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Essays on Education and Family Economics

Yue Hu
Clemson University, yhu2@clemson.edu

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Yue Hu
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Accepted by:
Dr. Devon Gorry, Committee Chair
Dr. Jonathan Leganza
Dr. Curtis Simon
Dr. Aspen Gorry

Abstract

This dissertation is consisted of three essays, the first two essays discuss the effect of American high school vocational education on individual's labor market and educational outcomes, the third essay discusses the effect of unilateral divorce law and how it affects women's labor force participation rates.

The first chapter investigates the average effect of American high school vocational classes on students' educational and labor market outcomes. Limited work has been done to study the returns to vocational education. Among the existing literature, studies that analyze the effect of high school vocational education by treating classes as a continuous choice mostly use OLS regression with extensive controls and local fixed effects. This method fails to account for certain unobservable characteristics that could affect class choice and students' subsequent life outcomes. Other studies exploiting admission cutoffs for oversubscribed vocational academies or programs offer more causal results, but they only study the effect of one particular vocational program and treat vocational education as a "track choice." This paper uses family fixed-effects to evaluate the marginal effect of vocational classes taken in high school. This approach improves upon the OLS regression method by further eliminating unobservable factors and so provides a more accurate estimate of the average effect of vocational education.

The study's main findings indicate that high school vocational classes serve as a sorting system, helping students recognize their comparative advantage and adjust their educational path accordingly. Students who take more vocational classes are more likely to opt for non-4-year college paths. Importantly, the analysis shows that, on average, additional vocational classes taken during high school do not hinder students' ability to graduate from college, be it a 2-year or 4-year institution. Regarding labor market outcomes, the research shows a positive effect, particularly in terms of annual earnings. Contrary to common expectations, these positive effects of vocational

classes are not short-lived; instead, they persist into an individual's mid-thirties. Overall, this study provides evidence that vocational education has a positive impact on both educational and labor market outcomes.

The contribution of this chapter is twofold. First, the family-fixed effects improve upon prior work and move closer to a causal design when analyzing the marginal effect of vocational classes. Previous research uses OLS with extensive controls, or adds state, region, or school fixed effects. However, these methods do not fully account for within-family characteristics, which is where family fixed effects prove effective. Second, this paper is the first paper to look at the age-by-age impact of vocational classes using American data, and the results serves as evidence that the positive effects persist into the mid-thirties.

The second chapter expands on the findings from the first chapter by examining the heterogeneity in returns to vocational education. Previous studies on heterogeneous returns have primarily focused on different fields of vocational education, with some exploring gender differences within specific vocational academies. This chapter, however, investigates the varying returns to vocational education across groups based on gender, race, ability level (measured by ASVAB scores), and maternal educational levels. The findings suggest a distinct divergence in labor market outcomes across genders, with males from relatively lower socioeconomic backgrounds experiencing higher returns from vocational classes.

The third chapter explores how family-related policies can influence labor force participation decisions. Specifically, it investigates the causal effect of unilateral divorce laws on women's labor force participation rates. The cost of divorce can affect an individual's perspective on marital stability and, consequently, influence decisions about labor force participation. This impact may vary for individuals exposed to the policy at different life stages.

Utilizing data from the March Current Population Survey (CPS), this study examines the impact of unilateral divorce laws on women's labor force participation across different age cohorts and educational levels. By exploiting the variation in states' implementation of the policy, states that have never adopted this policy serve as the control group, while those that have adopted it serve as the treatment group. Employing the Difference-in-Differences method, I estimate the average treatment effect of the law and use an event study to explore the effects at different time periods after the implementation of unilateral divorce laws. The findings suggest that unmarried women in the middle cohorts are significantly more likely to enter the labor force.

Dedication

To my mother, Chunxia Su. For all the love and care you have given me, and for all the courage and resilience you have demonstrated, you have made me who I am today.

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Chapter 1

Returns to Secondary School Vocational Classes: Evidence from Family Fixed Effects

1.1 Introduction

In 2022, among Americans aged 25 to 29, 51 percent hold less than a college degree (U.S. Bureau of Labor Statistics, 2023). For much of this demographic, high school represents the last stage of education before entering the labor market. As a result, the choice of high school curriculum can significantly impact one's labor market prospects. Given the worsening outcomes for non-college-educated workers (Autor, 2019) and the persistent demand for well-paying middle-skill jobs (Autor et al., 2003a), vocational coursework may be an appealing option for these students. Historically, vocational classes were widely taken by students. In 1992, 97 percent of high school graduates completed at least one vocational course, with the average graduate taking around 3.8 credits in vocational courses, which constituted approximately 16% of their total high school coursework (National Center for Education Statistics, 1995). However, over the years, the number of average credits taken for vocational courses declined. By 2013, the average had decreased to 2.6. Even though the credits taken in vocational classes have been declining over the years, the economic returns appear to be higher than those for general classes (non-vocational classes). Figure 1

illustrates the trend in average annual earnings for individuals with a high school degree or lower across different ages. Comparing panel (a) and panel (b), which depict the average annual earnings for variations in credits for general and vocational classes, respectively, the gap between high and low vocational class takers is wider than that for general class takers. This rough comparison may imply that the economic returns for vocational classes are higher than those for general courses, particularly for individuals with a high school education or below.

This paper aims to analyze the effects of high school vocational courses on educational and labor market outcomes. I assess the effects of vocational courses on both secondary and post-secondary education, as well as their influence on labor market outcomes, including annual earnings, weekly working hours, annual weeks of work, and employment status. There are trade-offs between vocational education and general education. The general curriculum focuses on concepts and offers a broad knowledge base that can facilitate ongoing learning, both on the job and in future educational pursuits. Knowledge of general education could be applied more widely; its versatility may also aid in adapting to evolving job roles driven by technological advancements. General education provides the cognitive foundation for further academic pursuits, especially for those aiming for higher education. However, the abstract nature of general courses may deter students less inclined toward academic learning. In contrast, vocational education offers occupational-specific training, which could facilitate the school-to-job transition. The classes offered provide a wide range of possibilities, with their practical, hands-on nature, which can attract students less inclined to the general curriculum. However, critics are concerned that the benefits of vocational classes on the school-to-work transition might be short-lived due to the specialized nature of skills, which could become obsolete more quickly in a rapidly changing technological landscape (Hanushek et al., 2017). Regardless of the debate between vocational and general education, students may benefit more by pursuing coursework aligned with their preferences and comparative advantage. Students with a comparative advantage in mechanical content might achieve better labor market outcomes without attending a 4-year college (Prada and Urzúa, 2017), and those with a comparative advantage in academic tracks may not benefit more from switching to an academic track (Meer, 2007).

Measuring the impact of educational decisions is challenging due to the selection of different curricula. The choices for classes are associated with students' social background characteristics, such as parental educational level, family wealth, and community atmosphere, all of which, in turn, shape their subsequent life outcomes.

To account for some of the selection issues, this paper utilizes family fixed effects. By using household data from the National Longitudinal Survey of Youth 1997 (NLSY97), I investigate differences in educational attainment and labor market outcomes within families, focusing on variations in vocational class credits taken among siblings. While this does not account for all individual selection, it accounts for shared family characteristics and some other implicit local characteristics, addressing certain selection issues. In contrast to the majority of research, which primarily examines vocational education as a track choice, I analyze the impact of additional vocational class credits. I look at the average effect of vocational classes and how it affects students in general.

This paper finds high school vocational classes significantly decrease the likelihood of attending a 4-year college, by 2.6 percentage points, but they show no significant association with other educational outcomes. This main finding indicates that high school vocational classes serve as a sorting system, helping students recognize their comparative advantage and adjust their educational path accordingly. Students who discover their strengths in vocational education are more likely to opt for non-4-year college paths. Importantly, the paper shows that, on average, additional vocational classes taken during high school do not hinder students' ability to graduate from college, be it a 2-year or 4-year institution. Regarding labor market outcomes, the findings show a positive effect, particularly in terms of annual earnings. Contrary to common expectations, these positive effects of vocational classes are not short-lived; instead, they persist into an individual's mid-thirties.

This paper proceeds as follows: Section 2 provides literature review, section 3 discusses the methodology, and section 4 describes the data. The results are presented in section 5 and section 6. Section 7 discusses robustness checks and potential mechanisms. Section 8 concludes.

1.2 Literature Review

Most previous studies focus on the economic benefit of vocational education. Descriptive studies around the 90's examining effects on labor market outcomes suggesting a positive effects on earnings (Mane, 1999; Bishop and Mane, 2004; Gustman and Steinmeier, 1982; Kang and Bishop, 1989). These effects are mostly revealed in the school-to-work transition, which is a short run benefit. Studies that examine the long-term and life-cycle effects suggests the relative benefit comparing to general education may be short lived and would be taken over by general education over time. They argued, vocational skills may become obsolete at a faster rates. (Hanushek et al., 2017; Golsteyn

and Stenberg, 2017a) However, (Hall, 2016) finds that to increase general education requirement for students on vocational track does not seem to be effective, it does not induce higher earnings nor reduce the risk of experiencing unemployment. There is no obvious limitation in acquiring jobs, as being admitted to vocational track does not increase the likelihood of working in jobs at risk of replacement by automation or offshoring (Silliman and Virtanen, 2022) Overall, the evidence on labor market outcomes is mixed.

Studies that examine the effect of vocational education on educational outcomes have mixed findings as well. Joyce and Neumark (2001) find participation of School-to-Work program is associated with later college enrollment. Neumark and Rothstein (2006b) examine several school-to-work programs and find that some boost postdentary education while others increase post-high school employment. Cellini (2006) used family fixed effects to analyze effects for the "Tech-prep" program, finding that participants are more likely to complete high school and attend a 2-year college, but are less likely to attend a 4-year college.

Recent years, more research favor case study in examining the effects of career academy or CTE programs. Exploiting cutoff in admission scores or the lottery-base enrollment which creates a quasi-experiment for the analysis, these studies reached some causal implications regarding the effects of vocational education.Dougherty (2018) use administrative data of three schools in Massachusetts, exploiting the oversubscribed application and using the admission score as cutoff point to form a Regression Discontinuity Design. He finds that participate in CTE program increase the probability of graduate from high school on time. Brunner et al. (2021) applied a similar design on the data from 16 high schools in Connecticut to analyze the effect of attending stand-alone technical high schools. They also find positive effects on in-school performance and high school graduation rates. Hemelt et al. (2019) exploited the lottery-based enrollment for vocational-program within a high school in North Carolina and found positive effects on high school graduation and college enrollment for males. Overall, these causal effect studies mainly focused on the effects of in school performances and high school attainment, very limited inference to effects on earnings given the fact that data are around the high school period. Owing to the limited representative nature of the dataset, the ability to project their results to a broader population may be limited. Their estimates are local average treatment effect, as the results are based on students who selectively apply for the same program or academy. These applicants, comparing to the general students, would have different characteristics, preferences, and aspirations. Also, effects on the labor market outcomes may be of

limited inference. On the one hand, they only observe labor market outcomes for a short period of time after graduation, on the other, it would only be applicable to students in that particular region, given the particular local labor market situations.

There is very few research looking at the returns to high school curriculum, and the ones that study high school curriculum mostly focusing on academic curriculums. Altonji (1992) finds the returns to additional courses in academic subjects is small. Goodman (2017) finds that by increase the minimum math requirement in high school, substantially increases the returns to Black students. The only paper that examines the effect of vocational classes by looking at the incremental increase in credits is by Kreisman and Stange (2020) . Using the same dataset as this paper, they focus on the educational attainment and the overall labor market outcomes for high school graduates. To account for selection issue, they control for characteristics of school, region and states. Their results show that for individuals who obtained high school degree, advanced level vocational classes contribute to the increase in wages.

This paper uses family fixed effects to estimate the marginal effects of one additional credit in vocational classes on various outcomes. Similar to Cellini (2006), I compare within family differences in the outcome variables, using the siblings who take less credits in vocational classes as the control group. While Cellini (2006) focus on the effects of the "Tech-Prep Program" and the variation lies in whether or not the sibling participates in the program, I analyze the effects of vocational classes in terms of credits taken by students. By doing so, I treat one more credit taken in vocational classes as a "continuum" choice similar to Kreisman and Stange (2020). Their estimates are obtained by controlling for states and region fixed effects, and mainly focus on high school graduates to see the postsecondary education and the overall wage effects. I analyze the average effects for all students, including those who did not graduate from high school, looking at their educational attendance and attainment outcomes. In terms of labor market outcomes, while previous work using NLSY97 data look at the aggregate effects on wages and earnings, I estimate the effects across age in order to capture the trend through time.

1.3 Methodology

To understand the impact of high school vocational courses, I start with the OLS regression without covariates controlling for the individual background characteristics. Let us denote the

outcome variable as "y", and the variable "voc" representing the number of vocational class credits. The model describing the outcome for individual i is as follows:

$$y_i = \beta_0 + \beta_{voc} CreditVoc_i + \mu_i. \tag{1.1}$$

In this simplified model, I only control for vocational credits. It's worth noting that the opportunity cost of an additional vocational class could encompass other types of classes or leisure time, although this remains unspecified. Consequently, the effect denoted by β_1 not only captures the impact of acquiring skills and knowledge through vocational classes but also the effect of extending the duration of high school by one more year.

1.3.1 Total Credits

To more accurately isolate the solo impact of vocational classes, I introduce the following model.:

$$y_i = \beta_0 + \beta_{voc} CreditVoc_i + \beta_{all} CreditAll_i + \mu_i. \tag{1.2}$$

I have included the variable $CreditAll_i$ into the model, representing the total credits completed during high school. The interpretation for β_{voc} now considers the following: while keeping the total credits constant, β_{voc} represents the incremental effect of one more school year hour of vocational class. It is assumed that students would not sacrifice their leisure time to enroll in additional classes; therefore, enrolling in more vocational classes comes at the expense of other classes. With the total credits held constant, when a student chooses to take an additional school year of vocational class, she is essentially trading off the skills and knowledge she could have acquired by taking other classes. For instance, if a student chooses to take one credit in a vocational class, forgoing one credit in an English class, and we assume a negative effect from the loss of skills and knowledge that could have been gained in the English class, and a positive effect from taking one credit in the vocational class, then β_{voc} represents the net effects of these two combined influences. In summary, β_{voc} captures this net effect of vocational class relative to the other classes.

The dependent variables encompass both educational and employment outcomes. The examination explores how vocational credits affect high school graduation, college attendance, and degree attainment for both 2-year and 4-year colleges. Employment outcomes are assessed across

different ages, investigating variations in yearly earnings, weekly working hours, weeks worked per year, and employment status.

