage, Wage Gap (%), is calculated by taking the male wage minus the female wage, divided the male wage. The observed wage gap is of 13.44%. Given that I focus on a sample of young graduates, who work full-time and have no children, this gap of 13.44% is huge and likely to magnify considerably with age.

[19] As I said already, the high return of competitiveness for Nursing is an outlier caused by graduates majoring in Nursing who are hospital managers.

Table 3.3: Simulations of Hourly Gender Wage Gap ($'s)

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	24.10	22.95	24.10	22.95
Female Wage	20.86	21.98	21.39	22.58
Wage Gap	3.24	0.97	2.71	0.37
Wage Gap (%)	13.44%	4.23%	11.24%	1.61%
Reduction in Gap		**70.06%**	**16.36%**	**88.58%**
Male Sample	37544	37544	37544	37544
Female Sample	41473	41473	41473	41473

Notes: Data from ACS and O*NET. Actual is the unsimulated gender wage gap. Equal Major Choices Across Gender shows the gender wage gap when every major has a gender composition of 52% female and 48% male. Equalized Traits shows the gender wage gap if females have the same average occupational traits within college major as men. Equalize Traits and Major shows the gender wage gap when females have the same average occupational traits within college major as men and every major has a gender composition of 52% female and 48% male. Refer to Table 3.1 for sample restrictions.

The second column, Equal Major Choices Across Gender (as shown in Equation 3.5). As male (female) graduates in the main sample are over-represented in majors associated with higher (lower) wages, the equalization of major choices across gender lead to a decrease of the average male wage from $24.10 to $22.95 and to an increase of the average female wage from $20.86 to $21.98. The gender wage decreases from $3.24 to $0.97 which results in a 70.06% reduction in the gender wage gap.[20] This shows that eliminating gender differences in college major has a large impact on the gender wage gap; however, it also shows that approximately 30% of the gender wage gap still remains even when men and women choose the same majors.

Are gender differences within major explained by segregation of women in occupations with less competitiveness, more social contribution and more flexibility? To answer this question, in the third column, Equalize Traits, I report the simulated gender wage gap if female graduates had the same average of the three occupational traits as male graduates for each of the majors (which is computed as shown in Equations 3.8 and 3.9). The average male wage stays the same as the actual male wage, while the female wage increases from $20.86 to $21.39 as a result of the female graduates now having the same average occupational traits within major as men. The gender wage gap decreases from $3.24 to $2.71 which results in a 16.36% reduction in the gender wage gap. This indicates that there are gender differences in returns to college major due to occupational segregation of gendered occupational traits.

The fourth column, Equalize Traits and Major, combines the previous two hypothetical scenarios and simulates the gender wage gap if female graduates had the same average occupational traits within major as male graduates and men and women distribution across majors was the same (as shown in Equation 3.10). This simulation results in a decrease of the gap

[20]This reduction is calculated by taking the difference between the simulated gender wage gap and the actual gender wage gap divided by the actual gender wage gap.

from $3.24 to $0.37 which is a 88.58% reduction. This indicates that once one accounts for gender differences in occupational traits within major and gender differences in college major, there is only a small gender wage gap remaining (1.61%.) for young, recent college graduates. Therefore, it is important for policy makers to be aware that occupational segregation within major occurs when deciding how to decrease the gender wage gap of college graduates.

Table 3.4 shows the same simulation results as in Table 3.3 when, instead of using female specific returns to occupational traits (as shown in Equation 3.8), I use the male returns to occupational traits. Table 3.4 shows very similar results to Table 3.3 indicating that there are not large gender differences in returns to occupational traits (as was already seen in Figures 3.5, 3.6 and 3.7).

Table 3.4: Simulations of Hourly Gender Wage Gap ($'s) with Male Coefficients

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	24.10	22.95	24.10	22.95
Female Wage	20.86	21.98	21.41	22.63
Wage Gap	3.24	0.97	2.69	0.32
Wage Gap (%)	13.44%	4.23%	11.16%	1.39%
Reduction in Gap		**70.06%**	**16.98%**	**90.12%**
Male Sample	37544	37544	37544	37544
Female Sample	41473	41473	41473	41473

Notes: Data from ACS and O*NET. Uses male instead of female returns to occupational traits as shown in Equation 3.4. Refer to Table 3.3 for additional notes.

4.2.2 STEM Simulations

Currently, policymakers in the United States have focused on increasing the proportion of female STEM graduates (science, technology, engineering and mathematics) to decrease the gender wage gap of college graduates. To assess the effectiveness of such policy, I simulate how much of the gender wage gap could reduce if men and women had the same distribution across STEM majors. Out of the 30 majors there are 7 STEM majors: Mechanical Engineering, Computer Science, Computer Engineering, Electrical Engineering, Civil Engineering, Biology and Psychology. Except for Biology and Psychology the remaining 5 STEM majors are the 5 most male dominated majors (see Figure 3.1), and are among the majors associated with the highest average wages (see Table 3.2), with the highest return to inflexibility and the lowest reward for social contribution (see Figures 3.6 and 3.7). Interestingly these 5 STEM majors are also the majors with the smallest gender difference in wage, competitiveness, social contribution and flexibility within major (see Table 3.2 and Figures 3.2-3.4). It is therefore

especially interesting to show how equalizing the distribution of women and men in these STEM majors would potentially reduce the gender wage gap.

Table 3.5 shows the results of this simulation in the second column, Equal Major Choices Across Gender in STEM, (computed as shown in Equation 3.11). Comparing the actual average wages in the first column with the simulated ones in the second columns, I find the average male wage decreases from $24.10 to $23.05, while the average female wage increases from $20.86 to $21.95, leading to a decrease of the gender wage gap to $1.10 corresponding to a 66.05% reduction. This is a striking result as the reduction in the gender wage gap when equalizing the distribution of men and women across all 30 majors was 70.06% only 4.01 percentage point higher. This suggests that a policy to increase the number of females graduates in few majors which are dominated by men and well paid, such as the 7 STEM majors, can have a large impact on the gender wage gap.