1.3.2 Ability, Preference and Other Controls

The problem with this specification (2) is that students' choices of classes are not random. Students' decisions to enroll in specific types of classes are not arbitrary; rather, they are influenced by various factors that can also affect their outcomes. Students who opt for a higher number of vocational classes may systematically differ from their peers who choose fewer. These distinctions may include characteristics on both the individual and family levels. For instance, individuals from disadvantaged backgrounds are more inclined to enter the labor market immediately after graduation, and they are also more likely to pursue vocational classes. Consequently, this can introduce a bias in the estimation of college attendance and completion rates, as those taking more vocational classes are less likely to pursue higher education. To address such disparities, I incorporate a vector of controls denoted as X_i into the previous model:

$$y_i = \beta_0 + \beta_{voc} CreditVoc_i + \beta_{all} CreditAll_i + \beta_x X_i + \epsilon_i. \tag{1.3}$$

The vector X_i includes observable individual characteristics and indicators of the family's socio-economic background. This includes the average household poverty ratio during the age range of 16-18, which corresponds to the period when most individuals are enrolled in high school. Additionally, it takes into account whether the respondent resided in a two-parent household and includes a binary variable indicating whether the mother has attained some college education. Furthermore, students' choices regarding the type of classes they take depend on their inherent abilities and personal preferences. In addition to the previously mentioned controls, I introduce two variables that serve as proxies for ability and vocational class preference. Following the specification outlined in Cellini (Cellini, 2006), I utilize the test score in a sub-test from the ASVAB (Armed Services Vocational Aptitude Battery) known as mechanical comprehension to proxy the respondent's preference for vocational classes. The ASVAB test is employed as a proxy for their overall ability.

1.3.3 Family Fixed-Effects

Equation (3), which incorporates controls for observable characteristics, can aid in mitigating some of the selection issues. However, there may exist additional unobservable characteristics that might influence students' class choices and subsequent outcomes. For example, genetic traits, the community atmosphere in which they reside, and the influence of friends with whom they grow up can play significant roles. In such instances, the utilization of family fixed effects would serve as an effective method to help mitigate the impact of these unobserved characteristics:

$$y_i = \beta_0 + \beta_{voc} CreditVoc_i + \beta_{all} CreditAll_i + \beta_x X_i + Z_f + u_i. \tag{1.4}$$

I augment the previous specification by incorporating Z_f, representing family fixed effects, to capture unobservable characteristics shared within families. This allows for a comparison among siblings who differ in the number of vocational class credits they have taken. Siblings share common genetic traits, are raised within the same family, and are exposed to the influences of the same neighborhood, culture, and even friends. The inclusion of family fixed effects serves to further eliminate the effects of these unobservable characteristics, rendering siblings a more suitable comparison group than randomly selected individuals. For instance, if a family resides in a neighborhood where the majority of children enter the workforce immediately after high school and, consequently, they opt for more vocational classes, children within the same family are likely to follow this pattern. This local influence remains unobserved, and in an OLS model, the impact of vocational classes on college attendance may be biased downward. By introducing family fixed effects, we also account for such local characteristics, given that siblings typically attend the same school and are exposed to the same local economic conditions.

1.3.4 Family Fixed-Effects Vary by Age

In addition to the above regression, I also use the following specification when estimating for the average effect on labor market outcomes:

$$y_{ia} = \beta_0 + \beta_{voc} CreditVoc_i + \beta_{all} CreditAll_i + \beta_x X_i + Z_{fa} + u_i. \tag{1.5}$$

In this specification, I allow the fixed effects to vary with age, accommodating the changing impact of family and siblings on the individual across different life stages. y_{ia} indicates the corresponding labor market outcomes at a given age, and Z_{fa} indicates the fixed effect that changes with age. It is to be expected that the influence from the family during one's twenties differs from that in one's thirties, making it reasonable to let these fixed effects evolve with age.

1.4 Data and Analysis Samples

I use the National Longitudinal Survey of Youth 1997 (NLSY97) to explore the effect of vocational class on various outcomes. The NLSY97 is a nationally representative dataset that includes 8,984 teenagers who were born between 1980 and 1984. Around the year of the first survey,1997, they were aged between 13-16. The survey is taken annually till 2013 and every other year afterward. By the year of the latest survey, 2019, the respondents are aged between 35-39. The dataset provides detailed transcript data which I utilize for the analysis of credits taken through high school. The dataset also has rich information on different measurements for labor market outcomes.

Panel (a) for Table 1.1 provides a description of the data sample. In order to analyze high school transcript information, I have narrowed the sample down to individuals for whom transcript data are available, resulting in a total of 6,232 individuals. Further refinement has been applied by restricting the sample based on the number of credits earned during high school; individuals with total credits below 3 (indicating less than three school years of classes) have been excluded. Additionally, individuals who exclusively pursued vocational classes during high school have also been excluded. The "Siblings" column displays the number of observations that are not singletons under each specified condition. This particular subset of the sample, comprised of individuals with siblings, is utilized for estimation purposes, specifically in the context of family fixed effects analysis.

Table 1.1 provides summary statistics for the background characteristics of both the full sample and the sibling sample. It is crucial to ensure that the sibling sample closely aligns with the characteristics of the full sample, as estimates from the sibling sample will be extrapolated to the broader population. The statistics in the table indicate that the mean values for each characteristic are comparable across the two samples, affirming the suitability of using estimates from the sibling sample for broader inferences.

I begin with analyzing the full sample, and Table 1.2 presents key statistics, including

high school credits and various outcomes. The sample is divided into "High takers" (above-average vocational credits) and "Low takers" (below-average vocational credits). Substantial differences in educational outcomes are observed across groups, impacting almost all measures except the likelihood of obtaining an associate degree. Employment outcomes also exhibit variations, with differences in employment duration at age 30 and employment status at ages 25 and 35.

The disparities in these outcomes can be attributed to two potential sources. Firstly, they may reflect the influence of vocational classes. Secondly, they could arise from systematic differences between individuals who opt for more vocational classes during high school and those who choose fewer. Table 1.3, which provides summary statistics on individual and family backgrounds for the full sample, sheds light on this matter. These two groups exhibit substantial disparities in various background characteristics. Notably, individuals classified as high takers are more likely to come from disadvantaged family backgrounds. They tend to be males with lower ASVAB scores and lower 8th-grade scores, originating from households with less wealth, residing in suburban areas, and having mothers with lower chances of attaining a college education. It's worth acknowledging the fact that high takers often come from disadvantaged families could potentially introduce a downward bias into the estimates.

In an effort to alleviate some of the systematic bias, I compare siblings. Table 1.4 shows the family background characteristics among siblings who took different credits in vocational classes. In the summary table, I exclude siblings who have the same number of credits in vocational classes. The high-taker group is the siblings in the family taking the highest credits in vocational classes, and the rest of the siblings are in the low-taker group. As expected, there are no significant differences in family backgrounds except for the fact that the high-taker siblings are more likely to be males. The only significant difference between the two groups lies in their ability. Siblings with higher vocational credits tend to have lower ASVAB and 8th-grade GPAs. But the differences between these two measures, compared to that in the full sample, are of a much smaller magnitude. (Among the two groups in the main sample, the difference in ASVAB and 8th grade GPA are respectively 7.565 and 0.341; for the sibling sample, the differences are 4.659 and 0.247.) In the comparison of the outcome variables, as shown in table 1.5, there are again fewer differences compared to the full sample. Comparison between the high- and low-takers in the full sample and sibling sample show that siblings share a lot more in common. They are similar in many of the observed characteristics, and they be overlapping on some of the unobservable characteristics as well. This makes siblings

better comparison groups.

1.5 Results

1.5.1 Educational Outcomes

I begin by examining educational outcomes, as shown in Table 1.6. Columns 1 through 3 correspond to the OLS model, while the last three columns pertain to the family fixed effects model. For model set, I gradually introduce variables. I begin with the unconditional estimation regression depicted by equation (1) that includes only $CreditVoc_i$ (the number of vocational class credits). Next, I move on to estimates from equation (2), where holding total high school credits constant by including $CreditAll_i$. Finally, I include variables that control for all observed background characteristics. Each estimate in the table represents the coefficient for the marginal effect of vocational class under different specifications.

1.5.1.1 OLS estimates

In the OLS model, an additional school year of vocational classes during high school, on average, does not show a correlation with the likelihood of obtaining a high school diploma. However, it is associated with a decrease in overall college attendance and college degree attainment. This negative association with college attendance stems from varying effects between 2-year and 4-year colleges. Column(3) suggests Vocational education is positively associated with attendance at 2-year colleges, which suggests a 1.2 percentage points in the probability of attending 2-year college. But it is negatively associated with 4-year college attendance, roughly 2.7 percentage points less likely to attend 4-year college. The OLS estimates also sgguest a significant decrease in the likelihood of attaining a 4-year degree, for about 2.2 percentage points. These OLS model effects remain consistent across different control variables. Although the estimates in column 2 that only control for vocational and total credits have a larger magnitude, the conditional estimates in column 3, which account for individual and family background characteristics, only attenuate the impact. This suggests that these observable characteristics do explain some of the effects on various educational outcome variables.

1.5.1.2 Family Fixed Effects estimates

The family fixed effects (FE) model produces different conclusions about its impact on educational outcomes. Column (5) presents results from the Family FE model, controlling only for vocational and total credits, revealing a negative association between vocational classes and attendance as well as degree attainment at 4-year colleges. When we further eliminate unobservable characteristics by including full control variables, the FE model yields distinct outcomes. Comparing the estimates in column 3 and column 6, the FE model with full control variables only indicates a significant 2.6 percentage points decrease in the attendance for a 4-year college and no significant correlation in other educational outcomes, contrary to the OLS model's suggestion of a significant increase in the probability of attending a 2-year college and the negative association for degree attainment for a 4-year college. Based on the results from FE model, taking an additional school year of vocational classes during high school is not associated with the probability of graduating from college, whether from a 2-year or 4-year college. These varying results on degree attainment suggest that the negative correlation found in the OLS model may be attributed to unobservable characteristics not accounted for in the model.

The results of the FE model imply that vocational curricula in high school may function as a sorting system, guiding students based on their comparative advantages. The negative association with 4-year college attendance, coupled with no correlation with graduation, suggests that students less inclined toward academic curricula might opt against pursuing higher education. However, for those who do attend college, taking additional vocational classes does not appear to hinder their ability to graduate.

1.5.2 Labor Market Outcomes

1.5.2.1 Overall OLS and Family Fixed Effect Results

To understand the impact of vocational classes on labor market outcomes, I look into the effects on several measurements: hours worked per week, weeks worked within a year, annual earnings, and employment status. Firstly, I examined the average effect of vocational classes. Exploring employment data pooled by age and specification (4), I calculated the average effects of vocational classes across this age range. Notably, I allowed family fixed effects to vary with age, acknowledging that the influence of family or siblings for an individual would vary at different ages. The findings

are presented in Table 1.7, which is structured similarly to the educational outcomes table, with the gradual inclusion of control variables. Overall, additional vocational classes were found to have a statistically significant impact on nearly every labor market outcome. A comparison between column 3 and column 6 reveals that the family fixed effects (FE) model produces estimates of larger magnitude than the ordinary least squares (OLS) model. This implies that an individual who takes one more credit in vocational classes is expected to experience a substantial average increase of $671.866 in annual earnings (in 2010 dollars) across the age range of 19-35.

1.5.2.2 Earnings Results by Age

The impact of vocational classes on labor market outcomes is expected to vary over time. To reveal how the effects evolve, I conduct a detailed examination of the marginal effects of vocational classes at each age. The estimates for various outcome variables are presented in Figure 1. The dot on each figure represents the results of a distinct regression at a particular age, depicting the trends in the changes of effects for vocational classes from age 19 to 35.

The family fixed effects (FE) model demonstrates a positive association between vocational courses and labor market outcomes. Panel (a) and (b) illustrates how the effects of vocational classes on annual earnings change over ages. The average impact of vocational coursework on annual earnings is smaller in the early twenties, then approaches zero between ages 24-26, and becomes significantly positive in the thirties. The FE model reveals that additional vocational classes during high school are associated with an increase of about $500 in the early twenties and approximately $\$2,000$ in the early thirties. Conversely, the OLS model suggests positive effects only exist in the early twenties and diminish with age, even turning negative in the thirties. OLS model results may be confounded by unobserved factors not captured by individual and social background controls, such as local labor market conditions, which could influence both vocational class choices and earnings. The family-fixed effects model helps account for such differences, as siblings living in the same household are exposed to similar local conditions. The family-fixed effects model addresses these variations, capturing the impact of shared local conditions on siblings residing in the same household.

1.5.2.3 Labor Market Outcomes by Age

Panels (c) through (h) present age-specific estimates regarding the impact of vocational coursework on various labor market outcomes. In line with earlier findings on annual earnings, the Family Fixed Effects (FE) model consistently reveals a positive correlation between high school vocational coursework and these outcome variables. In contrast, the Ordinary Least Squares (OLS) model does not lend support to this conclusion. Within the FE model, each additional year of vocational coursework is associated with a roughly one-hour increase in weekly working hours, spanning from the early twenties to the early thirties. Conversely, the OLS model indicates positive effects predominantly confined to the early twenties, with no significant influence in one's thirties. Likewise, the FE model indicates a positive association with the number of weeks worked per year, particularly for individuals aged 29 and above, showing an additional week of employment. Prior to age 29, the estimates remain positive but lack statistical significance. In contrast, the OLS model reveals an opposing pattern, with noteworthy positive effects between ages 19 and 22. Regarding employment status, neither model demonstrates significant variations across age groups, except for individuals aged 34 and older in the FE model. In this case, individuals with more vocational classes are more likely to be employed.

The family-fixed effects model indicates a consistent positive association between vocational classes and various labor market outcomes, extending across ages until the mid-thirties. In contrast, the OLS model suggests that this association is limited only to the early twenties. Vocational classes are primarily attended by individuals from socially disadvantaged backgrounds, who are also less likely to attend and complete college. This negative selection provides a lower bound for the effect of vocational classes, as seen in the results from the OLS model. The positive association with labor market outcomes in the early twenties can be attributed to the 'lock-in' effects, such as unemployment, that individuals from better socioeconomic backgrounds experience when pursuing further education. Consequently, these effects tend to diminish with age as these individuals graduate from college and enter the workforce. However, the family-fixed effects model presents a different pattern. Over time, the positive association becomes even more pronounced in one's thirties compared to their twenties. This suggests that when controlling for selection bias, the impact of vocational classes persists with age, and the positive effects endure at least until the mid-thirties.

1.6 Extensions

1.6.1 Robustness Check

One concern regarding the use of family fixed effects is driven by sample selection on the results. The balance test for background characteristics and outcome variables between the full sample and sibling samples has been conducted in the summary section, and the results suggest that the two samples are similar in terms of observable characteristics. The robustness check involves comparing estimates across OLS from the full sample, OLS from the sibling sample, and FE from the sibling sample. Table 1.8 presents the robustness check for labor market outcomes. Column 2 indicates the OLS results from the sibling sample. Comparing results from columns (1) and (2), the estimates from the sibling sample closely resemble those from the full sample, while the magnitude of results is larger for the fixed effects results. Table 13 displays the results for educational outcomes. The patterns for effects across different educational outcomes are similar between the full sample and sibling sample, but they differ from the fixed effects results with the sibling sample. This suggests that the effects observed in fixed effects models are not solely driven by sample selection and, furthermore, indicates that the fixed effects model to some extent accounts for the selection issue that the OLS model cannot address.