Table 3.5: Simulations of Hourly Gender Wage Gap ($'s) STEM Majors

	Actual	Equal Major Choices Across Gender in STEM	Equalize Traits in STEM	Equalize Traits and Major in STEM
Male Wage	24.10	23.05	24.10	23.05
Female Wage	20.86	21.95	20.97	22.07
Wage Gap	3.24	1.10	3.13	0.98
Wage Gap (%)	13.44%	4.77%	12.99%	4.25%
Reduction in Gap		**66.05%**	**3.40%**	**69.75%**
Male Sample	37544	37544	37544	37544
Female Sample	41473	41473	41473	41473

Notes: Data from ACS and O*NET. Actual is the unsimulated gender wage gap. Equal Major Choices Across Gender in STEM shows the gender wage gap when every STEM major has a gender composition of 52% female and 48% male. Equalized Traits in STEM shows the gender wage gap if females have the same average occupational traits within STEM major as men. Equalize Traits and Major in STEM shows the gender wage gap when females have the same average occupational traits within STEM major as men and every STEM major has a gender composition of 52% female and 48% male.

The third column, Equalize Traits in STEM, shows the simulated gender wage gap if women had the same average occupational traits (competitiveness, social contribution and flexibility) within STEM majors as men. This results in a reduction of the gender wage gap by 3.40%, which is about 13 percentage points smaller than the reduction of 16.36% produced by equalizing the traits within all majors (compare third column in Tables 3.3 and 3.5), confirming that occupational segregation by gendered occupational traits within STEM majors is not large as confirmed in Figures 3.2-3.4.

The fourth column, Equalize Traits and Major in STEM, shows the simulated gender wage gap if female graduates had the same average occupational traits as male STEM graduates for each of the STEM majors and if women and men had the same distribution across STEM majors (as shown in Equation 3.30). This results in a 69.75% reduction in the gender wage gap, which is 20 percentage points smaller than the corresponding reduction of 88.58% obtained

equalizing men and women distribution across all majors and traits choices within all majors (compare fourth column in Tables 3.3 and 3.5). This 20 percentage points difference in the reduction is likely to be explained by gender difference in occupational traits within non-STEM majors.

In conclusion, policies aiming at increasing the proportion of female STEM graduates can be effective to reduce the gender wage gap but do not cancel completely the gender differences in wages. Policies should also start considering the issues of occupational segregation of women within non-STEM Majors.

5 Diverse-Occupation and Specific-Occupation Majors

5.1 Diverse-Occupation Majors

The results in the last section suggest that even after equalizing the distribution of men and women across STEM majors there is still a substantial gender wage gap which is probably explained by occupational segregation of women within some majors. This section seeks to understand which majors are responsible for occupational segregation impacting the gender wage gap. To do this, I run separate Oaxaca-Blinder decompositions for each college major to see whether gender differences in wages are explained by gender differences in occupational traits.[21]

I find that in 18 out of the 30 most common majors, gender differences in occupational traits are significantly associated with the wage gap. In Table 3.6, I report the decomposition results only for these 18 majors, which I call 'diverse-occupation majors' because they are majors that tend to give access to a large variety of occupations and therefore allow for women to segregate into occupations with different traits than men.

Table 3.6 reports, separately for each of the 18 majors, the observed average gender wage gap (Wage Gap), the amount of the gender wage gap that is explained by gender differences in occupational traits and demographic variables (Explained), the amount of the gap explained only by the three occupational traits (**Occ Traits**) and only by other demographic characteristics **Other Demo**, the individual contribution of each of the three occupational traits to the explanation of the gender wage gap (competitiveness, contribution and inflexibility), and the residual unexplained part of gender wage gap (Unexplained).

[21] The methodology for the decompositions is shown in Appendix 8.2.

Table 3.6: Decompositions of Gender Wage Gaps Within Diverse-Occupation Majors

	Business Admin	Psychology	Marketing	Computer Science	Communications	Criminal Justice
Wage Gap	1.80***	1.56***	1.63***	0.99	0.55	2.50***
Explained	1.30***	1.44***	0.74***	0.29	0.93**	1.17**
Occ Traits	1.21***	1.13***	0.55**	0.84**	0.63*	1.06**
Competitiveness	0.68***	0.50***	0.36**	0.12	0.20	0.03
Contribution	0.22**	0.13	0.07	0.56**	0.17	-0.03
Inflexibility	0.31*	0.53***	0.12	0.16	0.26	1.06***
Other Demo	0.09	0.31**	0.19	-0.55	0.30**	0.11
Unexplained	0.50	0.12	0.89***	0.70	-0.38	1.33***

	English	Biology	Finance	Economics	Political Science	Parks and Rec
Wage Gap	0.10	0.97**	1.20**	0.30	0.92**	1.54***
Explained	0.69***	0.90***	1.20***	0.89***	0.75**	1.17***
Occ Traits	0.52**	0.81***	1.10***	0.92***	0.77**	0.74***
Competitiveness	0.20*	0.30**	0.56***	0.46**	0.22	0.19
Contribution	0.13	-0.07	0.06	0.15	0.08	0.19
Inflexibility	0.19*	0.58***	0.48***	0.31**	0.47**	0.36**
Other Demo	0.17	0.09	0.10	-0.03	-0.02	0.43***
Unexplained	-0.59*	0.07	0.00	-0.59	0.17	0.37

	History	Sociology	Fine Arts	Hospitality Management	Liberal Arts	Gen. Business
Wage Gap	0.65	1.38**	1.07	0.50	2.41***	1.62***
Explained	1.25***	1.38***	1.00**	0.90**	1.57***	0.82***
Occ Traits	1.17***	1.28***	0.80**	0.63**	1.33***	0.81***
Competitiveness	0.22	0.26	0.28	0.14	1.01***	0.43**
Contribution	0.17	0.03	0.26	0.08	0.26	0.12
Inflexibility	0.78***	0.99***	0.26	0.41**	0.06	0.26**
Other Demo	0.08	0.10	0.20	0.27	0.24	0.01
Unexplained	-0.60	0.00	0.07	-0.39	0.84	0.80**

Notes: *** p<0.01, ** p<0.05, * p<0.10. Data from ACS and O*NET. Standard errors are clustered at the occupational level but now shown for brevity. Male wage structure used as reference wage. This table shows O-B decompositions of within major hourly gender wage gaps. This table only shows the college majors where gender differences in occupational traits were a significant contributor to the gender wage gap. **Occ Traits** is the summed contribution of the individual occupational traits. **Other Demo** is the summed contribution of all demographic variables. Refer to Table 3.1 for sample restrictions.

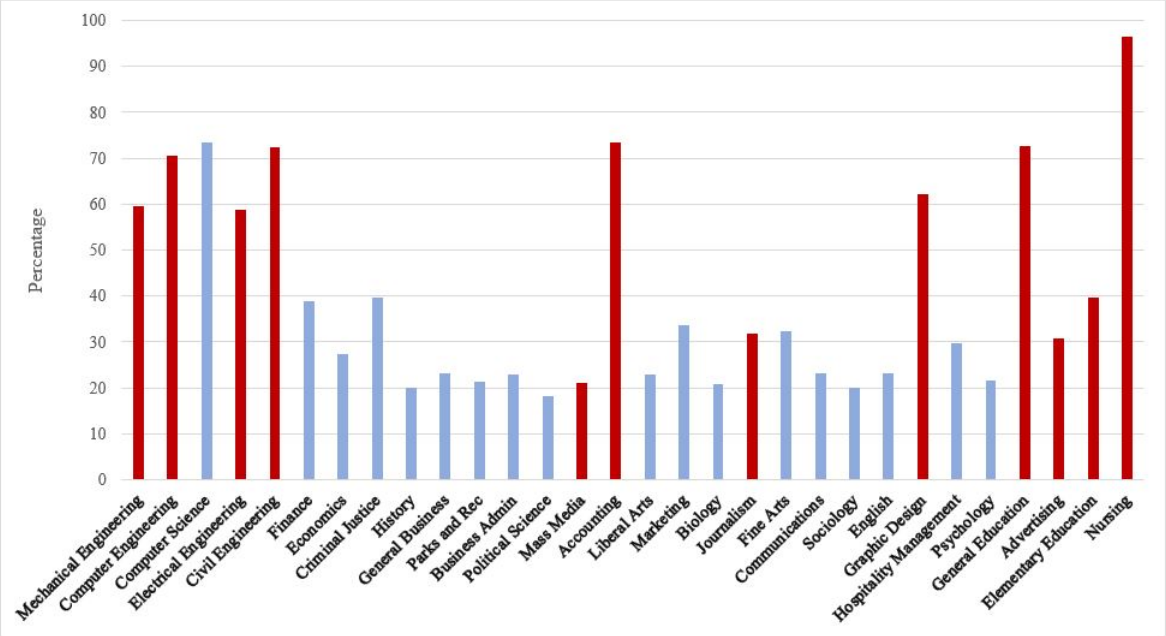
These results show that gender differences in occupational traits explain more than 30% of the gender wage gaps within these 18 diverse-occupation majors. Furthermore, gender differences in competitiveness of one's occupation explains gender differences in wages in 9 majors while this is true for only 2 majors with social contribution and 13 majors with inflexibility. Gender differences in inflexibility significantly explain part of the gender wage gap for 43% of the majors analysed while differences in competitiveness only significantly explain the gender wage gap in 30% of majors. Not only do gender differences in inflexibility contribute to the wage gaps within more majors than the other traits but gender differences in inflexibility explain a larger portion of the gender wage gaps within majors than the other traits. For example, gender differences in inflexibility (competitiveness) explains more than 50% of the gender wage gap in seven (two) majors. As suggested by Sloane et al. (2020) and

Goldin (2014), inflexibility seems to be an important factor in the gender wage gap of college graduates, even at the beginning of their careers before they have children.

5.2 Specific-Occupation Majors

To gain a better understanding of why occupational segregation occurs within some majors, I analyse whether the majors without occupational segregation are associated with sorting into few specific occupations. As suggested by Joy (2006, 2000) the potential for occupational segregation within college major is greater for majors which lead to a lot of potential occupations compared to majors with only few potential occupations.[22]

Figure 3.8: Percentage of Graduates in a Top 5 Most Common Occupation by Major



Notes: Data from ACS and O*NET. Red bars indicate specific-occupation majors without occupational segregation while blue bars indicate diverse-occupation majors from Table 3.6. Refer to Table 3.1 for sample restrictions.

Figure 3.8 displays the percentage of graduates in each of the majors that attain one of the five most common occupations for graduates of that major. This measure is used in Altonji et al. (2016b) as a measure of occupational concentration of a major. The higher the percentage of graduates in the top five occupations, the less scope of occupational segregation there is. The blue bars indicate the 18 diverse-occupation majors from Table 3.6 and the

[22]There are several previous papers that provide empirical evidence that some college majors are closely related to a few occupations in the labour market (Accounting, Engineering, Nursing, etc.) while other majors lead to a plethora of occupational choices (Business, Economics, etc.) (Ransom and Phipps, 2017; Altonji et al., 2016b; Arcidiacono et al., 2014; Altonji et al., 2012).

red bars are the 12 majors without significant occupational segregation by gender within major. The majors without gender differences in occupational traits tend to be also the majors with the highest concentration of graduates in the most common occupations for the major.[23] Therefore, I call these 'specific-occupation majors'. These majors tend to have clear occupational paths such as Engineering, Accounting, Education and Nursing. Notice also that these specific-occupation majors also include the male-dominated STEM majors of Engineering.

5.3 Simulation: Diverse-Occupation Majors

To analyse whether the diverse-occupation majors are mainly responsible for the portion of the gender wage gap related to the occupational segregation within major, Table 3.7 displays the results of the simulation that equalizes occupational traits within major only for the diverse-occupation majors. I find a 16.05% reduction in the gender wage gap when equalizing traits within the 18 diverse-occupation majors compared to a 16.36% reduction when equalizing traits within all 30 majors (compare Table 3.7 with Table 3.3). This provides evidence that 98% of the reduction in the gender wage gap explained by occupational segregation can be attributed to segregation within diverse-occupation majors.

Table 3.7: Simulations of Hourly Gender Wage Gap ($'s) Only Changing Traits in Diverse-Occupation Majors

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	24.10	22.95	24.10	22.95
Female Wage	20.86	21.98	21.38	22.56
Wage Gap	3.24	0.97	2.72	0.39
Wage Gap (%)	13.44%	4.23%	11.29%	1.70%
Reduction in Gap		**70.06%**	**16.05%**	**87.96%**
Male Sample	37544	37544	37544	37544
Female Sample	41473	41473	41473	41473

Notes: Data from ACS and O*NET. Actual is the unsimulated gender wage gap. Equal Major Choices Across Gender shows the gender wage gap when every major has a gender composition of 52% female and 48% male. Equalized Traits shows the gender wage gap if females have the same average occupational traits within diverse-occupation majors as men. Equalize Traits and Major shows the gender wage gap when females have the same average occupational traits within college major as men and every major has a gender composition of 52% female and 48% male. Refer to Table 3.1 for sample restrictions.