1.6.2 Potential Mechanism

The main findings suggest positive effects on labor market outcomes, especially a sustained positive trend till the mid-thirties. One potential channel is that vocational classes contribute to improved job matching, resulting in fewer job changes and facilitating the accumulation of earnings.

Having acquired specific skills and knowledge through vocational training, individuals with more vocational class experience may find it easier to secure a stable job that aligns with their abilities. On the other hand, individuals with a more general knowledge base, developed through academic classes, may have a wider array of opportunities but may also be more prone to job changes as they can fit into various occupations. However, it also makes them easier to be substituted, increasing the likelihood of transitioning from one occupation to another. To test this hypothesis, I explore the effects of vocational class credits on job match by looking into two indicators of job match — number of moves between occupations and the total number of unique jobs one has ever tried. A job change is counted as long as the reported occupation code differs from the previous

year, and the number of jobs counted does not include duplicate occupation codes. For example, from age 19 to 21, if one reported herself as a sales representative, cashier, and sales representative, she had two job changes and two unique jobs.

I followed the occupation categories defined by Autor and Dorn Autor and Dorn (2013a) to account for changes in occupation. Occupations are categorized into six groups based on the tasks underlying different jobs, indicating the intensity of manual /non-manual and routine/non-routine tasks for each job group. The six categories of occupations are as follows: Managers/professional/ tech/finance/public safety, Production/craft, Transport/construct/mechanical/mining/farm, Machine operators/assemblers, Clerical/retail sales, and Service occupations.

Table 1.10 presents the results for the effects on Job Match. The OLS results suggest that vocational credits are negatively associated with the total number of jobs one has ever tried and job changes, indicating that vocational classes taken during high school can contribute to a better job match later in the job market. However, results from the FE model do not support this result. The FE results are not statistically different from zero. Thus, comparing siblings implies that individuals coming from similar backgrounds and differing only in the credits taken for vocational classes during high school do not predict a better job match. The previous hypothesis does not hold; this discrepancy in results suggests that job match may not be the channel for a positive effect on earnings.

1.7 Conclusion

This paper investigates the impact of high school vocational classes on individuals' educational and labor market outcomes. Employing family fixed effects, I analyze within-family differences in outcome variables, considering variations in credits taken for vocational classes. The FE model represents an enhancement over the OLS model by better addressing some of the unobservable characteristics not captured by individual and family background controls. Results regarding educational outcomes indicate a significant negative association between vocational classes taken during high school and attendance for a 4-year college. However, there is no observed association with attendance for a 2-year college, and no suggestive evidence of an impact on college graduation. This implies that vocational classes may function as a sorting system, allowing students to discern their comparative advantage in vocational or general education. Individuals recognizing a lack of incli-

nation or proficiency in general education tend to divert away from 4-year colleges. For those who attend college, vocational classes during high school do not affect their ability to graduate. Contrary to common perceptions about vocational classes, which anticipate positive effects primarily in the early twenties with diminishing effects over time, the FE model results show sustained and persistent positive effects through the mid-thirties. The magnitude of the positive effect is more pronounced in the early thirties than in the early twenties, and similar patterns are observed for other labor market outcomes. This finding provides evidence of the enduring positive effects of vocational classes.

As a policy recommendation, it is advisable to expand access to vocational classes for a broader range of students. Students should be actively encouraged to explore various curricula to expose them to diverse content. Students tend to excel when they discover and follow their comparative advantage and align their educational path accordingly. Since 1985, there has been a growing emphasis on academic requirements, resulting in a decline in the number of credits earned from vocational classes. This decline may stem from concerns that vocational classes could potentially divert students from acquiring essential skills and knowledge, which may impede their future learning. However, the findings of this paper indicate that taking additional vocational classes during high school will not hinder students' ability to graduate from college once they are enrolled. In fact, the choice to forego 4-year colleges may align better with their individual comparative advantages. Furthermore, the research suggests that the skills and knowledge gained from vocational classes not only compensate for any potential loss but also generate positive effects on students' overall educational and labor market outcomes.

Students should be actively encouraged to explore various curricula to gain exposure to diverse content. Students tend to excel when they discover and align their educational path with their comparative advantage. Since 1985, with A Nation at risk, there has been a growing emphasis on academic requirements, resulting in a decline in the number of credits earned from vocational classes. This decline may stem from concerns that vocational classes could potentially divert students from acquiring essential skills and knowledge, which may impede their future learning. However, the findings of this paper indicate that taking additional vocational classes during high school will not hinder students' ability to graduate from college once they are enrolled. In fact, the choice to forego 4-year colleges may align better with their individual comparative advantages. Furthermore, the research suggests that the skills and knowledge gained from vocational classes not only compensate for any potential loss but also generate positive effects on students' overall educational and labor

market outcomes.

Table 1.1: Comparison - Full and Sibling Samples

	(1) Full	(2) Siblings
A. Sample Selection		
Whole Sample	8,984	4,035
Transcript Available	6,232	2,271
Total Credit>=3	5,874	2,124
B. Summary Statistics		
Credits		
Vocational class credits	3.574	3.770
	(2.860)	(2.890)
Core class credits	13.674	13.658
	(4.119)	(4.088)
Elective class credits	3.688	3.646
	(2.637)	(2.588)
Other class credits	3.232	3.170
	(2.013)	(1.899)
Total class credits	24.132	24.212
	(6.653)	(6.525)
Background Characteristics		
Male	0.497	0.504
	(0.500)	(0.500)
Black	0.132	0.123
	(0.339)	(0.328)
Hispanic	0.106	0.109
	(0.308)	(0.312)
Other race	0.011	0.010
	(0.106)	(0.101)
Birth Year	1981.896	1981.916
	(1.412)	(1.432)
Poverty Ratio	3.785	3.528
	(3.576)	(3.471)
Urban	0.698	0.677
	(0.459)	(0.468)
Mother w/ some college	0.482	0.457
	(0.500)	(0.498)
Single-Parent Family	0.286	0.268
	(0.452)	(0.443)
ASVAB	54.622	53.390
	(28.01)	(28.19)
Mechanical Comprehension	-0.406	-0.442
	(0.763)	(0.791)
8th Grade GPA	6.019	5.955
	(1.590)	(1.637)
Observations	4303	1570

Notes: mean coefficients; sd in parentheses. Data source: NLSY97. Number of Observations in panel B excludes missing values.

Table 1.2: Full sample - Credits and Outcome Variables

	(1) High Taker	(2) Low Taker	(3) Diff
Credits			
Vocational class credits	5.531	1.681	3.850***
	(2.882)	(0.876)	(0.0711)
Core class credits	13.818	13.535	0.283*
	(3.290)	(4.782)	(0.132)
Elective class credits	3.129	4.228	-1.099***
	(2.340)	(2.791)	(0.0848)
Other class credits	3.272	3.193	0.0789
	(1.951)	(2.071)	(0.0659)
Total class credits	25.681	22.634	3.048***
	(5.125)	(7.558)	(0.207)
Educational Outcomes			
High School Diploma	0.936	0.840	0.0958***
	(0.245)	(0.366)	(0.00997)
Ever attended college	0.747	0.796	-0.0490***
	(0.435)	(0.403)	(0.0135)
Attended 2-year	0.467	0.383	0.0838***
	(0.499)	(0.486)	(0.0162)
Attended 4-year	0.547	0.659	-0.112***
	(0.498)	(0.474)	(0.0158)
Obtained any college degree	0.428	0.552	-0.124***
	(0.495)	(0.497)	(0.0163)
Associate Degree	0.110	0.094	0.0160
	(0.313)	(0.292)	(0.0103)
Bachelor Degree	0.318	0.458	-0.140***
	(0.466)	(0.498)	(0.0159)
Employment Outcomes			
Emp. Status 25	0.872	0.849	0.0228*
	(0.334)	(0.358)	(0.0116)
Emp. Status 30	0.805	0.782	0.0232
	(0.396)	(0.413)	(0.0134)
Emp. Status 35	0.758	0.728	0.0301*
	(0.428)	(0.445)	(0.0143)
Weeks Employed 25	45.804	45.227	0.577
	(11.81)	(12.31)	(0.417)
Weeks Employed 30	47.881	46.623	1.259**
	(10.20)	(11.80)	(0.403)
Weeks Employed 35	47.499	46.964	0.535
	(9.841)	(10.63)	(0.390)
Earnings 25	30,334.089	29,169.301	1164.8
	(21374.5)	(20437.2)	(757.1)
Earnings 30	39,683.684	39,094.742	588.9
	(30779.5)	(29020.0)	(1120.6)
Earnings 35	49,570.964	52,032.545	-2,461.6
	(40316.5)	(41875.9)	(1782.5)
Observations	2120	2183	4303

Notes: mean coefficients; sd in parentheses

High taker and Low taker refers to individuals with higher or lower than average credits in vocational classes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

data source: NLSY97

Table 1.3: Full sample - Background Characteristics

	(1) High Taker	(2) Low Taker	(3) Diff
Male	0.540	0.455	0.0849***
	(0.499)	(0.498)	(0.0164)
Black	0.142	0.123	0.0188*
	(0.349)	(0.329)	(0.00899)
Hispanic	0.100	0.112	-0.0126
	(0.300)	(0.316)	(0.00821)
Other race	0.012	0.011	0.000491
	(0.107)	(0.105)	(0.00367)
Birth Year	1981.89	1981.902	-0.0120
	(1.409)	(1.415)	(0.0475)
Poverty Ratio	3.572	3.991	-0.419***
	(3.257)	(3.849)	(0.121)
Urban	0.652	0.743	-0.0905***
	(0.476)	(0.437)	(0.0152)
Mother w/ some college	0.436	0.527	-0.0904***
	(0.496)	(0.499)	(0.0164)
Single-parent Family	0.292	0.281	0.0115
	(0.455)	(0.449)	(0.0145)
ASVAB	50.778	58.343	-7.565***
	(27.11)	(28.37)	(0.889)
Mechanical Comprehension	-0.428	-0.386	-0.0418
	(0.761)	(0.764)	(0.0244)
8th Grade GPA	5.845	6.186	-0.341***
	(1.547)	(1.612)	(0.0517)
Observations	2120	2183	4303

Notes: mean coefficients; sd in parentheses

High taker and Low taker refers to individuals with higher or lower than average credits in vocational classes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

data source: NLSY97

Table 1.4: Sibling Sample - Background Characteristics

	(1) High Taker	(2) Low Taker	(3) Diff
Male	0.559	0.460	0.0981***
	(0.497)	(0.499)	(0.0287)
Black	0.115	0.117	-0.00189
	(0.320)	(0.322)	(0.0148)
Hispanic	0.101	0.111	-0.00962
	(0.302)	(0.314)	(0.0144)
Other race	0.011	0.009	0.00168
	(0.103)	(0.0951)	(0.00599)
Birth Year	1981.861	1981.965	-0.103
	(1.431)	(1.439)	(0.0845)
Poverty Ratio	3.539	3.726	-0.187
	(3.275)	(3.821)	(0.214)
Urban	0.672	0.675	-0.00231
	(0.470)	(0.469)	(0.0274)
Mother w/ some college	0.469	0.463	0.00534
	(0.499)	(0.499)	(0.0289)
Single-parent Family	0.273	0.266	0.00665
	(0.446)	(0.442)	(0.0252)
ASVAB	51.827	56.051	-4.224**
	(27.69)	(28.09)	(1.575)
Mechanical Comprehension	-0.404	-0.424	0.0206
	(0.762)	(0.806)	(0.0445)
8th Grade GPA	5.857	6.101	-0.244**
	(1.595)	(1.668)	(0.0938)
Observations	674	699	1373

Notes: mean coefficients; sd in parentheses.

High taker and Low taker refers to individuals with higher or lower than average credits in vocational classes. Excluding siblings with the same number of credits in vocational classes.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

data source: NLSY97

Table 1.5: Sibling Sample -Credit and Outcome Variables

	(1) High Taker	(2) Low Taker	(3) Diff
Credits			
Vocational Class credits	5.247	2.631	2.615***
	(3.034)	(2.155)	(0.155)
Core class credits	13.888	13.645	0.244
	(3.457)	(4.445)	(0.224)
Elective class credits	3.274	4.028	-0.753***
	(2.243)	(2.845)	(0.148)
Other class credits	3.249	3.071	0.178
	(1.865)	(1.897)	(0.109)
Total class credits	25.607	23.361	2.247***
	(5.213)	(7.082)	(0.347)
Educational Outcomes			
High School Diploma	0.942	0.857	0.0854***
	(0.234)	(0.351)	(0.0166)
Ever attended college	0.760	0.770	-0.0102
	(0.427)	(0.421)	(0.0242)
Attended 2-year	0.433	0.412	0.0216
	(0.496)	(0.493)	(0.0285)
Attended 4-year	0.570	0.616	-0.0458
	(0.495)	(0.487)	(0.0282)
Obtained any college degree	0.469	0.507	-0.0377
	(0.499)	(0.500)	(0.0289)
Associate Degree	0.106	0.106	-0.000583
	(0.308)	(0.309)	(0.0177)
Bachelor Degree	0.363	0.400	-0.0371
	(0.481)	(0.490)	(0.0283)
Employment Outcomes			
Emp. Status 25	0.870	0.855	0.0154
	(0.336)	(0.353)	(0.0197)
Emp. Status 25	0.806	0.785	0.0212
	(0.396)	(0.411)	(0.0232)
Emp. Status 30	0.750	0.748	0.00200
	(0.433)	(0.435)	(0.0251)
Weeks Employed 25	45.754	45.210	0.545
	(11.75)	(12.66)	(0.735)
Weeks Employed 25	48.011	46.383	1.627*
	(10.16)	(11.89)	(0.705)
Weeks Employed 35	48.276	47.290	0.986
	(8.798)	(9.889)	(0.621)
Earnings 25	31,278.835	31,371.502	-92.67
	(21201.6)	(21568.8)	(1353.2)
Earnings 30	44,978.133	38,746.177	6,232.0**
	(34570.8)	(29457.6)	(2097.1)
Earnings 35	54,414.542	48,424.936	5,989.6
	(45508.9)	(36107.1)	(3148.0)
Observations	674	699	1373

Notes: mean coefficients; sd in parentheses.