[23] Computer Science is an outlier as it has a high concentration of graduates in the top five occupations; however, gender differences in occupational traits for these graduates do contribute to explain the gender wage gaps.

6 Sensitivity Analysis

6.1 Simulations

The results for the simulations are robust to changing the dependent variable. Table 3.8 shows that the results remain when using log hourly wages instead of level hourly wages.

Table 3.8: Simulations of Log Hourly Gender Wage Gap ($'s)

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	3.06	3.02	3.06	3.02
Female Wage	2.94	2.98	2.97	3.01
Wage Gap	0.12	0.04	0.09	0.01
Male Sample	37544	37544	37544	37544
Female Sample	41473	41473	41473	41473

Notes: Data from ACS and O*NET. Refer to Table 3.3 for additional notes.

Table 3.9 shows the simulation results when using annual income instead of hourly wages. Table 3.9 Column 2 (Equal Major Choices Across Gender) shows that the gender wage gap decreases by 63.12% compared to 70.06% when analysing hourly wages. In addition, equalizing traits within major decreases the gender wage gap by 13.65% compared to 16.36% when using hourly wages. The differences between the simulations using different dependent variables are potentially due to the fact that within each college major, women tend to work fewer hours a week than men (even though they are working full-time). This can be seen in the fourth column where I equalize traits and weekly hours within college major. This results in a 23.23% reduction in the gender wage gap. The sixth column (Equalize Traits, Weekly Hours and Major) shows very similar to results as in Table 3.3 column 4. When equalizing traits and weekly hours within major along with equal representation within major, the gender wage gap reduces by 90.52% compared to 88.58% in Table 3.3.

Table 3.9: Simulations of Annual Gender Income Gap ($'s)

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalized Traits and Weekly Hours	Equalize Traits and Major	Equalize Traits, Weekly Hours and Major
Male Income	55141	52053	55141	55141	52053	52053
Female Income	45725	48580	47010	47912	50086	51160
Income Gap	9416	3473	8131	7229	1967	893
Income Gap (%)	17.08%	6.67%	14.75%	13.11%	3.78%	1.72%
Reduction in Gap		**63.12%**	**13.65%**	**23.23%**	**79.11%**	**90.52%**
Male Sample	37544	37544	37544	37544	37544	37544
Female Sample	41473	41473	41473	41473	41473	41473

Notes: Data from ACS and O*NET. Equalized Traits and Weekly Hours shows the gender wage gap if females have the same average occupational traits and weekly hours within college major. Equalize Traits, Weekly Hours and Major shows the gender wage gap when females have the same average occupational traits and weekly hours within college major as men and every major has a gender composition of 52% female and 48% male.

Table 3.10: Simulations of Hourly Gender Wage Gap ($'s) Including Individuals with Children and Working Part-time

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	23.90	22.80	23.90	22.80
Female Wage	20.62	21.56	21.17	22.19
Wage Gap	3.28	1.24	2.73	0.61
Wage Gap (%)	13.72%	5.44%	11.42%	2.68%
Reduction in Gap		**62.20%**	**16.77%**	**81.40%**
Male Sample	45054	45054	45054	45054
Female Sample	54357	54357	54357	54357

Notes: Data from ACS and O*NET. The sample is expanded to include individuals with children or work part-time (at least 20 hours a week). Refer to Table 3.3 for additional notes.

Table 3.11: Simulations of Hourly Gender Wage Gap ($'s) Including Individuals Still Enrolled in School

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	23.76	22.62	23.76	22.62
Female Wage	20.65	21.71	21.17	22.30
Wage Gap	3.11	0.91	2.59	0.32
Wage Gap (%)	13.09%	4.02%	10.90%	1.41%
Reduction in Gap		**70.74%**	**16.72%**	**89.71%**
Male Sample	41518	41518	41518	41518
Female Sample	47444	47444	47444	47444

Notes: Data from ACS and O*NET. The sample is expanded to include individuals still enrolled in school. Refer to Table 3.3 for additional notes.

Table 3.12: Simulations of Hourly Gender Wage Gap ($'s) Including Individuals with More Than Bachelor's Degree

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	25.19	23.77	25.19	23.77
Female Wage	21.83	23.17	22.29	23.65
Wage Gap	3.36	0.60	2.90	0.12
Wage Gap (%)	13.34%	2.52%	11.51%	0.50%
Reduction in Gap		**82.14%**	**13.69%**	**96.43%**
Male Sample	46058	46058	46058	46058
Female Sample	53779	53779	53779	53779

Notes: Data from ACS and O*NET. The sample is expanded to include individuals with more than a bachelor's degree. Refer to Table 3.3 for additional notes.

Tables 3.10, 3.11, 3.12 and 3.13 show that the results are robust to expanding the sample to include individual with children and work part-time, who are still enrolled in school and individuals with more than a bachelor's degree and excluding married individuals. The results for equalizing traits within major for these three different samples remain very similar to those found in the main result. However, the effect of having equal representation in every major can be slightly different based on the sample used. In Table 3.10 which expands the sample to include individuals with children and who work part-time, eliminating gender differences

Table 3.13: Simulations of Hourly Gender Wage Gap ($'s) Excluding Married Individuals

	Actual	Equal Major Choices Across Gender	Equalize Traits	Equalize Traits and Major
Male Wage	23.38	22.36	23.38	22.36
Female Wage	20.40	21.56	20.91	22.12
Wage Gap	2.98	0.81	2.47	0.24
Wage Gap (%)	12.75%	3.61%	10.55%	1.07%
Reduction in Gap		**72.95%**	**17.26%**	**91.94%**
Male Sample	28557	28557	28557	28557
Female Sample	29346	29346	29346	29346

Notes: Data from ACS and O*NET. The sample only includes individuals who are not married. Refer to Table 3.3 for additional notes.

in college major reduces the gender wage gap by 62.20% compared to 70.06% in the main sample. In addition, in the fourth column (Equalize Traits and Major) there is only a 81.40% reduction in the gap compared to 88.58% in Table 3.3. Due to data limitations, I am only able to control for potential experience; therefore, the larger remaining gender wage gap compared to Table 3.3 could be due to women with children having less experience which is not controlled for in this sample. Table 3.12 includes individuals with more than a bachelors degree (while controlling for whether they have a higher degree). The second column shows that having equal representation in every major reduces the gap by 82.14% compared to 70.06% in Table 3.3. This stronger result may be due to women shifting into majors which are associated with significantly higher wages if one gains a further degree. Table 3.13 excludes married individuals in the sample as married female graduates may sort into different occupations than single female graduates. This table shows that the results are robust to excluding married individuals indicating that even young, single female graduates sort into different occupations within college major.

6.2 Decompositions

Decompositions require the choice of a reference group. As shown in Equation 3.40 in Appendix 8.2, men are chosen as the reference group in the main analysis. It is common in the gender wage gap literature to use men as the reference group as it is assumed, in a world without discrimination, women would be compensated the same as men with similar characteristics. However, the choice of the reference group may have an effect on the results so it is important to analyse whether the results hold if the counterfactual changes. I do the same analysis as shown in Table 3.6 in Table 3.14 using women as the reference group and using the full sample (both men and women) as the reference group by using coefficients from pooled

Table 3.14: Decompositions of Gender Wage Gaps Within Diverse-Occupation Majors (Female Coefficients)

	Business Admin	Psychology	Marketing	Computer Science	Communications	Criminal Justice
Wage Gap	1.80***	1.56***	1.63***	0.99	0.55	2.50***
Explained	1.33***	1.16***	0.74***	1.27**	0.68***	1.06***
Occ Traits	1.24***	0.88***	0.49**	0.84*	0.42*	0.89***
Other Demo	0.09	0.28***	0.25*	0.43	0.26***	0.17
Unexplained	0.47	0.40	0.89***	-0.28	-0.13	1.44***

	English	Biology	Finance	Economics	Political Science	Parks and Rec
Wage Gap	0.10	0.97**	1.20**	0.30	0.92**	1.54***
Explained	0.61***	0.96***	0.88***	0.96***	0.73**	0.94***
Occ Traits	0.45**	0.83***	0.90***	0.92***	0.67***	0.57***
Other Demo	0.16	0.13	-0.02	0.04	0.06	0.37***
Unexplained	-0.51	0.01	0.32	-0.66	0.19	0.60

	History	Sociology	Fine Arts	Hospitality Management	Liberal Arts	Gen. Business
Wage Gap	0.64	1.38**	1.07	0.50	2.41***	1.62***
Explained	1.01***	1.23***	1.19***	1.04***	1.18***	0.76**
Occ Traits	0.86***	1.21***	0.93***	0.65***	1.23***	0.82***
Other Demo	0.15	0.02	0.26*	0.39*	-0.05	-0.06
Unexplained	-0.37	0.15	-0.12	-0.54	1.23*	0.86**

Notes: *** p<0.01, ** p<0.05, * p<0.10. Refer to Table 3.6 for additional notes.

Table 3.15: Decompositions of Gender Wage Gaps Within Diverse-Occupation Majors (Pooled Coefficients)

	Business Admin	Psychology	Marketing	Computer Science	Communications	Criminal Justice
Wage Gap	1.80***	1.56***	1.63***	0.99	0.55	2.50***
Explained	1.32***	1.22***	0.75***	0.41	0.77***	1.14***
Occ Traits	1.23***	0.94***	0.52**	0.81**	0.49*	1.01***
Other Demo	0.09	0.28***	0.23*	-0.40	0.28***	0.13
Unexplained	0.48	0.34	0.88***	0.58	-0.22	1.36***

	English	Biology	Finance	Economics	Political Science	Parks and Rec
Wage Gap	0.10	0.97**	1.20**	0.30	0.92**	1.54***
Explained	0.63***	0.95***	1.12***	0.91***	0.74**	1.07***
Occ Traits	0.47**	0.83***	1.04***	0.93***	0.73***	0.67***
Other Demo	0.16	0.12	0.08	-0.02	0.01	0.40***
Unexplained	-0.53*	0.02	0.08	-0.61	0.18	0.47

	History	Sociology	Fine Arts	Hospitality Management	Liberal Arts	Gen. Business
Wage Gap	0.64	1.38**	1.07	0.50	2.41***	1.62***
Explained	1.14***	1.28***	1.12***	1.02***	1.35***	0.79**
Occ Traits	1.03***	1.24***	0.88***	0.65***	1.30***	0.81***
Other Demo	0.11	0.04	0.24*	0.37**	0.05	-0.02
Unexplained	-0.50	0.10	-0.05	-0.52	1.06	0.83**

Notes: *** p<0.01, ** p<0.05, * p<0.10. Refer to Table 3.6 for additional notes.

regressions in Table 3.15. Both tables show that the decomposition results remain regardless of the chosen reference group.

7 Conclusion

This paper shows evidence of occupational segregation by gender within college major contributing to the gender wage gap of college graduates at the beginnings of their careers. By simulating what the gender wage gap would be under different scenarios, this paper enables a deeper understanding of where the gender wage gap of college graduates originates and how to potentially decrease it. Results show that gender differences in college major and occupation within major both contribute to the gender wage gap of college graduates. A large portion of the gender wage gap of college graduates could be reduced by getting more women into high paying specific-occupation STEM majors such as various types of engineering. In addition, this paper finds that occupational segregation by gender within diverse-occupation majors contributes to the gender wage gap of college graduates.

Findings show that gender differences in the inflexibility of one's occupation explains the largest portion of the within-major gender wage gap out of the three occupational traits. This finding coincides with Goldin's (2014) argument that reducing the gender wage gap further may require firms to reduce the compensating wage differential for inflexibility. The most male-dominated majors: Mechanical Engineering, Computer Engineering, Computer Science, Electrical Engineering and Civil Engineering feed into occupations which are characterized by high levels of inflexibility and indeed both male and female graduates in these majors end up with very similar levels of inflexible occupations. Furthermore, I find that the reward for inflexibility in these majors is much higher than in other majors, so it is not a surprise that women choose these majors much less frequently than men. Making occupations related to these majors more flexible and/or reducing the wage penalty for flexibility may enable more women into these majors thereby decreasing the gender wage gap due to these majors being the highest paid and most male-dominated majors. The next 7 most male-dominated majors are Finance, Economics, Criminal Justice, History, General Business, Park and Recreation and Business Administration. These are diverse-occupation majors that give access to a variety of occupations with varying levels of flexibility and with substantial penalties associated with flexibility. As a result I find that women choosing these types of majors end up in occupations with significantly higher levels of flexibility than men leading to gender wage gaps within these majors. Therefore, policies to make occupations more flexible could also help decrease the gender wage gaps within diverse-occupation majors.