High taker and Low taker refers to individuals with higher or lower than average credits in vocational classes. Excluding siblings with the same number of credits in vocational classes.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

data source: NLSY97

Table 1.6: Effects of Vocational Classes on Educational Outcome

	OLS - Full Sample			Family Fixed Effects - Sibling Sample		
	(1) Voc Only	(2) Voc and Total Credits	(3) All control	(4) Voc Only	(5) Voc and Total Credits	(6) All control
High School Diploma	0.026**	-0.002	0.001	0.037**	-0.000	-0.001
	(0.002)	(0.001)	(0.002)	(0.005)	(0.004)	(0.004)
	[4438]	[4438]	[4438]	[1621]	[1621]	[1621]
Attend Any college	-0.011**	-0.036**	-0.015**	0.003	-0.023**	-0.012*
	(0.002)	(0.002)	(0.002)	(0.006)	(0.006)	(0.006)
	[4438]	[4438]	[4438]	[1621]	[1621]	[1621]
Attend 2-year	0.015**	0.014**	0.012**	0.009	0.003	0.007
	(0.003)	(0.003)	(0.003)	(0.007)	(0.008)	(0.008)
	[4438]	[4438]	[4438]	[1621]	[1621]	[1621]
Attend 4-year	-0.023**	-0.054**	-0.027**	-0.010	-0.039**	-0.026**
	(0.003)	(0.002)	(0.003)	(0.007)	(0.007)	(0.007)
	[4438]	[4438]	[4438]	[1621]	[1621]	[1621]
Any college degree	-0.018**	-0.044**	-0.019**	-0.005	-0.021**	-0.008
	(0.003)	(0.003)	(0.003)	(0.006)	(0.007)	(0.007)
	[4438]	[4438]	[4438]	[1621]	[1621]	[1621]
2-year degree	0.004**	0.004*	0.003+	0.000	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.006)
	[4438]	[4438]	[4438]	[1621]	[1621]	[1621]
4-year degree	-0.023**	-0.048**	-0.022**	-0.006	-0.020**	-0.007
	(0.003)	(0.002)	(0.003)	(0.006)	(0.007)	(0.007)
	[4438]	[4438]	[4438]	[1621]	[1621]	[1621]

Notes: Each coefficient represents estimate for vocational classes from a separate regression. Specifications (1)-(3) are OLS models, (4)-(6) are family FE models. (1) includes only vocational credits; (2) includes both vocational and total credits; (3) includes vocational, total credits and individual and family background characteristics, which contain the following variables: male, black, hispanic, other race, povery-ratio, urban area, mother with some college education, ASVAB score, 8th grade GPA, and ASVAB-Mechanical comprehension score. Dummy variables for birth year, whether individual come from two-parent family, and a constant term. (4) is family FE model with only vocational credits; (5) is FE model includes both vocationl and total credits; (6) is the full FE model with controls for individual characteristics: male, black, hispanic, other race, ASVAB, 8th-grade GPA, ASVAB-Mechanical comprehension score, dummy variable for birth year and a constant term. Standard Errors are clustered at family level. Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source: National Longitudinal Survey of Youth 1997 (unweighted)

Table 1.7: Effects of Vocational Classes on Labor Market Outcomes

	OLS - Full Sample			Family Fixed Effects - Sibling Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
	Only Voc	Voc and Total Credit	All Controls	Only Voc	Voc and Total Credit	All Controls
Annual Earnings	36.196	-397.382***	155.702***	1066.399***	876.406***	684.086**
	(40.222)	(42.273)	(44.880)	(275.876)	(309.015)	(302.515)
	[60183]	[60183]	[60183]	[22026]	[22026]	[22026]
Weekly working hours	0.517***	0.316***	0.287***	1.001***	0.918***	0.729***
	(0.029)	(0.031)	(0.033)	(0.235)	(0.272)	(0.280)
	[69758]	[69758]	[69758]	[25527]	[25527]	[25527]
Anuual Weeks	0.339***	0.001	0.180***	0.916***	0.737***	0.655***
	(0.026)	(0.028)	(0.030)	(0.219)	(0.227)	(0.237)
	[68893]	[68893]	[68893]	[25361]	[25361]	[25361]
Employment Status	0.005***	-0.001**	0.002***	0.008**	0.004	0.003
	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)
	[52547]	[52547]	[52547]	[19458]	[19458]	[19458]

Notes: Each coefficient is estimated from seperate regression. specifications in column (1)-(3) are OLS models, column (4)-(6) are FE models. (1) includes only vocational credits; (2) includes both vocational and total credits; (3) includes vocational, total credits and individual and family background characteristics, which contain the following variables: male, black, hispanic, other race, povery-ratio, urban area, mother with some college education, ASVAB score, 8th grade GPA, and ASVAB-Mechanical comprehension score. Dummy variables for birth year, whether individual come from two-parent family, and a constant term. (4) is FE model with only vocational credits; (5) is FE model includes both vocationla and total credits; (6) is the full FE model with controls for individual characteristics: male, black, hispanic, other race, ASVAB, 8th-grade GPA, ASVAB-Mechanical comprehension score, dummy variable for birth year and a constant term.
Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source: National Longitudinal Survey of Youth 1997 (unweighted)

Table 1.8: Robustness - Labor Market Outcomes

	OLS Full Sample	OLS Sibling Sample	Family FE Sibling Sample
	(1)	(2)	(3)
Annual Earnings	155.702***	257.577***	684.086**
	(44.880)	(74.980)	(302.515)
	[60183]	[22026]	[22026]
Weekly working hours	0.287***	0.324***	0.729***
	(0.033)	(0.055)	(0.280)
	[69758]	[25527]	[25527]
Anuual Weeks	0.180***	0.283***	0.655***
	(0.030)	(0.049)	(0.237)
	[68893]	[25361]	[25361]
Employment Status	0.002***	0.003***	0.003
	(0.001)	(0.001)	(0.004)
	[52547]	[19458]	[19458]

Notes: All the coefficients in this table from a separate regression with full control variables, like the previous table.Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source: National Longitudinal Survey of Youth 1997 (unweighted)

Table 1.9: Robustness - Educational Outcomes

	OLS Full Sample	OLS Sibling Sample	Family FE Sibling Sample
	(1)	(2)	(3)
High School Diploma	0.001	0.002	-0.001
	(0.002)	(0.003)	(0.004)
	[4438]	[1621]	[1621]
Attend Any college	-0.015***	-0.017***	-0.012*
	(0.002)	(0.004)	(0.007)
	[4438]	[1621]	[1621]
Attend 2-year	0.012***	0.009*	0.007
	(0.003)	(0.005)	(0.009)
	[4438]	[1621]	[1621]
Attend 4-year	-0.027***	-0.030***	-0.026***
	(0.003)	(0.004)	(0.008)
	[4438]	[1621]	[1621]
Any college Degree	-0.019***	-0.015***	-0.008
	(0.003)	(0.004)	(0.007)
	[4438]	[1621]	[1621]
2-year Degree	0.003*	0.010***	-0.001
	(0.002)	(0.003)	(0.006)
	[4438]	[1621]	[1621]
4-year Degree	-0.022***	-0.024***	-0.007
	(0.003)	(0.004)	(0.007)
	[4438]	[1621]	[1621]

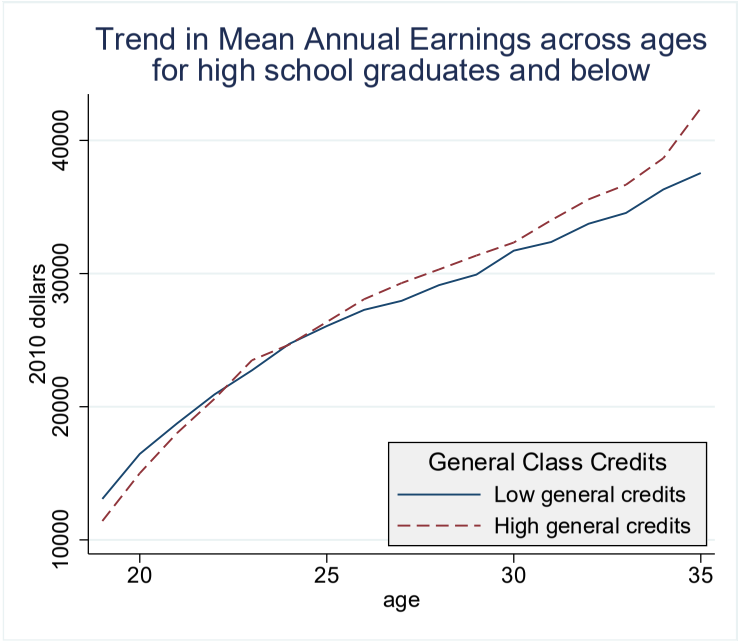
Notes: All the coefficients in this table are estimated from separate regressions with full control variables.Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source: National Longitudinal Survey of Youth 1997 (unweighted)

Table 1.10: Effects on Job Match

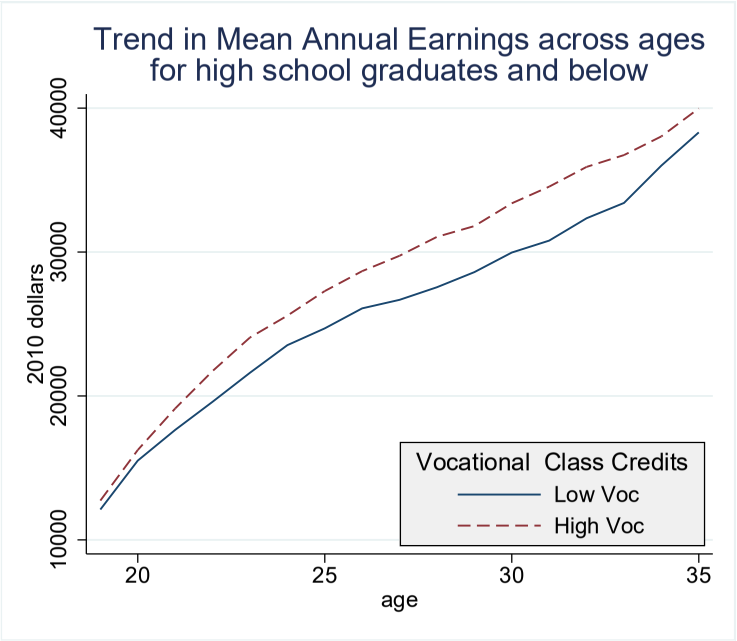
	OLS			Fixed Effects		
	Only Voc	Voc and Total Credit	All controls	Only Voc	Voc and Total Credit	All Controls
Total jobs	-0.053**	-0.058**	-0.044**	-0.021	-0.008	0.001
	(0.012)	(0.013)	(0.014)	(0.036)	(0.039)	(0.041)
	[3961]	[3961]	[3961]	[1453]	[1453]	[1453]
Moves	-0.055**	-0.051**	-0.036*	-0.013	0.005	0.015
	(0.014)	(0.015)	(0.016)	(0.044)	(0.048)	(0.049)
	[3961]	[3961]	[3961]	[1453]	[1453]	[1453]

Notes: No control includes only vocational credits; basic control includes vocational credits and all credits; full control includes all other demographic characteristics. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$; Source: National Longitudinal Survey of Youth 1997 (unweighted)

Figure 1.1: Annual Earnings across Ages for High School Graduates and Below



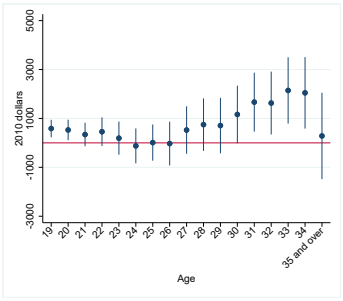
(a) general education



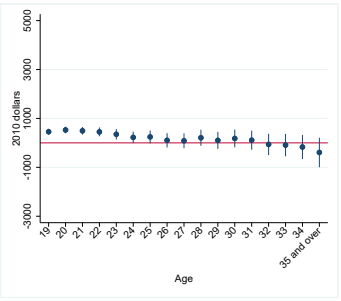
(b) vocational education

Note: Trend in Average income by groups in general credits and vocational credits. data source: NLSY97

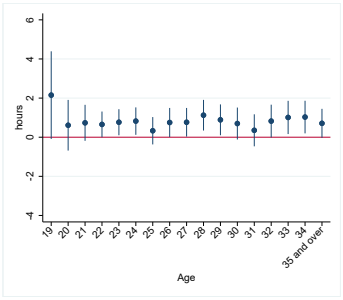
Figure 1.2: Effects of High School Vocational Classes on Labor Market Outcomes



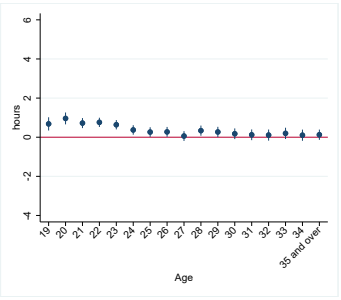
(a) Earnings - Fixed Effects



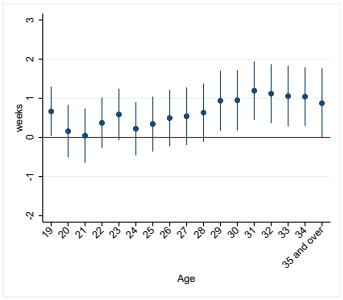
(b) Earnings - OLS



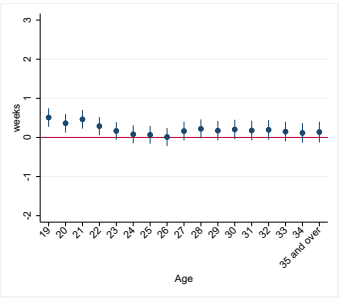
(c) Hours - Fixed Effects



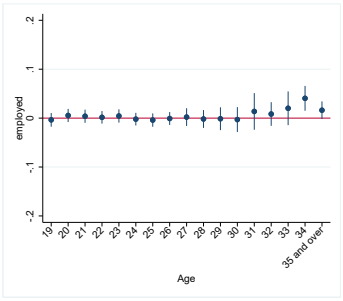
(d) Hours - OLS



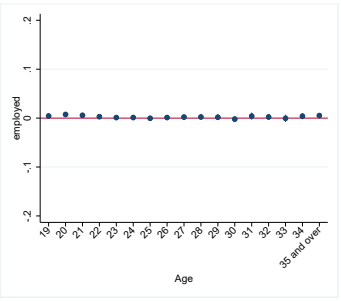
(e) Weeks - Fixed Effects



(f) Weeks - OLS



(g) Employment Status - Fixed Effects



(h) Employment Status - OLS

Note: Figures compare trend of marginal effects of vocational class on various outcomes across age between family FE model and OLS model. 'Age 35 and over' includes individuals aged 35 and 36.

Chapter 2

Heterogeneity in Returns to High School Vocational Classes

2.1 Introduction

From results in the first chapter, it is shown that there are on average positive effects of vocational classes on both educational and labor market outcomes. Results regarding educational outcomes indicate a significant negative association between vocational classes taken during high school and attendance for a 4-year college. However, there is no observed association with attendance for a 2-year college, and no suggestive evidence of an impact on college graduation. Having examined the average effects of vocational education, it is natural to ask: who benefits the most from this type of education? What characteristics do individuals who extract the most from vocational education possess?

However, in terms of examining the heterogeneity of returns to vocational education, most studies focus on the different fields or career clusters of the classes or on gender differences. Few works have elaborated on the demographic characteristics of the population who benefit more from vocational classes. Hall (2016) finds statistically significant effects of technological/industrial sector courses on reducing the risk of unemployment. Kreisman and Stange (2020), uses the NLSY97 dataset to find that fields such as Transportation & Industry, Business & Management, and Health Care contribute the most to positive wage gains. In examining the effect of the school-to-Work

Opportunities Act, Neumark and Rothstein (2006a) find that internship/apprenticeship programs are particularly advantageous for the less-advantaged, boosting college enrollment among those with the lowest test scores and increasing employment among Blacks and individuals with less-educated mothers. Silliman and Virtanen (2022), used Regression Discontinuity to exploit Finnish data, suggest that the benefits of vocational education may be even larger for people with low compulsory school GPAs. Papers analyzing the effect of specific CTE programs or academies mainly focus on gender divergence, finding higher application and attendance rates for males than for females, with positive effects on earnings and school performance primarily for males and no significant effects for female students (Brunner et al. (2021); Hemelt et al. (2019); Brunner et al. (2021))

Overall, there is limited evidence regarding the heterogeneity effect of vocational education by individual characteristics. To better understand who benefits more from high school vocational education, I examine the heterogeneous effects of vocational classes across four distinct sub-groups. Specifically, I assess the impact of vocational classes on key outcome variables considering various individual and family characteristics, namely gender, race, ability level (measured by ASVAB score), and mother's educational level. For each category, the sample is divided into two sub-groups: males and females for gender, whites and non-whites for race, and so on. This approach results in four pairs of comparisons. To measure the effect of vocational classes, I utilized the same family-fixed effects specification on the four pairs of sub-groups, comparing the estimates within each pair of criteria.

The structure of this chapter is as follows: first, I will briefly explain the main methodology used for estimation. Next, I will discuss the results. Finally, I will present the conclusion.

2.2 Methodology

To understand the specific impact of high school vocational classes among groups of people with different characteristics, I divide the sibling sample by four categories: race, gender, ability, and mother's educational level. I compare siblings within these sub groups, and try to find out, within groups of people with similar characteristics, where the effect of vocational classes is more prevalent.

Following the analysis from chapter 1, I repeat the exercise of specification (3), apart from variables representing credits taken in vocational classes and total credits throughout high school,

I also incorporate controls for observable characteristics, aiding in mitigating some of the selection issues, and the family fixed effects where it serves as an effective method to mitigate the impact of the unobserved characteristics that are common within families.

$$y_i = \beta_0 + \beta_{voc} CreditVoc_i + \beta_{all} CreditAll_i + \beta_x X_i + Z_f + u_i. \tag{2.1}$$

The variable $CreditVoc_i$ is the credits taken in vocational classes, the variable $CreditAll_i$ represents the total credits completed during high school. The interpretation for β_{voc} is the following: while keeping the total credits constant, β_{voc} represents the incremental effect of one more school year hour of vocational class. The vector X_i includes observable individual characteristics and indicators of the family's socio-economic background. This includes the average household poverty ratio during the age range of 16-18, which corresponds to the period when most individuals are enrolled in high school. Additionally, it takes into account whether the respondent resided in a two-parent household and includes a binary variable indicating whether the mother has attained some college education.

Furthermore, students' choices regarding the type of classes they take depend on their inherent abilities and personal preferences. In addition to the previously mentioned controls, I introduce two variables that serve as proxies for ability and vocational class preference. Following the specification outlined in Cellini (2006), I utilize the test score in a sub-test from the ASVAB (Armed Services Vocational Aptitude Battery) known as mechanical comprehension to proxy the respondent's preference for vocational classes. The ASVAB test is employed as a proxy for their overall ability.

In addition, I augment the previous specification by incorporating Z_f, representing family fixed effects, to capture unobservable characteristics shared within families. This allows for a comparison among siblings who differ in the number of vocational class credits they have taken. Siblings share common genetic traits, are raised within the same family, and are exposed to the influences of the same neighborhood, culture, and even friends. The inclusion of family fixed effects serves to further eliminate the effects of these unobservable characteristics, rendering siblings a more suitable comparison group than randomly selected individuals. For instance, if a family resides in a neighborhood where the majority of children enter the workforce immediately after high school and, consequently, they opt for more vocational classes, children within the same family are likely to follow this pattern. This local influence remains unobserved, and in an OLS model, the impact

of vocational classes on college attendance may be biased downward. By introducing family fixed effects, we also account for such local characteristics, given that siblings typically attend the same school and are exposed to the same local economic conditions.

2.3 Heterogeneity on Labor Market Outcomes

2.3.1 By Mother's Educational Level

Studies indicate that maternal education plays a major role in a child's development and can also serve as an indicator of the family's socioeconomic status. In the following analysis, I differentiate maternal education based on whether the mother has ever attended college. Figure 2.1 presents separate estimates for siblings from these two groups across four labor market outcomes.

The estimates suggest that among individuals whose mothers have not attended college, those who take more vocational classes during high school experience significantly more positive effects on their annual earnings. The trend is similar to that of the whole sibling sample. For individuals whose mothers have attended some college, the effect is very noisy and almost not significant across different ages. Similar patterns apply to the estimates for hours worked per week. Those who have taken more vocational classes and come from a family where the mother has not attended college, tend to work roughly one hour more per week compared to their peers. They also work roughly one week more every year compared to their counterparts whose mothers also did not attend college but who took fewer vocational classes. The distinction in employment between individuals by their mothers' educational background is less significant. Overall, those from households where the mother has less education may benefit more from taking more vocational classes. Mother's educational level serves as an indicator of household socioeconomic status. Families with mothers who have lower educational levels are more likely to be associated with lower wealth. Children raised in such families may feel pressure to enter the workforce after high school to contribute to the family income. For high school graduates, taking more vocational classes can facilitate easier entry into the workforce. Additionally, the specific skills acquired through vocational classes may qualify them for occupations that require specialized training. Skilled occupations available to high school graduates typically offer better compensation compared to jobs that do not require specialized skills.

2.3.2 By Individual's Ability

Next, I examine whether individuals with different levels of ability benefit differently from high school vocational classes. The siblings are divided into two groups based on their ASVAB scores: the high-ASVAB group, composed of individuals with scores above the average, and the low-ASVAB group, which includes those with scores below the average. Indicated in 2.2 For individuals in the low ASVAB group, the positive effects of vocational classes are particularly evident. While the effect on earnings is mostly negligible for both groups with higher and lower ability levels, some small but insignificant positive associations emerge at ages 27-29 and 33-34. There are consistent positive associations for working hours and weeks across different ages. Individuals with lower-than-average ASVAB scores who take more vocational classes during high school tend to work approximately one hour more per week compared to their peers with similar ASVAB scores but fewer vocational credits. This positive association mainly occurs during ages 21-22 and 26-29, where the effect is statistically significant. They also show a positive association in the number of weeks worked per year, although these effects are not statistically significant for most ages. Additionally, the low ASVAB group exhibits a slightly higher likelihood of being employed in their early thirties. Conversely, the high ASVAB group experiences a positive though insignificant association with vocational classes primarily in terms of earnings. There is no notable impact on working hours per year, weeks worked per year, or employment status for this group of individuals. As a result, high school vocational classes appear to exert a slightly more pronounced influence on individuals with lower ASVAB scores, while those with higher ASVAB scores do not seem to be significantly impacted.

2.3.3 By Race

Next, I investigate variations in the impact of vocational classes based on race, as depicted in Figure 2.3. Race is broadly categorized into two groups: whites and non-whites, due to the limited number of observations.

For whites, there is a pronounced positive association between high school vocational classes and earnings, especially in their early thirties. Between the ages of 31 and 34, an additional credit of vocational classes correlates with an approximate $\$2,000$ increase in annual earnings. Conversely, non-whites experience a similar positive association, albeit at a later age and with a smaller overall

magnitude. Among non-whites, individuals who take more vocational classes tend to work more hours and weeks compared to their counterparts. However, for whites, there isn't a significant positive association between vocational classes and these measurements. Specifically, for non-whites, each additional year of vocational coursework is linked to an increase of approximately one additional working hour per week, peaking at about two hours in the age ranges of 28-30 and 33-34. In contrast, white individuals experience less than a one-hour increase. Similarly, non-whites show a substantial increase in annual working weeks, particularly between the ages of 22-27, with an approximate half-week gain, which further increases to a full extra week around the ages of 28-30, and more than a week for individuals over 30. White individuals, however, experience an increase of less than one week. For non-whites, vocational coursework is also associated with a higher probability of being employed in their thirties, while this relationship remains statistically insignificant for their white counterparts.

In summary, apart from the impact on earnings, it is evident that non-whites tend to benefit more from additional vocational classes, particularly in terms of working hours, annual working weeks, and employment prospects.

2.3.4 By Gender

Finally, I examined the effects of vocational classes on labor market outcomes by gender. As shown in Figure 2.4, it appears that some of the positive associations are more pronounced among males.

In terms of annual earnings, the overall pattern of positive effects is similar across males and females, with coefficients roughly around zero. However, slightly more positive and statistically significant results are observed at the ages of 33 and 34 for both genders. The effects on hours worked differ significantly between males and females. Males who take one more credit in high school vocational classes are likely to increase their working hours by approximately two hours per week, starting from age 24 onwards. In contrast, there is no significant association between vocational credits taken and working hours for females. Furthermore, males who take more vocational classes tend to work for an additional week per year between the ages of 24 and 31. Conversely, for females, taking extra vocational classes shows almost no correlation with working weeks. Regarding employment status, there is no significant association for both males and females, with coefficients hovering around zero on average.

In summary, the effects of vocational classes are more evident among males than females. When taking more vocational classes, males tend to work more hours and weeks compared to their female counterparts.

2.4 Heterogeneity on Educational Outcomes

In Table 2.1, I estimate the effects of vocational classes on educational outcomes across various sub-groups, including ability level, mother's educational level, race, and gender, comparing them to the general results from the full sibling samples (depicted in column 9).

Overall, the direction of the effect is consistent with the full sibling sample, with statistically significant effects observed primarily in attendance at 4-year colleges. Notably, among individuals with high and low average ASVAB scores (columns 1 and 2), those with lower ASVAB scores are statistically significantly less likely to attend 4-year colleges. When comparing individuals from households with different levels of maternal education (columns 3 and 4), both groups show that taking more vocational classes reduces the likelihood of attending 4-year colleges. Interestingly, individuals whose mothers have some college educations are also significantly less likely to graduate from 4-year colleges when taking more vocational classes.

When comparing whites and non-whites in column (5) and (6), whites exhibit a significantly lower likelihood of attending a 4-year college and graduating from college. Among non-whites, the probability of graduating from high school is significantly lower at a 10% confidence level, and the likelihood of graduating from a 2-year college is lower by 2.1 percentage points at a 5% confidence level. However, non-whites are significantly more likely to graduate from a 4-year college. This variation in educational outcomes among non-whites suggests considerable heterogeneity within this group.

The comparison of gender across columns (7) and (8), the differences reveals interesting insights. Males exhibit a significantly lower likelihood of attending a 4-year college, by 5.7 percentage points, a difference notably larger than any other groups. Additionally, males are less likely to graduate from a 4-year college. Conversely, for females, the impact of taking additional vocational classes is not significant for most educational outcomes. However, it significantly increases their likelihood of graduating from a 4-year college by 3.3 percentage points at a 5% confidence level. Overall, the comparison of educational outcomes between males and females deviates significantly

from the general pattern, suggesting further investigation into underlying mechanisms.

2.5 Conclusion

Following the results in the first chapter, I analyze the impact of high school vocational classes on individuals' educational and labor market outcomes. The family-fixed effect model enhances the OLS model by better addressing unobservable characteristics not captured by individual and family background controls. Results regarding educational outcomes indicate a significant negative association between vocational classes taken during high school and attendance at a 4-year college. However, there is no observed association with attendance at a 2-year college and no evidence of an impact on college graduation. This suggests that vocational classes may function as a sorting system, allowing students to discern their comparative advantage in vocational or general education. Those recognizing a lack of inclination or proficiency in general education tend to avoid 4-year colleges. For those who attend college, vocational classes during high school do not affect their ability to graduate. Contrary to common perceptions that vocational classes have positive effects primarily in the early twenties with diminishing effects over time, the FE model results show sustained and persistent positive effects through the mid-thirties. The positive effect is more pronounced in the early thirties than in the early twenties, with similar patterns observed for other labor market outcomes. This finding provides evidence of the enduring positive effects of vocational classes.

Building on the findings in chapter 1, I explore who is more likely to benefit more from vocational classes. To answer this question, I divide the sibling sample by four characteristics: race, gender, ASVAB score, and mother's educational level, and compare siblings within each sub-group. For labor market outcomes, individuals from families with maternal education below a college degree exhibit patterns similar to the full sibling sample. By gender, the positive effect on earnings accrues to whites who take more vocational classes, whereas non-whites see less prevalent positive effects in earnings but a positive association in hours and weeks worked. Comparing results by ASVAB score, those with higher scores do not experience significant positive effects, while lower-scoring siblings show a positive association with hours worked before age 30. Gender differences reveal that the positive effects of vocational classes accrue to males in the form of increased hours and weeks worked.

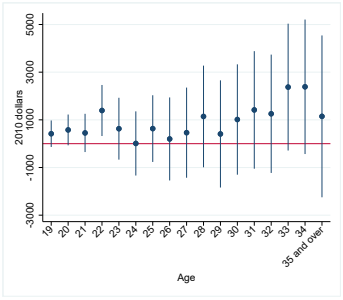
In terms of educational outcomes, each pair of sub-group shows similar patterns to the full sibling sample, with the most significant effect being on 4-year college attendance. Interestingly, when divided by maternal educational level, both groups are less likely to attend a 4-year college, while For those with higher maternal education, individuals taking more vocational classes are also significantly less likely to graduate from college. Similar patterns in terms of attendance and graduation from a 4-year college appear for whites and males. Notably, patterns for females differ from the average result; taking more vocational classes does not decrease their likelihood of attending a 4-year college and significantly increases their likelihood of graduating. The heterogeneity results reveal interesting patterns within sub-groups. Due to the limited sample size, further exploration is challenging, but the results suggest potential areas for further study, especially the divergence in educational outcomes between males and females and differences by race.