8 Appendix

8.1 Simulation: Equalizing Occupational Traits and Weekly Hours for Annual Income Simulations

I do another simulation where in addition to equalizing occupational traits between men and women, I also equalize hours worked within major. To calculate what the average female income is when also equalizing hours worked per week I use equation 3.8. First, $\overline{\mathbf{X}}_c^f$ is a vector of average demographic variables within major for women which can be shown separating weekly hours from the other demographic variables:

$$\overline{\mathbf{X}}_c^f = \left[\overline{Hours}_c^f, \overline{\mathbf{Z}}_c^f\right] \tag{3.31}$$

$\hat{\beta}_{c,x}^f$ is a vector of the regression coefficients for the average demographic variables and can also be shown separating weekly hours from the other demographic variables:

$$\beta_{c,demo}^{f\prime} = \left[\beta_{c,hours}^f, \beta_{c,z}^f\right] \tag{3.32}$$

I can then re-write Equation 3.8 with the addition of women working the same weekly hours as men:

$$\ddot{Inc}_c^f = \beta_{0_c}^f + \overline{\mathbf{Occ}}_c^m \beta_{c,occ}^f + \overline{Hours}_c^m \beta_{c,hours}^f + \overline{\mathbf{Z}}_c^f \beta_{c,z}^f \tag{3.33}$$

Then the gender earnings gap can be calculated with the following equation:

$$\overline{Inc}^m - \ddot{Inc}^f = \sum_{c=1}^{30} \left(\frac{n_c^m}{N^m} \overline{Inc}_c^m\right) - \sum_{c=1}^{30} \left(\frac{n_c^f}{N^f} \ddot{Inc}_c^f\right) \tag{3.34}$$

8.2 Methodology: Decompositions of Gender Wage Gaps Within College Majors

The Oaxaca-Blinder (O-B) decomposition is widely used in literature to analyse the gender wage gap as it enables one to dissect the gender wage gap into explained and unexplained components (Blinder, 1973; Oaxaca, 1973). The explained component describes how differences in characteristics of men and women contribute to the gender wage gap. The unexplained component describes if men and women receive different returns to their income for the same characteristics. To study if there is occupational segregation of recent college graduates, I use separate Oaxaca-Blinder decompositions for graduates of specific college majors to see if gender differences in occupational traits significantly contribute to the gender wage gap of

recent college graduates. The Oaxaca-Blinder decomposition estimates two separate linear regressions:

$$Wage^g_{ci} = \beta^g_{c,0} + \mathbf{Occ}^g_{ci}\beta^g_{c,occ} + \mathbf{X}^g_{ci}\beta^g_{c,x} + \epsilon^g_{ci} \tag{3.35}$$

where $Wage^g_{ci}$ is the annual income of individual i who is gender g, where $g = m$ for male and $g = f$ for female; c is college major from 1 to 30; $\beta^g_{c,0}$ is the intercept; $\mathbf{Occ}^g_{ci}$ is a vector of occupational traits; $\mathbf{X}^g_{ci}$ is a vector of demographic variables; $\beta^g_{c,occ}$ and $\beta^g_{c,x}$ are vectors of coefficients and ϵ^g_{ci} is the homoscedastic error term assumed to have a mean of zero. To analyse what gender differences affect the gender wage gap within each major, I first analyse the wages of men and women separately at their mean outcomes for each college major:

$$\overline{Wage}^m_c = \hat{\beta}^m_{c,0} + \overline{\mathbf{Occ}}^m_c\hat{\beta}^m_{c,occ} + \overline{\mathbf{X}}^m_c\hat{\beta}^m_{c,x} \tag{3.36}$$

$$\overline{Wage}^f_c = \hat{\beta}^f_{c,0} + \overline{\mathbf{Occ}}^f_c\hat{\beta}^f_{c,occ} + \overline{\mathbf{X}}^f_c\hat{\beta}^f_{x,c} \tag{3.37}$$

and then to analyse the mean gender wage gap, the difference is taken between the two linear regressions at the mean outcomes:

$$\overline{Wage}^m_c - \overline{Wage}^f_c = \left(\hat{\beta}^m_{c,0} - \hat{\beta}^f_{c,0}\right) + \overline{\mathbf{Occ}}^m_c\hat{\beta}^m_{c,occ} - \overline{\mathbf{Occ}}^f_c\hat{\beta}^f_{c,occ} + \overline{\mathbf{X}}^m_c\hat{\beta}^m_{c,x} - \overline{\mathbf{X}}^f_c\hat{\beta}^f_{c,x} \tag{3.38}$$

where $\overline{Wage}^m_c - \overline{Wage}^f_c$ describes the difference between the average wage of men and the average wage of women. $\overline{\mathbf{Occ}}^m_c$ is the vector of averages of the occupational traits for men and $\overline{\mathbf{Occ}}^f_c$ is the vector of averages of the occupational traits for women; $\overline{\mathbf{X}}^m_c$ is the vector of averages of the demographics for men and $\overline{\mathbf{X}}^f_c$ is the vector of averages of the demographics for women; $\hat{\beta}_{c,occ}$ are vectors of estimated coefficients for men and women for occupational traits; $\hat{\beta}_{c,x}$ are vectors of estimated coefficients for men and women for demographics . $(\hat{\beta}^m_{c,0} - \hat{\beta}^f_{c,0})$ is the difference in intercepts between male and female respondents. This intercept includes omitted variables that may be potentially important for estimation.