Table 2.1: Heterogeneity in Effects of vocational Classes

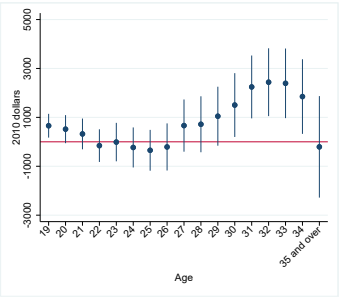
	(1) ASVAB High	(2) ASVAB Low	(3) Mother with college	(4) Mother with no college	(5) White	(6) Non-white	(7) Male	(8) Female	(9) Full Sibling Sample
								(8)	(9)
High School Diploma	0.006	-0.006	0.001	-0.004	0.003	-0.013*	0.002	0.012	-0.001
	(0.006)	(0.008)	(0.007)	(0.005)	(0.005)	(0.008)	(0.007)	(0.010)	(0.004)
	[797]	[824]	[673]	[948]	[959]	[662]	[820]	[801]	[1621]
Attend Any college	-0.012	-0.005	-0.019*	-0.011	-0.016*	-0.008	-0.023*	0.001	-0.012*
	(0.011)	(0.011)	(0.011)	(0.009)	(0.009)	(0.010)	(0.012)	(0.013)	(0.007)
	[797]	[824]	[673]	[948]	[959]	[662]	[820]	[801]	[1621]
Attend 2-year	0.034*	0.004	0.010	0.004	0.010	-0.002	0.006	-0.002	0.007
	(0.019)	(0.011)	(0.015)	(0.011)	(0.011)	(0.013)	(0.016)	(0.020)	(0.009)
	[797]	[824]	[673]	[948]	[959]	[662]	[820]	[801]	[1621]
Attend 4-year	-0.015	-0.033**	-0.025**	-0.025**	-0.031***	-0.010	-0.057***	-0.004	-0.026***
	(0.012)	(0.013)	(0.011)	(0.010)	(0.009)	(0.013)	(0.013)	(0.016)	(0.008)
	[797]	[824]	[673]	[948]	[959]	[662]	[820]	[801]	[1621]
Any college Degree	0.005	-0.009	-0.021*	-0.002	-0.008	-0.002	-0.022	0.020	-0.008
	(0.015)	(0.010)	(0.013)	(0.009)	(0.010)	(0.011)	(0.014)	(0.017)	(0.007)
	[797]	[824]	[673]	[948]	[959]	[662]	[820]	[801]	[1621]
2-year Degree	0.020	-0.010	0.003	-0.005	0.012	-0.021**	-0.000	-0.013	-0.001
	(0.014)	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)	(0.013)	(0.012)	(0.006)
	[797]	[824]	[673]	[948]	[959]	[662]	[820]	[801]	[1621]
4-year Degree	-0.016	0.001	-0.024**	0.003	-0.020**	0.019*	-0.022*	0.033**	-0.007
	(0.016)	(0.008)	(0.012)	(0.008)	(0.009)	(0.011)	(0.013)	(0.016)	(0.007)
	[797]	[824]	[673]	[948]	[959]	[662]	[820]	[801]	[1621]

Notes: All the coefficients in this table are Fixed effects results, and each is estimated from a seperate regression. Each regression includes vocational and total credits with controls for individual characteristics: male, black, hispanic, other race, ASVAB, 8th-grade GPA, ASVAB-Mechanical comprehension score, dummy variable for birth year and a constant term. Mother w/ college means individual's mother has some college education, mother w/o college refers to individual's mother with no college experience. Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source: National Longitudinal Survey of Youth 1997 (unweighted)

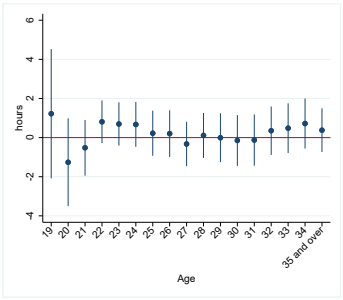
Figure 2.1: Heterogeneity by Mother's Educational Level - Family Fixed Effects



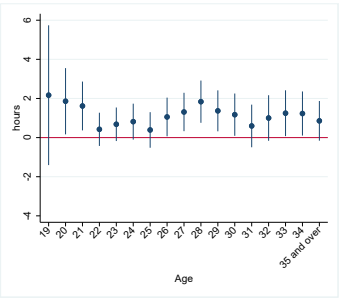
(a) Earnings - mother with some college



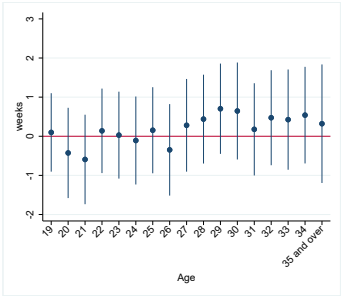
(b) Earnings - mother without college



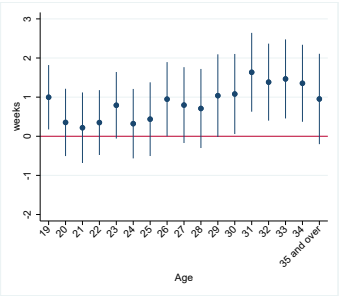
(c) Hours - mother with some college



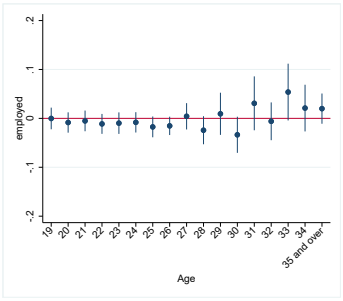
(d) Hours - mother without college



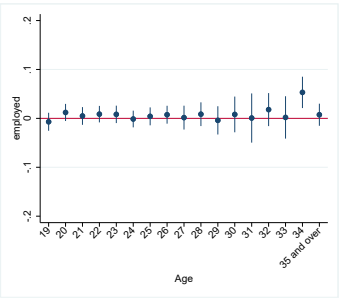
(e) Weeks - mother with some college



(f) Weeks - mother without college



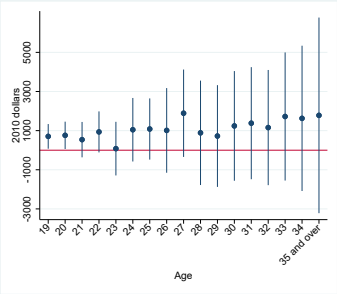
(g) Employment Status - mother with some college



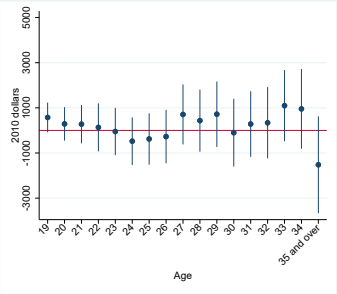
(h) Employment Status - mother without college

Note: Figures compare trend of marginal effects of vocational class on various outcomes across age from family FE model by mother's educational level.'Age 35 and over' includes individuals aged 35 and 36.

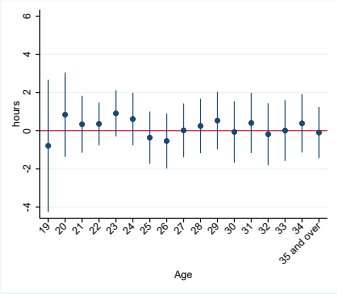
Figure 2.2: Heterogeneity by Ability - Family Fixed Effects



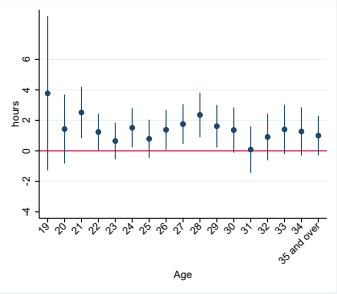
(a) Earnings - High ASVAB



(b) Earnings - Low ASVAB



(c) Hours - High ASVAB



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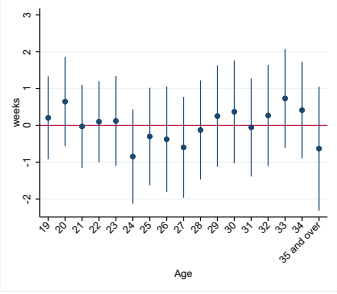
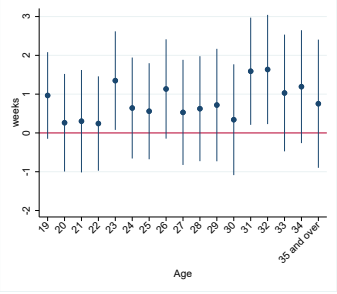
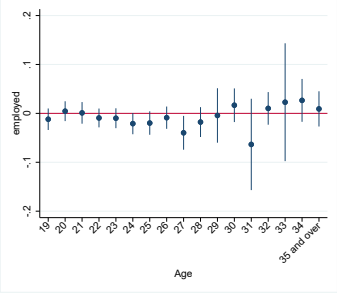


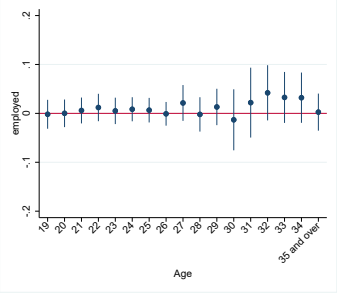
(e) Weeks - High ASVAB



(f) Weeks - Low ASVAB



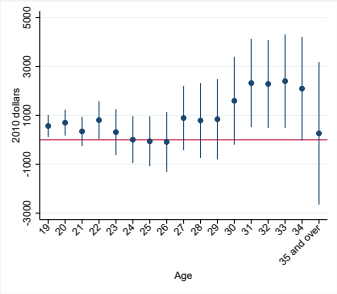
(g) Employment Status - High Asvab



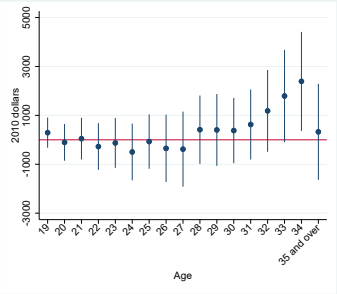
(h) Employment Status - Low ASVAB

Note: Figures compare trend of marginal effects of vocational class on various outcomes across age from family FE model by High and Low ability level (ASVAB score).'Age 35 and over' includes individuals aged 35 and 36.

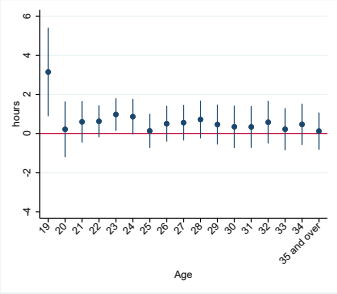
Figure 2.3: Heterogeneity by Race - Family Fixed Effects



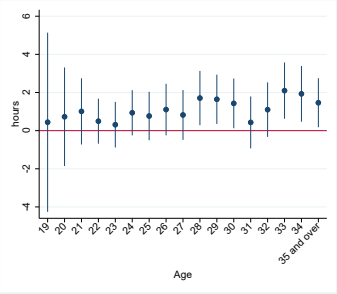
(a) Earnings - white



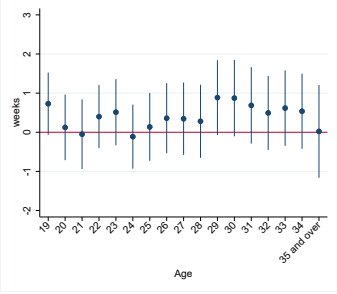
(b) Earnings - nonwhite



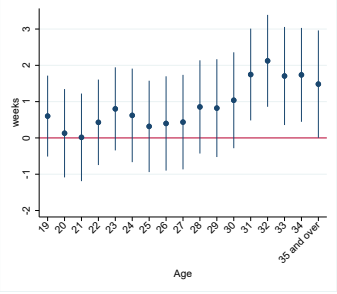
(c) Hours - white



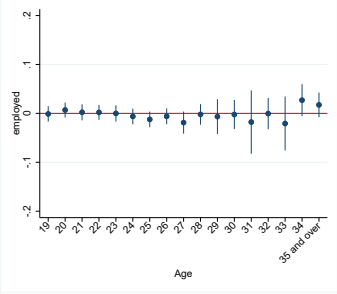
(d) Hours - nonwhite



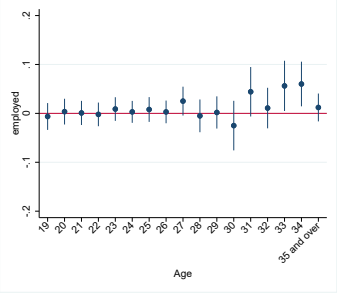
(e) Weeks - white



(f) Weeks - nonwhite



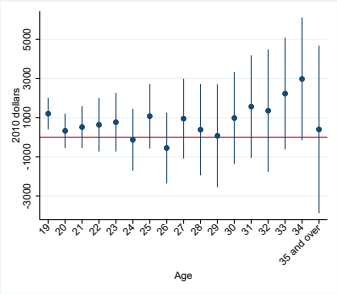
(g) Employment Status - white



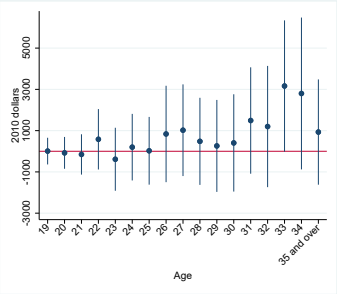
(h) Employment Status - nonwhite

Note: Figures compare trend of marginal effects of vocational class on various outcomes across age from family FE model by race.'Age 35 and over' includes individuals aged 35 and 36.

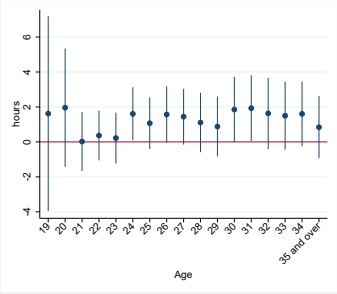
Figure 2.4: Heterogeneity by Gender - Family Fixed Effects



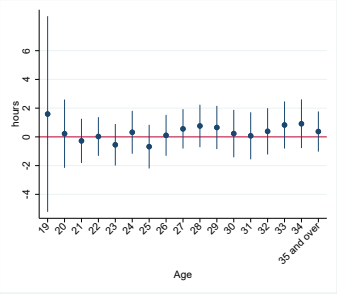
(a) Earnings - male



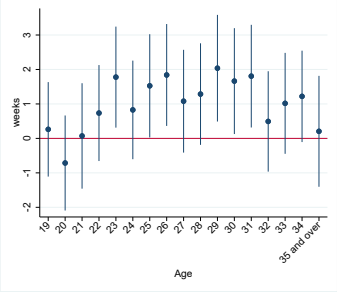
(b) Earnings - female



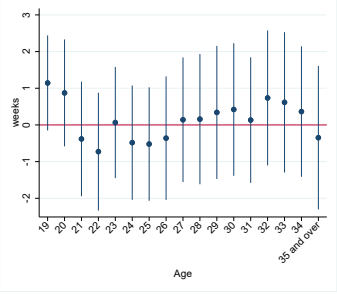
(c) Hours - male



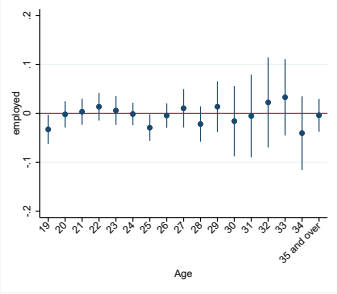
(d) Hours - female



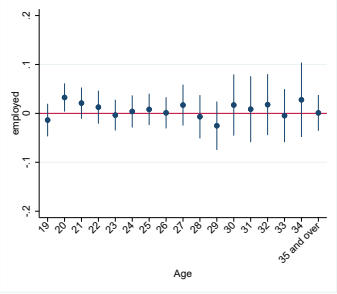
(e) Weeks - male



(f) Weeks - female



(g) Employment Status - male



(h) Employment Status - female

Note: Figures compare trend of marginal effects of vocational class on various outcomes across age from family FE model by gender.'Age 35 and over' includes individuals aged 35 and 36.

Chapter 3

Heterogeneous Effects of Unilateral Divorce Law on Women's Labor Force Participation by Cohorts

3.1 Introduction

The labor force participation rate for women increased significantly during the 1970s. Coinciding with this trend, unilateral divorce laws began to be implemented across states during the same period. Unilateral divorce makes it less costly to end a marriage, thereby altering the bargaining power of spouses within marriage and consequently affecting the value of marriage. This paper examines the relationship between the effect of unilateral divorce laws and female labor force participation.

During the 1970s, states gradually changed the divorce law to no-fault based which then evolved into unilateral divorce. Prior to this change, requirement for a divorce has to be either mutual consent or fault based. For the no-fault based and unilateral divorce law, it takes the will from only one spouse to dissolve a marriage and it does not require proof of marital fault. This liberation for the divorce law makes it easier to dissolve a marriage.

Research has studied the effects of this legal changes on the topics around marriage. Friedberg (1998) found one-sixth of the rise in divorce rate since the 1960s were explained by the unilateral

divorce law. Stevenson and Wolfers (2007) rebutted the finding and showed that the increase in divorce rate because of unilateral law is temporary and lasted for only a decade. The effects wane through the years and returned back to the level after about 10 years.

Early results that explore the effects of unilateral divorce law on female labor force participation used cross-sectional data to compare the effect of this legal change for the pre and post period. Peters (1986) used cross-sectional data of two years to compare the effect for the periods before and after the policy change and suggested that there is a two-percentage point rise in female labor force participation. Gray (1998), also used only cross-sectional data for only two years and argues that the effect of unilateral divorce law depends on the underlying property division law. However, Stevenson (2008) replicated and revised Gray's work by including more controls and expanding the sample size, and property division law no longer influenced the effect of the divorce law, and there is one-percentage point rise at 5 percent significance level in labor force participation. She further used march Census Population Survey data for year 1968-1995 and found out a clear and sharp rise in female labor force participation occurs just a few years after the law has been past.

Previous works discussed the effect of unilateral divorce law for women or married women in general, but they did not try to explore the heterogeneity across age or cohorts for women. The value for marriage or work may vary for women in different ages as they enter into different stages of lives. This legal change may also affect women differently by marital status and educational levels. For unmarried women, they need to support themselves often means they are already part of the labor force. However, the unilateral divorce law might alter their perspectives on the stability of marriage, potentially influencing their decision on whether or not to enter a marriage. The prospect of a less stable marriage, due to the reduced cost of divorce, may motivate them to participate in the labor force more actively. For married women, the effect might take two sides. Faced with a higher potential risk of marriage dissolution, these women might consider joining the labor force to maintain their human capital and secure a source of income in case of divorce. On the other hand, the unilateral divorce law could serve as leverage for women to leave unsatisfactory marriages, thereby increasing their bargaining power within the marriage to secure a better allocation of resources. If this is the case, the unilateral divorce law may decrease the likelihood of married women entering the labor force. In terms of educational levels, different educational levels reflect different levels of human capital, leading to varying job markets and opportunities outside of marriage. Thus, women with varying levels of educational levels may respond differently to this law change.

To explore these aspects, I investigate the effects of unilateral divorce law on women by marital status, high and low educational level, by the combination of marital status and educational levels, and different age groups. This paper also explores how this law affect women's choice of labor force participation when they experience this legal change in different ages. As states implement the law in different years, women, regardless of their natural age by the survey year, may actually experience this law change in different stages of their lives. How would the timing of being exposed to this law affect women's labor force decisions? In order to answer this question, we test the effect of this legal change by putting women into different groups by cohorts – their age when the policy was passed in the states.

The structure of the paper is as follows: section 2 describes the preliminary graphical trend, section 3 describes the data, section 4 explains the empirical strategy, and section 5 covers the two-sample test. The results are presented in section 6 and 7. Section 8 concludes.

3.2 Preliminary Graphical Trend

Figure 3.1 presents a general trend graph comparing the female labor force participation (LFP) rate between unilateral and non-unilateral states, including both married and unmarried women. This graph treats all the ever-unilateral states as unilateral states, without considering that some states were still in non-unilateral status before certain years. It is evident that the LFP rate for unilateral states is higher than that for non-unilateral states at nearly every point in time. The gap between the two lines widens during the years when the policy was gradually implemented across most states, from 1970 to 1978. While this figure does not fully account for the phased implementation of the legal change, the marked differences in the two trends suggest that unilateral states may have a positive effect on female labor force participation.

Figure 3.2 compares the LFP rate among women by marital status in two panels. The overall LFP trend for married women is very similar to the general trend, while unmarried women, on average, have a higher LFP. Notably, in both graphs, the LFP rate for women in unilateral states is almost always higher than that for women in non-unilateral states over time, regardless of marital status. From this coarse comparison of LFP rate trends between unilateral and non-unilateral states by marital status, it is observed that the effect might differ for married and unmarried women. The LFP rate for married women starting in 1968 is roughly about 42%, over time, this percentage has

increased, reaching about 72% in 1995. For unmarried women, the participation rate was already around 72% in 1968. Although the LFP rate for unmarried women increased to over 80% during this period, by 1995, it settled around 75%. The absolute increase in the LFP rate is greater for married women compared to unmarried women. This raises the question of whether the unilateral divorce law contributed to this increase in LFP rate and, and to what extent. Given the different patterns in the trend of overall LFP rate for women across marital statuses, it may provide insight to analyze the effects of the unilateral divorce law separately by marital status.

3.3 Data

I used the March Census Population Survey from 1968 to 1995 to explore the effects of unilateral divorce law on women's labor force participation rate. The analysis focuses on women ages 20 to 55, which is the age range during which women are actively eligible for the labor force. To compare women with different marital statuses, I define women who are married with their husband present as the married group. The unmarried group includes women who are married but with their husband not present, widowed, divorced, and never married. For comparisons across educational levels, I categorize women into two groups based on their college experience. The higher education group consists of women with at least one year of college education, while the lower education group includes women whose highest educational attainment is a high school diploma. The main analysis for the effects of unilateral divorce law examines women by different cohorts, defined by the age at which women living in a particular unilateral state first encountered this policy change. I have divided women into three cohorts: ages 20-28, 29-38, and 39-48. Since different states implemented the policy in different years, I focus on the effects of the policy from five years before enactment to 15 years after enactment.

Different states implemented the unilateral divorce law at different years, table 3.1 shows the timing for each unilateral states that changed their divorce law. Most of the states took action within year 1970 to 1977. Specifically, I followed Gray's coding of unilateral divorce laws.

3.4 Empirical Strategy

3.4.1 Basic Difference-in-Differences

To understand the impact of the unilateral divorce law, I exploit variations in the policy's implementation, treating non-unilateral states as the control group and unilateral states as the treatment group. I run the following specification:

$$\begin{aligned}\text{LaborForce}_{i,s,t} =& \alpha_0 + \beta_1 \text{Unilateral}_{i,s} \cdot \text{Post}_{i,s,t} \\ &+ \sum_t \gamma_j \text{ Year Fixed Effects}_{jt} + \sum_s \theta_k \text{ State Fixed Effects}_{ks} \\ &+ \mu_{i,s,t}\end{aligned} \tag{3.1}$$

$LaborForce_{i,s,t}$ is a dummy variable for individual i in state s at year t, equals to one if the individual is in the labor force, zero otherwise. $Unilateral_{i,s}$ is the dummy variable identifying unilateral states, and the $post_{i,s,t}$ is a dummy variable equals to one if individual i when the year t for state s has passed the year that policy is implemented. Additionally, I include year fixed effects and state fixed effects. β_1 is the main coefficient of interest and it represents the effect of unilateral divorce law on women's labor force participation.

3.4.2 Difference-in-Differences with Controls

There are other factors that will also affect women's labor force participation decisions, thus in additional to the previous basic model, I introduce the following regression:

$$\begin{aligned}\text{LaborForce}_{i,s,t} =& \alpha_0 + \beta_1 \text{Unilateral}_{i,s} \cdot \text{Post}_{i,s,t} \\ &+ \sum_t \gamma_j \text{ Year Fixed Effects}_{jt} + \sum_s \theta_k \text{ State Fixed Effects}_{ks} \\ &+ X_{i,s,t} + \mu_{i,s,t}\end{aligned} \tag{3.2}$$

$X_{i,s,t}$ is a vector including individual characteristics, namely: the number of children the women have, the number of children under age 6, race dummy for whites and non-whites, a dummy

variable indicating whether the individual lives in urban or suburban areas. The choice of joining the labor force is also influenced by the number of children a woman has, particularly those under age six, as women are more likely to be the one in the family devoting time to childcare. This decision may also vary based on race and geographic location. Urban areas tend to offer more job opportunities compared to suburban areas.

3.4.3 Difference-in-differences with State Specific Trend

To account for the possibility that, in the absence of unilateral divorce law, labor force participation trends in each state follow their own path over time, I added a state-specific trends to specification (3.2):

$$\begin{aligned} \text{LaborForce}_{i,s,t} =& \alpha_0 + \beta_1 \cdot \text{Unilateral}_{i,s} \cdot \text{Post}_{i,s,t} \\ &+ \sum_t \gamma_j \text{ Year Fixed Effects}_{jt} + \sum_s \theta_k \text{ State Fixed Effects}_{ks} \\ &+ \sum_s \delta_k \left(\text{State}_{ks} \cdot \text{Year}_t\right) + X_{i,s,t} + \mu_{i,s,t} \end{aligned} \tag{3.3}$$

Coefficient δ_k captures the linear trend of labor force participation rate for state s over time.

3.5 Two-Sample Test

For the difference-in-differences method to be valid, women from the unilateral and non-unilateral states must be comparable. Thus in table 3.1, I conduct a two sample test to compare the pre-period differences in labor force participation rate between the two states and the post-period differences. Since most of the states start to implement the policy after year 1969, I choose 1968 as the pre-period. In the pre-period, the average labor force participation rate for the unilateral states is 50.17%, and it is roughly 48.50% for the non-unilateral states. Column three shows that, the differences between these two groups are not statistically significant. But the post-period differences is statistically significant. Labor force participation rate in the unilateral states is roughly 63.45% for the unilateral states, and it is significantly about 2.46 percentage points more than the non-unilateral states.

3.6 Results

3.6.1 Main Results

Table 3.2 presents the main results of my analysis. Each set of numbers in the table represents results from a separate regression. Columns (1) to (3) correspond to specifications (1) to (3). Results in Column (1) includes the interaction term of the unilateral divorce dummy variable and the post-period dummy variable, along with the fixed effects. Results in the second column add individual control variables, and the third column adds the state-specific trends. The effects are analyzed by different cohorts and then combined, with results for the different cohorts reported horizontally.

In column (1), the results from the basic specifications show no statistically significant effect of the unilateral divorce law on women's labor force participation rate for any cohort. However, the magnitude of the effect is the greatest for the middle cohort. Column (2) reveals a similar pattern across cohorts, with the magnitude of the coefficient smaller after controlling for individual characteristics. In column (3), after adding the state-specific trends, the effect for the younger and elderly cohorts remains not significantly different from zero. Only the effect for the middle cohort is significant at the 10% significance level, indicating an increase in the labor force participation rate of around 2 percentage points. Overall, the effect is not statistically significant across the different regression results.

This main finding indicates that, overall, there is no suggestive evidence that unilateral divorce laws affect women's labor force participation rate. The pattern of effect magnitudes across cohorts, though mostly insignificant, may suggest that women who experience this change in law while in their 30s are the most responsive. Women in their twenties are more likely to already be in the labor force, so the introduction of the divorce law may not significantly change their behavior. Conversely, women in their later years are less likely to make significant changes to their lives. It is the women in their middle ages who, when faced with this law, still have the option to choose to participate in the labor force.

3.6.2 Heterogeneity Results

The unilateral divorce law may impact women differently depending on their marital status and educational level. The law might influence the behavior of unmarried women, as they still have

the opportunity to decide whether to enter into marriage, and the divorce law could alter their decision-making. For married women, the unilateral law could either induce them to join the labor force as a means to secure a source of income and insurance outside marriage in case of divorce, or it could serve as leverage to increase bargaining power inside marriage, leading to different possible effects. Additionally, the effect might vary for women with different educational levels, as these levels often correlate with different job opportunities. I conducted a heterogeneity analysis to understand better how women may react differently to this divorce law under varying circumstances.

Table 3.3 reports the effect of unilateral divorce law on women, segmented by their marital status, educational level, and the combination of both. I restricted my sample according to these categories, and each column represents the treatment effect for that particular subgroup. I used regression model specification 3.2, which includes the interaction term of the unilateral and post dummy variables, fixed effects, and individual control variables, to obtain all the coefficients in this table. Column (1) shows the overall effect of the unilateral divorce law across cohorts and for the cohorts combined. It does not show significant effect for unilateral divorce law either by cohorts or overall. When comparing the effects by marital status, the middle cohort unmarried women experience a roughly 3.4 percentage points increase in labor force participation at 10% significance level. The comparison among women by educational levels shows that, the significant effects mostly observed in the younger cohorts. For the cohort between age 20-28, the labor force participation rate for lower educational women decreases by about 2.74 percentage points, while their counterparts of higher educational levels are made more likely to join the labor force, by roughly 3.4 percentage points at 10% significance level. When we combine every cohort, the higher educational women are significantly more likely to join the labor force, the rate increases by roughly 3.7 percentage points. The positive effect is true for both married and unmarried women with higher educational levels. The negative effects for lower educational women mainly accrues to married women for the overall cohorts, where it is estimated to decrease their probability to of entering the labor force for roughly 1.8 percentage points at 10% significance level.