By adding and subtracting counterfactual means, $\overline{\mathbf{Occ}}^f_c\hat{\beta}^m_{c,occ}$ and $\overline{\mathbf{X}}^f_c\hat{\beta}^m_{c,demo}$, this equation can be rewritten in the standard Oaxaca-Blinder Decomposition notation:

$$\begin{aligned}\overline{Wage}^m_c - \overline{Wage}^f_c = \\ &\left(\hat{\beta}^m_{c,0} - \hat{\beta}^f_{c,0}\right) + \overline{\mathbf{Occ}}^m_c\hat{\beta}^m_{c,occ} - \overline{\mathbf{Occ}}^f_c\hat{\beta}^f_{c,occ} + \overline{\mathbf{X}}^m_c\hat{\beta}^m_{c,x} - \overline{\mathbf{X}}^f_c\hat{\beta}^f_{c,x} \\ &+ \overline{\mathbf{Occ}}^f_c\hat{\beta}^m_{c,occ} - \overline{\mathbf{Occ}}^f_c\hat{\beta}^m_{c,occ} + \overline{\mathbf{X}}^f_c\hat{\beta}^m_{c,x} - \overline{\mathbf{X}}^f_c\hat{\beta}^m_{c,x}\end{aligned} \tag{3.39}$$

$$\overline{Wage}_c^m - \overline{Wage}_c^f = \left(\hat{\beta}_{c,0}^m - \hat{\beta}_{c,0}^f\right) + \left(\overline{\mathbf{Occ}}_c^m - \overline{\mathbf{Occ}}_c^f\right)\hat{\beta}_{c,occ}^m + \overline{\mathbf{Occ}}_c^f\left(\hat{\beta}_{c,occ}^m - \hat{\beta}_{c,occ}^f\right) + \left(\overline{\mathbf{X}}_c^m - \overline{\mathbf{X}}_c^f\right)\hat{\beta}_{c,x}^m + \overline{\mathbf{X}}_c^f\left(\hat{\beta}_{c,x}^m - \hat{\beta}_{c,x}^f\right) \quad (3.40)$$

With this decomposition one can use males or females as the reference wage. $(\overline{\mathbf{Occ}}_c^m - \overline{\mathbf{Occ}}_c^f)\hat{\beta}_{c,occ}^m$ shows how much of the gender wage gap is explained by differences in occupational traits between men and women if women were paid the same as men. $\overline{\mathbf{Occ}}_c^f(\hat{\beta}_{c,occ}^m - \hat{\beta}_{c,occ}^f)$ shows how much of the gender wage gap is unexplained due to men and women being compensated differently for the same occupational traits. Furthermore, $(\overline{\mathbf{X}}_c^m - \overline{\mathbf{X}}_c^f)\hat{\beta}_{c,x}^m$ shows how much of the gender wage gap is explained by differences in demographics between men and women if women were paid the same as men. $\overline{\mathbf{X}}_c^f(\hat{\beta}_{c,x}^m - \hat{\beta}_{c,x}^f)$ shows how much of the gender wage gap is unexplained due to men and women being compensated differently for the same demographics. Using this decomposition method, it is simple to calculate the detailed decomposition of the explained portion of the gender wage gap due to gender differences in occupational traits:

$$\left(\overline{\mathbf{Occ}}_c^m - \overline{\mathbf{Occ}}_c^f\right)\hat{\beta}_{c,occ}^m = \sum_k \left(\overline{Occ}_{ck}^m - \overline{Occ}_{ck}^f\right)\beta_{ck,occ}^m \quad (3.41)$$

where k is each explanatory variable; $\overline{Occ}_{ck}^m$ is the sample average for the given occupational trait for men and $\overline{Occ}_{ck}^f$ is the sample average for the given occupational trait for women; $\hat{\beta}_{ck,occ}^m$ is the coefficient for occupational trait k for men. This detailed decomposition is one of the reasons why the Oaxaca-Blinder decomposition method is so widely used because it enables one to calculate how much each explanatory variable contributes to the gender wage gap. This is how I show whether gender differences in occupational traits significantly contribute to the gender wage gap for specific college majors.

Table 3.16: Mean Occupational Traits by College Major

	Competitiveness			Social Contribution			Inflexibility		
College Major	**Female**	**Male**	**Diff**	**Female**	**Male**	**Diff**	**Female**	**Male**	**Diff**
Mechanical Engineering	0.29	0.35	*	-0.95	-0.94		0.67	0.67	
Computer Engineering	0.69	0.71		-0.99	-1.08		0.40	0.40	
Computer Science	0.65	0.67		-0.93	-1.08	***	0.29	0.33	
Electrical Engineering	0.39	0.29	**	-0.93	-0.93		0.45	0.51	
Civil Engineering	0.39	0.47	**	-0.84	-0.86		0.51	0.62	***
Finance	0.38	0.68	***	-0.38	-0.44	**	0.26	0.46	***
Economics	0.34	0.53	***	-0.29	-0.38	**	0.23	0.40	***
Criminal Justice	-0.56	-0.31	***	0.36	0.31		-0.19	0.26	***
History	-0.29	-0.07	***	0.20	0.00	***	-0.32	0.08	***
General Business	0.15	0.35	***	-0.05	-0.22	***	0.09	0.27	***
Parks and Rec	-0.31	0.02	***	0.59	0.22	***	-0.62	-0.16	***
Business Admin	-0.01	0.35	***	-0.02	-0.20	***	0.02	0.37	***
Political Science	-0.01	0.14	***	0.00	-0.09	**	-0.06	0.17	***
Mass Media	0.30	0.23		-0.26	-0.39	***	0.04	0.02	
Accounting	0.37	0.45	***	-0.58	-0.59		0.12	0.21	***
Liberal Arts	-0.50	0.00	***	0.38	-0.10	***	-0.47	0.01	***
Marketing	0.34	0.53	***	-0.08	-0.23	***	0.20	0.33	***
Biology	-0.40	-0.21	***	0.07	-0.17	***	-0.35	-0.04	***
Journalism	0.48	0.64	***	-0.27	-0.51	***	0.09	0.12	
Fine Arts	-0.06	0.09	**	-0.13	-0.47	***	-0.41	-0.15	***
Communications	0.13	0.29	***	0.04	-0.16	***	-0.02	0.11	***
Sociology	-0.38	-0.09	***	0.48	0.19	***	-0.39	0.01	***
English	-0.22	-0.04	***	0.08	-0.10	***	-0.30	-0.17	***
Graphic Design	0.42	0.39		-0.55	-0.68	***	-0.11	-0.03	***
Hospitality Management	0.08	0.27	***	0.36	0.24	**	-0.07	0.33	***
Psychology	-0.47	-0.16	***	0.50	0.23	***	-0.42	-0.13	***
General Education	-0.97	-0.68	***	0.82	0.55	***	-0.17	0.05	***
Advertising	0.33	0.42		-0.04	-0.22	***	0.14	0.15	
Elementary Education	-1.11	-0.90	***	0.88	0.71	***	-0.20	-0.04	***
Nursing	-0.38	-0.40		2.05	1.99	***	-1.07	-1.05	

Notes: *** p<0.01, ** p<0.05, * p<0.10. Data from American Community Survey and O*NET. This table shows the descriptive statistics that are shown in Figures 3.2, 3.3 and 3.4. Occupational traits are standardized to (0,1) for the entire college graduate sample. Diff indicates whether a t-test of difference in means for females and males is statistically significant. Refer to Table 3.2 for sample sizes.