Next, in table 3.4, I estimate the treatment effects using specification (3.3) where state-specific trends are included. When the assumption for a common trend is loosened, the results differ from the previous table. When comparing women by marital status, unmarried women in the middle cohort significantly increased their labor force participation rate by almost 5 percentage points. In contrast, the effects for married women in the other two cohorts are not statistically significant.

The comparison across educational levels shows no significant evidence of the effect of the unilateral divorce law overall, but the effects for higher educational women, when all cohorts are combined, are about positively 3 percentage points at the 5% significance level.

Examining the results for women within different marital status by educational levels, the middle cohort unmarried women, both with high and low educational levels, show statistically significant effects of the unilateral divorce law, the probability for entering the labor force increases for roughly 4.6 percentage points for the unmarried women with lower educational levels and about 6.9 percentage points for the unmarried women with higher educational levels, both at 5% significance level. For married women by educational levels, there does not show significant effects by different cohorts, but for the married women with higher educational levels, when we combine cohorts, there is a 1.6 percentage points increase at 10% significance level.

Overall, these results resonate with the findings from the main analysis, where unmarried women in middle cohort, experiences significant positive impacts from the unilateral divorce law. The younger and older cohorts do not exhibit significant effects. This finding might be because unilateral divorce law changes unmarried women's perspective on the stability of marriage, and it incentivizes them to participate more actively in the labor force.

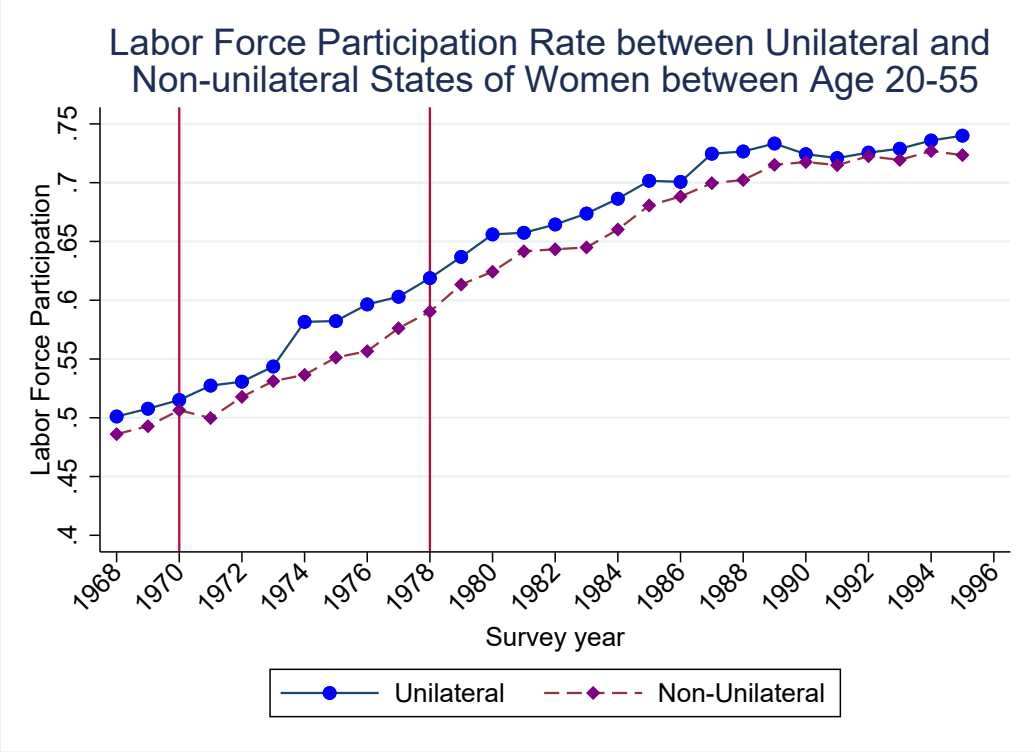
3.7 Conclusion

During the 1970s, states gradually implemented unilateral divorce laws, coinciding with an increase in women's labor force participation during that period. Since unilateral divorce laws make it less costly to divorce, marriage may seem less stable. Traditionally, women may leave the labor force after marriage to devote time to childbearing and household chores. Being away from the labor force can lead to depreciation in human capital, making it more difficult to return later. With unilateral divorce laws making marriage less stable, women might consider staying longer in the labor force as a way to maintain their human capital. Women when first introduced to this change of law at different stages in their lives may also react differently to this policy. With this hypothesis, I analyze the effects of unilateral divorce law on women's labor force participation rate.

Using data from the March Current Population Survey, I exploit the variation in the implementation of unilateral divorce laws across states and use a two-way fixed effects difference-in-differences model to evaluate their effects. Without the inclusion of state-specific trend variables, I

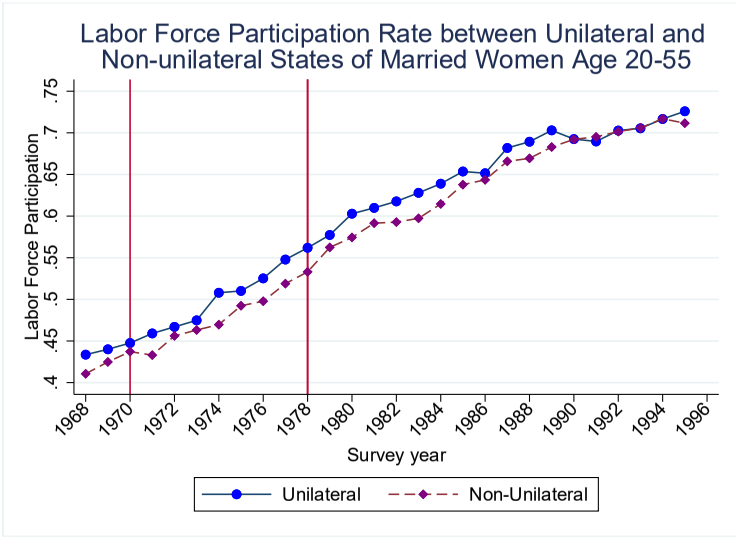
find no significant evidence of overall effects of unilateral divorce laws on labor force participation. However, under the same specification, there are significant heterogeneous effects observed. Younger cohorts with lower educational levels are significantly less likely to participate in the labor force, whereas higher-educated women across all cohorts are more likely to join the labor force. Pattern for the effects is slightly different when the state-specific trends are included. Women in the middle cohort exhibit an approximately two-percentage-point increase in labor force participation at a 5% significance level. This significant effect for the middle cohort is also observed when further examining the effects by marital status. Specifically, unmarried women in the middle cohorts are significantly more likely to participate in the labor force. This may suggest that the younger cohort remains in the labor force, and alterations in divorce laws do not significantly impact their behavior, while the older cohort, already in the later stages of their lives, finds it relatively difficult to make significant changes.

Figure 3.1: Labor Force Participation Rate for Women aged between 20-55

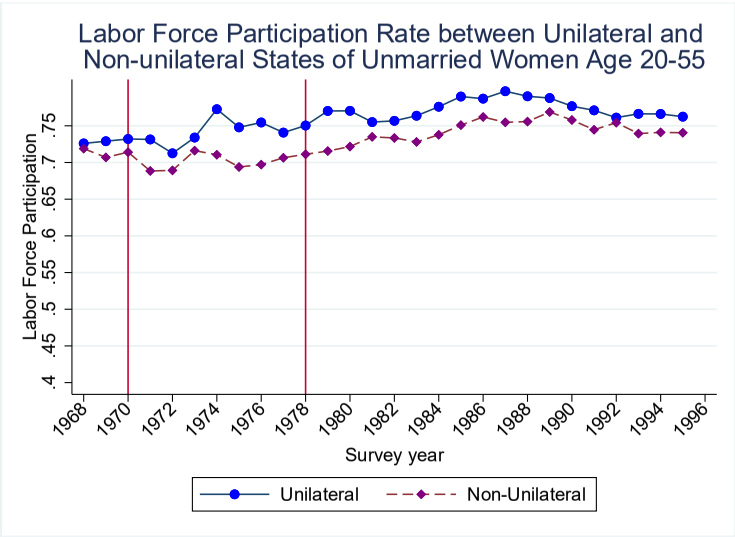


Note: The figure illustrates the trend of labor force participation rate for women aged between 20-55, between unilateral and non-unilateral states. Data source: March CPS. (weighted

Figure 3.2: Labor Force Participation Rate for Women aged 20-55 by Marital Status



(a) Married Women



(b) Unmarried Women

Note: Trend in Labor Force Participation Rate of women across Unilateral and non-unilateral states by marital status. data source: March CPS. (weighted)

Table 3.1: Female Employment Rate between
Unilateral and Non-Unilateral States Pre- and Post the Policy Enactment

	(1)	(2)	(3)
	Non-Uni States	Unilateral States	Difference
Employment Rate 1965	0.3499	0.3483	0.0015
	(0.4769)	(0.4764)	(0.4767)
Employment Rate 1979	0.3484	0.3610	-0.01261***
	(0.4764)	(0.4803)	(0.4781)

Notes: mean coefficients; sd in parentheses.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$;
Source: March CPS (weighted)

Table 3.1: Timeline of Unilateral Divorce Law Implementation

Pre-1967	Alaska, Oklahoma
1969	Kansas
1970	California, Iowa
1971	Alabama, Colorado, Florida, Idaho, New Hampshire, North Dakota
1972	Kentucky, Michigan, Nebraska
1973	Arizona, Connecticut, Georgia, Hawaii, Indiana, Maine, Nevada, New Mexico, Oregon, Washington
1974	Minnesota, Texas
1975	Massachusettsc, Montana
1976	Rhode Island
1977	Wyoming
1985	South Dakota

Table 3.2: Main Effects of Unilateral Divorce Law

	(1) Basic	(2) With Control	(3) With Control and State-Specific Trend
Cohort 20-28	0.00933	-0.0126	0.00400
	(0.00808)	(0.00871)	(0.0120)
	49,214	49,214	49,214
Cohort 29-38	0.0139	0.00854	0.0185*
	(0.0122)	(0.0104)	(0.0103)
	41,584	41,584	41,584
Cohort 39-48	-0.00252	-0.0127	0.000764
	(0.0216)	(0.0202)	(0.0263)
	31,464	31,464	31,464
Overall	0.0130	-0.00133	0.0114
	(0.0101)	(0.00924)	(0.0133)
	122,262	122,262	122,262

Notes: The coefficients in this table are treatment effects for unilateral divorce law and each is estimated from a separate regression. Column (1) includes unilateral dummy variable, post period dummy variable, and year and state fixed effects. Column (2) includes additional individual characteristics: number of children, number of children under age 6, race, a dummy variable for urban or suburban areas. Column (3) includes an additional state-specific trend.Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source:March CPS (unweighted)

Table 3.3: Effects of Unilateral Divorce Law on Labor Force Participation by Cohort, Marital Status and Educational Levels - No State-Specific Trends

	(1) Ovearll	(2) Unmarried	(3) Married	(4) Low Education	(5) High Education	(6) Unmarried and Low Edu	(7) Unmarried and High Edu	(8) Married and Low Edu	(9) Married and High Edu
Cohort 20-28	-0.0126	-0.00991	-0.0139	-0.0274***	0.0304*	-0.0361	0.0371	-0.0213	0.00831
	(0.00871)	(0.0217)	(0.0156)	(0.00712)	(0.0160)	(0.0291)	(0.0220)	(0.0203)	(0.0141)
	49,214	14,001	35,213	29,864	19,350	7,971	6,030	21,893	13,320
Cohort 29-38	0.00854	0.0341*	-0.00330	0.00436	0.0336	0.0296	0.0519	-0.00714	0.0239
	(0.0104)	(0.0177)	(0.0113)	(0.00842)	(0.0191)	(0.0173)	(0.0327)	(0.0106)	(0.0198)
	41,584	9,292	32,292	29,593	11,991	6,396	2,896	23,197	9,095
Cohort 39-48	0.000764	0.0132	-0.00652	-0.0102	0.0301	-0.00235	0.0411	-0.0148	0.0201
	(0.0263)	(0.0524)	(0.0241)	(0.0300)	(0.0227)	(0.0556)	(0.0795)	(0.0272)	(0.0230)
	31,464	7,103	24,360	24,048	7,416	5,354	1,748	18,694	5,666
Overall	-0.00133	0.0179	-0.0107	-0.0113	0.0371***	0.00264	0.0525*	-0.0183*	0.0197*
	(0.00924)	(0.0206)	(0.00768)	(0.0104)	(0.00980)	(0.0267)	(0.0267)	(0.00858)	(0.00907)
	122,262	30,397	91,865	83,505	38,757	19,721	10,676	63,784	28,081

Notes: The coefficients in this table are treatment effects for unilateral divorce law and each is estimated from a separate regression. All results are estimated by specification (3.2). Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source:March CPS (unweighted)

Table 3.4: Effects of Unilateral Divorce Law on Labor Force Participation by Cohort, Marital Status and Educational Levels - With State-Specific Trends

	(1) Ovearll	(2) Unmarried	(3) Married	(4) Low Education	(5) High Education	(6) Unmarried and Low Edu	(7) Unmarried and High Edu	(8) Married and Low Edu	(9) Married and High Edu
Cohort 20-28	0.00400	-0.0144	0.0122	-0.00531	0.0320	-0.0369	0.0197	0.00814	0.0247
	(0.0120)	(0.0190)	(0.0219)	(0.0132)	(0.0206)	(0.0263)	(0.0262)	(0.0263)	(0.0152)
	49,214	14,001	35,213	29,864	19,350	7,971	6,030	21,893	13,320
Cohort 29-38	0.0185*	0.0506***	0.00654	0.0164	0.0237	0.0462**	0.0691**	0.00679	0.00815
	(0.0103)	(0.0157)	(0.0108)	(0.0112)	(0.0200)	(0.0189)	(0.0293)	(0.0118)	(0.0171)
	41,584	9,292	32,292	29,593	11,991	6,396	2,896	23,197	9,095
Cohort 39-48	0.000764	0.0132	-0.00652	-0.0102	0.0301	-0.00235	0.0411	-0.0148	0.0201
	(0.0263)	(0.0524)	(0.0241)	(0.0300)	(0.0227)	(0.0556)	(0.0795)	(0.0272)	(0.0230)
	31,464	7,103	24,360	24,048	7,416	5,354	1,748	18,694	5,666
Overall	0.0114	0.0108	0.00778	0.00333	0.0327**	-0.00509	0.0429	0.00268	0.0169*
	(0.0133)	(0.0184)	(0.0131)	(0.0163)	(0.0138)	(0.0261)	(0.0306)	(0.0153)	(0.00876)
	122,262	30,397	91,865	83,505	38,757	19,721	10,676	63,784	28,081

Notes: The coefficients in this table are treatment effects for unilateral divorce law and each is estimated from a separate regression. All results are estimated by specification (3.3). Standard Errors are in parenthesis, number of observations for each specification is in square parenthesis.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Source:March CPS (unweighted)

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