Conclusion

This thesis investigates the importance of gender and the family on attitudes and labour market outcomes of individuals. Chapters 1 and 2 provide evidence of the significant influence parents have in the formation of attitudes and aspirations of children while Chapters 2 and 3 sought to understand whether occupational segregation by gender exists in samples who have little reason, other than their gender, to aspire to and attain different occupations. The three chapters of this thesis, although self-contained, explore interrelated ideas about the importance of one's gender and their attitudes on economic outcomes. First this conclusion will summarise the findings and contributions of the chapters separately and then will explain their collective contributions and avenues of future research.

Contributing to the literature on the cultural transmission of norms and attitudes, Chapter 1 analysed the intergenerational transmission of gender-role attitudes. By utilising the NLSY79 which has several measures of a mother's gender-role attitudes across time, this chapter showed evidence of attenuation bias due to measurement error in the intergenerational correlation when a short-run measure of the mother's attitudes is used as a proxy for her long-run attitudes. By using a two-stage least-squares estimation strategy, this chapter demonstrated that the intergenerational correlation was significantly larger when correcting for measurement error. More specifically, a one standard deviation increase in the mother's gender-role attitudes was associated with a 25.3% of a standard deviation increase in the child's gender-role attitudes. This finding is approximately four times larger than previous estimates of the intergenerational transmission of gender-role attitudes showing that mothers play a large role in teaching children gender norms and the formation of the children's attitudes (Farré and Vella, 2013). Future research would benefit from analysing the long-run impacts of parent's, especially father's, gender-role attitudes on outcomes of their children.

Chapter 2 focused on gender differences in the traits of aspired occupations of adolescents contributing to the literature on occupational segregation by revealing that a source of gender differences in occupations occurs before entry into the labour market. Using the NLSY79

and NLSY79CYA, this chapter found evidence that male and female adolescents, on average, followed gender norms by aspiring to occupations associated with traits society views as appropriate for their gender. Male adolescents aspired to occupations associated with higher levels of expected income, competitiveness, inflexibility, riskiness and physicality while female adolescents aspired to occupations associated with higher levels of social contribution and interactional skills. This segregation resulted in a gender earnings gap in aspirations of 19% showing how aspiring to occupations deemed appropriate for one's gender results in young girls having lower economic aspirations. Furthermore, this chapter found evidence of the significant influence that parents have on the occupational aspirations of adolescents, especially if the parent is the adolescent's role model.

As Chapter 2 found that the traits of an adolescent's aspired occupations are significantly associated with the traits of their attained occupation approximately twenty years later, policies should attempt to expand adolescents' ideas about appropriate types of work for men and women by providing them opportunities to see and hear from individuals in gender atypical occupations in school. In addition, more research about gender differences in aspirations, before and during their careers, and their impacts on labour market outcomes would be beneficial.

Contributing to the literature on gender wage gaps of college graduates, Chapter 3 showed how occupational segregation by gender within college major affects the gender wage gap of recent, young college graduates using the ACS and O*NET database. This chapter found that majors which lead to a large set of potential occupations, diverse-occupation majors, have significant levels of occupational segregation while majors which lead to a defined set of occupations, specific-occupation majors, do not have significant occupational segregation. This chapter found that 16.36% of the gender wage gap of young college graduates could be explained by gender differences in occupational traits within major. Chapter 3's main finding is showing the contribution of gender differences in occupational traits, especially inflexibility, within detailed college majors to the gender wage gap of college graduates. This is an important finding as this provides evidence of men and women with the same educational specialisation sorting into different occupations at the beginnings of their careers. More specifically, this chapter found that gender differences in the inflexibility of occupations within diverse-occupation majors explains a significant portion of the gender wage gap in 43% of majors analysed and that women sorting into majors which lead to more flexible occupations keeps them out the high earning STEM majors such as Engineering.

This evidence indicates that policies to decrease the gender wage gap of college graduates should focus on making high-skilled occupations more flexible and decreasing the compensating wage differential for inflexible occupations as suggested in Goldin (2014). This could enable more women to choose majors which feed into occupations associated with higher levels of inflexibility. Future research should focus on how the traits of occupations associated with specific majors affect the decisions of students choice in college major. Furthermore, research on gender differences in occupations within major over the life-course would be fruitful.

In addition to the individual contributions of these chapters, this thesis as a whole enables a deeper understanding of why occupational segregation by gender has remained a significant contributor to the gender wage gap owing to the influence of gender norms and their intergenerational transmissions. The findings in Chapters 2 and 3 that young women aspire to and attain more flexible occupations than men, resulting in a gender wage gap, are important and policy relevant. One could argue that policies should try to encourage women to sort into these higher paying inflexible occupations; however, results in Chapter 2 show that this is not a viable solution unless there is a shift in gender norms.

Chapter 2 found a large negative relationship between the inflexibility of the mother's occupation and the daughter's aspired occupation while no relationship was found between mothers and sons. This result, along with the positive relationship between a mother's and children's gender-role attitudes found in Chapter 1, enables a deeper understanding about the expectations of working mothers. Even though gender-role attitudes in the United States have become more progressive over the past century, this does not mean that society believes mothers should sacrifice time with their family for their work. Gender norms still place the burden of household work and childcare on women. This potentially explains the negative relationship found in Chapter 2 as daughters see their mothers having a difficult time balancing family and work responsibilities and aspire to more flexible occupations as they do not want to experience this struggle for themselves.

These findings coincide with the policy recommendations of Goldin (2014) which argues that a reduction in the gender wage will require firms to make occupations more flexible and/or not compensate inflexible occupations as much. The COVID-19 pandemic has required firms to provide the ability for their employees to work from home creating a shock to the structure of occupations. This gives firms opportunities to create more flexible work arrangements which can benefit their employees, especially women.

Historically, women's economic progress saw large gains during and after structural and technological shifts in the economy which changed perceptions about gender appropriate roles

and occupations. In light of the pandemic, there are ample avenues of future research. It will be beneficial to study whether family members spending more time in the household results in shifts in gender-role attitudes and gender norms and their influence on labour market outcomes. In addition, it will be interesting to research whether the pandemic and/or increase in family time results in changes to occupational preferences especially regarding inflexibility.

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